FINAL

4 JUNE 2014

REMEDIAL INVESTIGATION REPORT

FORMER MOVING TARGET MACHINE GUN RANGE AT SOUTH BEACH INVESTIGATION AREA MARTHA'S VINEYARD, MASSACHUSETTS

FUDS Project No. D01MA048600
Contract No. W912DY-04-D-0019
Task Order No. 0006

Prepared for:
U. S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT

UXB

Prepared by:
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ACRONYMS

µ	micro(s)
ADR	Automated Data Review
AirMag	airborne magnetometry
AMEC	AMEC Environment & Infrastructure, Inc.
Aqua Survey	Aqua Survey, Inc.
ARAR	applicable or relevant and appropriate requirements
AUF	area use factor
B	the concentration of the COPEC in the food of the receptor
bgs	below ground surface
CENAE	United States Army Corps of Engineers, New England District
CERCLA	Comprehensive Environment Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHE	Chemical Hazard Evaluation
CHF	Contaminant Hazard Factor
cm	centimeter(s)
COC	chain of custody
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
C_s	soil concentration of the COPEC
CSM	conceptual site model
CWM	chemical warfare materiel
DDESB	Department of Defense Explosives Safety Board
DERP	Defense Environmental Restoration Program
DGM	Digital Geophysical Mapping
DNT	dinitrotoluene
DoD	United States Department of Defense
DQO	Data Quality Objective
EcoSSL	Ecological Soil Screening Level
EHE	Explosive Hazard Evaluation
EM	electromagnetic
EOD	explosives, ordnance, and disposal
EPC	exposure point concentration
ERA	ecological risk assessment
ESP	Explosives Siting Plan
ESTCP	Environmental Security Technology Certification Program
EZ	exclusion zone
°F	degree(s) Fahrenheit
FDE	Findings and Determination of Eligibility
FDEM	Frequency Domain Electromagnetic
FIR	food ingestion rate
FS	Feasibility Study
ft	foot or feet
FUDS	Formerly Used Defense Site
GIS	Geographic Information System

GPO	geophysical prove-out
GPS	global positioning system
GSV	geophysical system verification
HA	hazard assessment
HE	high explosives
HFD	hazardous fragment distance
HHE	Health Hazard Evaluation
HHRA	Human Health Risk Assessment
HMX	1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HQ	hazard quotient
IDW	investigation derived waste
in.	inch(es)
INPR	Inventory Project Report
IS	incremental sample
ISO	industry standard object
IVS	instrument verification strip
kg	kilogram(s)
kg dw/kg-day	kg dry weight of food per kg body weight per day
K_H	Henry's Law Constant
K_{OC}	organic carbon partition coefficient
L/kg	liters per kilogram
m	meter(s)
MADCR	Massachusetts Department of Conservation and Recreation
MADEP	Massachusetts Department of Environmental Protection
MC	munitions constituent
MCL	Maximum Contaminant Level
MCP	Massachusetts Contingency Plan
MD	munitions debris
MDF-H	maximum fragmentation distance, horizontal
MEC	munitions and explosives of concern
MGA	magnetic gradiometer array
mg/kg	milligrams per kilogram
mg/kg-day	mg per kg body weight per day
mg/L	milligrams per liter
MGFD	munitions with the greatest fragmentation distance
MK	Mark
MMRP	Military Munitions Response Program
MPF	migration pathway factor
MPPEH	Material Potentially Presenting an Explosive Hazard
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
MSD	minimum separation distance
msl	mean sea level
mV	millivolts
NAEVA	NAEVA Geophysics, Inc.
NC	nitrocellulose

NG	nitroglycerin
NOAEL	no observed adverse effort level
P	ingestion rate of soil as a proportion of food ingestion rate
QA	quality assurance
QC	quality control
QSM	Quality Systems Manual
RAGS	Risk Assessment Guide for Superfund
RDX	1,3,5-trinitro-1,3,5-triazine
RF	receptor factor
RI	Remedial Investigation
RL	reporting limit
RSL	Regional Screening Level
RTK	real time kinematic
SDDW	small diameter driven well
SUF	seasonal use factor
SUXOS	Senior Unexploded Ordnance Supervisor
TBC	to be considered
TCRA	Time Critical Removal Action
TestAmerica	TestAmerica, Inc.
TNT	2,4,6 - trinitrotoluene
TPP	Technical Project Planning
TSERAWG	Tri-Services Environmental Risk Assessment Work Group
TtEC	Tetra Tech EC, Inc.
TTOR	The Trustees of Reservations
UCL	upper confidence limit
UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan
USACE	United States Army Corps of Engineers
USAESCH	United States Army Engineering Support Center, Huntsville
USDA-SCS	United States Department of Agriculture – Soil Conservation Service
USEPA	United States Environmental Protection Agency
UXB	UXB International, Inc.
UXO	unexploded ordnance
UXOSO	Unexploded Ordnance Safety Officer
VOC	volatile organic compound
VRH	VRHabilis, LLC
TRV	toxicity reference value
WAA	Wide Area Assessment
WAAS	Wide Area Augmentation System
ww	wet weigh

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GLOSSARY

Anomaly – An anomaly is any item that is seen as a subsurface irregularity after geophysical investigation. This irregularity should deviate from the expected subsurface ferrous and nonferrous material at a site (pipes, power lines, etc.).

Anomaly Avoidance – This is a technique employed on property known or suspected to contain unexploded ordnance (UXO), other munitions that may have experienced abnormal environments [e.g., discarded military munitions (DMM)], munitions constituents (MC) in high enough concentrations to pose an explosive hazard, or chemical agents, regardless of configuration, to avoid contact with potential surface or subsurface explosive or chemical agent hazards, to allow entry to the area for the performance of required operations.

Archives Search Report (ASR) – An ASR is a detailed investigation report on past munitions activities conducted on an installation. The principal purpose of the archives search is to assemble historical records and available field data, assess potential ordnance presence, and recommend follow-up actions at a Defense Environmental Restoration Program (DERP) Formerly Used Defense Site (FUDS). There are four general steps in an archives search: records search phase, Site Safety and Health Plan, site survey, and ASR, including risk assessment. The ASR has since been replaced in the Military Munitions Response Program (MMRP) process by the Historical Records Review.

Blind Seeding –Part of the geophysical system verification process, "seeds" (inert items similar in size/shape to MEC items of concern) are buried at locations unknown to the geophysical or intrusive contractor as a quality control check of their equipment and processes.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) – CERCLA authorizes federal action to respond to the release or threatened release of hazardous substances into the environment or a release or threat of release of a pollutant or contaminant into the environment that may present an imminent or substantial danger to public health or welfare.

Data Quality Objective (DQO) – The DQOs are project-specific statements that clarify the study objective, define the most appropriate type of data to collect, determine the most appropriate conditions from which to collect the data, and specify tolerable limits on decision errors (used in establishing the quantity and quality of data needed).

Decision Document (DD) – DDs serve to provide the reasoning for the choice of or changes to a Superfund site cleanup plan. DDs include Proposed Plans (PPs), Records of Decision (RODs), ROD Amendments, and Explanations of Significant Differences, along with other associated memoranda and files. DDs are required by Section 117 of CERCLA, as amended by SARA, for remedial actions taken pursuant to Sections 104, 106, 120, and 122. Sections 300.430(f)(2),

300.430(f)(4), and 300.435(c)(2) of the National Contingency Plan (NCP) establish the regulatory requirements for these DDs.

Defense Environmental Restoration Program (DERP) – Established in 1984, DERP promotes and coordinates efforts for the evaluation and cleanup of contamination at DoD installations.

Dig Sheet – A list of selected targets with the target location given in the referenced coordinate system, represented amplitude of response based on selection criteria, and any comments or details regarding target properties.

Discrete – A sample that represents a single location or short time interval. A discrete sample can be composed of more than one increment. The term has the same meaning as "individual sample."

Downline Width – The distance between readings recorded by the sensor.

Explosive Ordnance Disposal (EOD) personnel – Military personnel who have graduated from the naval School, Explosive Ordnance Disposal; are assigned to a military unit with a service defined EOD mission; and meet service and assigned unit requirements to perform EOD duties. EOD personnel have received specialized training to address explosive and certain chemical agent hazards during both peacetime and wartime. EOD personnel are trained and equipped to perform render safe procedures on nuclear, biological, chemical, and conventional munitions and on improvised explosive devices.

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.

Feasibility Study (FS) – The FS follows the remedial investigation. During the FS, the remedial investigation data are analyzed and remedial alternatives are identified and evaluated. The FS serves as the mechanism for the development, screening, and detailed evaluation of alternative remedial actions.

Formerly Used Defense Site (FUDS) – FUDS include those properties previously owned, leased, or otherwise possessed by the United States and under the jurisdiction of the Secretary of Defense, or manufacturing facilities for which real property accountability rested with the DoD but were operated by contractors (government owned, contractor operated) and that were later legally disposed of. FUDS is a subprogram of the DERP.

Hot rock – "Hot rock" is a term used to describe a rock with enough magnetism to be detected by geophysical instrumentation as an anomaly.

Incremental Sampling – Incremental Sampling is a structured composite sampling and processing protocol that improves the reliability and defensibility of sampling data by reducing

data variability and provides a reasonable estimate of a chemical's mean concentration for the volume of soil being sampled. The three key components of ISM are systematic planning, field sample collection, and laboratory processing and analysis. Typically, 30 to 100 increments (1 – 5 kilograms) of uniform size are collected from surface soils across a grid formation that represents a specific area entire decision unit. In the lab, the entire sample is spread into a grid formation and the sub-sample is generated using similar techniques employed in the field, only on a much smaller scale. This entire sub-sample is used for analysis and multi-incremental sample replicates are usually normally distributed with very few outliers. Thus, the goal of limiting discrete sample variability is achieved.

Inert – An inert substance is one that is not generally reactive. This is a synonym for "inactive."

Magnetometer Survey and Intrusive Investigation (Mag and Dig) – A mag & dig survey consists of using analog instrumentation for surface and subsurface anomaly detection with real-time follow-on intrusive investigation to confirm the source and nature of detected anomalies.

Material Potentially Presenting an Explosive Hazard (MPPEH) – Material owned or controlled by DoD that, prior to determination of its explosives safety status, potentially contains explosives or munitions (e.g., munitions containers and packaging material; munitions debris (MD) remaining after munitions use, demilitarization, or disposal; range-related debris) or potentially contains a high enough concentration of explosives that the material presents an explosive hazard (e.g., equipment, drainage systems, holding tanks, piping, or ventilation ducts that were associated with munitions production, demilitarization, or disposal operations). Excluded from MPPEH are munitions within the DoD-established munitions management system and other items that may present explosion hazards (e.g., gasoline cans and compressed gas cylinders) that are not munitions, and are not intended for use as munitions.

Military Munitions – All ammunition products and components produced for or used by the armed forces for national defense and security, including ammunition products or components under the control of the DoD, the Coast Guard, the Department of Energy, and the National Guard. The term includes confined gaseous, liquid, and solid propellants; explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries, including bulk explosives, and chemical warfare agents; chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges; and devices and components thereof. The term does not include wholly inert items; improvised explosive devices; and nuclear weapons, nuclear devices, and nuclear components, other than 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 USC 101(e)(4)(A) through (C)).

Military Munitions Response Program (MMRP) – The United States Congress established the MMRP under the DERP to address UXO, DMM, and MC located on current and former defense sites. MMRP eligible sites include other than operational ranges where UXO, DMM, or MC are known or suspected. Properties classified as operational military ranges, permitted munitions disposal facilities, or operating munitions storage facilities are not eligible for the MMRP.

Munitions and Explosives of Concern (MEC) – This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks, means UXO, as defined in 10 USC 101(e)(5)(A) through (C); DMM, as defined in 10 USC 2710(e)(2); or MC (e.g., TNT, RDX), as defined in 10 USC 2710(e)(3), present in high enough concentrations to pose an explosive hazard.

Munitions Constituents (MC) – Any material originated from UXO, DMM, or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of ordnance or munitions.

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

Munitions Response Action – Response actions, including investigation, removal actions, and remedial actions to address the explosives, human health, or environmental risks presented by UXO, DMM, or MC or to support a determination that no removal or remedial action is required.

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. An MRA is composed of one or more munitions response sites (MRSs).

Munitions Response Site (MRS) – A discrete location within an MRA that is known to require a munitions response.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP) – Revised in 1990, the NCP provides the regulatory framework for responses under CERCLA. The NCP designates the DoD as the removal response authority for explosive hazards associated with military munitions.

Ordnance – Explosives, chemicals, pyrotechnics, and similar stores. Examples of ordnance are bombs, guns and ammunition, flares, smoke, or napalm.

Peak Response – The highest value recorded over an item or highest value of the gridded data.

Remedial Action – An action consistent with the permanent remedy taken in the event of a release or a threatened release of a hazardous substance into the environment, to prevent or minimize the release of hazardous substances so that they do not migrate to cause substantial danger to present or future public health, welfare, or the environment.

Remedial Investigation – An RI is performed to to collect data to characterize site conditions and assess risk/hazard to human health and the environment. The RI process includes scoping and site characterization. Data collected in the RI influence the development of remedial alternatives in the Feasibility Study.

Seed items – Seed items are known magnetic sources, such as inert munitions or other metallic items that are used in a quality control program to verify that geophysical instrumentation used for anomaly detection is working properly and accurately.

Static Test – Test to determine whether a particular geophysical instrument is collecting stable readings. Improper instrument function, the presence of local sources of ambient noise, and instability in the earth's magnetic field are all potential causes of inconsistent, non-repeatable readings.. This test involved collecting background data in a static (i.e., stationary) mode for one minute, collecting data with a test item for one minute, and removing the test item and collecting background data for one additional minute.

Transects – Lines for ecological measurements; a strip of ground along which ecological measurements are made at regular intervals.

Unexploded Ordnance (UXO) – Military munitions that have been primed, fuzed, armed, or otherwise prepared for action; have been fired, dropped, launched, projected, or placed in a manner that constitutes a hazard to operations, installation, personnel, or material; and remain unexploded either by malfunction, design, or any other cause. (10 USC 101(e)(5)(A) through (C) and 40 CFR 266.201)

UXO-Qualified Personnel – UXO-qualified personnel have performed successfully in military EOD positions or are qualified to perform in the following Department of Labor, Service Contract Act, Directory of Occupations, and contractor positions: UXO Technician II, UXO Technician III, UXO Safety Officer, UXO Quality Control Specialist, or Senior UXO Supervisor.

UXO Technicians – UXO Technicians are qualified for filling Department of Labor, Service Contract Act, Directory of Occupations, and contractor positions: UXO Technician I, UXO Technician II, or UXO Technician III.

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1.0 EXECUTIVE SUMMARY

1.0.1 Between 14 December 2010 and 2 November 2011, UXB International, Inc. (UXB) and its subcontractors conducted a Remedial Investigation (RI) at the Former Moving Target Machine Gun Range at South Beach Investigation Area, which will be referred to hereinafter as the Investigation Area. UXB prepared this document under contract to the U.S. Army Engineering Support Center, Huntsville (USAESCH), Contract No. W912DY-04-D-0019, Task Order No. 006. Field activities conducted during this RI were in accordance with the RI Work Plan (UXB, 2011).

1.0.2 The purpose of this RI was to collect data necessary to determine the nature and extent of potential munitions and explosives of concern (MEC) and munitions constituents (MCs) resulting from historical military activities conducted within the Investigation Area. In order to fully develop the Investigation Area conceptual site model (CSM), the RI Report includes data collected during the current investigation and results from previous investigations, UXO emergency responses, and time critical removal actions (TCRAs). The data presented is used to support fate and transport analysis, evaluate the potential risks to human health and the environment, and will be used to support the development of a Feasibility Study (FS) to evaluate future response actions at the Investigation Area, if necessary. This RI Report documents the methods and procedures employed during field activities, and presents the results of the Investigation Area site characterization.

1.0.3 Between 1944 and 1947, the Investigation Area was used as a gunnery and rocket firing range with munitions consisting of 0.30 and 0.50 caliber ammunition, MK1 rockets, and 2.25 to 5 in. rockets. Practice rockets consisted of the rocket motor, containing propellant to transport the rocket to its intended target, and a warhead. The propellant consisted of a double-base powder comprised largely of nitrocellulose (NC) and nitroglycerin (NG). Since the end of military operations in 1947, rocket motors and warheads have been discovered at the Investigation Area by the public and beach patrol personnel. On two occasions (March 2008 and February 2009), a 100-pound bomb (one suspected as photoflash, and one suspected of containing high explosive) was discovered on the far eastern side of the Investigation Area at Wasque Point.

1.0.4 To achieve the goals established for this RI, various field investigative activities were conducted including: geophysical surveying, intrusive investigations, and environmental sampling for analysis of MCs. The Investigation Area was subdivided into three sub-area types according to sub-area geomorphology, which included land, beach, and ocean areas. The investigations were designed such that the type of geophysical methods and instrumentation proposed were appropriately matched to the unique character of each sub-area.

1.0.5 A wide area assessment (WAA) was initially performed to help identify high density areas of geophysical anomalies that might be indicative of an area previously used as a military target, aid in determining the extent of potential MEC contamination, and focus subsequent detailed intrusive investigations. The WAA consisted of:

- Analog density transects in the upland areas using hand-held analog instruments to minimize the amount of brush clearing;
- Digital Geophysical Mapping (DGM) transects on the beach area where no vegetation clearing was required; and,
- Analog mag/dig ocean transects.

1.0.6 This work was supplemented with an airborne magnetometry (AirMag) survey performed using a magnometer array mounted to a helicopter. The AirMag was flown over portions of the land and beach at 3 to 10 feet (ft) above the surface.

1.0.7 Data collected during the WAA was subsequently used to site grids for additional DGM surveying and intrusive investigation within land and beach areas. Based upon the results of the WAA, anomalies were identified, mapped using ESRI ArcGIS, and analyzed to identify high density anomaly areas. The grids were sited in areas of high, medium, and low anomaly densities to refine the extent, and establish the nature of MEC contamination through subsequent intrusive investigations. High density anomaly areas were then used to determine the size and location of grids over which additional DGM data would be collected. One land DGM and thirty-five beach grids were located within the Investigation Area. Geophysical data were collected in the grids by towing the electromagnetic (EM) sensor system by hand across the surface within each grid. DGM data collected within the grids were evaluated and a list of anomalies to be intrusively investigated was generated.

1.0.8 The intrusive investigation was conducted by reacquiring the anomaly locations selected for intrusive investigation and excavating the locations to identify the source of the anomaly. Excavation of land/beach locations were conducted by unexploded ordnance (UXO) technicians. Once identified, debris was classified as non-MD, cultural artifacts, MD, or MEC. During the intrusive investigation, 1 MD and 85 non-MD items were recovered. The recovered MD item was a 5-inch Mk 1 practice rocket. An additional MD item (5" MK 6 practice warhead) was discovered by a contractor while excavating for a swimming pool at one of the residences. Since the MD item was found within the boundary of the Investigation Area, it is included in this RI report.

1.0.9 Due to the dynamic nature of the ocean surf zone, a "Mag and Dig" technique was used for ocean transects. Divers identified anomalies on transects using an underwater hand-held analog instrument, and subsequently excavated each anomaly as it was found. This methodology provided both WAA and intrusive investigation to provide nature and extent data. Mag and Dig operations recovered 96 MD items and 13 non-MD items. Recovered MD items consisted of

2.25 and 3.5-inch rocket motors and 1 to 5-inch warhead fragments, and were concentrated south of Katama Bay, between the former machine gun range and Wasque Point. MD items discovered during the intrusive investigation were removed, demilitarized, and properly disposed.

1.0.10 To better understand the movement of MD items in the surf zone and support the characterization of nature and extent of MEC, if present, at the Investigation Area, an ocean transport study was conducted. The study included a MEC transport grid baseline survey conducted from 16 through 22 June, 2010 and a post-storm event follow-up survey 4 through 20 October, 2010. In addition, a MEC transport acoustic transponder (pinger) survey was conducted from 21 October through 9 November, 2010. During the baseline survey, 24 anomalies were detected at previously cleared TCRA grids 5/6, and 155 anomalies were detected at previously cleared TCRA grids 18/19. During the post-storm event survey, conducted five months after the baseline survey, 22 anomalies were detected at TCRA grid 5/6, and 385 anomalies detected at TCRA Grid 18/19 (Figure 5-4) . The presence of anomalies found during the follow-up (post-storm event) survey demonstrates that ferrous items are moving into these two grid areas, with a measurable change after storm events. The pinger survey was not successful as no return signal was identified when attempting to locate the pingers. However, one of the transponders broke free and washed ashore roughly 1 mile to the east of the area it was emplaced, confirming a strong prevailing easterly ocean current.

1.0.11 The Environmental Security Technology Certification Program (ESTCP) initiated a project to develop and demonstrate a WAA technique for locating and delineating munitions-like objects in marine condition environments. Geophysical data collected during this study identified 540 anomalies, of which 95 items were selected for intrusive investigation. The intrusive investigation was conducted between 29 June and 24 September 2010, by VRHabilis. Of the 95 items, two were MD items consisting of expended rocket motors; 49 were non-MD; and 44 were "no-finds". The two items of MD were located on the transect closest to the beach.

1.0.12 Between 13 October and 2 November 2011, environmental sampling for MCs was conducted at the Investigation Area including incremental sampling of surface soils, discrete, biased surface and subsurface soil sampling, and groundwater sampling. Samples were analyzed for MCs, including antimony, copper, lead, nickel, and zinc, and explosive compounds, including pentacrythrite tetranitrate (PETN) and nitroglycerin (NG), previously identified as components of munitions identified within the Investigation Area. Analytical results detected lead in three surface soil samples at concentrations exceeding ecological screening criterion but below the human health screening criterion. All other detections of metals in soil and groundwater were below human health and ecological screening criterion. No explosives were detected in soil samples collected within the Investigation Area. In groundwater, 2-nitrotoluene, 3-nitrotoluene, and 4-nitrotoluene were detected at concentrations below human health and ecological screening criterion. No other explosives were detected in groundwater samples.

1.0.13 A Munitions Response Site Prioritization Protocol (MRSPP) ranking will be calculated to assign a relative risk for the Investigation Area in the MMRP Inventory to determine the future funding sequence of MRSs for future response activities. This ranking system uses scores of 1 through 8, 1 indicating the highest potential hazard and 8 indicating the lowest potential hazard, to determine a relative priority for response activities. The MRSPP worksheets and score will be submitted as a stand-alone submittal.

1.0.14 A Human Health Risk Assessment (HHRA) was conducted for the Investigation Area to provide a comprehensive assessment of potential risks to individuals that may be exposed to hazardous constituents at the Investigation Area. The HHRA concluded that there is no unacceptable risk to human health from MC at the Investigation Area.

1.0.15 A screening-level Ecological Risk Assessment was performed to evaluate risks posed to ecological receptors (plants, invertebrates, herbivores, predators, and marine receptors) due to exposures to residual MCs. Based on the low concentrations of MCs within soil and groundwater samples, and the results of this assessment, it was concluded that none of the MCs evaluated pose a potential for risk to ecological receptors.

1.0.16 Based upon RI results, it is recommended that the current MRA Boundary be revised to include the extent of MD determined through previous investigation, geophysical and intrusive investigation data. It is recommended that the Former Moving Target Machine Gun Range at South Beach Investigation Area be renamed to the South Beach MRA and subdivided into two MRSs: 1) the Former Machine Gun Range and Katama Rocket Range MRS (695 acres); and, 2) the Remaining Ocean Area MRS (3,736 acres).

1.0.17 Two 100 pound bombs have been reported at two instances (one in 2008 and one in 2009) at Wasque point, approximately 2.1 miles from where the majority of MD was identified. One was suspected to be HE filled by the responding explosives, ordnance, and disposal (EOD) technicians, and the other was suspected to be a photoflash bomb. Due to the mission of the EOD to render items safe by detonation (as opposed to perforating the items to first determine whether the items contain explosives) coupled with the large amount of explosives used by the EOD team, USACE has concluded that it is highly unlikely and extremely difficult to determine if an item was MD or MEC after detonation. There is also, no supporting evidence through historical research or the RI that 100 pound bombs were part of historical military operations conducted at South Beach and therefore are considered isolated finds unrelated to this site. No additional MEC or MD was identified during the RI at Wasque Point.

1.0.18 Although no MEC was identified at the investigation area, a FS is recommended to evaluate future response action alternatives with regard to potential MEC hazards at the South Beach MRA. Due to the significant density of MD discovered and estimated to remain within the MRS boundary coupled with likely public exposure to the practice rockets and the need for

UXO-certified technicians to respond to such findings, the project team feels pursuing an FS is warranted.

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2.0 INTRODUCTION

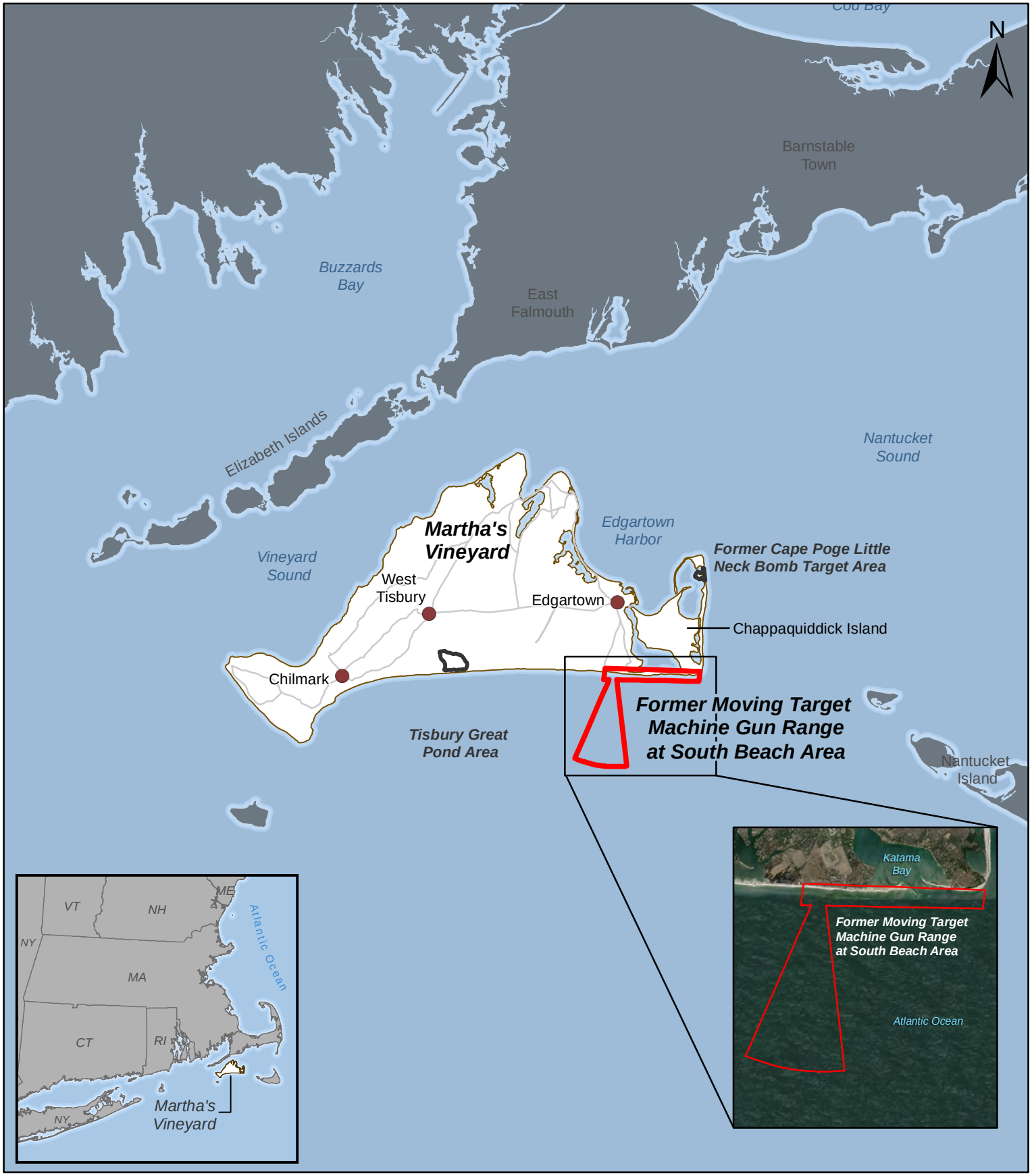
2.0.1 UXB has prepared this document under contract to the USAESCH, Contract No. W912DY-04-D-0019, Task Order No. 006. This report was prepared in accordance with United States Army Corps of Engineers (USACE) Engineering Manual 1110-1-1200 (USACE, 2003), Draft Engineering Pamphlet 1110-1-18 (USACE, 2006), and the Guidance for Conducting Remedial Investigations and Feasibility Studies under Comprehensive Environment Response, Compensation, and Liability Act (CERCLA), (United States Environmental Protection Agency [USEPA], 1988). Field activities were conducted in accordance CERCLA 1980, as amended by Superfund Amendments and Reauthorization Act of 1986; the National Contingency Plan; and the RI Work Plan (UXB, 2011).

2.0.2 This Remedial Investigation (RI) Report was prepared by UXB on behalf of the United States Army Corps of Engineers, New England District (CENAE) for the Former Moving Target Machine Gun Range at South Beach Investigation Area, located in Martha's Vineyard, Massachusetts, referred to hereinafter as the Investigation Area (Figure 2-1). The Formerly Used Defense Site (FUDS) boundary (Figure 2-2) for the Former Moving Target Machine Gun Range at South Beach (D01MA048600R01) consists of 4,201.5 acres covering the historic range, including areas where munitions debris (MD) and suspected munitions and explosives of concern (MEC) items had been identified. The Investigation Area boundaries (Figure 2-2) were delineated based upon the former range location and areas where MD and suspected MEC items have been previously identified. The Investigation Area boundaries (478 acres) includes a portion of the FUDS site, including much of the upland, beach, inland water, and ocean areas with the exception of the triangular ocean area extending 7,500 yards seaward from the former range. Because the entire FUDS area was not part of the target range, it was not included in this RI. The Investigation Area originally included a small portion of inland water (7.7 acres), comprised of a small area in Katama Bay immediately north of the barrier beach and a fresh water pond at the tip of Wasque Point. However, due to severe erosion of Wasque Point, the fresh water pond was lost to the sea, and the barrier beach continued to shift creating shoaling in Katama Bay.

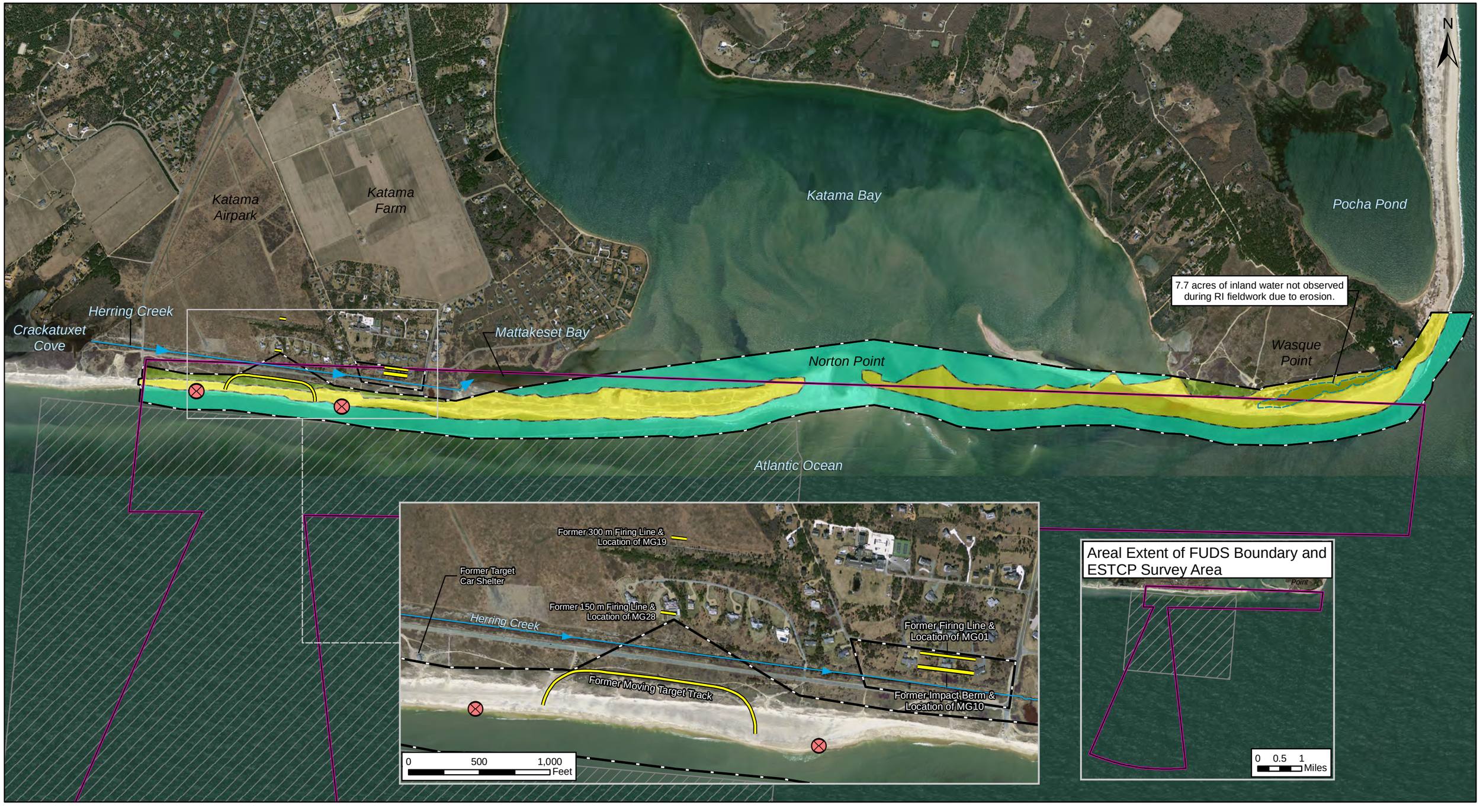
2.1 Purpose

2.1.0.1 The purpose of this RI Report is to document methods employed during field activities and present the results of the Investigation Area site characterization. The RI was conducted to collect data necessary to:

- Determine the nature and extent of MEC and munitions constituents (MCs);
- Support MC fate and transport analysis;
- Evaluate the potential risks to human health and the environment;
- Support the development of a Munitions Response Site Prioritization Protocol (MRSPP) score; and,
- Support the development of a Feasibility Study (FS) to evaluate future response actions.



US Army Corps of Engineers	**FIGURE 2-1** Site Location - Martha's Vineyard, MA					
0 2.5 5 10 15 Miles 0 5 10 15 20 25 Kilometers	UXB amec	NOTES: Base map data source: ESRI	03/04/2013	Rev:	SBeach_MV_Island_ Remedial_Inv_Rpt.mxd	
			Drawn: JBO	Chk: DMS	PROJ: 562910000	



Former Rocket Target

Moving Target and Machine Gun Range Features

Herring Creek

ESTCP Survey Area

South Beach FUDS Boundary

South Beach Investigation Area

South Beach Investigation Areas Subdivisions

Beach - 190.4 acres

Land - 18.7 acres

Ocean - 268.7 acres

US Army Corps of Engineers

FIGURE 2-2

Site Map - Former Moving Target Machine Gun Range at South Beach Investigation Area, Martha's Vineyard, MA

0 150 300 600 900 1,200 Meters

0 700 1,400 2,800 4,200 Feet

UXB amec

NOTES:
2009 Aerial Data Source: MassGIS

06/25/2013	Rev:	SBeach_Site_Loc_Remedial_Inv_Rpt.mxd	
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2.2 Property Description and Problem Identification

2.2.0.1 The following subsections describe potential safety hazards, physical characteristics, and potential receptors within the Investigation Area.

2.2.1 Explosives Safety Hazards

2.2.1.0.1 On two occasions (March 2008 and February 2009), a 100-pound bomb was identified on-shore at Wasque Point, east of the former machine gun range (Figure 2-3) (USACE, 2008 and VRHabilis, LLC [VRH], 2009).

2.2.2 Physical Characteristics

2.2.2.1 Site Description

2.2.2.1.0.1 As shown on Figure 2-1, the Investigation Area is located in the Town of Edgartown along the southern shore of Martha's Vineyard, Massachusetts. The Investigation Area encompasses an area of approximately 478 acres, divided into approximately 18.7 acres of land, 190.4 acres of beach, and 268.7 acres of ocean (Figure 2-2). The Investigation Area originally included a small portion of inland water (7.7 acres) which was comprised of a small strip of Katama Bay immediately north of the barrier beach and a fresh water pond at the tip of Wasque Point. However, due to severe erosion of Wasque Point, the fresh water pond was lost to the sea, and the barrier beach continued to shift creating shoaling in Katama Bay, preventing any investigation of the inland water portion of the Investigation Area.

2.2.2.1.0.2 The Investigation Area is bound to the south by the Atlantic Ocean and on the northern side by residential, commercial, and agricultural land. The FUDS boundary (Figure 2-2) for the Former Moving Target Machine Gun Range at South Beach (D01MA048600R01) consists of 4,201.5 acres covering the historic range including areas where MD and suspected MEC items had been identified. An Environmental Security Technology Certification Program (ESTCP) project was also conducted over a rectangular area of the Atlantic Ocean approximately 2.3 miles in the long-shore direction and approximately 1.8 miles in the off-shore direction, as shown on Figure 2-2.

2.2.2.1.0.3 The Investigation Area consisted of an oval-shaped track, three firing lines, two rockets targets, an impact berm, a Target Car Shelter, and other support structures (Figure 2-4). The oval-shaped moving target track was located in the western end of the land portion of the site. Two firing lines were located north of the moving target track, one located 150 meters (m) from the moving target track and another located 300 m from the track. A third firing line was located northeast of the moving target track and an associated impact berm was located south of the firing line. Two rocket targets were located east and west of the moving target track and were used as an aerial rocket firing training area.

US Army Corps of Engineers

NOTES:
2009 Aerial Data Source: MassGIS

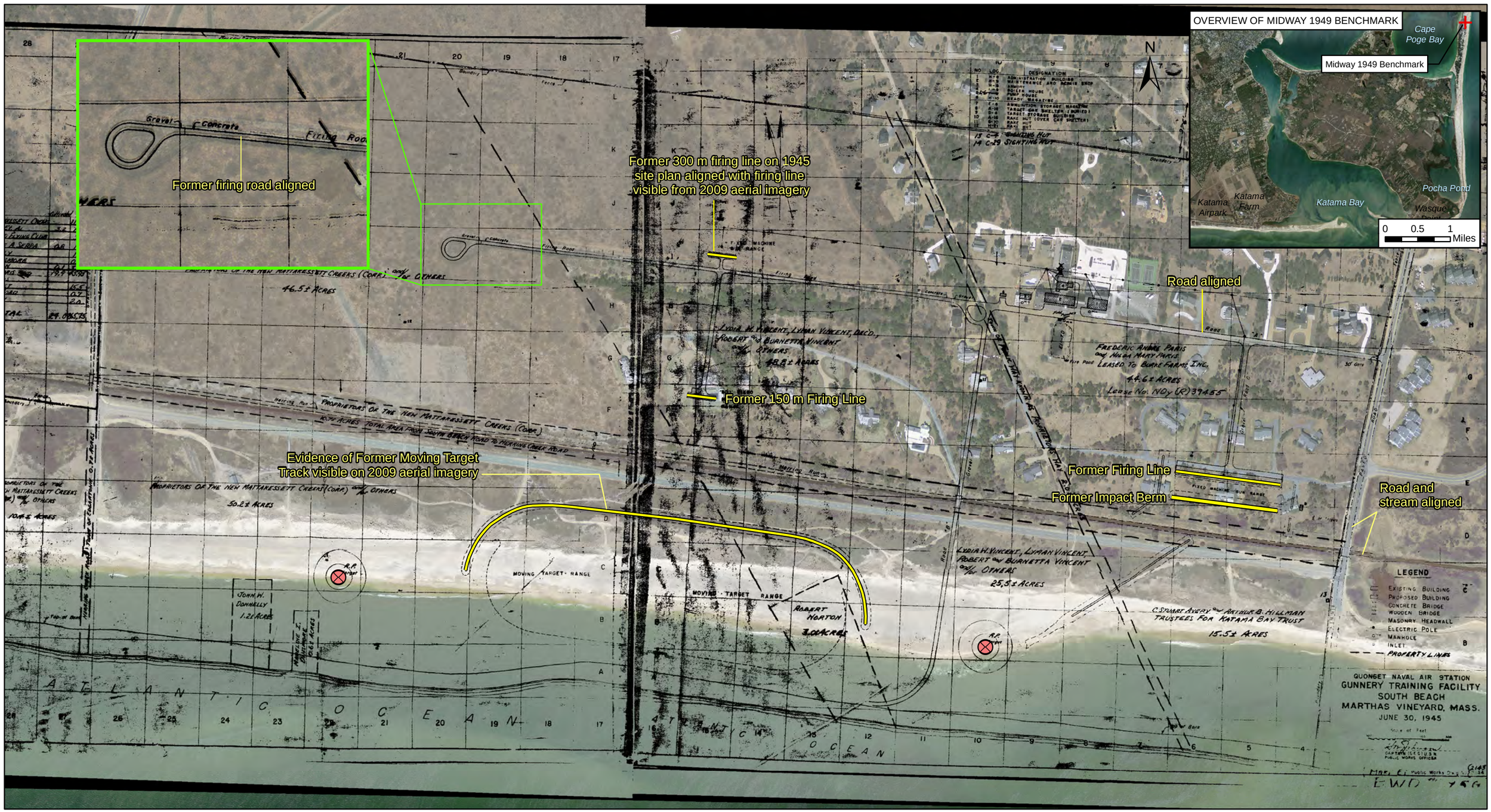
UXB amec

0 500 1,000 1,500 2,000 2,500 Feet
0 100 200 300 400 Meters

FIGURE 2-3

Location of Historic MEC Finds - Former Moving Target Machine Gun Range at South Beach Investigation Area, Martha's Vineyard, MA

06/24/2013	Rev:	Drawn: JBO	Chk: DMS	SBeach_Wasque_UXO_Find_Remedial_Inv_Rpt.mxd	PROJ: 562910000



Moving Target and Machine Gun Range Features

Former Rocket Target

This map shows an overlay of a June 06, 1945 Site Plan drawing of the Former Moving Target Machine Gun Range at South Beach (Site Plan) and a 2009 aerial image. The Site Plan was spatially referenced using features found on both the Site Plan and aerial imagery as control points. Moving Target and Machine Gun Range Features were then delineated using the spatially referenced Site Plan.

US Army Corps of Engineers

FIGURE 2-4

Overlay of June 30, 1945 Site Plan and 2009 Aerial Imagery - Former Moving Target Machine Gun Range at South Beach Investigation Area, Martha's Vineyard, MA

0 25 50 100 150 200 250 300 350 Meters

0 125 250 500 750 1,000 1,250 Feet

UXB amec

NOTES:
2009 Aerial Data Source: MassGIS

03/04/2013	Rev:	SBeach_All_Activities_Results_Remedial_Inv_Rpt.mxd	
Drawn: JBO	Chk: DMS	PROJ: 562910000	

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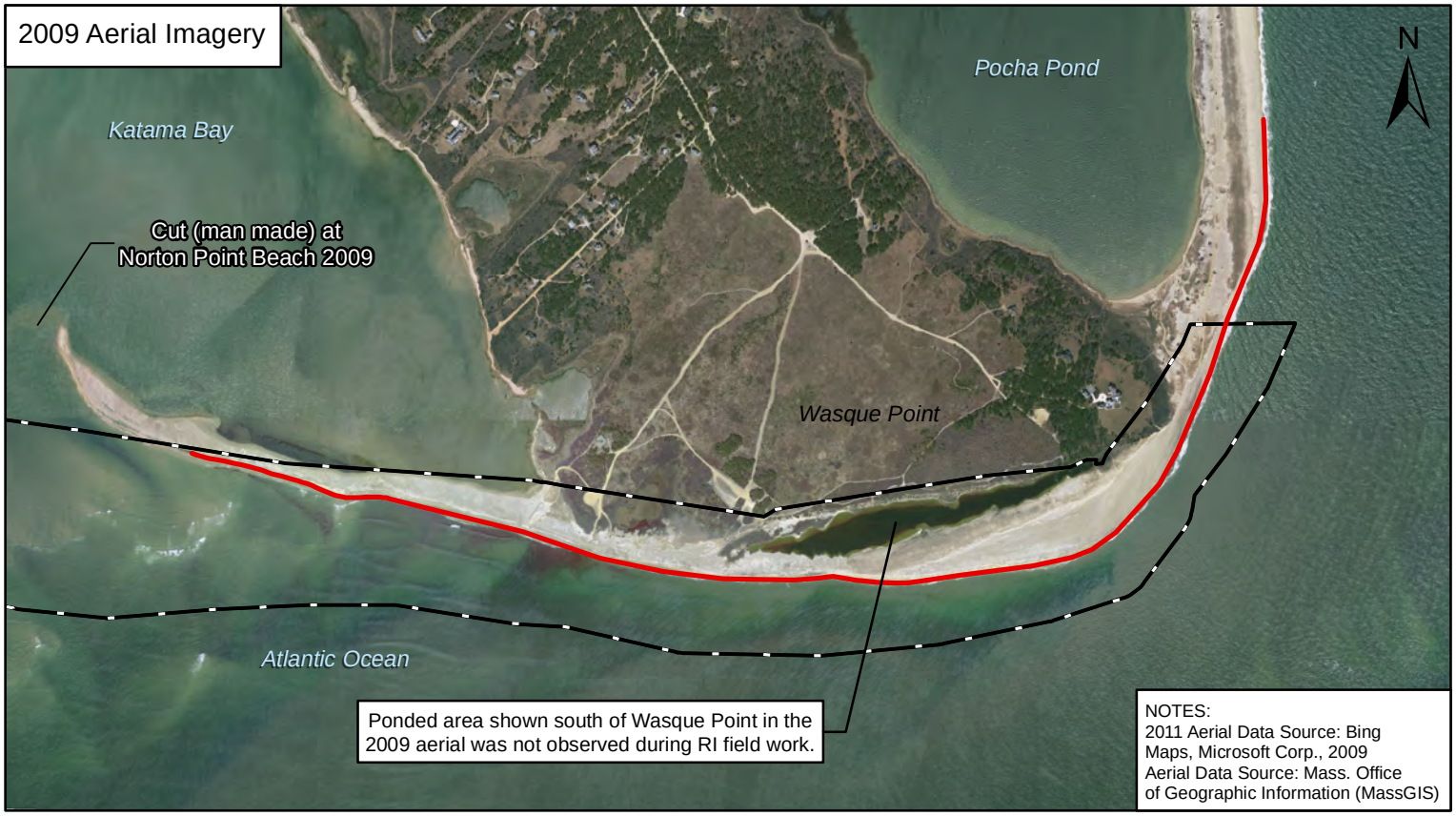
2.2.2.1.0.4 The Investigation Area is exposed to continuous storm surges via hurricanes and nor'easters that contribute and intensify beach erosion. Due to extensive erosion, the former range is now believed to be approximately 150 yards seaward of its location when used by the U.S. Navy and at least half of the moving target range is now in the Atlantic Ocean. The relatively rapid erosion rate was observed during the RI as approximately 575 feet (ft) of beach eroded into the Atlantic Ocean (Figure 2-5). Tides in this area have eroded the Norton Point Beach and split the beach in half, connecting Katama Bay and the Atlantic Ocean, and have eroded portions of beach, an unnamed pond, and bluff at Wasque Point.

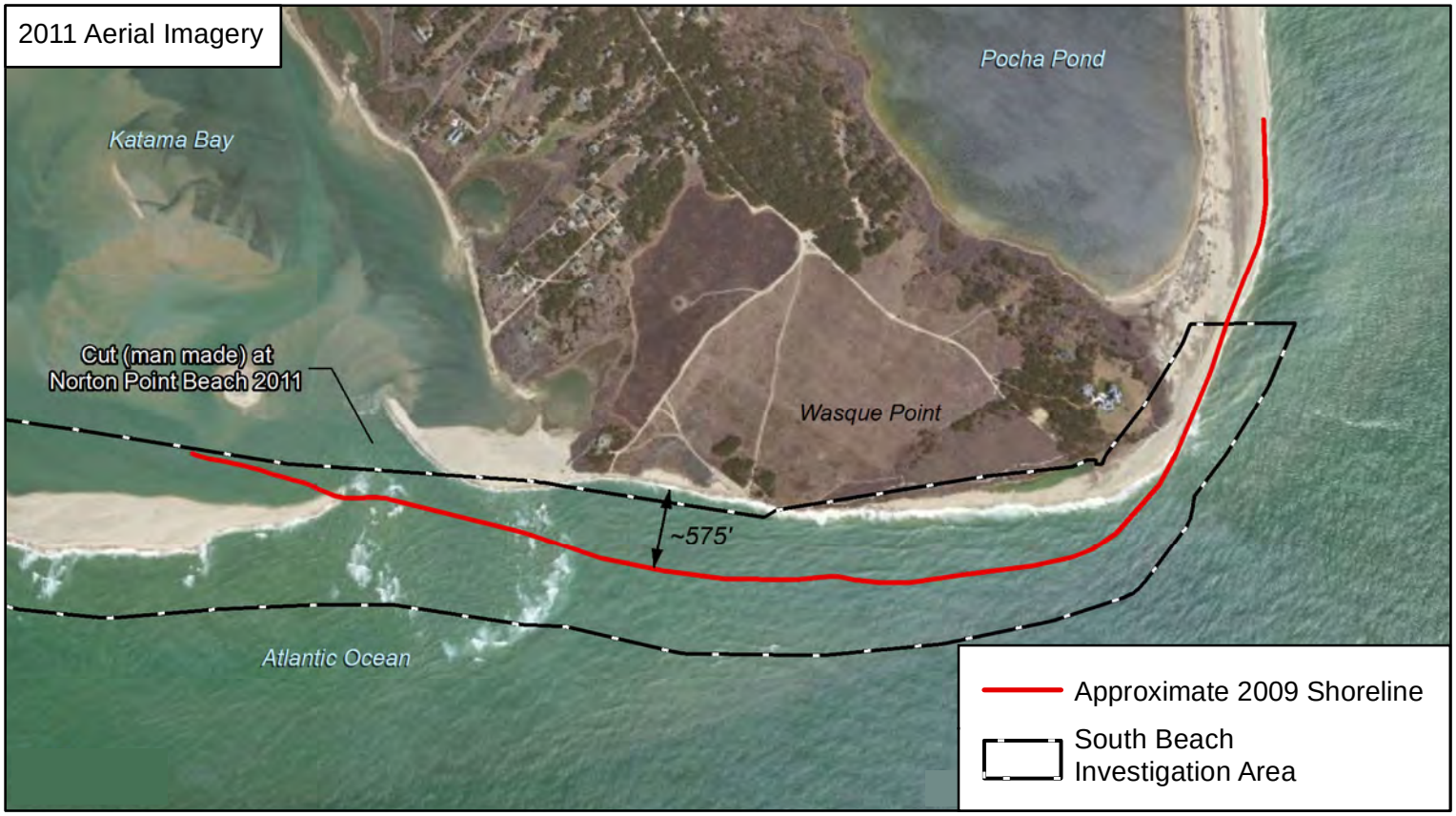
2.2.2.2 Current and Future Land Use

2.2.2.2.0.1 Currently, the site is owned by Dukes County [Massachusetts Department of Conservation and Recreation (MADCR)], private landowners, The Trustees of Reservations (TTOR), and the Commonwealth of Massachusetts (some beach property as well as inland and coastal waters). Figure 2-6 illustrates which property tracks are owned by public entities and which tracts are privately owned within the Investigation Area. South Beach is managed by the Edgartown Parks and Recreation Department from May through Labor Day of each year. The former range encompasses an area that is currently a public beach used for recreational purposes such as hiking, canoeing, kayaking, recreational fishing, clamming, crabbing, wildlife observation, photography, education, and other water-related activities. Land use is not expected to change in the future; however it is possible that additional upland and beach habitat may be lost due to erosion (UXB, 2011).

2.2.2.3 Topography

2.2.2.3.0.1 The inland portion of the site is relatively flat at South Beach and slowly rises to the east toward the bluff at Wasque Point (Figure 2-7). Elevations within the Investigation Area range from 0 ft above mean sea level (msl) along the shore to approximately 32 ft above msl at Wasque Point. Due to the dynamic nature of the beach portion of the site, the landscape of the beach is continuously changing.





US Army Corps of Engineers

FIGURE 2-5

Shoreline Erosion at South Beach and Wasque Point, Martha's Vineyard, MA

0 600 1,200 2,400 3,600 4,800 Feet

0 200 400 600 800 1,000 1,200 Meters

UXB amec

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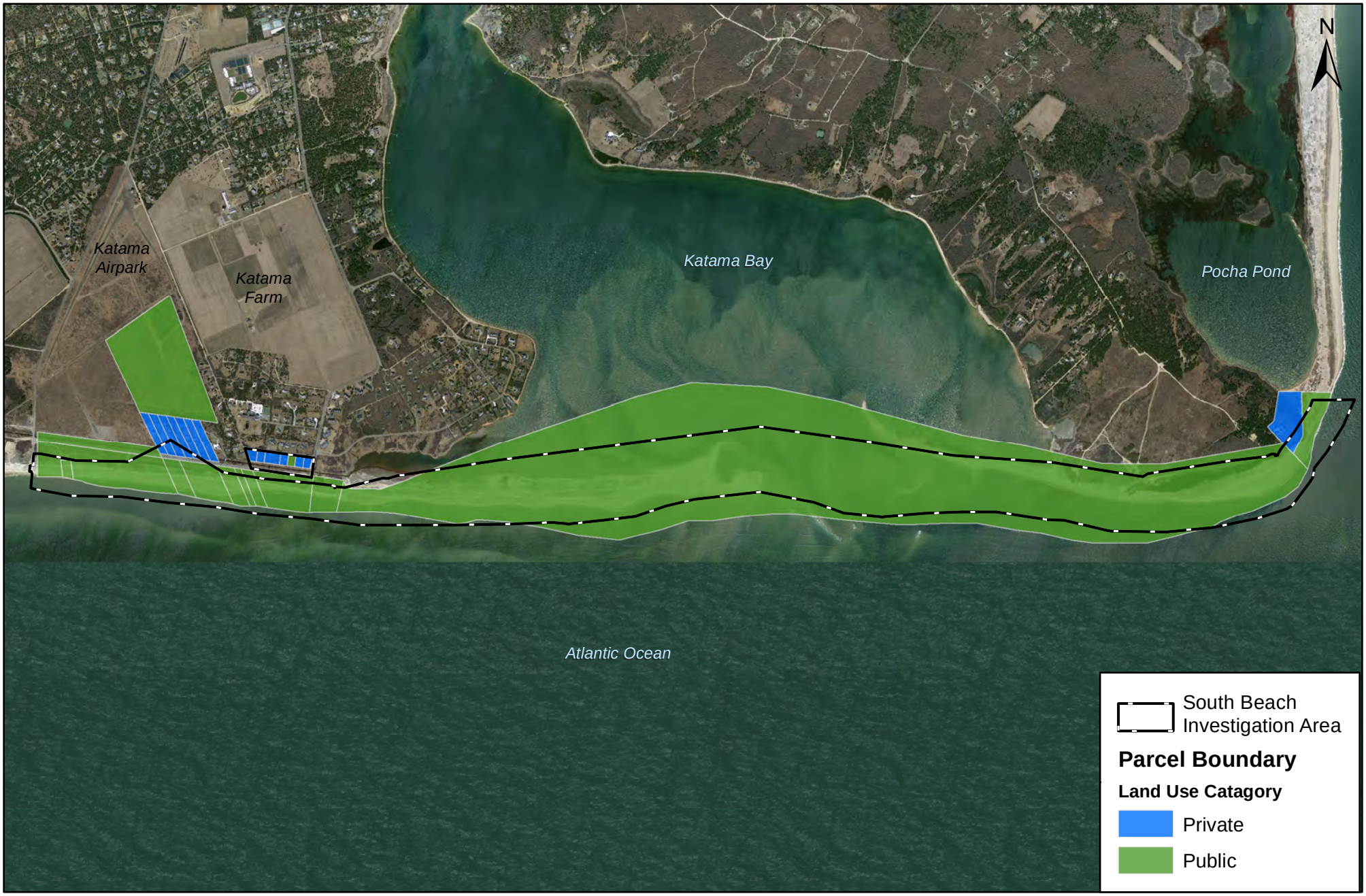

US Army Corps of Engineers

NOTES:
2009 Aerial Data Source: MassGIS

UXB amec

0 1,100 2,200 3,300 4,400 5,500 Feet

0 250 500 750 1,000 Meters

FIGURE 2-6

Current Land Use - Former Moving Target Machine Gun Range at South Beach Investigation Area, Martha's Vineyard, MA

06/19/2013	Rev:	Drawn: JBO	Chk: DMS	CPoge_Privt_Pub_Land_Remedial_Inv_Rpt.mxd	PROJ: 562910000

US Army Corps of Engineers	NOTES: Base Map Data Source: USGS; obtained through ESRI online services.	UXB amec	**FIGURE 2-7** Topographic Map - Former Moving Target Machine Gun Range at South Beach Investigation Area, Martha's Vineyard, MA

0 1,100 2,200 3,300 4,400 5,500 Feet

0 250 500 750 1,000 Meters

03/04/2013	Rev:	Drawn: JBO	Chk: DMS	SBeach_USGS_Topo_Remedial_Inv_Rpt.mxd	PROJ: 562910000

2.2.2.4 Habitat and Vegetation

2.2.2.4.0.1 The current Investigation Area includes three habitat types: 1) upland habitat; 2) beach; and 3) ocean (Figure 2-2). These areas provide habitat to a variety of plants, invertebrates, herbivores, predators, and marine receptors. The Investigation Area includes all or portions of three significant open space areas that are designated for conservation: the Katama Air Field on the west side, the Katama Farm on the north side, and the South Beach State Park along the southern coastline. The upland portions of the Investigation Area are part of the sandplains habitat of Martha's Vineyard that originally supported a grassland or open woodland vegetation dominated by little bluestem (*Schizachyrium scoparium*), switchgrass (*Panicum virgatum*), Indian grass (*Sorghastrum nutans*), and other species of grasses, sedges, and forbs. Dominant trees of this habitat included scrub oak (*Quercus ilicifolia*) and pitch pine (*Pinus rigida*) (USFWS, no date). Various human disturbances, including agricultural and residential development, have modified or removed this natural vegetation type over much of the Investigation Area. The beach habitat includes large areas of un-vegetated beach face backed by dunes supported by American beach grass (*Ammophila breviligulata*), seaside goldenrod (*Solidago sempervirens*), bayberry (*Myrica pensylvanica*), and other species adapted to coastal sand environments.

2.2.2.4.0.2 The investigation area is mapped as "Core Habitat" and "Critical Natural Landscape" by the MA NHESP BioMap2 town report for Edgartown (MA NHESP, 2012). Core habitat identifies areas that are critical to long-term persistence of rare species in Massachusetts. Critical Natural Landscape encompasses habitat used by wide ranging species (e.g. tern), large areas of contiguous habitat, and buffer habitat. The Investigation Area is within Core Habitat area 102 and Critical Natural Landscape area 45.

2.2.2.5 Climate

2.2.2.5.0.1 Martha's Vineyard has a temperate marine climate. Although Martha's Vineyard's weather is typically moderate, there are occasions where the island experiences extreme weather conditions such as nor'easters and hurricanes. Martha's Vineyard's generally experiences a delayed spring season, being surrounded by an ocean that is still cold from the winter; however, it is also known for an exceptionally mild fall season, due to the ocean remaining warm from the summer. The highest temperature ever recorded on Martha's Vineyard was 99 degrees Fahrenheit (°F) in 1948, and the lowest temperature ever was -9°F in 1961 (USACE, 2009a).

2.2.2.5.0.2 Precipitation on Martha's Vineyard and the islands of Cape Cod and Nantucket is the lowest in the New England region, averaging slightly less than 40 inches (in.) per year. This is due to storm systems that move across western areas, building up in mountainous regions, and dissipating before reaching the coast (USACE, 2009a).

2.2.2.6 Soils

2.2.2.6.0.1 The soils at Investigation Area consist of beaches, Udipsamments, Carver loamy coarse sand, Katama sandy loam. A description of the soils located at various locations within the Investigation Area is provided below.

2.2.2.6.0.2 Soils underlying the Investigation Area consist of beach areas and Udipsamments soils, which are found near the coast. Both soils consist of deep sand of various texture that have rapid to very rapid permeability. Due to the continuous washing and rewashing by waves, beach areas typically do not have plant cover. Most areas of Udipsamments will have a cover of grasses and shrubs. The beaches nearest the ocean are inundated twice daily by tides. The entire beach is generally flooded by spring tides and storm tides (United States Department of Agriculture – Soil Conservation Service [USDA-SCS], 1986).

2.2.2.6.0.3 Carver loamy coarse sand and Katama sandy loam soils are located on the remaining portion of the site. These soils are very deep and range from well to excessively drained. These soils typically consist of sandy loam and loamy coarse sand over coarse sand. The permeability of these soils ranges from moderately rapid to very rapid. Depth to seasonal high water table is greater than 6 ft below ground surface (bgs) in both soils (USDA-SCS, 1986).

2.2.2.7 Geology

2.2.2.7.0.1 The Investigation Area and the island of Martha's Vineyard are relicts of the last ice age and the warming trends that followed. Repeated glaciations scraped soil and rock from the mainland of New England. Eighteen-thousand years ago, the glaciers reached their southernmost extent and began to melt and retreat, depositing the rock and soil, once trapped within the ice, as terminal moraines. These terminal moraines can be found on Martha's Vineyard (USACE, 2009a).

2.2.2.7.0.2 The geological deposits that make up the site consist of recent beach and marsh sediments, glacial deposits, interglacial deposits, and glacially deformed ancient coastal plain sediments. The island consists mostly of deposits from the last glacial stage, but in places consists of glacial or interglacial deposits as much as 300,000 years old. These deposits overlie solid bedrock and ranges from 500 ft thick on the north shore of Martha's Vineyard to 900 ft thick on the south shore (USACE, 1999). The bedrock consists of metamorphic rocks, such as schist and gneiss, and igneous rocks (USACE, 2008a; USACE, 2009a).

2.2.2.8 Surface Water Hydrology

2.2.2.8.0.1 Soils in the upland areas and on the beaches are excessively drained and have very high permeability (USDA-SCS). Therefore, there is very little to no surface water runoff in these areas.

2.2.2.8.0.2 Mattakeset Herring Creek flows through the south-central portion of the site between two former firing lines and the former moving target track (Figure 2-2). This stream flows from Crackatuxet Cove southeast into Mattakeset Bay. A visual survey of the "creek" identified the drainage as a concrete culvert that is ephemeral in nature and was not sampled during the RI.

2.2.2.9 Groundwater Hydrology

2.2.2.9.0.1 The principal aquifers on Martha's Vineyard are moraines and outwash deposits, which derive their water from local precipitation. Bedrock is much less permeable than the overlying sediments, commonly contains seawater, and is not considered to be part of the aquifers of Martha's Vineyard (USACE, 2009a).

2.2.2.9.0.2 The water table at South Beach generally mimics topography and is weakly influenced by tidal fluctuations. Groundwater quality studies indicate that salt-water intrusion occurs along the coastline and to a lesser degree throughout the interior of the island. Depth to groundwater ranges from greater to 6 ft bgs in upland soils to near ground surface in lower areas near shorelines and marshes (USACE, 2009a). The shallow freshwater aquifer is underlain by brackish water that is unsuitable for human consumption (USACE, 2008a). In general, supplies of water for homes, cooling, and small businesses can be developed in most areas of outwash from wells that are 1.5 to 2 in. in diameter with 3 ft of screen set about 10 ft below the water table.

2.2.3 Potential Human and Ecological Receptors

2.2.3.1 Demographics

2.2.3.1.0.1 The Investigation Area is located in Edgartown, Martha's Vineyard, Massachusetts. According to the 2010 Census, census track 2003 (approximately 27 square mile area) has a population of 4,067 and contains 5,220 total housing units, of which 1,788 houses are occupied by year-round residents, 3,258 are seasonal or occasional use, and the remaining 168 houses are unoccupied. The population density in this area is 151 persons per square mile (US Census Bureau, 2012).

2.2.3.2 Potential Receptors

2.2.3.2.0.1 Based on the historical use and physical characteristics of the Investigation Area, potential media of concern include surface soil, subsurface soil, and groundwater. Potential receptors include residents, visitors/trespassers, site workers, and biota (mammals, fish, soil invertebrates, birds, reptiles, insects, and plants). A detailed discussion of potential human and ecological receptors is discussed in Sections 7.3 and 7.4, respectively.

2.2.3.2.0.2 Because access to the Investigation Area is not restricted, impacted soils could present a risk to residents, visitors/trespassers, and biota via direct contact, accidental ingestion,

and ingestion of plants that uptake constituents from the soil. Potentially impacted surface water could present a risk to residents, visitors/trespassers, and biota via direct contact and accidental ingestion. Potentially impacted groundwater could present a risk to residents, site workers, and biota via direct contact and ingestion.

2.2.3.3 Threatened, Endangered, or Special Concern Species

2.2.3.3.0.1 The investigation area has been designated as a Priority Habitat of Rare Species and Estimated Habitats of Rare Wildlife in the Massachussetts Natural Heritage Atlas 13th Edition (effective October 1, 2008). Habitat alteration within areas mapped as Priority Habitats (PH) may result in a take of a state-listed species, and is subject to regulatory review by the Natural Heritage & Endangered Species Program. Priority habitat maps are based on known occurrence of rare species and habitat considerations. The Investigation Area is mapped as PH 15. Based upon coordination with the U.S. Fish and Wildlife Service, National Marine Fisheries Service, and Massachusetts Natural Heritage and Endangered Species Program; there are approximately 37 federal/state threatened, endangered, and/or special concern species that have been observed on Martha's Vineyard (Table 2-1). Table 2-1 is specific to Martha's Vineyard. Table 2-2 summarizes the observed species found within the Investigation Area. These include piping plover (Charadrius melodus) a federally threatened species which utilizes beach and nearby upland habitat, and the federally endangered roseate tern (Sterna dougallii) and four federally listed sea turtle species which utilize nearshore ocean habitat. Sea turtles occur seasonally off the coast of Martha's Vineyard from June through early November of any year. While they may occur near shore off South Beach, they are likely to occur in the offshore MRS only briefly as transients. State listed species include many insect and plant species which may utilize upland coastal sandplain or beach habitat.

2.2.3.3.0.2 The RI field work schedule was developed to avoid nesting seasons/fledgling seasons (spring/summer) asmuch as possible. During the RI fieldwork conducted from December 2010 to November 2011, the field crew coordinated on a daily basis with the TTOR who was monitoring daily bird activity on South Beach to ensure the RI work was not interfering or encroaching on the protected birds species. On only one occasion did the UXO field crew observe two nesting piping plovers on the eastern end of South Beach. Massachusetts Natural Heritage and Endangered Species Program (MNHESP) was notified of the siting, however, they were not within the designated work area. No other threatened or endangered species were observed within the investigation area.

Table 2-1. Endangered, Threatened, and Special Concern Species Observed on Martha's Vineyard

Common Name	Scientific Name	State Status	Federal Status
Birds			
Common Tern	*Sterna hirundo*	Special Concern	--
Roseate Tern	*Sterna dougallii*	Endangered	Endangered
Least Tern	*Sterna antillarum*	Special Concern	--
Northern Harrier	*Circus syneus*	Threatened	--
Piping Plover	*Charadrius melodus*	Threatened	Threatened
Reptiles			
Green Sea Turtle	*Chelonia mydas*	Threatened	Threatened
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered	Endangered
Loggerhead Sea Turtle	*Caretta caretta*	Threatened	Threatened
Kemp's ridley Sea Turtle	*Lepidochelys kempi*	Endangered	Endangered
Insects			
Chain dot Geometer	*Cingulia cateraria*	Special Concern	--
Coastal Heathland Cutworm	*Abagrotis nefascia*	Special Concern	--
Gerhard's Underwing Moth	*Catocala Herodias gerhardi*	Special Concern	--
Faded Grey Geometer	*Stenoporpia Polygrammaaria*	Threatened	--
Pine Barrens Zale	*Zale sp 1 nr. lunifera*	Special Concern	--
Pink Sallow Moth	*Psectraglea carnosa*	Special Concern	--
Sandplain Euchaena	*Euchlaena madusaria*	Special Concern	--
Barrens Buckmoth	*Hemileuca maia*	Special Concern	--
Melsheimer's Sack Bearer	*Cicinus Melsheimeri*	Threatened	--
Pine Barrens Lycia	*Lycia ypsilon*	Threatened	--
Coastal Swamp Metarranthis Moth	*Metarranthis pilosaria*	Special Concern	--
Slender Clearwig Sphinx Moth	*Henaris pilosaria*	Special Concern	--
Spartina Borer Moth	*Spartiniphagia inops*	Special Concern	--
Imperial Moth	*Eacles imperialis*	Threatened	--
Barrens Metarranthis Moth	*Metarranthis apiciaria*	Endangered	--
Comet Darner	*Anax longippes*	Special Concern	--
Purple Tiger Beetle	*Cicindela purpurea*	Endangered	--
Northeastern Tiger Beetle	*Cicindela dorsalis*	Endangered	Threatened
Three-Lined Angle Moth	*Digrammia eremiata*	Threatened	--
Plants			
Sandplain gerardia	*Agalinus acuta*	Endangered	Endangered
Bristly Foxtail	*Setaria parviflora*	Special Concern	--
Bushy Rockrose	*Crocanthemum dumosum*	Special Concern	--
Purple Needlegrass	*Aristida purpurascens*	Threatened	--
Sandplain Flax	*Linum intercursum*	Special Concern	--
Saltpond Pennywort	*Hydrocotyle verticellata*	Threatened	--
Pygmyweed	*Tillacea aquatica*	Threatened	--
Sandplain Blue-eyed grass	*Sisinchium fuseatum*	Special Concern	--
Nantucket Shadbush	*Amelanchier nantuckensis*	Special Concern	--
Sea-Breach Knotweed	*Polygonum glaucum*	Special Concern	--

Note: This list was obtained from the RI Work Plan (UXB, 2011).
-- Status not listed

Table 2-2. Observed Species within Former Moving Target Machine Gun Range at South Beach Investigation Area

Species	Federal Threatened and Endangered Species?	Massachusetts Threatened and Endangered Species?	Found Within FUDS MRS?	Found On Martha's Vineyard?	Comment	Reference
Piping plover (Charadrius melodus)	Yes	Yes	Yes	Yes	5 pairs of piping plovers nested at Norton Point Beach in Edgartown, 2010 TTOR data observed Piping Plovers at Norton Point	Final TCRA After Action Report (March 2010)
Common Tern (Sterna hirundo)	No	Yes	Yes	Yes	2010 nesting data provided by TTOR - Least and Common Tern nesting was recorded at Norton Point Beach	Chapter 7.0 Environmental Protection Plan, Final RI Work Plan (November 2010)
Least Tern (Sterna antillarum)	No	Yes	Yes	Yes		

2.3 Historical Information

2.3.0.1 In 1944, the Department of the Navy acquired leases on approximately 264 acres at South Beach. The leases were acquired for the purpose of a gunnery and rocket firing range for the 1st Naval District flight training program at Naval Air Station Quonset Point, Rhode Island and Navy Auxiliary Air Station Martha's Vineyard, Massachusetts. An oval-shaped moving target track, three fixed machine gun firing lines, two rocket targets, a Target Car Shelter, and other support features were constructed near the ocean (Figure 2-4). Two fixed machine gun firing lines, located north of the moving target track, were used to fire ammunition at targets that traveled along the oval-shaped track. The third fixed machine gun range, located northeast of the moving target range, was used to fire ammunition at targets placed in front of a soil impact berm. The two rocket targets, located on the eastern and western side of the moving target track, were used by pilots to practice their rocket firing skills. Military ordnance potentially used at the site included 0.30 and 0.50 caliber ammunition and Mark (MK) 1 practice rockets. The site remained active until 1947 when the U.S. Navy approved the discontinuance of the site. Following closure of the site, the moving target track was removed (USACE, 2010).

2.3.0.2 The Target Car Shelter that was built at the former range was swept into the ocean due to erosion and is now located approximately 500 ft off-shore. In 1983, an attempt was made by a Massachusetts State Trooper to demolish the Target Car Shelter. According to internal correspondence between Town of Edgartown personnel, a combination of plastic explosives (C-3

or C-4) and dynamite were used in an attempt to demolish the Target Car Shelter (Edgartown). However, the attempt failed and the Target Car Shelter currently presents a safety hazard due to exposed rebar and abrasive edges.

2.4 Previous Investigations

2.4.0.1 Investigations conducted at the Investigation Area prior to the 2011 RI include:

- Ordnance and Explosive Waste Remediation Project, USACE (1988);
- Unexploded Ordnance (UXO) Removal, Department of the Army [Explosive Ordnance Disposal (EOD)] (1989);
- Inventory Project Report (2008);
- Time Critical Removal Action (TCRA) (2009);
- Emergency Response, VRH (2008 to 2011); and,
- Emergency Response, UXB (2012).

2.4.1 Unexploded Ordnance Removal

2.4.1.0.1 Between November 1988 and May 1989, a UXO removal action was conducted within the Investigation Area, which concentrated in areas encompassing beaches and sand dunes (Figure 2-8). During the removal action, approximately 1,655 MD items were successfully recovered with approximately 99 of those items being warheads. As part of this removal action, the beaches and sand dunes where intrusive activities occurred were restored (Army, 1989).

2.4.2 Inventory Project Report

2.4.2.0.1 In 2008, the USACE prepared an Inventory Project Report (INPR) in support of the Defense Environmental Restoration Program (DERP) for FUDS. The Findings and Determination of Eligibility (FDE) established an area from South Beach to Wasque Point as a FUDS. A Military Munitions Response Program (MMRP) project was proposed and the INPR identified a MEC category hazard potential. A MRSPP priority ranking was deferred and was to be scored based on the finding of the proposed TCRA (USACE, 2008c).

2.4.3 Time Critical Removal Action

2.4.3.0.1 Between 18 April and 25 September 2009, a TCRA was conducted within the Investigation Area (USACE, 2010) to remove MEC, Material Potentially Presenting an Explosive Hazard (MPPEH), and explosive hazards at the site.

2.4.3.0.2 The removal action was conducted on approximately 22 acres within the Investigation Area, which were subdivided into grids. Within each grid, 5-ft sweep lanes were established for conducting the magnetometer-assisted surface/subsurface/underwater clearance operations using a Schonstedt GA-52Cx magnetometer. Anomalies identified by the magnetometer were investigated and removed using hand tools and mechanical equipment.

US Army Corps of Engineers

NOTES:
2009 Aerial Data Source: MassGIS

UXB amec

0 200 400 600 800 1,000 Feet

0 50 100 150 200 Meters

FIGURE 2-8

1988 - 1989 UXO Removal Areas - Former Moving Target Machine Gun Range at South Beach Investigation Area, Martha's Vineyard, MA

03/06/2013	Rev:	Drawn: JBO	Chk: DMS	SBeach_ESTCP_Anomalies_SB_Remedial_Inv_Rpt.mxd	PROJ: 562910000

MEC, regardless of size, as well as MPPEH, MD, non-MD, and range-related debris equal to or greater than an AN-MK23 Practice Bomb were removed and/or disposed. Figure 2-9 presents the locations of MD items that were identified and removed during the TCRA. During clearance operations, 617 MD items and 933 pounds of non-MD were removed. These items included 2.25 to 3.5 in. rocket motors, a 3 in. rocket motor with a 5 in. warhead, a 3.5 in. rocket motor with a 5 in. warhead, and 3.5 to 5 in. warheads. In addition to clearance operations, five demolition events were performed at South Beach in which 42 items were perforated and found to be inert. No MEC/MPPEH found at the site during the TCRA contained high explosive filler (USACE, 2010).

2.4.4 Emergency Response

2.4.4.0.1 Between May 2008 and August 2011, VRH responded to four emergency calls associated with potential ordnance. The EOD incident reports from May 2008 state that a 100 pound bomb suspected of containing high explosives was detonated. As stated previously, due to the mission of the EOD to render items safe by detonation (as opposed to perforating the items to first determine whether the items contain explosives) coupled with the large amount of explosives used by the EOD team, USACE has concluded that it is highly unlikely and extremely difficult to determine if an item was MD or MEC after detonation. The details of this emergency response and others are presented in Table 2-2, and the emergency response reports are included in Appendix A.

Table 2-2. Emergency Responses
Former Moving Target Machine Fun Range at South Beach Investigation Area

Date	Location	Quantity	Ordnance Description	Response Action
05-2008[(1)]	Wasque Point	1	100-pound bomb (suspected of containing HE)	Massachusetts Bomb Squad detonated the bomb. Based upon the detonation, the bomb was suspected of being a live ordnance.
26-08-2008[(2)]	South Beach	8	• 41.5-in. x 3.125-in. rocket motor • 38.5-in. x 3.125-in. rocket motor • 25.5-in. x 2.75-in. rocket motor • 24.5-in. x 2.75-in. rocket motor • 22.5-in. x 2.75-in. rocket motor • 24.75-in. x 2.75-in. rocket motor • 26-in. x 2.75-in. rocket motor • 6-in. x 2.75-in. rocket motor	n/a
13-02-2009[(2)]	Wasque Point	1	100-pound bomb	VRH identified item as ordnance and secured the immediate area. The Massachusetts Bomb Squad and Navy EOD were notified. Navy EOD detonated the bomb and determined that the bomb likely contained incendiary compounds when observing the resulting explosion.
1-08-2011[(2)]	Norton Point	1	2.25-in. rocket motor	VRH personnel determined the item to be free of hazardous/ energetic material and was removed to a secure container.

Date	Location	Quantity	Ordnance Description	Response Action
2-17-12[3]	South Beach	1	5-in. MK6 practice warhead	UXB personnel determined that the item was safe to move for detonation. The warhead was moved to South Beach at the entrance to Norton Point and detonated. The item was determined to be a MD item.

Notes: [1] Information obtained in the Amended Findings and Determination of Eligibility, South Beach at Martha's Vineyard, (Moving Target Machine Gun Range) (USACE, 2008c).
[2] Information obtained from VHR Emergency Response Reports (VHR, 2008; 2009; and 2011).
[3] Information obtained from UXB Daily Report (UXB, 2012).
EOD - explosive ordnance disposal **in.** - inch(es) **MD** - munitions debris **VRH** - VRHabilis, LLC

US Army Corps of Engineers

NOTES:
2009 Aerial Data Source: MassGIS

UXB amec

0 225 450 675 900 1,125 Feet

0 100 200 300 Meters

FIGURE 2-9

2009 TCRA Results - Former Moving Target Machine Gun Range at South Beach Investigation Area, Martha's Vineyard, MA

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3.0 PROJECT REMEDIAL RESPONSE OBJECTIVES

3.0.1 This section discusses the results of the Technical Project Planning (TPP) Process, used to identify project objectives, assist in the data collection design, and guide the project ensuring effective and efficient progress. The TPP Process is a systematic process that involves four phases of planning activities designed to accelerate progress to site closeout within all project constraints. Phase I activities bring together a TPP team to identify the current project and to document both short- and long- term project objectives through completion of all work at a site (site closeout). Phase II efforts involve an evaluation to determine if additional data are needed to satisfy the project objectives. The data need requirements for the additional data are then identified during the balance of Phase II efforts. Phase III activities involve identifying the appropriate sampling and analysis methods for the data needed. During Phase IV, the TPP team finalizes a data collection program that best meets the short- and long-term project needs. The following TPP meetings were held at the Edgartown Town Hall:

- TPP Meeting #1 (24 March 2010);
- TPP Meeting #2 (14 October 2010);
- TPP Meeting #3 (16 June 2011); and,
- TPP Meeting #4 (5 September 2012).

3.0.2 During the TPP process, stakeholders provided input which resulted in the development of a conceptual site model (CSM), preliminary remediation goals, the identification of potential applicable or relevant and appropriate requirements (ARARs) and "to be considered" (TBC) information, development of an Institutional Analysis, and determination of data needs and data quality objectives (DQOs) of the investigation. The TPP team consisted of:

- USAESCH;
- CENAE;
- UXB;
- AMEC Environment & Infrastructure, Inc. (AMEC) (subcontractor);
- VRHabilis (subcontractor);
- Aqua Survey, Inc. (subcontractor);
- Massachusetts Department of Environmental Protection (MADEP);
- MADCR;
- USEPA;
- TTOR; and,
- Town of Edgartown.

3.1 Conceptual Site Model and Project Approach

3.1.0.1 Evaluation of the site history, potential contaminant sources, environmental setting, and current and future land use have led to the development of a CSM, the major components of which have been summarized in Table 3-1. A discussion of the sources, release mechanisms, fate and transport processes as well as the pathway exposure analysis are discussed below.

3.1.1 Sources

MEC

3.1.1.0.1 The source of MEC at the Investigation Area consists of the potential presence of bombs containing HE fillers, composed of 2,4,6-trinitrotoluene (TNT) or similar products. Although the use of bombs at the Investigation Area has never been documented, these potential MEC hazards have been identified at the Investigation Area on two occasions.

MCs

3.1.1.0.2 MCs associated with ordnance potentially used at the Investigation Area include metals used in ammunition casings, bullets, and rockets as well as explosive compounds used as propellants in small-arms and rockets.

3.1.1.0.3 Generally, 0.30 and 0.50 caliber ammunition consists of a brass casing (70 percent copper and 30 percent zinc) that contains the primer and propellant and holds in place a bullet/projectile composed of a lead-antimony alloy. The cartridges are loaded with varying amounts of propellant, which are either single-base or double-base propellants. Single base propellants within these munitions are primarily composed of nitrocellulose (NC) and 2,4-dinitrotoluene (DNT), while double-base propellants are composed primarily of NC and nitroglycerin (NG).

3.1.1.0.4 Rocket warheads and motors are typically made of solid steel that contain various hardening agents (e.g., carbon, zinc, copper). As mentioned above, rocket motors contain double-base solid rocket propellant composed primarily of NC and NG.

3.1.2 Release Mechanisms

3.1.2.0.1 The site was used for gunnery and rocket firing practice from approximately 1944 to 1947. Historic military activities at the site resulted in the accumulation of ammunition casings around the firing lines, bullets/projectiles around the moving target and within the impact berm, and small-arms propellant residue within and near the firing lines (Figure 2-4). Additionally, rocket motors and warheads landed at one of two rocket targets located at the site. The primary release mechanism includes the weathering/corrosion of propellants and metal casings and bullets, potentially leading to the release of MCs into the environment.

Table 3-1. Evaluating Existing Data
Preliminary Conceptual Site Model Summary
Former Moving Target Machine Gun Range at South Beach Investigation Area

Facility Profile	Physical Profile	Release Profile	Land Use and Exposure Profile	Ecological Profile
Facility Description: • Investigation Area is ~ 478 acres. • FUDS boundary is 4,201.5 ac • Located south of Edgartown along the southern edge of Martha's Vineyard, Massachusetts. • Historical structures used by the U.S. Navy on the site include a moving target machine gun range track, a Target Car Shelter, two circular target areas, three former firing lines, and other support structures. **Site History:** • The site was used from 1944 to 1947 by the Naval Air Station Quonset Point, Rhode Island for the purpose of a gunnery and rocket firing range. • Rockets, bombs, and bomb fragments have been observed on the property. **Munitions Potentially Used:** • 0.30 and 0.50 caliber ammunition • MK 1 rockets • 2.25 in. to 5 in. rockets	**Site Characteristics:** • Approximately 18.7 acres of land • Approximately 190.4 acres of beach • Approximately 268.7 acres of ocean • Due to extensive beach erosion, the former range is now believed to be approximately 150 yards seaward of South Beach. **Topography:** • The site is relatively flat. • The beach portion of the site is dynamic with surf continuously eroding and depositing sand. **Vegetation:** • Low grass vegetation. **Surface Water:** • Mattakeset Herring Creek flows through the south-central portion of the site between two former firing lines and the former moving target track. • Surface water runoff is not expected in upland areas. **Soils:** • Soils located on the sand dunes consist of medium to coarse sands and are excessively drained. **Geology:** • Glacial deposits consisting of recent beach and marsh sediments, glacial deposits, interglacial deposits, and glacially deformed ancient coastal plain sediments [(2)]. • Bedrock is encountered at approximately 500 ft below ground surface and is comprised of metamorphic and igneous rocks [(2)]. **Hydrogeology:** • Depth of groundwater ranges from 0 to greater than 6 ft bgs. • Groundwater on Martha's Vineyard is primarily discharged directly to the ocean and surrounding bays. **Meteorology:** • Average Annual Rainfall = 46 in. per year [(2)].	**Contaminants of Potential Concern:** • Antimony, copper, lead, nickel, zinc, and explosives. • Munitions and explosives of concern (MEC) are a concern due to 100-pound bombs that have been identified and suspected of containing high explosives. The origin of the bombs identified at Wasque Point is unknown. **Media of Potential Concern:** • Surface soil, subsurface soil, and groundwater. **Confirmed Munitions Debris Locations:** • During the 1988-1989 unexploded ordnance removal action, 1,655 munitions debris items were successfully recovered with approximately 99 of those items being warheads. • During the 2009 Time-Critical Removal Action, 617 munitions debris items were identified and removed. Items included 2.25 to 5 in. sub-caliber aircraft rockets, 5 in. rocket warheads, 1 to 3.5 in. rocket warheads, 3 to 3.25 in. rockets with warheads, and 3 to 3.25 in. rockets with 5 in. warheads. These items were found offshore primarily near the southwest target and at the southeastern most portion of the site. Other debris items were found to the east of the southwest target. **Potential Pathways:** • Munitions constituents from items located on the sand dunes would most likely leach through the soil into groundwater. • Due to beach erosion, items and constituents located within the beach could be transported to the ocean during large storm events. • Constituents could also be adsorbed to soil particles and remain close to the source. • Erosion of soil by water or wind may expose buried munitions items.	**Current Landowners:** • South Beach is owned and managed by the Commonwealth of Massachusetts, Department of Conservation and Recreation (MADCR), and managed by the Edgartown Parks and Recreation Department from the first of May through Labor Day of each year. • Private landowners occupy small portions of the property. **Current Land Use:** • The former range encompasses an area that is currently a public beach used for recreational purposes such as hiking, canoeing, kayaking, fishing, clamming, crabbing, wildlife observation, photography, education, and other water related activities. • The northern portion of the site is developed with single-family residential homes, commercial real estate, and asphalt roads. All modern utilities used by these facilities run within the former range site boundaries. **Future Land Use:** • Land use is not expected to change in the future. **Potential Receptors:** • Potential receptors associated with current and future land use include residents, recreation users, onsite workers, and biota. • There is concern for public safety due to munitions items washing onto the shore at South Beach. [(1)]	**Property Description:** • The former site consists of uplands that contain residential and commercial development, a small strip of beach, and the Atlantic Ocean. • The primary use of the property is residential use and recreational use, with a moderate degree of disturbance. **Potential Ecological Receptors:** • Inland and marine plant species, fish, birds, insects, soil invertebrates, and mammals that inhabit or migrate through the site. Associated threatened and endangered species are included. **Threatened and Endangered Species:** • There are approximately 37 federal/state threatened, endangered, and/or special concern species that could be present at the site. [(1)] **Relationship of Munitions Debris to Habitat:** Munitions items may be located within and/or adjacent to habitat areas

Notes:
[(1)] UXB International, Inc., 2011. *Final Revision 1, Remedial Investigation Work Plan, Former Cape Poge Little Neck Bomb Target MRS, Former Moving Target Machine Gun Range at South Beach MRS, & Tisbury Great Pond MRS, Martha's Vineyard, Massachusetts*. January.
[(2)] U.S. Army Corps of Engineers, 2010. *Draft Final Site Specific Final Report For The Time Critical Removal Action (TCRA) at Former Cape Poge Little Neck Bomb Target Site, Chappaquiddick Island, Dukes County, Massachusetts, and Former Moving Target Machine Gun Range at South Beach, Martha's Vineyard, Edgartown, Massachusetts*. January.
[(3)] U.S. Army Corps of Engineers St. Louis District, 2009b. *Draft Report, Preliminary Assessment, Cape Poge Little Neck Bomb Target Site, Chappaquiddick Island, MA, FUDS Property – D01MA0595*. February.
[(4)] United States Department of Natural Resources-Soil Conservation Service (USDA-SCS), 1986. *Soil Survey of Dukes County, Massachusetts*. September.
[(5)] Department of the Army, 1989. *After Action Report – Ordnance Clearance Operation on Martha's Vineyard, MA; 14 March 1989 – 12 May 1989.* May.

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3.1.3 Fate and Transport Processes

MEC and MD

3.1.3.0.1 The ultimate fate of MEC and MD items at the site is governed by various physical factors/transport processes. Natural erosion over time of soil by wind or by water can result in the exposure of buried MEC or MD by the removal of the overlying soil.

3.1.3.0.2 Historically, the rocket targets were located at the land/beach interface. At these locations, items containing MEC or MD are subject to ocean currents that likely facilitated the movement of these items out to sea or horizontally along the beach.

3.1.3.0.3 An additional concern at the site is the movement of munitions items by the public. The public and beach patrol personnel have retrieved and brought on-shore numerous rocket motors since military operations ended (USACE, 2008c).

MCs

3.1.3.0.4 MCs were evaluated in the RI and are discussed in section 6.0.

3.1.4 Exposure Pathway Analysis

MEC

3.1.4.0.1 Exposure to MEC via surface and subsurface soil were evaluated during the development of the RI Work Plan (UXB, 2011) and summarized on Figure 3-1. Based on the exposure analysis, potential receptors for MEC include residents, recreational users, on-site workers, and biota.

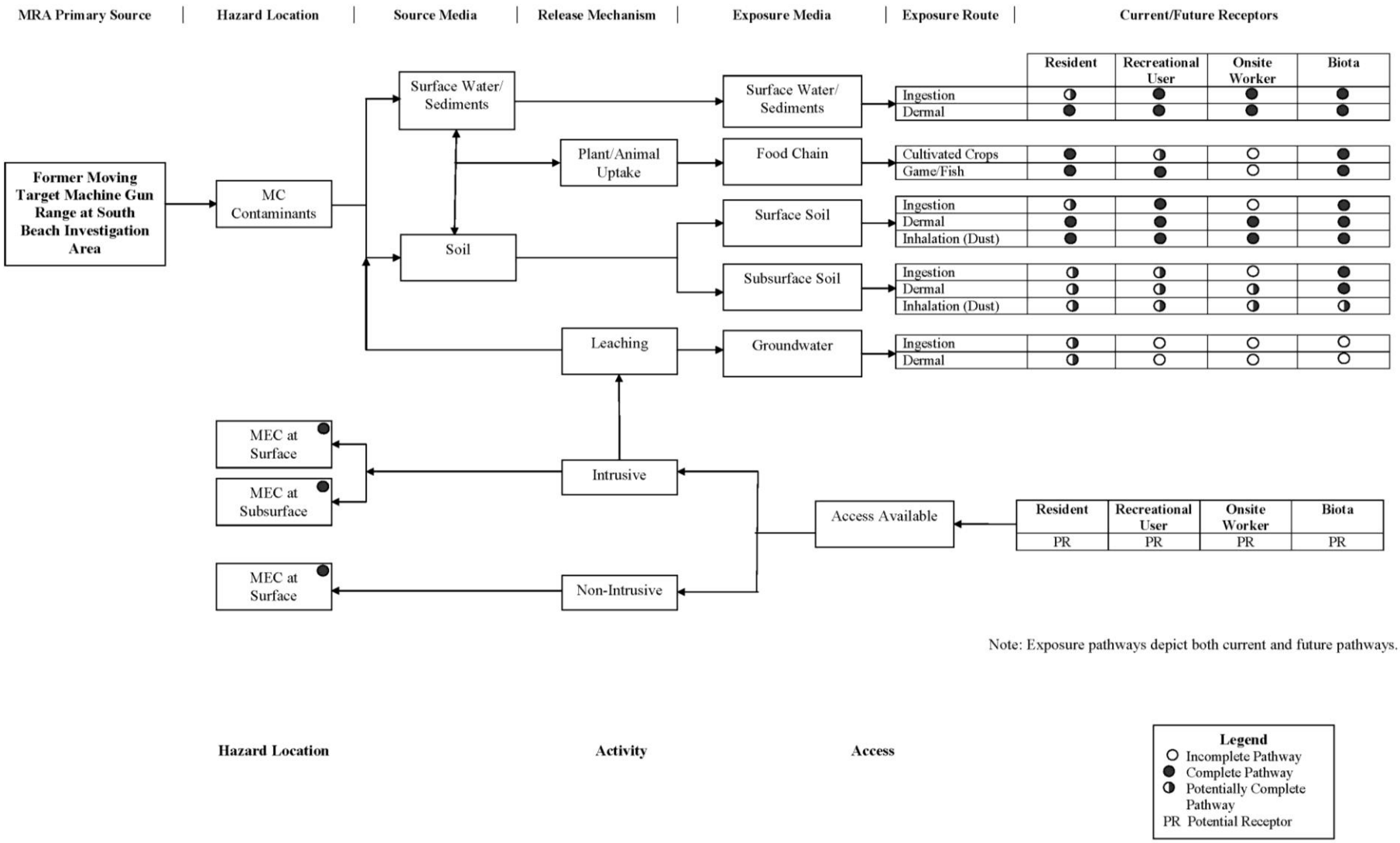
MCs

3.1.4.0.2 Exposure to MCs via surface soil, subsurface soil, and groundwater were evaluated and the results are summarized on Figure 3-1.

3.1.4.0.3 The food chain exposure pathway was evaluated for potential receptors through the consumption of cultivated crops, native vegetation, and game/fish exposure routes. Exposure of MCs through consumption of cultivated crops is considered complete for residents and biota, potentially complete for recreational users, and incomplete for on-site workers. Exposure through consumption of native vegetation is considered complete for biota and potentially complete for residents, recreational users, and on-site workers. Exposure through consumption of game/fish is considered complete for residents, recreational users, and biota; and considered incomplete for on-site workers.

3.1.4.0.4 The surface soil exposure pathway was evaluated for potential receptors through the ingestion, dermal contact, and inhalation exposure routes. Exposure of MCs through ingestion of surface soil is considered complete for recreational users and biota, potentially complete for

Figure 3-1. Conceptual Site Model Summary



residents, and incomplete for on-site workers. Exposure through dermal contact and inhalation is considered complete for all receptors.

3.1.4.0.5 The subsurface soil exposure pathway was evaluated for potential receptors through the ingestion, dermal contact, and inhalation exposure routes. Exposure of MCs through ingestion of subsurface soil is considered complete for biota, potentially complete for residents and recreational users, and incomplete for on-site workers. Exposure through dermal contact is considered complete for biota and incomplete for residents, recreational users, and on-site workers. Exposure through inhalation is considered potentially complete for all receptors.

3.1.4.0.6 The groundwater exposure pathway was evaluated for potential receptors through the ingestion and dermal contact exposure pathway. Exposure of MCs through these pathways was considered potentially complete for residents and incomplete for all other receptors.

3.2 Preliminary Remediation Goals

3.2.0.1 Preliminary Remediation Goals were developed for MEC, MPPEH, and MD as well as associated MCs. For MEC, MPPEH, and MD, the Preliminary Remediation Goals include characterizing the nature and extent of these items and reducing the associated risks. To meet these Preliminary Remediation Goals, a geophysical survey and visual inspection were conducted to identify MEC, MPPEH, and MD items as well as subsurface anomalies. Once anomalies were identified, an intrusive investigation was conducted on all anomalies that met or exceeded selection criteria for MEC. To determine the risk associated with MEC, the MPPEH items were vented and perforated.

3.2.0.2 The Preliminary Remediation Goals for MCs are the screening criterion identified during the TPP process to be protective of human health and ecological receptors. If environmental media containing MCs above the screening criterion are identified, a risk assessment shall be conducted to determine risk to human health and the environment and determine additional action necessary to mitigate risk, if required. To evaluate relevant MCs, environmental media (soil, and groundwater) were sampled and analyzed for MCs potentially released at the site. Additionally, a screening level human health risk assessment (HHRA) and screening level ecological risk assessment (ERA) were conducted to determine if any MCs required additional assessment. Constituents exceeding the applicable regulatory criterion, were further evaluated in a baseline HHRA following the USEPA risk assessment guidance (USEPA, 1989) and an ERA in accordance with current guidance including the 2001 USEPA Supplemental Guidance to Risk Assessment Guide for Superfund (RAGS), Ecological RAGS (USEPA, 1997), and the Massachusetts Method 3 Risk Characterization methodology under the Massachusetts Contingency Plan (MCP) (MADEP, 1996). Applicable screening criteria are provided in Table 3-2.

Table 3-2. Human Health and Ecological Screening Criterion
Former Moving Target Machine Gun Range at South Beach Investigation Area

Media of Concern	Screening Criterion	
	Human Health	Ecological
Soil	Criteria for human health were identified as the lower of: 1. USEPA Residential Risk Screening Level 2. MADEP Method 1 Soil Standard (S1 value selected as most stringent)	Criteria for ecological were identified as the USEPA EcoSSL (lowest of avian, mammalian, plant, or invertebrate)
Groundwater	USEPA MCLs	n/a

Notes:
EcoSSL - Ecological Soil Screening Level
MADEP - Massachusetts Department of Environmental Protection
MCL - Maximum Contaminant Levels
USEPA - U.S. Environmental Protection Agency
n/a - not available

3.3 Identification of Potential ARARs

3.3.0.1 A list of potential ARARs [in accordance with 40 Code of Federal Regulations (CFR) §300.415(j)] and TBC information were identified. This information influences the development of remedial alternatives by establishing numerical clean-up levels and other standards.

3.3.0.2 The following five criteria that must be met for a standard, requirement, criteria, or limitation to be considered an ARAR:

1. The requirement must be promulgated;
2. The requirement must be related to a Federal/State environmental law or state siting law;
3. The requirement must be substantive;
4. The requirement must be a cleanup standard, standard of control, or requirement that specifically addresses a CERCLA hazardous substance, pollutant, or contaminant; remedial action; or remedial location; and,
5. The requirement must be applicable or relevant and appropriate.

3.3.0.3 Non-promulgated advisories or guidance issued by federal or state governments are not legally binding and do not have the status of ARARs. Such requirements may; however, be useful and are TBC. TBC requirements (40 CFR §300.400[g][3]) complement ARARs but do not override them. They are useful for guiding decisions regarding cleanup levels or methodologies when regulatory standards are not available.

3.3.0.4 A list of potential ARARs for activities at the Investigation Area are provided in Table 3-3.

Table 3-3. Potential ARARs
Former Moving Target Machine Gun Range at South Beach Investigation Area

Standard, Requirement, Criteria, or Limitation	Citation	Description	Potential ARARs or TBC
Federal Requirements			
MA Endangered Species Act	321 CMR 8:00 and 10:00	This Act provides for listing of endangered or threatened species or species of concern, and of their habitat and prohibits the taking, possession, transport, export, processing, sale or purchase of such species and any other species listed under the federal Endangered Species Act (16 U.S.C. § 1531). The Act also prohibits any alteration of significant habitat of any protected species that may reduce the viability of the habitat.	ARAR
RCRA, Hazardous Waste Identification, Container Management, Miscellaneous Units OB/OD, and– Military Munitions (Solid Waste Identification)	40 CFR 262.11, 264 Subparts I and X and 266.202 Subpart M	Establishes rules for identification, management, and treatment of hazardous wastes including container management and open burn / open detonation and management.	ARAR

Notes:
ARAR - Applicable or Relevant and Appropriate Regulation
CFR - Code of Federal Regulations
CMR – Code of Massachusetts Regulations
U.S.C. - United States Code

3.4 Summary of Institutional Analysis

3.4.0.1 The objective of this analysis is to gather background information and document which stakeholders have jurisdiction over the subject property and to assess the capability and willingness of these entities to assert institutional controls protecting the public from potential explosive hazards present at the site. An Institutional Analysis Report will be developed and presented in the Feasibility Report.

3.5 Data Needs and Data Quality Objectives

3.5.0.1 The following sections discuss the data needs previously identified for the Investigation Area and the DQOs developed to ensure that these data needs were met. The data needs and project objectives for this RI were discussed and agreed upon by the TPP Team.

3.5.1 Data Needs

3.5.1.0.1 An evaluation of existing data was conducted to determine the data needs and the methods required to fulfill those needs. The evaluation results are presented in Section 3.1, *Conceptual Site Model and Project Approach*, which confirms the use and presence of military ordnance at the site. Data needs identified during the TPP process included:

- Characterizing potential release points for MCs present within environmental media;
- Identifying MCs within environmental media;
- Characterizing the nature and extent of MEC, MD, and MCs; and,
- Collecting adequate data to define the potential risks associated with MEC and MCs present.

3.5.1.0.2 During the TPP process, the TPP team agreed to the following investigation requirements necessary to fill the identified data gaps:

TPP Meeting #1

- Conduct incremental sampling for surface soil and collect biased, discrete samples for subsurface soil.
- Analyze explosives and a limited list of inorganics associated with munitions used (practice rocket).
- Compare analytical results to USEPA Regional Screening Levels (RSLs) (USEPA, December, 2009) or MADEP delineation criteria, whichever is more stringent.

TPP Meeting #2

- Conduct aerial geophysics for the Investigation Area.
- Conduct blind seeding on grids only. Conduct blind seeding on all water except ocean.

TPP Meeting #3

- Focus the MC investigation at South Beach on the three firing lines and the impact berm.
- Sample groundwater from the tire wash well.
- Sample groundwater from a subset of domestic wells with consideration to well construction and filtration.
- Sediment samples are not initially required.
- Shellfish sampling at South Beach is not initially required.
- Surface water samples are not initially required.
- Collect incremental surface soil samples at the firing lines and impact berm from native soils only (e.g., not from a manicured lawn). Collect discrete subsurface soil samples at incremental sample (IS) locations to determine vertical extent in native soil. Collect background samples if soil sample concentrations exceed human health screening criteria.

Follow-up Conference Call to TPP Meeting #3

- Implement a phased approach to groundwater sampling. Initially, four grab samples will be collected using Small Diameter Driven Well (SDDW) technology approved by MADEP. Collect one sample in the vicinity of the public well at the life guard station and the remainder will be collected in the vicinity of the moving target range, firing lines, and impact berm. Background samples will be collected if results indicate groundwater concentrations exceed human health screening criterion.
- Collect surface and subsurface soil samples (incremental sample in target area and discrete, biased samples in other areas). Incremental samples should consist of more than 30 increments (between 75 and 100) selected by the systematic random sampling procedure. Discrete samples are recommended within areas with the greatest MEC density.

3.5.2 Data Quality Objectives

3.5.2.0.1 DQOs are outputs derived from the seven-step DQO process that are used to guide environmental data collection activities (USEPA, 2000). This process provides a systematic approach for defining the criteria that a data collection design should satisfy. DQOs are qualitative and quantitative statements that define the purpose of the investigation, what the data collected should represent to satisfy the objectives of the investigation, and specify the quality of data required to support decisions made during the investigation. The overall project objectives with respect to data quality are to obtain data that are technically sound and legally defensible. This is accomplished through the proper implementation of field sampling and surveying procedures, field logs and chain of custody (COC) documentation, controlled laboratory analysis, and validation of the reported data prior to their use. A discussion of the DQOs for each investigation element performed during this RI is provided in the following subsections.

3.5.2.1 Geophysical Investigation

3.5.2.1.0.1 The overall objective of the geophysical investigation is to define the nature and extent of MEC, MPPEH, and MD. To ensure that the activities conducted during the geophysical investigation satisfy this objective, the following geophysical DQOs were developed.

3.5.2.1.0.2 **DQO 1 – The MEC footprint will be defined such that a representative boundary of MEC contamination is discerned.**

3.5.2.1.0.3 The extent of MEC and MD at the Investigation Area was defined through the collection of geophysical data (analog and digital) within land, beach, inland water, and ocean areas.

3.5.2.1.0.4 **DQO 2 – The total geophysical acreage surveyed should be a minimum of 0.75 percent of the total munitions response site (MRS), or Investigation Area, acreage for a statistically valid survey to result.**

3.5.2.1.0.5 The total acreage surveyed on land, beach, inland water and ocean is 8.57 acres, or 2.35 percent of the total acreage (364 acres) of the Investigation Area

3.5.2.1.0.6 **DQO 3 – The coordinates obtained from the positioning system will be of sufficient accuracy to allow for appropriate relocation of MEC items for intrusive investigation.**

3.5.2.1.0.7 This DQO was achieved by collecting data with the real time kinematic (RTK) global positioning system (GPS) system over a known point. All collected data was within the required 4 in. [10 centimeters (cm)].

3.5.2.1.0.8 **DQO 4 – Have sufficient data collected along each line to detect munitions items.**

3.5.2.1.0.9 This DQO was achieved by calculating the percentage of sequential data points separated by more than 25 cm to ensure that the number of readings that fell outside did not exceed 25 cm.

3.5.2.1.0.10 **DQO 5 – Maintain appropriate lane spacing to provide greater than 90 percent coverage at project line spacing (2.5 ft).**

3.5.2.1.0.11 This DQO was achieved by evaluating the collected data through the generation of footprint coverage maps.

3.5.2.1.0.12 **DQO 6 – Anomaly characteristics (peak response and downline width) will be repeatable to greater than or equal to 65 percent of expected minimum value.**

3.5.2.1.0.13 This DQO was achieved by comparing the test item coordinates and response in the instrument verification strip (IVS) against the initial day's results.

3.5.2.1.0.14 **DQO 7 – Anomaly characteristics (peak response and downline width) will be repeatable within 0.73 m of original location for data positioned with GPS and 0.88 m of the original location.**

3.5.2.1.0.15 This DQO was achieved by comparing the DGM selected target location to the intrusive dig location.

3.5.2.1.0.16 **DQO 8 – The DGM system will respond consistently from the beginning to the end of an operation.**

3.5.2.1.0.17 This DQO was achieved by evaluating the static test results to ensure that the static response did not exceed +/-10 percent after background correction.

3.5.2.2 Munitions and Explosives of Concern Intrusive Investigation

3.5.2.2.0.1 The DQOs for MEC intrusive investigation activities performed and a summary of how each of these DQOs were accomplished are provided below.

3.5.2.2.0.2 **DQO 1 – MEC will be uniquely identified as to type, condition, orientation, etc.**

3.5.2.2.0.3 This DQO was achieved by conducting intrusive investigations within 36 grids resulting in the identification and recovery of 0 MEC items.

3.5.2.3 Munitions Constituents Investigation

3.5.2.3.0.1 The DQOs for MC field investigation activities performed and a summary of how each of these DQOs were accomplished are provided below.

3.5.2.3.0.2 **DQO 1 – Field and Analytical performance/acceptance criteria per method as detailed in the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) Version 4.2 and defined on Worksheet #12 in the approved RI Work Plan (UXB, 2011).**

3.5.2.3.0.3 All data was collected and analyzed in accordance with the procedures, methods, and performance/acceptance criteria detailed in the DoD QSM Version 4.2 and defined in Worksheet #12 of the UFP-QAPP in the approved RI Work Plan (UXB, 2011).

3.5.2.3.0.4 **DQO 2 – The quantity and location of samples is acceptable when nature and extent is determined using the Decision Rules identified in Worksheet #12, Step 5, in the approved RI Work Plan (UXB, 2011).**

3.5.2.3.0.5 This objective was achieved by conducting incremental and discrete soil sampling as well as groundwater sampling within the Investigation Area in accordance with the approved RI Work Plan (UXB, 2011). These samples were analyzed by the contracted laboratory for the target explosives listed in Method 8321B including NG, DNT and breakdown products (2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 2-nitrotoluene, 3-nitrotoluene and 4-nitrotoluene, and 4-amino-2,6-DNT). Also, select metals (antimony, copper, iron, lead, nickel, and zinc) were analuzed using Method 6020A by ICP/MS. Based upon the results of initial soil and groundwater sampling, all decision rules contained within Step 5 were satisfied.

3.5.2.3.0.6 **DQO 3 – SW 846 Methods will provide an acceptable detection limit and accuracy for use in decisions related to attaining cleanup goals.**

3.5.2.3.0.7 All analytical data were analyzed using analytical methods listed in the Uniform Federal Policy – Quality Assurance Project Plan (UFP-QAPP), provided in the RI Work Plan (UXB, 2011).

3.5.2.3.0.8 **DQO 4 – The laboratory will review and apply usability qualifiers to the analytical data.**

3.5.2.3.0.9 The scope of work defined for the contracted laboratory includes data review and the use of usability qualifiers for all analytical results, where applicable.

3.5.2.3.0.10 **DQO 5 – All data will be verified using the Automated Data Review (ADR) software tool.**

3.5.2.3.0.11 All analytical data was verified using ADR software by USAESCH.

3.5.2.3.0.12 **DQO 6 – A data validation will be conducted on 100 percent of the analytical; data by an experienced chemist to assess the data usability. The data usability will then be evaluated by the appropriate agencies for final approval.**

3.5.2.3.0.13 Data validation was performed on 100 percent of the analytical data by a qualified chemist.

4.0 CHARACTERIZATION OF MEC AND MCs

4.0.1 The objective of this RI was to collect data necessary to determine the nature and extent of MEC and MCs; evaluate the potential risks to human health and the environment; and support the development of an FS to evaluate future response actions, if necessary. To achieve these objectives, various field investigative activities were conducted; including, geophysical surveying of land, beach, and ocean waters; intrusive investigations of anomalies; and environmental sampling of soil and groundwater for analysis of MCs. This section presents a summary of the field activities conducted during this RI.

4.1 Site Preparation

4.1.0.1 Prior to characterization activities, several preparation activities were conducted including a utility clearance, obtaining an underwater archaeology permit, and vegetation/brush clearing. A utility clearance was conducted at proposed drilling locations to ensure no impacts to underground utilities would result from drilling activities. An underwater archaeology permit was obtained prior to MEC investigation activities in the ocean in accordance with the Board of Underwater Archaeological Resources special use permit 10-003 (Appendix C). Finally, vegetation was cleared as necessary to allow access for the geophysical investigation. While performing brush clearing activities, sensitive ecosystems and endangered/protected plant species were avoided in accordance with the Environmental Protection Plan (EPP) (UXB, 2011).

4.1.0.2 Before field activities began, field personnel were briefed on health and safety issues and the need for avoiding sensitive biological and cultural resources based on the EPP (UXB, 2011). An EPP field manual, providing a brief description/picture of protected animal and plant species, was prepared in collaboration with the CENAE Environmental Specialist and personnel were trained on its use as part of site-specific training. The EPP field manual was provided to all field personnel and consulted as needed. It should be noted that no rare species or cultural resources were encountered during the field effort.

4.2 MEC Characterization

4.2.0.1 This section details the approach, methods, and operational procedures used during MEC characterization activities. The overall goal of MEC characterization activities was to delineate the nature and extent of MEC within the Investigation Area. To accomplish this goal, characterization activities were conducted in a phased approach that included:

- Collection of geophysical data via instrument-aided reconnaissance and digital geophysical mapping (DGM);
- Data processing and interpretation;
- Dig sheet development; and,
- Intrusive investigation.

4.2.0.2 A project sequence overview is presented in Figure 4-1 to understand the chronology of activities conducted at the Investigation Area.

4.2.0.3 Field activities were managed from a rented house in Edgartown, Massachusetts, which was used as the field office and the central command post during investigation activities. The field office was used as a location to store equipment and supplies, health and safety records, material safety data sheets, site maps, and project documents as well as park vehicles necessary to complete the field investigation.

4.2.1 Geophysical Investigation

4.2.1.0.1 A geophysical investigation was conducted to delineate the nature and extent of surface and subsurface metal debris by measuring variations (anomalies) in both local magnetic and electromagnetic fields. Geophysical surveying was conducted during two phases of work. During the first phase, geophysical data was collected along linear, reconnaissance transects located throughout the Investigation Area, and supplemented with an airborne magnetometry (AirMag) survey. During the second phase, the nature of the anomaly source was investigated by either DGM over selected grids and intrusively investigating all anomalies that met or exceeded selection criteria for MEC within the grids, or reacquiring and intrusively investigating anomalies located along transects investigated during the first phase.

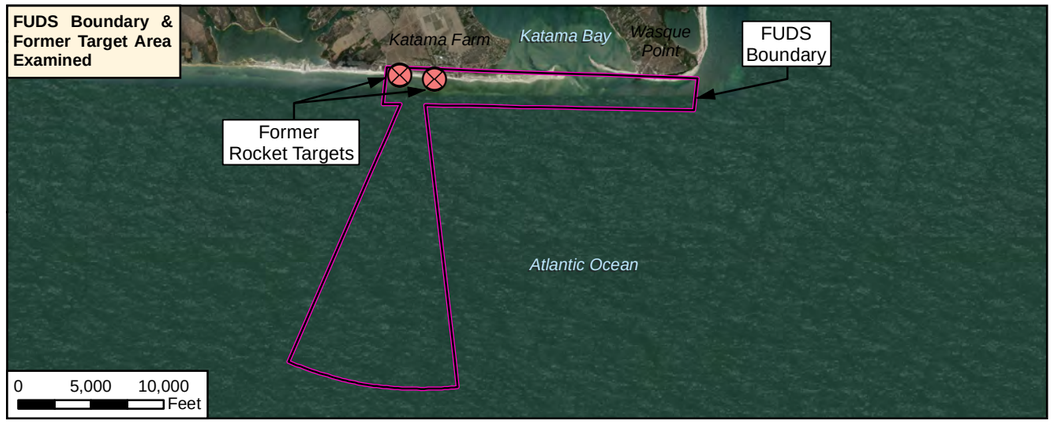
4.2.1.0.2 Prior to conducting the geophysical survey, the Investigation Area was subdivided into three sub-area types according to sub-area geomorphology, which are listed and defined below.

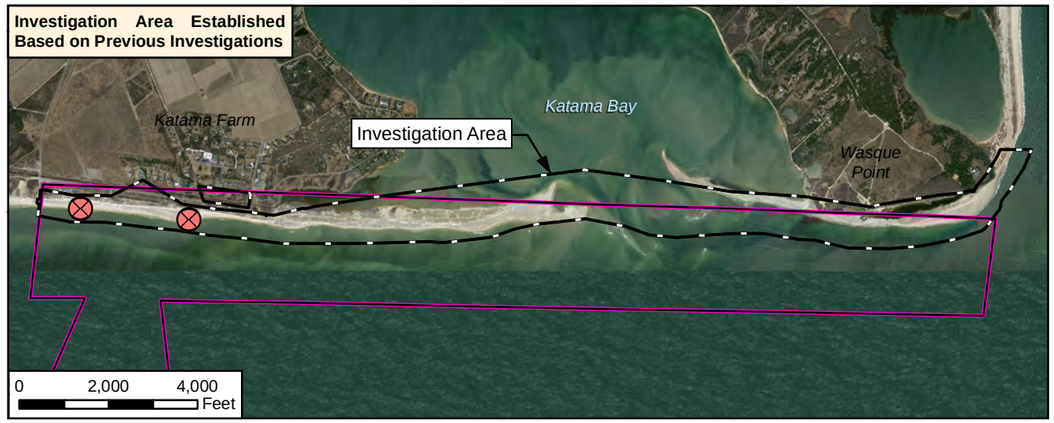
- Beach – the land immediately adjacent to either marine or fresh water;
- Land – all land excluding beaches and dunes; and,
- Ocean – those waters directly associated with the Atlantic Ocean.

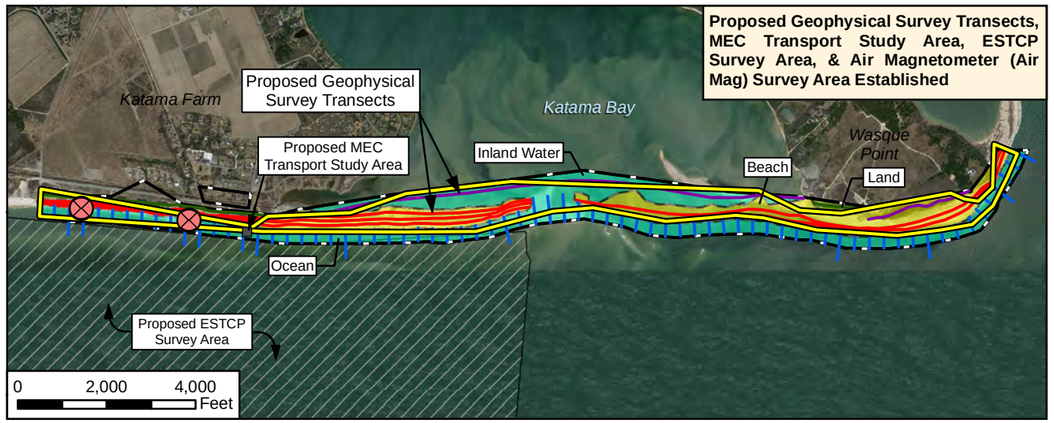
4.2.1.0.3 The geophysical investigation was designed such that the type of geophysical methods and instrumentation proposed were appropriately matched to the unique character of the sub-area. Analog magnetometry transects were completed in land and ocean areas, and beach areas were investigated using digital electromagnetic (EM) methods and instrumentation as summarized in Table 4-1.

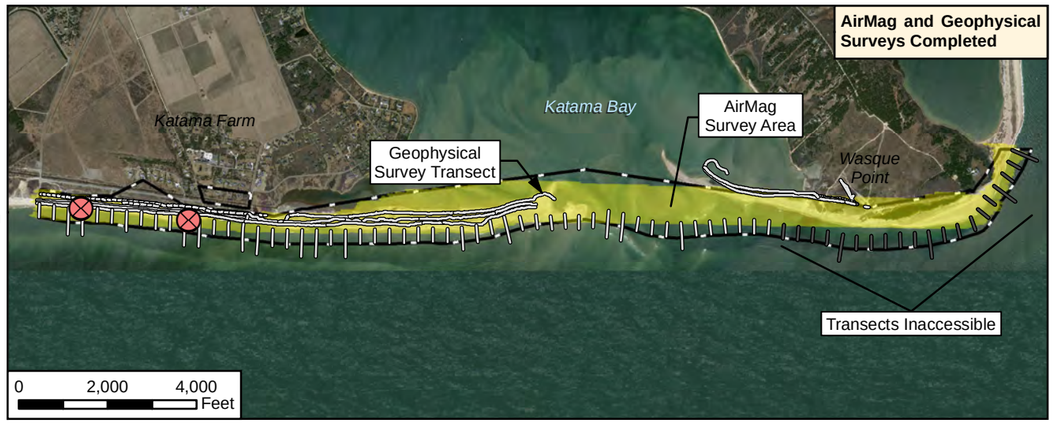
Table 4-1. Analog, DGM Transect, and Grid Coverage
Former Moving Target Machine Gun Range at South Beach Investigation Area

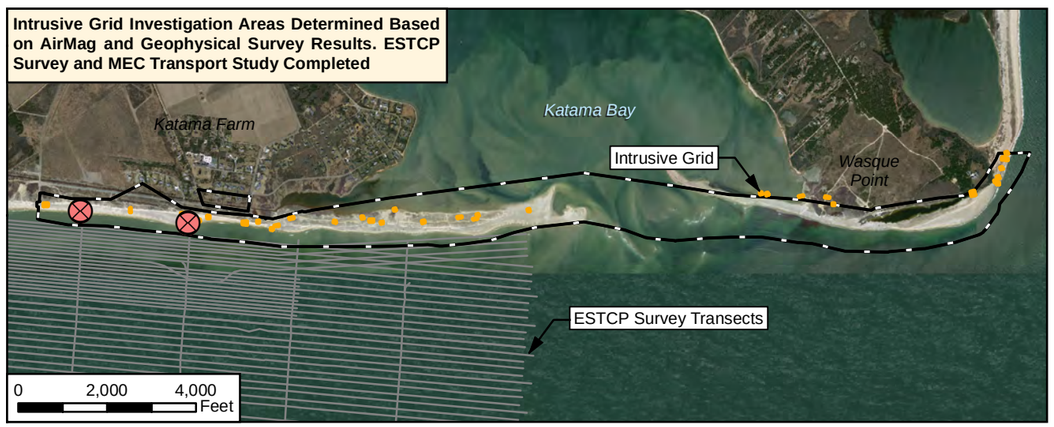
Area	Transects (miles)	Transects (acres)	Grids (acres)
Land	0	0	0.06
Beach	8.14	3.03	2.34
Ocean	3.35	1.2	2.0

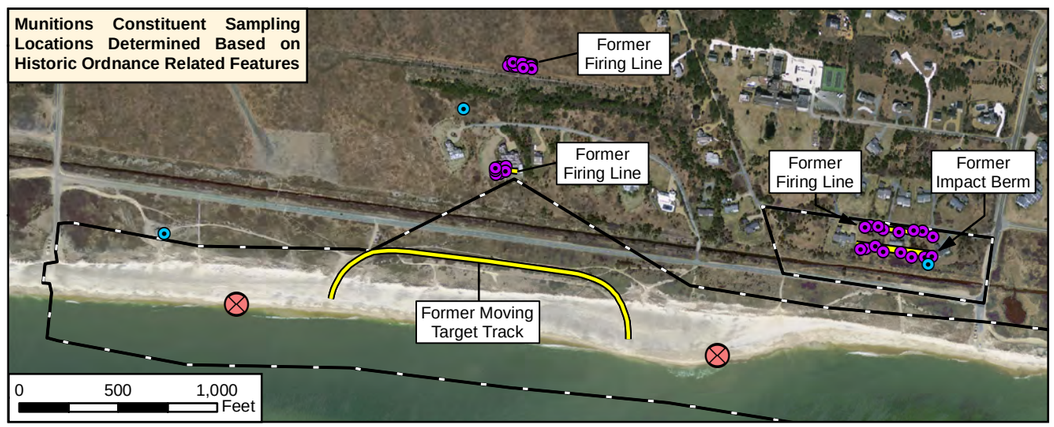


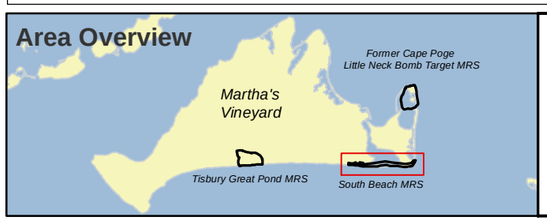












US Army Corps of Engineers

FIGURE 4-1

Project Sequence Overview -
Former Moving Target Machine Gun Range at South Beach Investigation Area, Martha's Vineyard, MA

N	- SCALE AS SHOWN -	UXB amec	NOTES: 2009 Aerial Data Source: MassGIS	06/19/2013	Rev:	CPoge_Dec_Logic_Flowcht_ Remedial_Inv_Rpt.mxd
				Drawn: JBO	Chk: DMS	PROJ: 562910000

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4.2.1.1 Wide Area Assessment

4.2.1.1.0.1 During geophysical surveying, a wide area assessment (WAA) was initially performed to help identify large areas of geophysical anomalies that might be indicative of an area previously used as a military target, aid in determining the extent of potential MEC contamination, and focus subsequent detailed intrusive investigation. The WAA consisted of:

- Analog density transects in the upland areas using hand-held analog instruments to minimize the amount of brush clearing; and,
- DGM transects on the beach area where no vegetation clearing was required using a cart-mounted EM61 coil.

4.2.1.1.0.2 This work was supplemented with an AirMag survey performed using an AirMag array mounted to a helicopter and flown over the land and beach at 3 to 10 ft above the surface.

Airborne Magnetometry

4.2.1.1.0.3 Between 6 February and 18 February 2011, a low-altitude airborne vertical magnetic gradient geophysical survey was conducted by Battelle Oak Ridge Operations using Battelle's VG-22 airborne vertical gradient magnetometry system. AirMag was utilized as a WAA tool to provide reconnaissance level magnetometry data over a large percentage of the Investigation Area to detect spatially large areas of elevated anomalies which may be indicative of the presence of a historical aerial bombing target. The objective of the survey was to collect high resolution AirMag data to detect groupings and clusters of MEC and MD items.

4.2.1.1.0.4 The AirMag survey was conducted over approximately 364 acres within the Investigation Area, predominantly over non-residential land and ocean waters just off-shore (Figure 4-2).

4.2.1.1.0.5 Preliminary modeling suggested that the height of the airborne system above the ground may limit the resolution of detection such that a single AN-MK23 practice bomb may not be detected; however, concentrated contamination with AN-MK23 and MD would likely prove detectable. To test the data limits of AirMag at the Investigation Area, test flights were performed over a specially installed IVS at the Martha's Vineyard Airport. The results of the test flights suggested that the AirMag survey could successfully identify a highly contaminated aerial bombing target if one were present but would not likely identify a single AN-MK23 practice bomb. The results of the test flights are presented in Appendix A.

4.2.1.1.0.6 An IVS of ten representative target items was established at Martha's Vineyard airport and used to verify positioning and system operation. The target items were laid on the surface and the line was flown at 1 to 2 m altitude during each day of project operations. Data were also acquired at a suite of altitudes ranging from 1 to 5 m for sensitivity assessment.

Analog Frequency-Domain Electromagnetic Detectors

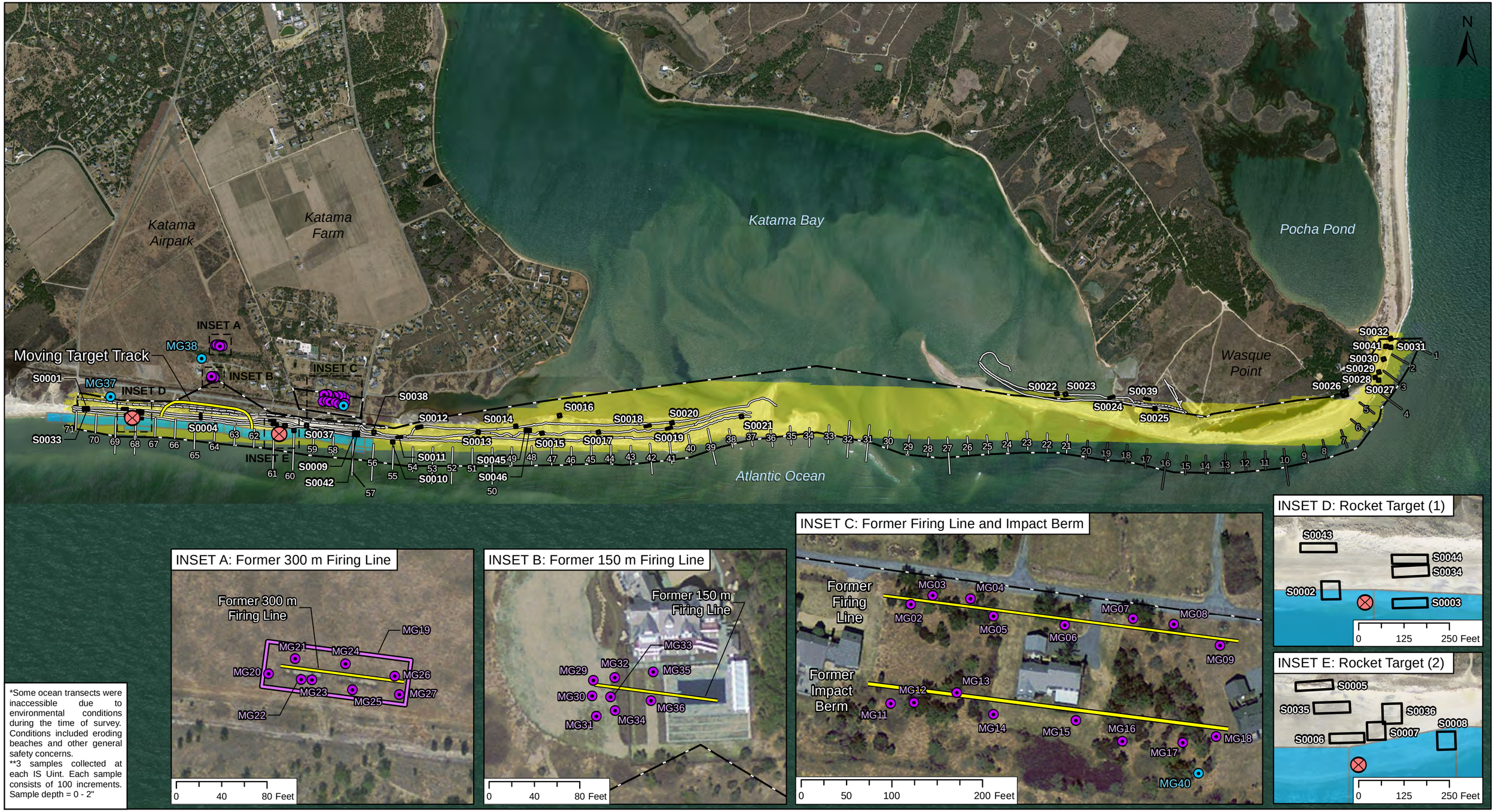
4.2.1.1.0.7 Analog transect surveys were conducted on land within the Investigation Area by UXB using a MineLab brand model F3 Frequency-Domain Electromagnetic (FDEM) induction "all-metal" detectors. This model was chosen for use at the Investigation Area because of the historical use of the AN-MK5 practice bomb, which is composed of a zinc alloy that is non-ferromagnetic and thus not detectable using strictly magnetic-based sensors. The "all-metal" detector can detect the nearby presence of metallic objects (including, but not limited to ferromagnetic objects) by producing a "known" local EM field that induces a secondary EM field in the nearby metal object. This secondary field perturbs the known transmitted EM field, thus producing an EM "anomaly" in the return signal. FDEM instruments generate the known EM field via a transmitting antenna, sometimes referred to as a transmitter coil, and detect the secondarily induced perturbations via an EM receiver antenna or Receiver coil.

4.2.1.1.0.8 The objective of the transect surveys was to locate areas of elevated concentrations of geophysical anomalies that might represent potential historical military target areas or areas impacted with MEC or MD. Analog "Bin Lines" were collected along three reconnaissance transects, two on the western side of the Investigation Area (totaling 5,914.21 ft in length or 0.41 acres) and one on the eastern side of the Investigation Area (totaling 1,248.84 ft in length or 0.09 acres). A "Bin Line" is a geophysical transect surveyed using an analog instrument where surface and subsurface anomalies are counted and recorded in a hand-held data logger. The data recorded includes different types of items observed on the surface and a sum count of subsurface anomalies within the "bin". The acreages of analog transects and DGM grids surveyed within the Investigation Area are shown in Table 4-1 and the transect locations are shown on Figure 4-2. During the analog reconnaissance, transects were surveyed using Trimble GeoXH Wide Area Augmentation System (WAAS) enabled GPS units that provided sub-meter accuracy.

Digital Geophysical Mapping

4.2.1.1.0.9 DGM included the collection of data along transects and within grids located throughout the Investigation Area. A discussion of DGM within grids can be found in Section 4.2.1.2. Land and beach DGM transects were surveyed by NAEVA Geophysics, Inc. (NAEVA). Underwater DGM was attempted by Aqua Survey, Inc. (ASI), but was not able to be completed due to shoaling and underwater snags.

4.2.1.1.0.10 Between 10 December and 11 December 2010, NAEVA performed DGM transects (land-based) at the Investigation Area. DGM was performed using the Geonics® EM61-MK2 time-domain metal detector integrated with a Trimble 5700 RTK GPS system. The EM61-MK2 is a high-resolution time-domain EM instrument designed to detect, with high



*Some ocean transects were inaccessible due to environmental conditions during the time of survey. Conditions included eroding beaches and other general safety concerns.
**3 samples collected at each IS Uint. Each sample consists of 100 increments. Sample depth = 0 - 2"

- Groundwater Sample
- Discrete Subsurface Soil Sample
- Former Rocket Target
- Moving Target and Machine Gun Range Features
- Geophysical Survey Transect
- Ocean Transect Inaccessible*
- Incremental Sampling (IS) Unit**
- TCRA Grid (2009)
- AirMag Survey Area
- Intrusive Grid
- South Beach Investigation Area
- S0001 Intrusive Grid ID

US Army Corps of Engineers

FIGURE 4-2

Geophysical Survey Transect, Intrusive Grid, & MC Sampling Locations - Former Moving Target Machine Gun Range at South Beach Investigation Area, Martha's Vineyard, MA

0 200 400 800 1,200 1,600 Meters
0 750 1,500 3,000 4,500 Feet

UXB amec

NOTES:
2011 Aerial Data Source: Bing Maps, Microsoft Corp.

06/19/2013	Rev:	SBeach_All_Activities_Loc_Remedial_Inv_Rpt.mxd	
Drawn: JBO	Chk: DMS	PROJ: 562910000	

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spatial resolution, shallow ferrous and non-ferrous metallic objects. The EM61-MK2 system consists of two air-cored coils, a digital data recorder, batteries and processing electronics. The EM61-MK2's transmitter generates a pulsed primary magnetic field, which then induces eddy currents in nearby metallic objects producing a secondary magnetic field. Each of the two spatially separated receiver coils measures these secondary fields. The EM61-MK2 offers the ability to measure the secondary fields at three distinct time intervals in the bottom coil or four intervals if no top coil measurements are recorded. Earlier time gates provide enhanced detection of smaller metallic objects. Secondary voltages induced in both coils by the secondary magnetic field are measured in millivolts (mV). Target resolution of approximately 0.5 m is expected with the system. EM61-MK2 data were initially stored in a hand-held data logger or field personal computer. Following the completion of each data file, data were transferred to a laptop computer for preliminary evaluation and editing.

4.2.1.1.0.11 Underwater DGM work at the Investigation Area was attempted by ASI on 18 March 2011. The work began with the establishment and QC check of a real-time kinematic differential global positioning system (RTK-DGPS) base station location. This system consists of a Trimble 5700 base station with Trimmark 3 radio modem at the base station and a Trimble MS750 rover with Teledyne radio modem. Previously established benchmarks that were close to the survey area had been lost due to beach erosion so NGS benchmark Midway 1949 was used to transfer control and QC points to the temporary locations to be used during the project. The area to be surveyed consisted of a narrow body of water between the beach and dune.

4.2.1.1.0.12 The land IVS was run and the cart was deployed at the eastern end of the body of water. Electronics were put in a small unpowered boat and a line was run to the Argo Avenger at the western end of the water body. The Argo pulled the boat and cart for a short distance before the cart snagged on an underwater obstruction (likely a fallen tree) and broke. The cart was recovered and no further survey operations were conducted by Aqua Survey. For the reasons above, inland water DGM work at the Investigation Area was considered complete as of 18 March 2011.

4.2.1.1.0.13 Digital geophysical data were acquired at a walking pace in a person portable fashion (EM61 MK2 integrated with RTK GPS). Bottom coil height was maintained at the standard height of 40 cm above the ground by mounting the system on manufacturer supplied wheels. A Trimble TSC2 survey controller connected to the integrated RTK GPS system was used to follow the intended path of each transect. Navigation with GPS was accomplished with a single GPS sensor mounted over the center of the coil to provide real-time positional tracking capabilities. The instrument was operated in 4-Channel mode, recording secondary voltages in the bottom coil at four time gates. If vegetation or site conditions precluded collection along the intended path, the operator veered around the obstacle and continued back on path. For transects

intended for beach areas that are currently underwater due to beach erosion, data collection was done at low tide as close to the water line as possible.

4.2.1.1.0.14 During land-based geophysical data collection, NAEVA installed an on-site IVS for quality control (QC) and validation of the EM61-MK2 system. Transect data were collected, processed, and reviewed. Raw data, processed data, final data, associated reports, and target lists were delivered to UXB in the specified formats.

4.2.1.2 Grid Selection and Mapping

4.2.1.2.0.1 Data collected during the WAA was subsequently used to site grids for additional DGM surveying and intrusive investigation within land and beach areas. Based upon the results of the WAA, anomalies were identified, mapped using ESRI ArcGIS, and analyzed for areas of elevated concentrations of anomalies. Anomalies from available data sets were evaluated, including AirMag, analog land transects, and DGM land transects. The grids were sited in areas of high, medium, and low anomaly densities to refine the extent, and establish the nature of MEC contamination through subsequent intrusive investigation. Areas of elevated anomaly densities were then used to determine the size and location of grids over which additional DGM data would be collected. The grid sizes were chosen based upon the relative number of anomalies in that area. In areas where the anomaly density was only slightly elevated, a larger grid (e.g. 100-ft by 100-ft square or equivalent square-footage) was used such that the best estimate of anomaly density could be determined. In areas where the anomaly density was relatively high, small footprint grids were used (50-ft by 50-ft square grids or 25-ft by 100-ft grids). In areas where delineating the lateral boundary of an anomaly cluster was the objective, long, narrow grids were installed (e.g., 50-ft by 200-ft rectangles). Proposed grid sizes and locations were presented to the USACE for concurrence prior to final placement. A weekly conference call conducted between the USAESCH, CENAE, and UXB, for which minutes were prepared, was typically held to discuss decisions related to proposed grid locations and anomaly selections.

4.2.1.2.0.2 NAEVA returned to the Investigation Area from 2 March to 30 March 2011. During this time, NAEVA mapped land-based grids based off analog and DGM transects as well as AirMag data. The objective of the DGM grid surveys was to characterize all geophysical anomalies within localized areas as suggested by the results of the WAA.

4.2.1.2.0.3 The DGM survey was conducted within grids using appropriate EM61 coil, and location of each anomaly recorded using an integrated RTK GPS unit. Forty-five land DGM grid footprints were selected within the Investigation Area, however, a number of those grid locations were eventually determined to be inaccessible due primarily to varying tide levels and beach erosion. Many of these inaccessible grid locations were replaced with grids in other accessible locations. The total number of grids completed were 36 (35 grids had 0.06 acre footprints while one had a 0.24 acre footprint). Geophysical data were collected in the grids by

towing the EM sensor system by hand. For each grid setup, consisting of various footprint geometries including 100-ft by 100-ft grids or 50-ft by 50-ft grids, measuring tapes were stretched along the grid to be surveyed and ropes were laid out at 25-ft intervals across the direction of travel. Each rope had marks painted every 2.5 ft, which allowed the operator to walk straight lines of overlapping coverage. Data coverage was monitored in the field using Geomar's Nav61MK2 data collection program. DGM data collection within grids used an EM61-MK2.

4.2.1.3 Geophysical Data Processing

4.2.1.3.0.1 Prior to intrusive investigation, DGM data collected within the grids were evaluated and "picks" were made of anomalies to be intrusively investigated. Geosoft Oasis Montaj and ESRI ArcMap were used for analog transects. Geosoft Oasis Montaj for DGM data post processing, in conjunction with ArcMap. The following subsections discuss the data analysis process followed to identify intrusive investigation areas.

4.2.1.3.1 Data Storage and Initial Editing

4.2.1.3.1.0.1 EM61-MK2 data were stored in an Allegro CX data logger using Geomar's Nav61MK2 software and then downloaded into a laptop computer for further on-site processing using Geomar's TrackMaker 61MK2 software.

4.2.1.3.1.0.2 Daily logs, QC, and grid field information forms were input digitally into handheld personal digital assistant and synchronized to the project database. Initial data processing was performed by the field team, which included reviewing the data for integrity and completeness, and creating positioned XYZ files for each data file and QC test for use in further processing of the geophysical data. Data point positions in the raw XYZ files were in Universal Transverse Mercator coordinates in the WGS84 reference frame.

4.2.1.3.2 Preprocessing

4.2.1.3.2.0.1 Converted raw data files were imported into Geosoft's Oasis Montaj to perform the following:

- Review and finalize all QC tests (IVS lines, static, cable shake, personnel) prior to processing of the DGM data for that day;
- Evaluate GPS positional accuracy;
- Evaluate data density;
- Apply auto leveling and instrument drift corrections;
- Apply initial lag correction;
- Use minimum curvature gridding to produce a regular data grid of Channel 2; and,
- Generate preliminary contour map(s) from gridded data.

4.2.1.3.3 Final Processing

4.2.1.3.3.0.1 After completion of preprocessing, the data were further evaluated and processed to generate final processed data files. Final processing steps included:

- Evaluation and refinement of auto leveling and instrument drift corrections for all channels;
- Evaluation and refinement of lag correction;
- Additional digital filtering and enhancement, as necessary;
- Targeting of data;
- Generation of formatted American Standard Code for Information Interchange files containing processed data by dataset;
- Generation of final maps for each grid showing contoured gridded data, target locations, and culture;
- Generation of final target lists for each grid;
- Generation of processing report; and,
- Creation of dig sheets for each grid.

4.2.1.3.3.0.2 The QC data for each survey were evaluated for compliance with requirements specified in the Work Plan and are provided in Appendix D. The results of the latency test were evaluated to determine the instrument latency correction necessary for transect data or evaluated gridded anomalies to determine the correction necessary for grids. This corrected for delays that occur in the electronics of the EM61-MK2 and in the processing of the data on the data recording computer. The latency correction was computed by determining the latency value that corrects the position to overlap the anomaly due to the latency test item when the sensor travels over it in different directions. Typically, this value was between 0.2 and 0.4 seconds.

4.2.1.3.3.0.3 Once the latency correction value had been determined, the value was applied to the whole data set and the geophysicist gridded the total channel data using Geosoft. The gridded channel 2 data were then displayed on a map with a color ramp to represent changing response values. The displayed values were evaluated to determine if they were consistent with the known site conditions and whether the data meet expected data quality standards.

4.2.1.3.4 Digital Geophysical Anomaly Selection

4.2.1.3.4.0.1 The anomaly selection process was established using data gathered with input from the USAESCH project geophysicist. The UX-Detect module within Oasis Montaj was used to identify peak amplitude responses above 3 mV in Channel 2 believed to be associated with nearby metallic sources. Initial target selections were made based on the gridded data. Data profiles corresponding to the anomalies selected by Geosoft were then analyzed by trained

geophysicists, with the targets evaluated as to their validity and position, as single-source anomalies may generate multiple target designations depending on shape and orientation. Targets found to be invalid or incorrectly located were removed or adjusted. Additionally, anomalies that were not selected by the UX-Detect module, yet deemed to represent a potential MEC target, were manually selected. All target selection was performed on final processed data from Channel 2 of the bottom coil of the EM61-MK2. The criteria for selecting and locating anomalies included the following:

- The maximum amplitude of the response with respect to local background conditions;
- The lateral extent (width) of the response;
- The location of the response with respect to the edge of the survey area, unsurveyable areas, land features, or cultural features within or adjacent to the survey area; and,
- The shape and amplitude of the response with respect to the response of known targets buried in the IVS.

4.2.1.3.4.0.2 Consistent response decay across the other three channels to flag potential noise targets (i.e., non-noise targets should exhibit channel amplitudes such that Ch1>Ch2>Ch3>Ch4.) Additional advanced processing techniques were used to calculate the decay constant and size of the anomalies. The decay constant may be used in conjunction with other advanced processing parameters to aid in selecting anomalies most likely to be produced by MEC.

4.2.1.3.4.0.3 Anomaly selections were merged so that closely spaced anomaly selections (peaks that appear to be caused by the same source item) were consolidated to a single pick. Anomalies which were known to be caused by visible metal objects (e.g., fences) were removed from the target list. The anomaly selections and the data were then evaluated by the geophysical processor to ensure that the remaining anomaly selections were reasonable. The processor added or deleted any anomaly selections as necessary.

4.2.1.3.5 Dig Sheet Development

4.2.1.3.5.0.1 Geophysical anomalies were identified in the EM61-MK2 data collected in the grids at the various locations during the RI field work. The project geophysicist used the anomaly selection process described previously and the prioritization process to develop dig sheets that specified the anomalies to be intrusively investigated (Appendix E). The information maintained on these dig sheet included:

- A unique anomaly identification number; northing and easting coordinates for each anomaly;
- The geophysical instrument response value from the original survey;
- The geophysical instrument response from the reacquisition;
- The reacquisition and intrusive investigation dates; The depth of the recovered item(s);

- A description of the source of the anomaly; and,
- Other pertinent comments.

4.2.2 Intrusive Investigation

4.2.2.0.1 An intrusive investigation was conducted to resolve the source of any geophysical anomalies identified during the WAA and DGM mapping within grids. The investigation was conducted by reacquiring anomaly locations that were selected for intrusive investigation and excavating the locations to identify the source of the anomaly.

4.2.2.0.2 Intrusive investigation activities were conducted by teams consisting of either a three-man team consisting of one UXO Technician III (team leader), one UXO Technician II, and one UXO Technician I; or a five-man team of one UXO Technician IIIs, two UXO Technician II's, and two UXO Technician I's. Teams reacquired anomaly locations using a RTK GPS or sub-meter accuracy Trimble GeoXH WAAS GPS units. Once anomaly locations were identified, the team excavated the area to identify the source of metal debris. Excavation of land/beach locations were conducted by UXO technicians. Once identified, debris was classified as non-MD, cultural artifacts, MD, or MEC. All MEC and MD discovered during the intrusive investigation were removed and properly disposed.

4.2.2.0.3 Due to the dynamic nature of the ocean surf zone, a "Mag and Dig" technique was used for ocean transects. Initially, 71 ocean transects were planned, but due to access/safety concerns associated with storm events and beach erosion during the course of the project, 20 were unable to be completed. Between 10 and 14 October 2011, transects 71 to 62 were completed; 11 November and 15 December 2011 – areas along Norton Point (transects 61 to 54) were completed and, 20 February and 05 May 2012, transects 53 to 21 were completed (Figure 4-2). Transects 20 through 1 inclusive were not completed as noted above. VRH performed Mag and Dig operations in the surf zone ocean areas along the southern shore of the Investigation Area. Analog surveying was conducted on 51 ocean transects starting at the water's edge and extending perpendicular to the shoreline a distance of up to 600 ft seaward, which is the practical length of the diver umbilical. The dive team consisted of a dive team supervisor, a primary diver, a stand-by diver, and two dive tenders. Divers identified anomalies along transects using an underwater hand-held analog instrument, and subsequently excavated each anomaly as it was found. This methodology provided both WAA and intrusive investigation to provide nature and extent data, with tape and azimuth coordinates obtained for each offshore anomaly investigated.

4.2.2.1 Anomaly Reacquisition

4.2.2.1.0.1 Reacquired anomalies were intrusively investigated usually on the same day that reacquisition took place. The selected geophysical anomalies were located using Trimble GeoXH

sub-meter GPS units with an external antenna (see Appendix F). Anomaly locations were marked with pin flags labeled with the appropriate anomaly identification number. Pertinent information recorded during the reacquisition included the reacquisition time, date, and the grid number.

4.2.2.2 Excavation Methods

4.2.2.2.0.1 During the intrusive investigations conducted at the Investigation Area, the appropriate minimum separation distances (MSD) (see below) were established per the approved Explosives Siting Plan (ESP) (USAESCH, 2010). Due to the location of the investigation sites at the Investigation Area, there were no nonessential personnel or occupied structures within the MSDs.

4.2.2.2.0.2 Intrusive operations at each anomaly location were initiated by hand. The intrusive team excavated at the location of the pin flag within the search radius until the source of the anomaly was found or a no-contact was determined. If no single point within the search radius was determined to be an anomaly location (i.e., all readings remained constant), the center point of the radius was dug until the source of the anomaly was found or a no-contact was determined. A location was considered a no-contact when no specific metallic items were encountered after excavating 2 ft in depth, and no definite anomalous signal remained in the excavation. If present, the signal was pursued until a metallic item was found or until a depth of 4 ft bgs was reached.

4.2.2.2.0.3 Excavation procedures at each anomaly location were conducted in accordance with the RI Work Plan (UXB, 2011). The excavation methods included first excavating and setting aside any root mass, followed by excavating to depth to interrogate the anomaly. Once the anomaly was recovered and the excavation confirmed "safe", the excavated material was replaced in reverse order, with the root mass placed last. No additional site restoration was necessary after excavation activities as the work plan (UXB, 2011) prescribed natural re-colonization of vegetation.

4.2.2.3 Munitions with the Greatest Fragmentation Distance

4.2.2.3.0.1 The munitions with the greatest fragmentation distance (MGFD) for an area is the munitions that have the greatest fragmentation distance of any or all MEC items that are reasonably expected to be found within that area, based on research or site characterization. As presented in the DoD Explosives Safety Board (DDESB)-approved Explosives Siting Plan (ESP), Correction 1 (USAESCH, 2010), the MGFDs for this RI was the 5-in. MK1 Rocket. The specific MGFDs for the Investigation Area were presented in the ESP (USAESCH, 2010) and the RI Work Plan (UXB, 2011).

4.2.2.4 Minimum Separation Distance

4.2.2.4.0.1 The MSD is the protective distance based on the characteristics of the selected MGFD (see above). The specific MSDs for this RI were presented in the DDESB-approved ESP, Correction 1 (USAESCH, 2010) and the RI Work Plan (UXB, 2011). MSDs for unintentional detonations were established for nonessential personnel based on the hazardous fragment distance (HFD) for the appropriate MGFD. MSDs for intentional detonations were also established for disposal operations and these were based on the maximum fragmentation distance, horizontal (MDF-H) for the appropriate MGFD, though these distances could be reduced if engineering controls were used.

4.2.2.5 Exclusion Zones

4.2.2.5.0.1 Exclusion zones (EZs) were established during the RI to protect the public and non-essential personnel from both intentional and unintentional detonations. The primary protective distance used was the MSD for unintentional detonations, which was based on the HFD for the appropriate MGFD (see above), and these EZ distances were enforced throughout the intrusive operations at the Investigation Area. The appropriate EZ distance for intentional detonations, which was based on the MDF-H for the appropriate MGFD modified as necessary using engineering controls (see above), was enforced during all MEC disposal operations conducted during the RI.

4.2.3 Ocean Transport Study

4.2.3.0.1 Since the end of military operations in 1947, MPPEH items have periodically washed up on South Beach presenting a potential risk to the public. To better understand the movement of MD items in the surf zone and support the characterization of nature and extent of MEC, if present, at the Investigation Area, an ocean transport study was conducted.

4.2.3.0.2 The study was conducted during several mobilizations, including a MEC transport grid survey conducted from June 16 through 22, 2010 and a storm event follow-up survey October 4 through 20, 2010. In addition, a MEC transport acoustic transponder (pinger) survey was conducted from October 21 through November 9, 2010. The objectives of the study were to:

1. Determine whether MPPEH can be transported by ocean waves;
2. Determine the area within the coastal surf zone where wave-driven MPPEH transport is most likely to occur; and,
3. Determine whether prevailing wave-induced erosion is likely to continue exposing and transporting MPPEH if any remain buried under the existing beach; if so, determine the sections of beach that might be most vulnerable.

4.2.3.0.3 The surveys were conducted by UXO divers using analog geophysical instruments. A summary of the activities conducted during the ocean transport study are presented below the complete transport study report is included as Appendix A.

4.2.3.0.4 **MEC Transport Grid Surveys** – The purpose of this portion of the ocean transport study was to determine if additional items had migrated into the previously cleared grids, and what effect storm events may have on this migration. To accomplish this, two one-acre grids were established, within the previous TCRA Grids 5/6 and 18/19 (Figure 4-3), where the majority of MD items were removed. These grids were surveyed in June 2010 to determine the number of anomalies that were initially present. Following a storm event in October 2010, a second survey was conducted to determine if the anomalies had moved positions and whether new anomalies were present.

4.2.3.0.5 **MEC Transport Acoustic Transponder (Pinger) Survey** – The Transport Acoustic Pinger Survey was conducted to determine the area within the coastal surf zone where wave-driven MPPEH transport is most likely to occur. Eight acoustic target transponders (pingers) were placed within TCRA Grids 5/6 and 18/19 (Figure 4-3). Each grid was seeded with 4 rocket stimulants and each seed was fitted with a pinger for tracking purposes. At the conclusion of the field operations, the seeds were interrogated.

4.2.4 ESTCP Characterization

4.2.4.0.1 The ESTCP, commensurate with its mission to develop standardized and effective data collection methods at munitions contaminated sites, initiated a project to develop and demonstrate a WAA technique for locating and delineating munitions-like objects in marine condition environments. In a cooperative effort, the USACE and the ESTCP combined their resources with a plan wherein the data collected during the ESTCP WAA demonstration could be used to augment the information being collected as part of this RI. The fundamentals of that plan would be that ESTCP would conduct its WAA study in an area useful to the RI and would be incorporated into the RI CSM.

4.2.4.0.2 The objective of the ESTCP WAA was to address the lack of effective and proven approaches for conducting WAA at sites where MEC may be present underwater. The objective of the USACE RI portion of the study was to provide divers trained and certified in EOD related activities to conduct underwater investigations potentially involving MPPEH/MEC. The diver's objectives included assisting Tetra Tech EC, Inc. (TtEC) with dive-related activities during the installation of an IVS, and completing the validation of the ESTCP WAA results.

4.2.4.0.3 The ESTCP completed their WAA demonstration over a rectangular area of the Atlantic Ocean approximately 12,500 ft long (approximately 2.3 miles) in the long-shore direction and approximately 9,800 ft long (approximately 1.8 miles) in the off-shore direction.

TtEC collected magnetic gradiometer array (MGA) along 29 parallel, east-west transects totaling 7.1 kilometers in length (23,294 ft) (Figure 4-4).

4.2.5 Quality Control

4.2.5.0.1 To establish confidence in the data reliability, quality control (QC) tests were conducted throughout the project. Tests were conducted prior to, during, and after all data collection sessions. QC tests for the EM61-MK2 were conducted after a minimum 15-minute warm-up period for the electronics.

4.2.5.1 Geophysical System Verification Plan

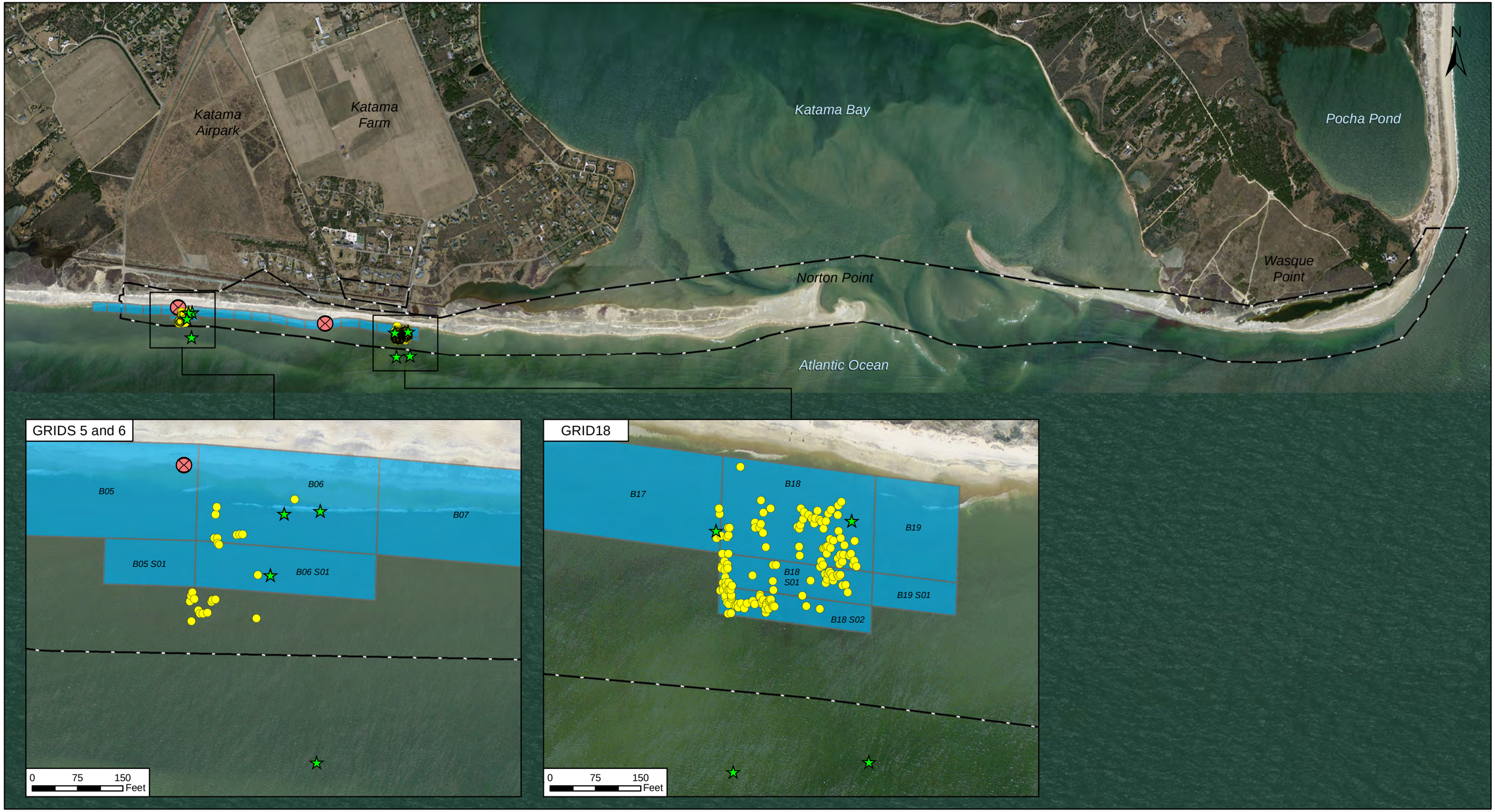
4.2.5.1.0.1 The geophysical system verification (GSV) plan is an alternative to traditional geophysical prove-outs (GPOs). The protocol is based on extensive physics-based modeling of instrument response to industry standard objects (ISOs) at different orientations and depths. At the Investigation Area, three small ISOs (1 in. by 4 in. steel pipes) and two medium ISOs (2 in. by 8 in. steel pipes) were seeded at detectable depths bgs to create an IVS.

4.2.5.1.1 Instrument Verification Strip

4.2.5.1.1.0.1 As an alternative to establishing a GPO, NAEVA built IVSs at the Investigation Area. It was installed in accordance with the standard operating procedure which was integrated in the RI Work Plan (UXB, 2011). The IVS is a seeded strip used to demonstrate the detection sensor functionality, evaluate the geologic response and geophysical data collection. Before starting field work and at any time a change is made in equipment or operator, the IVS was run to validate the overall process. All three IVSs were seeded at various depths that produced a consistent and predictable detection instrument response. The IVS locations were selected in an area that represent the terrain, vegetation, and underlying rock and/or soils that naturally exist at the site. A single line over the IVS was collected daily to ensure data quality and equipment functionality.

4.2.5.1.1.0.2 The IVS is an integral component of the GSV process. The purpose of surveying the IVS is to demonstrate the effectiveness of all instrumentation, methods, and personnel prior to the initiation of fieldwork and to document the site-specific capabilities of a DGM system. Serial number identifications were recorded in the database for all instrumentation (i.e. data logger, EM61-MK2 electronics, coils), and the IVS was mapped using the same personnel, equipment, and methodologies employed for the DGM survey.

4.2.5.1.1.0.3 A suitable area within or near the Investigation Area yet containing similar geologic and vegetative conditions, free of interference and anomalous response, was chosen for the locations of each IVS. Prior to finalizing the IVS location, the DGM team thoroughly checked the area using the EM61-MK2 in an analog mode. Any pre-existing anomalies were marked and avoided during IVS construction. Once a suitable location was found, a background



Pinger Start Location

Sweep 1 Anomaly (June 2010)

Former Rocket Target

TCRA Grid (2009)

South Beach Investigation Area

US Army Corps of Engineers

FIGURE 4-3

MEC Transport Grid and Pinger Locations - Former Moving Target Machine Gun Range at South Beach Investigation Area, Martha's Vineyard, MA

0 150 300 600 900 1,200 1,500 Meters

0 700 1,400 2,800 4,200 5,600 Feet

UXB amec

NOTES:
2009 Aerial Data Source: MassGIS

06/24/2013	Rev:	SBeach_MEC_Transport_Loc_Inv_Rpt.mxd
Drawn: JBO	Chk: DMS	PROJ: 562910000

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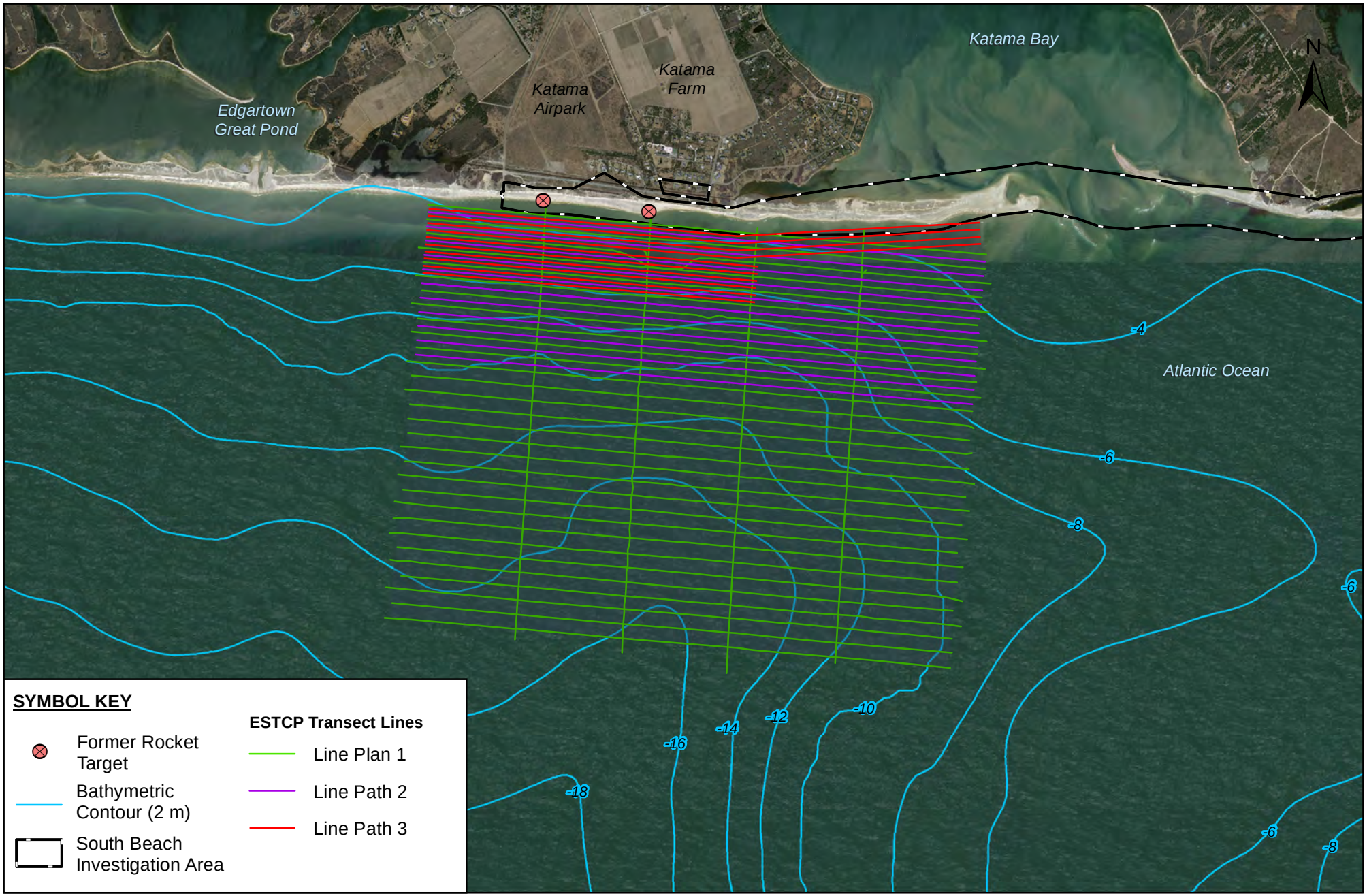

US Army Corps of Engineers

NOTES:
2009 Aerial Data Source: MassGIS

UXB amec

0 1,500 3,000 4,500 6,000 7,500 Feet

0 300 600 900 1,200 Meters

FIGURE 4-4

ESTCP Grid Locations - Former Moving Target Machine Gun Range at South Beach Investigation Area, Martha's Vineyard, MA

06/24/2013	Rev:	Drawn: JBO	Chk: DMS	SBeach_ESTCP_Loc_Remedial_Inv_Rpt	PROJ: 562910000

survey was performed to establish the locations of any existing anomalies, of which there were none. Following this, five items were buried according to Table 4-2. After the seeding was completed, the start and end points of the IVS line and the locations of the ISOs were recorded using a Trimble RTK GPS.

Table 4-2. South Beach IVS Design
Former Moving Target Machine Gun Range at South Beach Investigation Area

Item	Easting (m)	Northing (m)	Depth (to center of mass)	Item Size	Orientation
1	372143.084	4578696.409	25.4 cm	Small ISO	Vertical
2	372148.071	4578695.915	43.25 cm	Medium ISO	Vertical
3	372153.052	4578695.502	22.9 cm	Small ISO	Vertical
4	372158.059	4578694.988	5.1 cm	Medium ISO	Vertical
5	372162.971	4578694.631	15.2 cm	Small ISO	Vertical

Notes:
cm – centimeters **ISO** - industry standard object **m** - meter(s)

4.2.5.1.1.0.4 The IVS was initially mapped with five lines of data consisting of a line directly over the ISOs, a line on either side at the standard line spacing (2.5 ft), a line on one side at half line spacing (1.25 ft), and a background/noise line offset about 10 ft from the ISOs. The IVS data were used to document the repeatable responses of known objects at known depths. Daily peak responses were compared to the ideal response as documented during the initial 5-line IVS. Subsequent runs of the IVS recorded data directly over the ISOs and along the background line.

4.2.5.1.2 Blind Seeding

4.2.5.1.2.0.1 The blind seeding portion of the GSV was conducted and evaluated by UXB. Seed items were emplaced at varying depths throughout the gridded area of collection, so that at least one seed item would be surveyed each day. The locations of these items were not provided to NAEVA. The UXB Geophysicist evaluated the data delivered by NAEVA and did not report a failure to detect or target any of the blind seeds. Table 4-3 summarizes the blind seeding activities.

Table 4-3. Summary of Blind Seeding Activities
Former Moving Target Machine Gun Range at South Beach Investigation Area

Grid ID	Seed ID	Easting	Northing	Recovered	DGM Target ID	EM61Signal CH1_Final	EM61Signal CH2_Final	EM61Signal CH3_Final	EM61Signal CH4_Final
S0004	18	372731.1	4578662.7	Yes	0001	154.7004	113.6119	69.99406	36.16392
S0002	2	373721.978	4578549.441	Left in place, accreted dune sand buried seed item.	004	7.119659328	3.669598077	1.269639222	0.30964993
S0012	10	373826.752	4578592.903	Yes	0005	126.4339487	87.01307929	48.73473586	23.12214084
S0013	16	374128.821	4578578.128	Yes	0003	100.9322432	64.01378754	32.64980825	13.09334358
S0015	8	374455.8	4578576	Yes	0001	40.06992	25.12492	14.78148	6.144783
S0022	15	377052.6	4578769	Yes	0001	137.1972	97.57404	57.37266	28.48161
S0023	6	377089.7	4578759	Yes	0001	145.7731	89.43471	42.64093	16.10783
S0024	24	377331.8	4578751	Yes	0001	345.8892	230.5737	128.4292	58.85593
S0028	25	378652.772	4578844.97	Yes	0001	319.6241318	223.3852584	133.2001175	67.60787424
S0029	26	378669.421	4578877.333	Yes	0001	285.5950166	204.0675445	130.0585347	69.94128633
S0030	21	378688.7	4578945	Yes	0001	167.5934	103.9669	53.77035	20.71165

4.2.5.2 Instrument/Equipment Testing

4.2.5.2.0.1 The following QC procedures were performed and documented during the data collection process and reviewed by a qualified geophysicist on a daily basis.

4.2.5.2.1 Geonics® EM61-MK2

4.2.5.2.1.0.1 Each day of data collection, the instrument was powered-on for a warm-up period of at least 15 minutes to stabilize readings and minimize instrument drift. After warm-up, a series of 60-second static QC tests were performed with the instrument immobilized over an area of minimal background response in order to document proper instrument function. These tests were also performed at the end of each day. While checking instrument performance, the static background test also documents local site noise levels. The instrument operator monitored the response during the tests for abnormal behavior. During data processing, the tests were further analyzed quantitatively.

4.2.5.2.1.0.2 Digital geophysical data was collected at a rate high enough (≥10 readings/second) to achieve the DQO that 98% of the along-track readings did not exceed 25cm. For grids, at least 90 percent of the across-track sampling was equal to the proposed 2.5 ft line spacing. QC procedures were performed and documented during the data collection process and reviewed by a qualified geophysicist on a daily basis. The standard of performance adhered to the most recent USACE performance requirements for RI/FS using DGM methods. Static and dynamic repeatability for both detection and positioning systems, geodetic accuracy, coverage, target selections, and anomaly resolution was consistently monitored at appropriate frequencies to ensure that all requirements and DQOs were achieved.

Personnel Test

4.2.5.2.1.0.3 While logging the data, the operator looked for changes in response associated with personnel in proximity to the instrument coil. Support personnel not actively operating the instrument generally do not approach the coil during production surveys. This test is designed to confirm that the instrument operator, who is closest to the coil during logging, does not interfere with the data. Common sources of operator interference include metal items in pockets and steel-toed boots.

Cable Shake Test

4.2.5.2.1.0.4 In the cable shake test, all system cables are shaken while logging and monitoring for data spikes. This test functions to detect problems associated with damaged or loose connectors, damaged cables, and other defects. Replacing the offending component usually resolves problems in this test.

Background/Spike Test

4.2.5.2.1.0.5 Performed at the beginning and end of each day, the background/spike test consists of three 60-second lines of data: background, ISO/spike, and background. Background lines are monitored for data spikes and noise level while the spike line is examined for consistent response. Monitoring background noise enables the Geophysical Data Processor to calibrate data leveling during processing. For the spike test, a small ISO is approximately centered above the EM61-MK2 coil. During the DGM survey, an item height of 50 cm was initially used, but was later changed to 43 cm. Daily spike response values were plotted against the small ISO response curve at the given depth. The acceptance criterion for the spike response was ±20 percent of the expected response according to the response curve (13.35 millivolts [mV] and 22.4 mV in Channel 2); static tests were also plotted on a scale of ±2 mV so that any abnormally high data spikes could be observed.

Repeat Data

4.2.5.2.1.0.6 After completion of each dataset, approximately 2 percent of the data were recollected in a separate file to demonstrate instrument consistency and data integrity throughout the course of the survey. Repeat data also serves to evaluate and validate the particular collection and positioning methods. Evaluation of repeat data was conducted qualitatively against original data profiles.

4.2.5.2.2 Trimble 5700 RTK GPS System

4.2.5.2.2.0.1 At the beginning of the day, and after setting up the base station and before collecting any data, the GPS antenna was mounded on a survey pole and placed at a known point to check the accuracy. The reported position was compared to the known position to check for proper base station and rover operation. The locations were stored in Trimble Survey Controller

and input into the PDA for inclusion in the project database. Positional discrepancies within 10 cm were considered acceptable.

4.2.5.3 Data Processing and Database Quality Control

4.2.5.3.0.1 New field data (XML files) were imported into the database and were checked to make sure that all the field notes were formatted and filled in correctly. Dataset identification and grid identification were verified as unique with no duplicated information. Line paths plotted to be sure that all the grids associated with a dataset were present in the database and that any missing grid identifications were updated. The actual acreage of data collection was calculated and was updated in the database.

4.2.5.3.0.2 Raw field reports were printed and checked to confirm they contained all the proper information, including grid identification, sketch maps and field notes. At the end of processing a dataset, processing reports were generated from the project database, which list down-line data density statistics, GPS quality, leveling, lag, and gridding parameters used in processing each dataset, as well as a list of all associated file names and supporting QC test results. Suspected culture or noise targets were identified in the comments field of the target lists. Processors examined all data prior to NAEVA demobilizing from the site.

4.2.5.3.0.3 The hand held analog instruments used for instrument-aided reconnaissance and anomaly avoidance were checked at the start and end of each day by operating the instrument over a test plot seeded with metallic test items. The instruments were considered functional if the items could be detected. The instrument was also shaken to check for loose parts and bad electrical connections. The instrument checks were recorded in the field log book. No deficiencies in the operation of the Schonstedt magnetometers were noted.

4.2.5.4 Intrusive Investigation Quality Control

4.2.5.4.0.1 Each anomaly was intrusively investigated and characterized by the intrusive team. For location data, the daily GPS QC Check was documented in the team's logbook (see Appendix E). The intrusive team leader documented the source of the anomaly, and verified that the anomaly had been adequately characterized. A final reading was taken with the EM61-MK2 at the anomaly location to confirm that the area had been cleared. Any remaining response at an anomaly location was investigated unless the source of the response could be attributed to an anomaly greater than 3 ft from the original peak. In addition to the post-intrusive checks by the dig teams, the site geophysicist reviewed the dig results and compared what was found by the intrusive teams with the geophysical anomalies selected from the DGM data.

4.2.6 Munitions Management

4.2.6.1 MEC Storage

4.2.6.1.0.1 In accordance with the ESP (USAESCH, 2010), a collection point was established within the work area for the storage of MEC items for same-day consolidated shots if items were acceptable to move; however, no MEC items were found within this Investigation Area. MD items recovered during the project were stored in a locked container, with access controlled by the Senior Unexploded Ordnance Supervisor (SUXOS) and Unexploded Ordnance Safety Officer (UXOSO).

4.2.6.2 MEC Disposal

4.2.6.2.0.1 Since MEC was not discovered during the RI, disposal of MEC items was not required. An account of recovered MPPEH and MD items, including photographs, was maintained during the RI. Each piece of recovered MPPEH and MD was given a unique database identification number, and the item was tracked from discovery to final disposition. The SUXOS was responsible for the tracking and maintenance of all ordnance recovered during the project.

4.2.6.3 Inspection of Material Potentially Presenting an Explosive Hazard

4.2.6.3.0.1 MPPEH items observed during intrusive operations were evaluated by the SUXOS and the UXOSO. There were no items confirmed or suspected to be MEC. Once the MPPEH was determined to be free of explosive hazards, the SUXOS certified and signed, and the UXOSO verified and signed the DD Form 1348-1A (Appendix H) to certify the material as MD. After inspection and certification, the recovered MD items were placed in the locked storage container at the secure storage area until appropriate disposition was arranged at the conclusion of each field season.

4.3 MC Characterization

4.3.0.1 The following subsections provide a description of the environmental sampling activities performed at the site in order to characterize MCs. This includes all field activities, duration and procedures for collecting samples and data, and variations from the work plan.

4.3.1 Field Activities and Methodologies

4.3.1.0.1 Between 13 October and 2 November 2011, environmental sampling for MCs was conducted at the Investigation Area. Field activities were documented in a field log, which is included in Appendix E. A photograph log of MC sampling activities is included in Appendix I. The procedures and methodologies for field investigation activities followed those outlined in the RI Work Plan (UXB, 2011). Any deviations from these plans and sampling rationale are discussed in Section 4.3.2.

4.3.1.0.2 Table 4-4 provides a summary of the MCs that were potentially released at the site. Samples collected during this investigation (soil and groundwater) were analyzed for these MCs.

Table 4-4. Summary of Munitions Constituents
Former Moving Target Machine Gun Range at South Beach Investigation Area

Constituent	CAS Number*	Synonym/ Abbreviation	Description*
Metals			
Antimony	7440-36-0	--	Alloy used as a hardening agent
Copper	7440-50-8	--	Bomb casing alloy metal
Lead	7439-92-1	--	Bomb casing alloy metal and a constituent in spotting charges
Nickel	7440-02-0	--	Bomb casing alloy metal and a constituent in spotting charges
Zinc	7440-66-6	--	Bomb casing alloy metal
Explosives Compounds			
1,3,5-Dinitrotoluene	99-35-4	1,3,5-DNT	TNT co-contaminant and breakdown product
1,3-Dinitrotoluene	99-65-0	1,3-DNT	DNT breakdown product and TNT co-contaminant
2,4,6-Trinitrotoluene	118-96-7	2,4,6-TNT	Nitroaromatic explosive.
2,4-Dinitrotoluene	121-14-2	2,4-DNT	Nitroaromatic explosive/ propellant; also TNT co-contaminant
2,6-Dinitrotoluene	606-20-2	2,6-DNT	Nitroaromatic explosive/ propellant; also TNT co-contaminant
2-Amino-4,6-Dinitrotoluene	355-72-78-2	--	TNT breakdown product
2-Nitrotoluene	88-72-2	--	DNT co-contaminant
3-Nitrotoluene	99-08-1	--	DNT co-contaminant
4-Amino-2,6-Dinitrotoluene	1946-51-0	--	TNT breakdown product
4-Nitrotoluene	99-99-0	--	DNT co-contaminant
Octahydro-1, 3, 5, 7-tetranitro-1,3,5,7-tetrazocine	2691-41-0	HMX	Nitramine explosive; also RDX co-contaminant[a]
Nitrobenzene	98-95-3	--	DNT co-contaminant
Nitroglycerin	55-63-0	NG	Nitrate ester explosive/propellant
Pentaerythritol tetranitrate	78-11-5	PETN	Nitrate ester explosive
Hexahydro-1,3,5-trinitro-1,3,5-triazine	121-82-4	RDX	Nitramine explosive; also HMX co-contaminant[a]
Methyl-2,4,6-trinitrophenylnitramine	479-45-8	Tetryl	Nitramine explosive

*Information gathered from ATSDR Toxicological Profiles (located at http://www.atsdr.cdc.gov/toxprofiles/) and the Hazardous Substances Data Bank (located at http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB).
[a]RDX contains approximately 10 % HMX which is an impurity formed during the synthesis of RDX.

4.3.1.1 Soil Investigation

4.3.1.1.0.1 Between October 13 and October 15, 2011, one incremental soil (0 to 2 in. bgs), 33 discrete surface soil (2 to 12 in. bgs), and 33 discrete subsurface soil (12 to 18 in. bgs) samples were collected at the site (Figure 4-2). One incremental field triplicate sample, two duplicate surface soil samples, and four duplicate subsurface soil samples were collected for QC purposes. Discrete soil sample locations were biased toward areas where the geophysical/intrusive investigation identified high concentrations of MEC and MD.

4.3.1.1.0.2 Incremental soil samples were collected at one location within the Investigation Area (MG19) in an area with high anomaly density found during the intrusive investigation (Figure 4-2). Due to the presence of manicured lawns/fill, incremental soil samples proposed at sample locations MG01, MG10, and MG28 were not collected. The dimensions of incremental sample unit MG19 were based on historical data and the results of the geophysical/intrusive investigation and measured 45-ft by 65-ft with grids that were 3.25-ft by 9-ft.

4.3.1.1.0.3 The four corners of incremental sample unit MG19 were recorded using a GPS unit capable of sub-meter accuracy. To determine a statistically random starting point, a Graphical Information System (GIS) tool was used to select a random point location in a corner grid of each sample unit. When using this tool, the spatial extents of the corner grid were used to constrain the acceptable locations in which the point could be placed. Using a random number generator function, the tool chose a random x, y coordinate pair that had a location within the constraining extent. A sample was then collected at the same relative location in each sample unit grid.

4.3.1.1.0.4 Within the sample unit, one increment was collected from each grid for a total of 100 increments. Each sample unit was subdivided into 100 grids. One increment was collected from each grid, totaling 100 increments per sample unit. Each increment was collected from 0 to 2 in. bgs using a stainless steel soil coring tool in the same relative location within each grid. A field triplicate was collected in the sample unit also using a random number generator, collected in a similar fashion to the first IS. Samples were placed in a new, clean gallon-sized polyethylene bag, which was sealed, labeled, and taped closed prior to shipment to the contracted laboratory.

4.3.1.1.0.5 Additional soil samples were collected as discrete, biased soil samples collected at locations where MD had been identified. Discrete samples were also collected within the incremental sampling units in an effort to collect native soil and determine vertical extent. Discrete sample intervals listed in Table 4-5 reflect native soils. Fill material was not sampled, since it was emplaced after historic munitions activities. These samples were collected and homogenized using stainless steel tools and placed in the containers provided by the laboratory.

4.3.1.1.0.6 Soil samples were collected in accordance with the MC Sampling and Analysis Plan, an appendix of the RI Work Plan (UXB, 2011). A sample collection log documenting surface soil sample collection is included as Appendix E. Table 4-5 provides a summary of the soil samples collected at the site.

Table 4-5. Soil Sample Summary
Former Moving Target Machine Gun Range at South Beach Investigation Area

Station ID	Sample ID	Sample Date	Sample Type	Matrix	Depth (in)	Rationale
MG02	SB054	10/15/11	Discrete	Surface Soil	2-12	Discrete sample collected from former firing line, where .50 and .30 ammunition was reportedly fired.
MG02	SB055	10/15/11	Discrete	Subsurface Soil	12-18	Discrete sample collected from former firing line, where .50 and .30 ammunition was reportedly fired.
MG03	SB056	10/15/11	Discrete	Surface Soil	2-12	Discrete sample collected from former firing line, where .50 and .30 ammunition was reportedly fired.
MG03	SB057	10/15/11	Discrete	Subsurface Soil	12-18	Discrete sample collected from former firing line, where .50 and .30 ammunition was reportedly fired.
MG04	SB058	10/15/11	Discrete	Surface Soil	2-12	Discrete sample collected from former firing line, where .50 and .30 ammunition was reportedly fired.
MG04	SB059	10/15/11	Discrete	Subsurface Soil	12-18	Discrete sample collected from former firing line, where .50 and .30 ammunition was reportedly fired.
MG05	SB060	10/15/11	Discrete	Subsurface Soil	2-12	Discrete sample collected from former firing line, where .50 and .30 ammunition was reportedly fired.
MG05	SB061	10/15/11	Discrete	Subsurface Soil	12-18	Discrete sample collected from former firing line, where .50 and .30 ammunition was reportedly fired.
MG06	SB062	10/15/11	Discrete	Surface Soil	3-12	Discrete sample collected from former firing line, where .50 and .30 ammunition was reportedly fired.
MG06	SB063	10/15/11	Discrete	Subsurface Soil	12-18	Discrete sample collected from former firing line, where .50 and .30 ammunition was reportedly fired.
MG06	SB064	10/15/11	Duplicate	Subsurface Soil	12-18	Duplicate sample for quality control.
MG07	SB065	10/15/11	Discrete	Surface Soil	2-12	Discrete sample collected from former firing line, where .50 and .30 ammunition was reportedly fired.
MG07	SB066	10/15/11	Discrete	Subsurface Soil	12-18	Discrete sample collected from former firing line, where .50 and .30 ammunition was reportedly fired.
MG08	SB067	10/15/11	Discrete	Surface Soil	2-12	Discrete sample collected from former firing line, where .50 and .30 ammunition was reportedly fired.
MG08	SB068	10/15/11	Discrete	Subsurface Soil	12-18	Discrete sample collected from former firing line, where .50 and .30 ammunition was reportedly fired.
MG09	SB069	10/15/11	Discrete	Surface Soil	4-12	Discrete sample collected from former firing line, where .50 and .30 ammunition was reportedly fired.
MG09	SB070	10/15/11	Discrete	Subsurface Soil	12-18	Discrete sample collected from former firing line, where .50 and .30 ammunition was reportedly fired.
MG11	SB071	10/15/11	Discrete	Surface Soil	2-12	Discrete sample collected from former impact berm, where .50 and .30 ammunition was reportedly fired.
MG11	SB072	10/15/11	Discrete	Subsurface Soil	12-18	Discrete sample collected from former impact berm, where .50 and .30 ammunition was reportedly fired.
MG12	SB073	10/15/11	Discrete	Surface Soil	2-12	Discrete sample collected from former impact berm, where .50 and .30 ammunition was reportedly fired.
MG12	SB074	10/15/11	Discrete	Subsurface Soil	12-18	Discrete sample collected from former impact berm, where .50 and .30 ammunition was reportedly fired.
MG12	SB075	10/15/11	Duplicate	Surface Soil	2-12	Discrete sample collected from former impact berm, where .50 and .30 ammunition was reportedly fired.
MG13	SB077	10/15/11	Discrete	Surface Soil	2-12	Discrete sample collected from former impact berm, where .50 and .30 ammunition was reportedly fired.
MG13	SB078	10/15/11	Discrete	Subsurface Soil	12-18	Discrete sample collected from former impact berm, where .50 and .30 ammunition was reportedly fired.
MG14	SB079	10/15/11	Discrete	Surface Soil	4-12	Discrete sample collected from former impact berm, where .50 and .30 ammunition was reportedly fired.
MG14	SB080	10/15/11	Discrete	Subsurface Soil	12-17	Discrete sample collected from former impact berm, where .50 and .30 ammunition was reportedly fired.

Table 4-5. Soil Sample Summary
Former Moving Target Machine Gun Range at South Beach Investigation Area

Station ID	Sample ID	Sample Date	Sample Type	Matrix	Depth (in)	Rationale
MG15	SB081	10/15/11	Discrete	Surface Soil	2-12	Discrete sample collected from former impact berm, where .50 and .30 ammunition was reportedly fired.
MG15	SB082	10/15/11	Discrete	Subsurface Soil	12-18	Discrete sample collected from former impact berm, where .50 and .30 ammunition was reportedly fired.
MG16	SB083	10/15/11	Discrete	Surface Soil	2-12	Discrete sample collected from former impact berm, where .50 and .30 ammunition was reportedly fired.
MG16	SB084	10/15/11	Discrete	Subsurface Soil	12-18	Discrete sample collected from former impact berm, where .50 and .30 ammunition was reportedly fired.
MG17	SB085	10/15/11	Discrete	Surface Soil	4-12	Discrete sample collected from former impact berm, where .50 and .30 ammunition was reportedly fired.
MG17	SB086	10/15/11	Discrete	Subsurface Soil	12-18	Discrete sample collected from former impact berm, where .50 and .30 ammunition was reportedly fired.
MG17	SB087	10/15/11	Duplicate	Subsurface Soil	12-18	Duplicate sample for quality control.
MG18	SB088	10/15/11	Discrete	Surface Soil	2-12	Discrete sample collected from former impact berm, where .50 and .30 ammunition was reportedly fired.
MG18	SB089	10/15/11	Discrete	Subsurface Soil	12-18	Discrete sample collected from former impact berm, where .50 and .30 ammunition was reportedly fired.
MG19	IS016	10/13/11	IS	Surface Soil	0-2	Sampling unit covered the former 300 m Firing Line, where .50 and .30 ammunition was reportedly fired.
MG19	IS017	10/13/11	Duplicate IS	Surface Soil	0-2	Duplicate IS to determine percent relative standard deviation.
MG19	IS018	10/14/11	Triplicate IS	Surface Soil	0-2	Triplicate IS to determine percent relative standard deviation.
MG20	SB090	10/13/11	Discrete	Surface Soil	2-12	Discrete sample collected from former 300 m Firing Line, where .50 and .30 ammunition was reportedly fired.
MG20	SB091	10/13/11	Discrete	Subsurface Soil	12-18	Discrete sample collected from former 300 m Firing Line, where .50 and .30 ammunition was reportedly fired.
MG21	SB092	10/14/11	Discrete	Surface Soil	2-12	Discrete sample collected from former 300 m Firing Line, where .50 and .30 ammunition was reportedly fired.
MG21	SB093	10/14/11	Discrete	Subsurface Soil	12-18	Discrete sample collected from former 300 m Firing Line, where .50 and .30 ammunition was reportedly fired.
MG22	SB094	10/13/11	Discrete	Surface Soil	2-12	Discrete sample collected from former 300 m Firing Line, where .50 and .30 ammunition was reportedly fired.
MG22	SB095	10/13/11	Discrete	Subsurface Soil	12-18	Discrete sample collected from former 300 m Firing Line, where .50 and .30 ammunition was reportedly fired.
MG22	SB096	10/13/11	Duplicate	Subsurface Soil	12-18	Duplicate sample for quality control.
MG23	SB098	10/14/11	Discrete	Surface Soil	2-12	Discrete sample collected from former 300 m Firing Line, where .50 and .30 ammunition was reportedly fired.
MG23	SB099	10/14/11	Discrete	Subsurface Soil	12-18	Discrete sample collected from former 300 m Firing Line, where .50 and .30 ammunition was reportedly fired.
MG24	SB100	10/14/11	Discrete	Surface Soil	2-12	Discrete sample collected from former 300 m Firing Line, where .50 and .30 ammunition was reportedly fired.
MG24	SB101	10/14/11	Discrete	Subsurface Soil	12-18	Discrete sample collected from former 300 m Firing Line, where .50 and .30 ammunition was reportedly fired.
MG25	SB102	10/14/11	Discrete	Surface Soil	2-12	Discrete sample collected from former 300 m Firing Line, where .50 and .30 ammunition was reportedly fired.
MG25	SB103	10/14/11	Discrete	Subsurface Soil	12-18	Discrete sample collected from former 300 m Firing Line, where .50 and .30 ammunition was reportedly fired.
MG26	SB104	10/14/11	Discrete	Surface Soil	2-12	Discrete sample collected from former 300 m Firing Line, where .50 and .30 ammunition was reportedly fired.

Table 4-5. Soil Sample Summary
Former Moving Target Machine Gun Range at South Beach Investigation Area

Station ID	Sample ID	Sample Date	Sample Type	Matrix	Depth (in)	Rationale
MG26	SB105	10/14/11	Discrete	Subsurface Soil	12-18	Discrete sample collected from former 300 m Firing Line, where .50 and .30 ammunition was reportedly fired.
MG27	SB106	10/14/11	Discrete	Surface Soil	2-12	Discrete sample collected from former 300 m Firing Line, where .50 and .30 ammunition was reportedly fired.
MG27	SB107	10/14/11	Discrete	Subsurface Soil	12-18	Discrete sample collected from former 300 m Firing Line, where .50 and .30 ammunition was reportedly fired.
MG29	SB109	10/15/11	Discrete	Surface Soil	3-12	Discrete sample collected from former 300 m Firing Line, where .50 and .30 ammunition was reportedly fired.
MG29	SB110	10/15/11	Discrete	Subsurface Soil	12-18	Duplicate sample for quality control.
MG30	SB111	10/15/11	Discrete	Surface Soil	3-12	Sampling unit covered length of the former 150 m Firing Line, where .50 and .30 ammunition was reportedly fired.
MG30	SB112	10/15/11	Discrete	Subsurface Soil	12-18	Duplicate IS to determine percent relative standard deviation.
MG31	SB113	10/15/11	Discrete	Surface Soil	3-12	Triplicate IS to determine percent relative standard deviation.
MG31	SB114	10/15/11	Discrete	Subsurface Soil	12-16	Sample collected within the former 150 m firing line, where .50 and .30 ammunition was reportedly fired.
MG32	SB115	10/14/11	Discrete	Surface Soil	8-13	Sample collected within the former 150 m firing line, where .50 and .30 ammunition was reportedly fired.
MG32	SB116	10/14/11	Discrete	Subsurface Soil	13-18	Sample collected within the former 150 m firing line, where .50 and .30 ammunition was reportedly fired.
MG33	SB117	10/15/11	Discrete	Surface Soil	6-14	Sample collected within the former 150 m firing line, where .50 and .30 ammunition was reportedly fired.
MG33	SB118	10/15/11	Discrete	Subsurface Soil	14-18	Sample collected within the former 150 m firing line, where .50 and .30 ammunition was reportedly fired.
MG33	SB119	10/15/11	Duplicate	Surface Soil	6-14	Sample collected within the former 150 m firing line, where .50 and .30 ammunition was reportedly fired.
MG34	SB121	10/15/11	Discrete	Surface Soil	4-12	Sample collected within the former 150 m firing line, where .50 and .30 ammunition was reportedly fired.
MG34	SB122	10/15/11	Discrete	Subsurface Soil	12-18	Sample collected within the former 150 m firing line, where .50 and .30 ammunition was reportedly fired.
MG35	SB123	10/14/11	Discrete	Surface Soil	6-12	Sample collected within the former 150 m firing line, where .50 and .30 ammunition was reportedly fired.
MG35	SB124	10/14/11	Discrete	Subsurface Soil	12-18	Sample collected within the former 150 m firing line, where .50 and .30 ammunition was reportedly fired.
MG35	SB125	10/14/11	Duplicate	Subsurface Soil	12-18	Sample collected within the former 150 m firing line, where .50 and .30 ammunition was reportedly fired.
MG35	SB123A	10/20/11	Discrete	Surface Soil	2-12	Sample collected within the former 150 m firing line, where .50 and .30 ammunition was reportedly fired.
MG35	SB124A	10/20/11	Discrete	Subsurface Soil	12-18	Sample collected within the former 150 m firing line, where .50 and .30 ammunition was reportedly fired.
MG36	SB126	10/14/11	Discrete	Surface Soil	6-12	Sample collected within the former 150 m firing line, where .50 and .30 ammunition was reportedly fired.
MG36	SB127	10/14/11	Discrete	Subsurface Soil	12-14	Sample collected within the former 150 m firing line, where .50 and .30 ammunition was reportedly fired.

4.3.1.2 Groundwater Investigation

4.3.1.2.0.1 On 2 November 2011, three groundwater samples and one duplicate sample were collected at the site (Figure 4-2). Tidewater, Inc. provided drilling services using a remote controlled Geoprobe® drill rig and the small diameter driven well sample collection method (MADEP, 1999). Groundwater samples were collected to characterize the groundwater within the Investigation Area and to determine whether historical military activities have affected groundwater quality. No monitoring wells were installed during this RI. Due to lack of access, proposed groundwater sample MG39 GW008 was not collected.

4.3.1.2.0.2 Groundwater samples were collected using a peristaltic pump and low flow sampling techniques. A sample was collected after stabilization of field measurements; including, temperature, specific conductance, dissolved oxygen, oxidation reduction potential, salinity, and turbidity. The laboratory provided sample containers were filled directly through an inline 0.45 micrometer (µm) filter connected to tubing. Groundwater sample locations are shown on Figure 4-2. A sample collection log documenting groundwater sample collection is included as Appendix E. Table 4-6 provides a summary of the groundwater samples collected at the site.

Table 4-6. Groundwater Sample Summary
Former Moving Target Machine Gun Range at South Beach Investigation Area

Station ID	Sample ID	Sample Date	Sample Type	Matrix	Depth (ft)	Location
MG37	GW006	11/2/11	Regular	Groundwater	8-12	Discrete sample at former moving target track
MG37	GW010	11/2/11	Duplicate	Groundwater	8-12	Discrete sample at former moving target track
MG38	GW007	11/2/11	Regular	Groundwater	12-16	Discrete sample northwest of former 150 m firing line
MG40	GW009	11/2/11	Regular	Groundwater	12-16	Discrete sample south of former impact berm

4.3.2 Variations from the Work Plan

4.3.2.0.1 The sampling procedures and analytical protocols presented in the RI Work Plan (UXB, 2011) were followed; however, the following deviations occurred:

- Due to the presence of manicured lawns/fill, incremental soil samples MG01, MG10, and MG28 were not collected; and,
- Due to lack of access, proposed groundwater sample MG39 GW008 was not collected.

4.3.3 Sample Procedures and Analysis

4.3.3.0.1 Chemical analysis of environmental samples collected at the Investigation Area were conducted by TestAmerica, Inc. (TestAmerica) located in Arvada, Colorado, a DoD

Environmental Laboratory Accreditation Program certified lab. COCs for samples sent to TestAmerica are included in Appendix E. Analytical procedures followed Method 3050/6020A for discrete soil metals analysis, Method 8321B for discrete soil explosives analysis, Method 8330B (prep only, no grinding)/6020A for metals IS analysis, Method 8330B (prep only)/8321B for explosives IS analysis, Method 3050/6020A for metals analysis of groundwater, and Method 3535A/8321B for explosives analysis of groundwater.

4.3.4 Data Validation

4.3.4.0.1 One-hundred percent of the MC data was validated according to the DoD QSM Version 4.2 and verified by the USAESCH using Automated Data Review (ADR) software. Data quality was evaluated against the DQOs established in the RI Work Plan (UXB, 2011).

4.3.4.0.2 A presentation of various field and laboratory quality assurance (QA)/QC criteria used to evaluate data quality and results of the data quality evaluation process are included in the Data Validation Report (Appendix D). Based on the Data Quality Indicators (precision, accuracy, representativeness, comparability, and completeness), the data quality for the site was evaluated and determined to be usable for the evaluation of the nature and extent of contamination and for use in evaluating potential effects of existing site conditions on human health. Data were qualified as discussed in the QA/QC Evaluations (Appendix D). Qualified data are usable with the limitations described. Results of data quality evaluation are summarized as follows:

- Accuracy and Precision goals were met;
- Project Representativeness goals were achieved;
- Samples collected during the RI generated Analytical Level III data, which allows for adequate comparability to past and future investigations; and,
- Laboratory completeness was 100 percent, and field completeness was 95 percent.

4.3.5 Investigation Derived Waste

4.3.5.0.1 Less than 10 gallons of investigation derived waste (IDW) was generated during equipment decontamination activities and low flow groundwater purging. A waste characterization sample (MV01 IDW01) was collected on 3 November 2011 and analyzed at TestAmerica Denver. The IDW was transported to and disposed at the Edgartown Wastewater Treatment Facility.

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5.0 REVISED CONCEPTUAL SITE MODEL AND RI RESULTS

5.0.1 Results from the MEC and MC investigations have been evaluated and used to update the pre-investigation CSM discussed in Section 3.1.

5.1 MEC Investigation Results

5.1.1 AirMag Results

5.1.1.0.1 Within the Investigation Area, 4,349 anomalies were identified above the threshold value presented in Figure 5-1. A full description of the Battelle VG-22 system, the field operations, and the findings of the AirMag survey are presented in Appendix A and summarized in Table 5-1.

Table 5-1. AirMag Summary Table
Former Moving Target Machine Gun Range at South Beach Investigation Area

Site	Coverage	Mean Altitude	Total Number of Anomalies	Number of Anomalies Picked	Collection Dates	Number of Reflights Lines
South Beach	364 acres	2.34 meters	4,349	Priority 1 = 2,254 Priority 2 = 776 Priority 3 = 1,319	2/10/11, 2/11/11, 2/17/11	6

5.1.2 Analog Results (Land)

5.1.2.0.1 The objective of the analog transect surveys to locate areas of elevated concentrations of geophysical anomalies that could represent potential historical military target areas or areas impacted with MEC or MD was achieved as shown in Figure 5-2. High densities of anomalies were confirmed in the western portion of the Investigation Area between Left and Right Fork corresponding to the historic target area and in one small area on Wasque Point. Characterization of these areas was completed by placing DGM Grids and intrusively investigating them.

5.1.3 Digital Geophysical Mapping Results

5.1.3.0.1 DGM data were collected within transects and grids over 5.43 acres of land and beach areas of the Investigation Area.

Transects:

5.1.3.0.2 The objective was to locate elevated areas of geophysical anomalies that could represent MEC or MD. DGM data were collected along five transects covering 3.03 acres at the Investigation Area resulting in a total of 97 anomalies identified above the targeting threshold of 3 mV in Channel 2. This data was used to locate grids for intrusive investigation as discussed in Section 5.1.3.3 and as indicated in Figure 5-3.

Table 5-2. Summary of MEC and MD Recovered (Land and Beach)
Former Moving Target Machine Gun Range Investigation Area

Dig Descriptions					Cleared	Comments
MEC	MPPEH	MD	Non-MD	CA		
---	---	---	---	---	---	Relocated due to beach erosion
N/A	N/A	N/A	N/A	N/A	8-Mar	0 anomalies
---	---	---	---	---	---	Relocated due to beach erosion
N/A	N/A	N/A	2	N/A	8-Mar	
N/A	N/A	N/A	6	N/A	8-Mar	
---	---	---	---	---	---	Relocated due to beach erosion
N/A	N/A	N/A	3	N/A	8-Mar	
N/A	N/A	N/A	11	N/A	9-Mar	
N/A	N/A	N/A	7	N/A	9-Mar	
N/A	N/A	N/A	9	N/A	9-Mar	
N/A	N/A	N/A	3	N/A	9-Mar	
N/A	N/A	N/A	4	N/A	8-Mar	
N/A	N/A	N/A	3	N/A	8-Mar	
N/A	N/A	N/A	2	N/A	8-Mar	
N/A	N/A	N/A	3	N/A	8-Mar	
N/A	N/A	N/A	4	N/A	8-Mar	
N/A	N/A	N/A	N/A	N/A	8-Mar	0 anomalies
N/A	N/A	N/A	2	N/A	10-Mar	
N/A	N/A	N/A	1	N/A	10-Mar	
N/A	N/A	N/A	2	N/A	10-Mar	
---	---	---	---	---	---	Relocated due to beach erosion
N/A	N/A	N/A	2	N/A	23-Mar	22 No finds due to nails in the boardwalk.
N/A	N/A	N/A	N/A	N/A	15-Mar	2 No finds
N/A	N/A	N/A	2	N/A	10-Mar	
N/A	N/A	N/A	1	N/A	10-Mar	
N/A	N/A	N/A	2	N/A	15-Mar	
N/A	N/A	N/A	N/A	N/A	15-Mar	Relocated due to beach erosion
N/A	N/A	N/A	2	N/A	15-Mar	
N/A	N/A	N/A	1	N/A	22-Mar	Replaced S0001
N/A	N/A	1	N/A	N/A	23-Mar	Replaced S0003/5" HVAR Mk 1 (initially MPPEH but later determined inert/MD)
N/A	N/A	N/A	N/A	N/A	21-Mar	Replaced S0006/0 anomalies
N/A	N/A	N/A	N/A	N/A	21-Mar	Replaces S0007/0 anomalies
N/A	N/A	N/A	N/A	N/A	21-Mar	Replaced S0008/0 anomalies
N/A	N/A	N/A	1	N/A	22-Mar	Replaced S0010
N/A	N/A	N/A	4	N/A	22-Mar	Replaced S0025
---	---	---	---	---	---	Intended to replace S0026/not necessary
N/A	N/A	N/A	N/A	N/A	29-Mar	Replaced S0031/0 anomalies
N/A	N/A	N/A	2	N/A	28-Mar	Replaced S0009
N/A	N/A	N/A	N/A	N/A	4-Apr	Reserve Grid/0 anomalies
N/A	N/A	N/A	N/A	N/A	4-Apr	Reserve Grid/0 anomalies
N/A	N/A	N/A	4	N/A	4-Apr	Reserve Grid
N/A	N/A	N/A	2	N/A	4-Apr	Reserve Grid
0	**0**	**1**	**85**	**0**		

MAP A: SOUTH BEACH WEST RESULTS

Katama Bay

N

Atlantic Ocean

0 350 700 1,400 2,100 Feet

MAP B: SOUTH BEACH EAST RESULTS

Katama Bay

Wasque Point

Atlantic Ocean

0 350 700 1,400 2,100 Feet

Former Rocket Target

South Beach Investigation Area

Vertical Gradient (nT/m)*

4.5
3.5
2.4
1.4
0.0
-1.2
-2.2
-3.7
-4.7

*The scale of the vertical gradient is -3 to 3 nanoTesla/meter (nT/m)

US Army Corps of Engineers

FIGURE 5-1

Air Magnetometer Results - Former Moving Target Machine
Gun Range at South Beach Investigation Area, Martha's Vineyard, MA

-SCALE AS SHOWN-

UXB amec

NOTES:
2009 Aerial Data Source: MassGIS

03/04/2013	Rev:	SBeach_Air_Mag_Results_Remedial_Inv_Rpt.mxd	
Drawn: JBO	Chk: DMS	PROJ: 562910000	

Former Rocket Target

Analog Geophysical SurveyTransect*

South Beach Investigation Area

Anomaly Density**
Anomalies per bin

37
5.0
4.0
3.5
3.0
2.0
1.0
0.0

*Each segement of the Geophysical Survey Transect line equals one 50 foot survey transect bin.
**Anomaly density values are estimated based on counts per geophysical survey transect bin.

US Army Corps of Engineers

FIGURE 5-2

Land Analog Transect Results - Former Moving Target Machine Gun Range at South Beach Investigation Area, Martha's Vineyard, MA

0 200 400 800 1,200 1,600 Meters

0 750 1,500 3,000 4,500 Feet

UXB amec

NOTES:
2011 Aerial Data Source: Bing Maps, Microsoft Corp.

03/04/2013	Rev:	SBeach_All_Activities_Loc_Remedial_Inv_Rpt.mxd	
Drawn: JBO	Chk: DMS	PROJ: 562910000	

Katama Airpark

Katama Farm

Katama Bay

Pocha Pond

Wasque Point

Atlantic Ocean

N

Location of 5" HVAR found 22-Mar-2011

Approximate location of 5" MK 6 Practice warhead found Feb-2012

INSET A

INSET B

INSET C

Approximate locations of 100 lb bombs found 13-Feb-2009 and 100 lb HE found Dec-2008

*Some ocean transects were inaccessible due to environmental conditions during the time of survey. Conditions included eroding beaches and other general safety concerns.

INSET A

5" HVAR Mk 1 (initially MEC but later determined inert)

0 200 400 Feet

INSET B

0 200 400 Feet

INSET C

0 175 350 Feet

Anomaly Type

- MEC
- MD
- Non-MD
- Cultural Artifact
- No Find
- Seed
- Former Rocket Target
- Geophysical Survey Transect
- Ocean Transect Inaccessible*
- Ocean Transect with MD
- Ocean Transect with no MEC, MPPEH, or MD
- Intrusive Grid
- South Beach Investigation Area
- TCRA Grid (2009)
- S0001 Intrusive Grid ID

US Army Corps of Engineers

FIGURE 5-3

Geophysical Survey Transect and Intrusive Grid Results - Former Moving Target Machine Gun Range at South Beach Investigation Area, Martha's Vineyard, MA

0 200 400 800 1,200 1,600 Meters

0 750 1,500 3,000 4,500 Feet

UXB amec

NOTES:
2011 Aerial Data Source: Bing Maps, Microsoft Corp.

09/04/2013	Rev:	SBeach_All_Activities_Results_Remedial_Inv_Rpt.mxd
Drawn: JBO	Chk: DMS	PROJ: 562910000

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Inland Water

5.1.3.0.3 Due to the constantly changing barrier beach/shoaling, there were no inland water grids investigated. Sufficient data from the beach and ocean intrusive investigation was obtained to develop the findings and conclusion for this report.

Ocean

5.1.3.0.4 Mag and Dig operations were conducted along 51 ocean transects in the surf zone along the eastern and northern shore of the Investigation Area. No MEC items were identified and a total of 96 MD items and 13 non-MD items were identified as noted in Table 5-3.

Table 5-3. Summary of MEC and MD Recovered (Ocean)
Former Moving Target Machine Gun Range Investigation Area

Ocean Transect	Dig Descriptions					Cleared	Planned Transect Length (ft)	Actual Transect Length (ft)	Comments
	MEC	MPPEH	MD	Non-MD	CA				
1-20	-	-	-	-	-	-	300-600	0	Transect not complete due to eroding beaches and safety concerns.
21	N/A	N/A	N/A	N/A	N/A	19-Apr	300	300	No Finds
22	N/A	N/A	N/A	N/A	N/A	20-Apr	300	300	No Finds
23	N/A	N/A	N/A	N/A	N/A	3-May	300	300	No Finds
24	N/A	N/A	N/A	N/A	N/A	3-May	300	300	No Finds
25	N/A	N/A	N/A	N/A	N/A	2-May	300	300	No Finds
26	N/A	N/A	N/A	N/A	N/A	2-May	300	300	No Finds
27	N/A	N/A	N/A	N/A	N/A	30-Apr	300	600	No Finds
28	N/A	N/A	N/A	N/A	N/A	30-Apr	300	300	No Finds
29	N/A	N/A	1	N/A	N/A	19-Apr	300	300	1 - MD (Expended 2.25" rocket motors @ 30').
30	N/A	N/A	N/A	N/A	N/A	17-Apr	300	300	No Finds
31	N/A	N/A	2	N/A	N/A	17-Apr	300	600	2 - MD (Expended 2.25" rocket motors @ 260' and 380').
32	N/A	N/A	6	N/A	N/A	12-Apr	300	600	6 - MD (Expended 2.25" rocket motors @ 265' , 290', 290', 370', 385' and 400').
33	N/A	N/A	N/A	N/A	N/A	4-Apr	300	300	No Finds
34	N/A	N/A	N/A	N/A	N/A	3-Apr	300	300	No Finds
35	N/A	N/A	N/A	N/A	N/A	2-Apr	300	300	No Finds
36	N/A	N/A	N/A	N/A	N/A	30-Mar	300	300	No Finds
37	N/A	N/A	N/A	N/A	N/A	30-Mar	300	300	No Finds
38	N/A	N/A	N/A	N/A	N/A	28-Mar	300	300	No Finds
39	N/A	N/A	N/A	N/A	N/A	27-Mar	600	600	No Finds
40	N/A	N/A	2	N/A	N/A	26-Mar	300	300	2 - MD (2 - Expended 2.25" rocket motors @ 230' and 245').

Table 5-3. Summary of MEC and MD Recovered (Ocean)
Former Moving Target Machine Gun Range Investigation Area

Ocean Transect	Dig Descriptions					Cleared	Planned Transect Length (ft)	Actual Transect Length (ft)	Comments
	MEC	MPPEH	MD	Non-MD	CA				
41	N/A	N/A	8	N/A	N/A	23-Mar	300	380	8 - MD (7 - Expended 2.25" rocket motors; 1 - Expended 3.5" rocket motor @ 60', 70', 72', 130', 150', 170', 250' and 280'. Support trailer located 200-ft from ocean, therefore transect could only extend to 380-ft.
42	N/A	N/A	2	N/A	N/A	22-Mar	300	500	2 - MD (2 - Expended 2.25" rocket motors @ 329' and 500'). Support trailer located 100-ft from ocean, therefore transect could only extend to 500-ft.
43	N/A	N/A	N/A	N/A	N/A	21-Mar	300	300	No Finds
44	N/A	N/A	5	12	N/A	20-Mar	300	300	5 - MD (4 - Expended 2.25" rocket motors; 1 - Expended 3.5" rocket motor @ 70', 130', 170', 180' and 240'). 12 - Non-MD (Fence posts).
45	N/A	N/A	2	N/A	N/A	19-Mar	300	300	2 - MD (2 - Expended 2.25" rocket motors @ 160' and 160').
46	N/A	N/A	2	N/A	N/A	17-Mar	300	300	2 - MD (1 - Expended 2.25" rocket motor @ 180'; 1 - Expended 3.5" rocket motor found west of Transect in the range of 0' to 300'; item dragged to shore with divers support lines so exact location unknown).
47	N/A	N/A	N/A	N/A	N/A	16-Mar	300	300	No Finds
48	N/A	N/A	N/A	N/A	N/A	15-Mar	300	300	No Finds
49	N/A	N/A	N/A	N/A	N/A	15-Mar	300	300	No Finds
50	N/A	N/A	N/A	N/A	N/A	15-Mar	600	600	No Finds
51	N/A	N/A	N/A	N/A	N/A	6-Mar	300	300	No Finds
52	N/A	N/A	10	N/A	N/A	6-Mar	300	600	10 - MD (7 - Expended 2.25" rocket motors; 3 - Expended 3.5" rocket motors @ 190', 240', 250', 270', 270', 280', 290', 290', 300' and 320').
53	N/A	N/A	15	N/A	N/A	27-Feb	300	600	15 - MD (12 - Expended 2.25" rocket motors; 1 - 3.5" Expended rocket motor; 1 - 3" Expended rocket motor; 1 - 5" warhead fragment @ 200', 223', 230', 230', 230', 230', 240', 248', 250', 250', 260', 260', 270', 270' and 275').
54	N/A	N/A	11	N/A	N/A	13-Dec	300	400	11 - MD (10 - Expended 2.25" rocket motors; 1 - 3" Expended rocket motor @ Surf Zone, Surf Zone, 215', 220', 240', 240', 260', 290', 290', 300' and 350').
55	N/A	N/A	17	N/A	N/A	12-Dec	300	375	17 - MD (15 - Expended 2.25" rocket motors; 2 - Expended 3" rocket motors @ Surf Zone, 80', 105', 105', 150', 165', 195', 220', 240', 260', 280', 293', 295', 295', 313', 315' and 325').
56	N/A	N/A	10	N/A	N/A	6-Dec	600	600	10 - MD (8 - Expended 2.25" rocket motors; 1 - 3" Expended rocket motor; rocket motor fragments @ 110', 170', 175', 180', 235', 248', 250', 260', 260' and 340').

Table 5-3. Summary of MEC and MD Recovered (Ocean)
Former Moving Target Machine Gun Range Investigation Area

Ocean Transect	Dig Descriptions					Cleared	Planned Transect Length (ft)	Actual Transect Length (ft)	Comments
	MEC	MPPEH	MD	Non-MD	CA				
57	N/A	N/A	N/A	N/A	N/A	5-Dec	600	600	No Finds
58	N/A	N/A	N/A	N/A	N/A	7-Dec	300	300	No Finds
59	N/A	N/A	N/A	N/A	N/A	1-Dec	300	300	No Finds
60	N/A	N/A	N/A	N/A	N/A	2-Dec	600	600	No Finds
61	N/A	N/A	N/A	N/A	N/A	2-Dec	600	600	No Finds
62	N/A	N/A	N/A	N/A	N/A	14-Oct	300	300	No Finds
63	N/A	N/A	N/A	1	N/A	10/14 - 12/01/11	300	300	Pipe fragments
64	N/A	N/A	N/A	N/A	N/A	10/12 - 11/22/11	300	300	No Finds
65	N/A	N/A	3	N/A	N/A	10/12 - 11/22/11	300	450	3 - MD (Expended 2.25" rocket motors @ 80', 115' and 400').
66	N/A	N/A	N/A	N/A	N/A	12-Oct	300	300	No Finds
67	N/A	N/A	N/A	N/A	N/A	11-Oct	300	300	No Finds
68	N/A	N/A	N/A	N/A	N/A	11-Oct	600	600	No Finds
69	N/A	N/A	N/A	N/A	N/A	11-Oct	600	600	No Finds
70	N/A	N/A	N/A	N/A	N/A	11-Oct	300	300	No Finds
71	N/A	N/A	N/A	N/A	N/A	11-Oct	300	300	No Finds
Totals	**0**	**0**	**96**	**13**	**0**				

5.1.4 Ocean Transport Study

5.1.4.0.1 The results of the ocean transport study summarized below are presented in detail in Appendix A.

5.1.4.0.2 MEC Transport Grid Surveys: During the baseline survey, 24 anomalies were detected at TCRA grids 5/6, and 155 anomalies were detected at TCRA grids 18/19. There were no items visible on the ocean bottom in either location. During the post-storm event survey, conducted 5 months after the baseline survey, 22 anomalies were detected at TCRA grid 5/6, and 385 anomalies detected at TCRA Grid 18/19 (Figure 5-4) . In addition, there were MD items visible on the ocean bottom in both locations. The presence of anomalies found during the follow-up (post-storm event) survey demonstrates that ferrous items are moving into these two grid areas, with a measurable change after storm events. While the original work plan included a third survey at the conclusion of the project, extreme weather conditions and severe beach erosion/shoaling prevented the last survey.

5.1.4.0.3 MEC Transport Acoustic Transponder (Pinger) Survey: Although interrogation of the eight pingers was attempted, no return signal was identified. During this portion of the study,

severe/unpredictable weather patterns over the winter months prohibited divers from locating and tracking the items. However, one rocket simulant was recovered on the beach approximately 1 mile east of the grid location and turned over to TTOR.

5.1.5 ESTCP Characterization Results

5.1.5.0.1 Geophysical data for 540 anomalies was provided by Tetra-Tech, and following evaluation, 95 items were selected for intrusive investigation. The intrusive investigation was conducted between 29 June and 24 September 2010 by VRHabilis. Of the 95 items, two were MD items consisting of expended rocket motors; 49 were non-MD consisting of buried cables, pipelines, fence posts, trash/debris, "hot rocks"; and 44 were "no-finds". The two items of MD were located on the transect closest to the beach (Figure 5-5). A complete ESTCP report is included in Appendix A.

5.2 MC Investigation Results

5.2.1 Soil

5.2.1.0.1 Based on the results of the intrusive investigation, 1 incremental soil (0 to 2 in. bgs), 33 discrete surface soil (2 to 12 in. bgs), and 33 discrete subsurface soil (12 to 18 in. bgs) sample locations were identified at the Investigation Area. Samples were collected in areas with the highest potential to contain MCs.

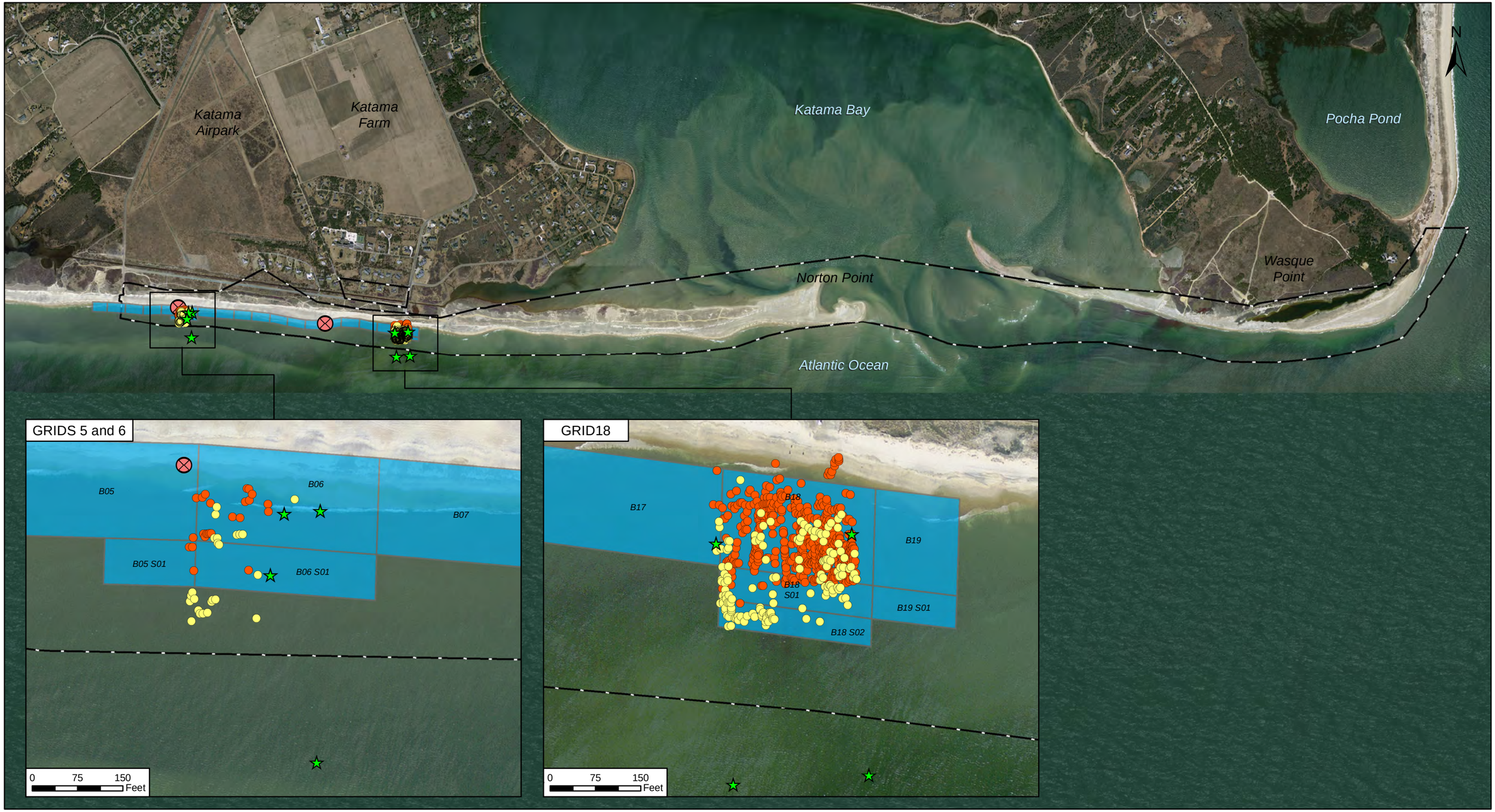
5.2.1.0.2 Analytical results from surface and subsurface soil sampling are presented in Tables 5-4 and 5-6, respectively. A statistical summary of surface and subsurface soil data collected at the site are presented in Tables 5-5 and 5-7, respectively. MC sampling locations are shown on Figure 4-2. Analytical Laboratory Reports are included in Appendix D. A summary of the results is presented below.

Metals

5.2.1.0.3 Metals (antimony, copper, lead, nickel, and zinc) were analyzed in surface soil samples, collected at one incremental sample location and 33 discrete sample locations. Each of the metals were detected at the incremental sample location. Antimony was detected at 20 of the 33 discrete surface soil sample locations and the remaining metals were detected at every discrete sample location. Lead was detected above ecological screening criterion of 11 mg/kg at IS location MG19 and at discrete soil sample location MG32. No metals were detected at concentrations exceeding the human health soil screening criterion.

Explosives

5.2.1.0.4 Explosives were analyzed in surface and subsurface soil samples. No explosives compounds were detected in surface or subsurface soil samples.



- Pinger Start Location
- Sweep 1 Anomaly (June 2010)
- Sweep 2 (September/October 2010)
- Former Rocket Target
- TCRA Grid (2009)
- South Beach Investigation Area

US Army Corps of Engineers

FIGURE 5-4

MEC Transport Study Results - Former Moving Target Machine
Gun Range at South Beach Investigation Area, Martha's Vineyard, MA

0 150 300 600 900 1,200 1,500 Meters
0 700 1,400 2,800 4,200 5,600 Feet

UXB amec

NOTES:
2009 Aerial Data
Source: MassGIS

06/24/2013	Rev:	SBeach_MEC_Transport_Results_Inv_Rpt.mxd	
Drawn: JBO	Chk: DMS	PROJ: 562910000	

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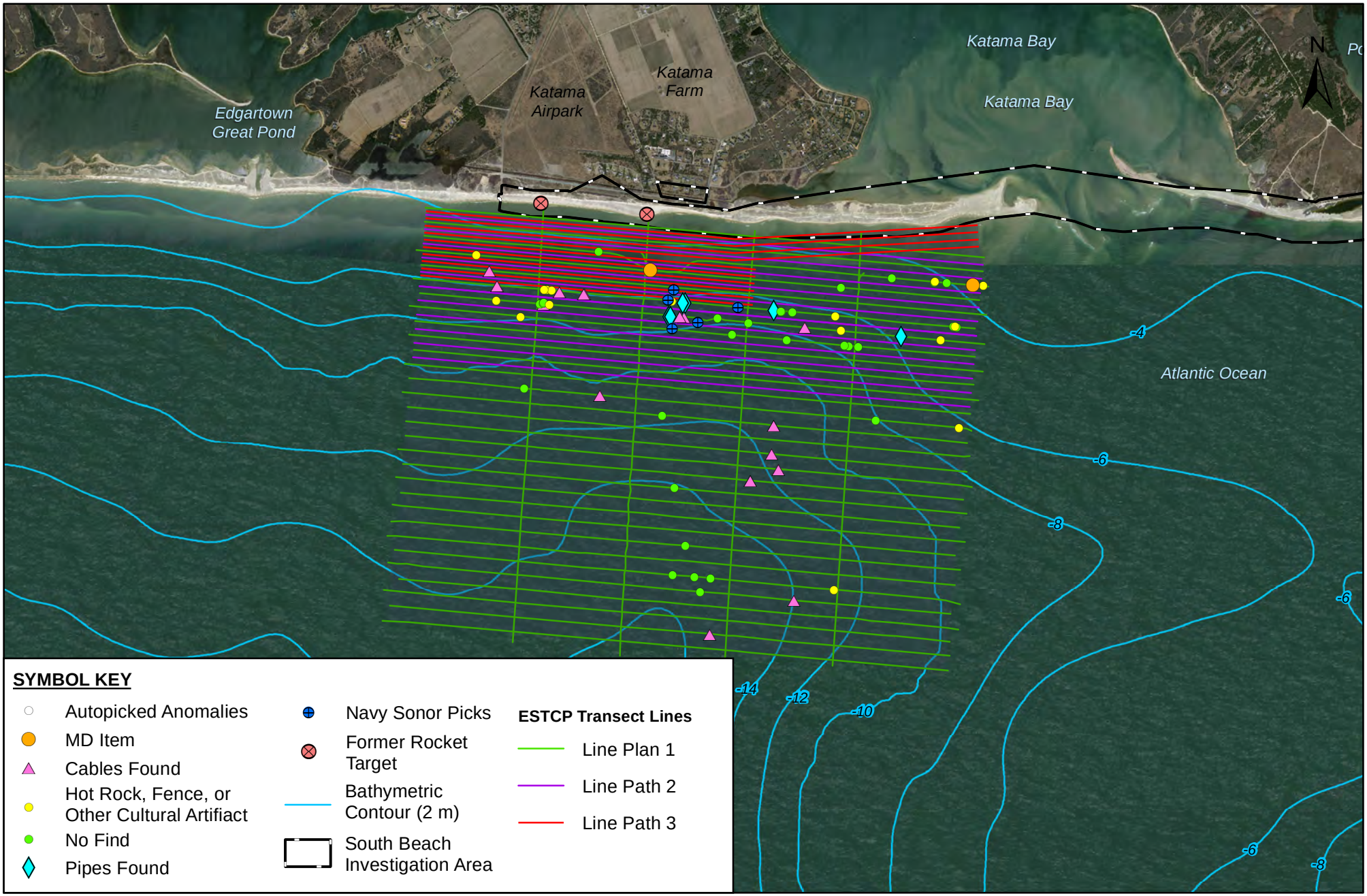

US Army Corps of Engineers

NOTES:
2011 Aerial Data Source: Bing Maps, Microsoft Corp., Bathymetric Data Source: MassGIS

UXB amec

0 1,500 3,000 4,500 6,000 7,500 Feet

0 300 600 900 1,200 Meters

FIGURE 5-5

ESTCP Results - Former Moving Target Machine Gun Range at South Beach Investigation Area, Martha's Vineyard, MA

02/26/2013	Rev:	Drawn: JBO	Chk: DMS	SBeach_ESTCP_Anomalies_SB_Remedial_Inv_Rpt.mxd	PROJ: 562910000

Table 5-4. Surface Soil Sample Results Summary
Former Moving Target Machine Gun Range at South Beach Investigation Area

Station ID	Sample ID	Sample Date	Sample Type	Sample Depth Interval (inches)	Metals by 6020A				
					Antimony	Copper	Lead	Nickel	Zinc
Human Health Screening Criterion[1]					20	3100	300	20	2500
Ecological Screening Criterion[2]					0.27	28	11	38	46
Results are presented in milligrams per kilogram (mg/kg)									
MG02	SB054	10/15/2011	Regular	2-12	0.21 U	**2.5 J**	**3.8**	**2.4**	**8.6**
MG03	SB056	10/15/2011	Regular	2-12	**0.015 J**	**2.9**	**6.8**	**2.5**	**9.5**
MG04	SB058	10/15/2011	Regular	2-12	**0.017 J**	**1.6 J**	**5.2**	**1.2**	**5**
MG05	SB060	10/15/2011	Regular	2-12	**0.022 J**	**3.1**	**6**	**2.3**	**14**
MG06	SB062	10/15/2011	Regular	3-12	**0.015 J**	**2.1 J**	**7**	**2.5**	**9.3**
MG07	SB065	10/15/2011	Regular	2-12	**0.016 J**	**2.2 J**	**6.3**	**1.7**	**6.8**
MG08	SB067	10/15/2011	Regular	2-12	**0.019 J**	**5.4**	**8.1**	**4**	**13**
MG09	SB069	10/15/2011	Regular	4-12	**0.018 J**	**2.6**	**4.3**	**2.2**	**8**
MG11	SB071	10/15/2011	Regular	2-12	**0.015 J**	**2.6**	**4.2**	**3**	**11**
MG12	SB075	10/15/2011	FD	2-12	**0.017 J**	**1.7 J**	**7.9**	**2**	**7.9**
MG12	SB073	10/15/2011	Regular	2-12	**0.017 J**	**1.8 J**	**8.4**	**2.3**	**8.1**
MG13	SB077	10/15/2011	Regular	2-12	**0.016 J**	**2.8**	**4.8**	**3**	**11**
MG14	SB079	10/15/2011	Regular	4-12	**0.015 J**	**2.2 J**	**7.2**	**1.8**	**7.4**
MG15	SB081	10/15/2011	Regular	2-12	**0.013 J**	**2.5**	**7.9**	**2.2**	**9.1**
MG16	SB083	10/15/2011	Regular	2-12	**0.025 J**	**2.1 J**	**8.3**	**2.1**	**6.2**
MG17	SB085	10/15/2011	Regular	4-12	**0.013 J**	**2.7**	**5.1**	**3.2**	**14**
MG18	SB088	10/15/2011	Regular	2-12	**0.015 J**	**2.4 J**	**8.5**	**3.9**	**11**
MG19	IS016	10/13/2011	Regular	0-2	**0.034 J**	**3.7 J**	**14**	**2.6**	**13 J**
MG19	IS017	10/13/2011	FT	0-2	**0.04 J**	**3.4 J**	**12**	**2.5**	**12 J**
MG19	IS018	10/14/2011	FT	0-2	**0.043 J**	**3.9 J**	**11**	**2.6**	**15 J**
MG20	SB090	10/13/2011	Regular	2-12	0.025 U	2.3 U	**4.7**	**1.8**	**6.5**
MG21	SB092	10/14/2011	Regular	2-12	0.023 U	**2.4 J**	**4.1**	**2.2**	**8.3**
MG22	SB094	10/13/2011	Regular	2-12	0.022 U	**2.1 J**	**4.5**	**2.4**	**7.6**
MG23	SB098	10/14/2011	Regular	2-12	0.023 U	**2.3 J**	**4.7**	**2.5**	**7.2**

Table 5-4. Surface Soil Sample Results Summary (continued)
Former Moving Target Machine Gun Range at South Beach Investigation Area

Station ID	Sample ID	Sample Date	Sample Type	Sample Depth Interval (inches)	Metals by 6020A				
					Antimony	Copper	Lead	Nickel	Zinc
Human Health Screening Criterion[1]					20	3100	300	20	2500
Ecological Screening Criterion[2]					0.27	28	11	38	46
Results are presented in milligrams per kilogram (mg/kg)									
MG24	SB100	10/14/2011	Regular	2-12	0.026 U	**3.2**	**5.8**	**3**	**11**
MG25	SB102	10/14/2011	Regular	2-12	0.031 U	**3.3**	**5.4**	**2.9**	**8**
MG26	SB104	10/14/2011	Regular	2-12	0.027 U	**2.3 J**	**6.1**	**2.5**	**9.3**
MG27	SB106	10/14/2011	Regular	2-12	0.025 U	**1.5 J**	**6**	**1.4**	**5.6**
MG29	SB109	10/15/2011	Regular	3-12	**0.018 J**	**3.6**	**5.4**	**2.9**	**13**
MG30	SB111	10/15/2011	Regular	3-12	**0.015 J**	**4**	**5.4**	**3.3**	**10**
MG31	SB113	10/15/2011	Regular	3-12	0.2 U	**3.5**	**3.7**	**3.5**	**10**
MG32	SB115	10/14/2011	Regular	8-13	0.22 U	**1.8 J**	**16**	**2.2**	**7.8**
MG33	SB117	10/15/2011	Regular	6-14	**0.015 J**	**3.6**	**5.6**	**3.5 J**	**12**
MG33	SB119	10/15/2011	FD	6-14	**0.014 J**	**3.7**	**6**	**4.8 J**	**12**
MG34	SB121	10/15/2011	Regular	4-12	0.21 U	**4.3**	**4.3**	**6.2**	**17**
MG35	SB123	10/14/2011	Regular	6-12	0.026 U	**3.8**	**6.4**	**3.4 J**	**10**
MG35	SB123A	10/20/2011	Regular	2-12	**0.024 J**	**5 J**	**9.6 J**	**3.2 J**	**14 J**
MG36	SB126	10/14/2011	Regular	6-12	**0.014 J**	**4**	**4.1**	**4.4**	**14**

Notes:
[1] Criteria for human health were identified as the lower of 1) U.S. Environmental Protection Agency Risk Screening Level (residential selected as the most stringent) 2) Massachusetts Department of Environmental Protection Method 1 Soil Standard (SI value selected for the greatest stringency).
[2] Criteria for ecological were identified using the U.S. Environmental Protection Agency Ecological Soil Screening Level (lowest of avian, mammalian, plant or invertebrate).

Detected concentration is greater than ecological screening criterion.

Acronyms

FD - field duplicate **J** - quantitation estimated
FT - field triplicate **U** - not detected

Table 5-5. Surface Soil Data Statistical Summary
Former Moving Target Machine Gun Range at South Beach Investigation Area

Constituent	HHSC[(1)] (mg/kg)	ECOSC[(2)] (mg/kg)	Analyzed	Detected	Percent of Detection	Exceeded HHSC	Exceeded ECOSC	Percent Exceeded ECOSC	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Maximum Detection Location
Antimony	20	0.27	38	25	66	0	0	0	0.013	0.043	MG19 IS018
Copper	3100	28	38	37	97	0	0	0	1.5	5.4	MG08 SB067
Lead	300	11	38	38	100	0	3	8	3.7	16	MG32 SB115
Nickel	20	38	38	38	100	0	0	0	1.2	6.2	MG34 SB121
Zinc	2500	46	38	38	100	0	0	0	5	17	MG34 SB121
1,3,5-Trinitrobenzene	2200	0.376	38	0	0	0	0	0	n/a	n/a	n/a
1,3-Dinitrobenzene	6.1	0.073	38	0	0	0	0	0	n/a	n/a	n/a
2,4,6-Trinitrotoluene	19	6.4	38	0	0	0	0	0	n/a	n/a	n/a
2,4-Dinitrotoluene	0.7	1.28	38	0	0	0	0	0	n/a	n/a	n/a
2,6-Dinitrotoluene	61	0.0328	38	0	0	0	0	0	n/a	n/a	n/a
2-Amino-4,6-dinitrotoluene	150	10	38	0	0	0	0	0	n/a	n/a	n/a
2-Nitrotoluene	2.9	9.9	38	0	0	0	0	0	n/a	n/a	n/a
3-Nitrotoluene	2.9	12	38	0	0	0	0	0	n/a	n/a	n/a
4-Amino-2,6-dinitrotoluene	150	3.6	38	0	0	0	0	0	n/a	n/a	n/a
4-Nitrotoluene	30	22	38	0	0	0	0	0	n/a	n/a	n/a
HMX	1	27	38	0	0	0	0	0	n/a	n/a	n/a
Nitrobenzene	4.8	1.31	38	0	0	0	0	0	n/a	n/a	n/a
Nitroglycerin	6.1	71	38	0	0	0	0	0	n/a	n/a	n/a
PETN	120	100	38	0	0	0	0	0	n/a	n/a	n/a
RDX	1	7.5	38	0	0	0	0	0	n/a	n/a	n/a
Tetryl	240	0.99	38	0	0	0	0	0	n/a	n/a	n/a

Notes:
[(1)] Criteria for human health were identified as the lower of 1) U.S. Environmental Protection Agency Regional Screening Level (residential selected as the most stringent) 2) Massachusetts Department of Environmental Protection Method 1 Soil Standard (SI value selected for the greatest stringency).
[(2)] Criteria for ecological were identified using the U.S. Environmental Protection Agency Ecological Soil Screening Level (lowest of avian, mammalian, plant or invertebrate).

ECOSC - Ecological Screening Criterion
HHSC - Human Health Screening Criterion
mg/kg - milligrams per kilogram
n/a – not applicable

Table 5-6. Subsurface Soil Sample Results Summary
Former Moving Target Machine Gun Range at South Beach Investigation Area

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth Interval (inches)	Metals by 6020A				
					Antimony	Copper	Lead	Nickel	Zinc
Human Health Screening Criterion[1]					20	3100	300	20	2500
Ecological Screening Criterion[2]					0.27	28	11	38	46
Results are presented in milligrams per kilogram (mg/kg)									
MG02	SB055	10/15/2011	Regular	12-18	0.19 U	**4.1**	**2.5**	**3.9**	**18**
MG03	SB057	10/15/2011	Regular	12-18	0.2 U	**3.2**	**3**	**2.8**	**9.5**
MG04	SB059	10/15/2011	Regular	12-18	**0.013 J**	**3.1**	**3**	**3.1**	**10**
MG05	SB061	10/15/2011	Regular	12-18	**0.016 J**	**2.6**	**2.6**	**1.8**	**7.1**
MG06	SB064	10/15/2011	FD	12-18	**0.024 J**	**3.2**	**4.9**	**3**	**10**
MG06	SB063	10/15/2011	Regular	12-18	**0.015 J**	**3.3**	**4.6**	**3.2**	**12**
MG07	SB066	10/15/2011	Regular	12-18	**0.013 J**	**2.5**	**3.5**	**2.5**	**7.5**
MG08	SB068	10/15/2011	Regular	12-18	**0.014 J**	**3.7**	**3**	**3.4**	**9.5**
MG09	SB070	10/15/2011	Regular	12-18	0.2 U	**2.5**	**3.6**	**2.5**	**7.5**
MG11	SB072	10/15/2011	Regular	12-18	0.2 U	**2 J**	**3.7**	**3.4**	**8.7**
MG12	SB074	10/15/2011	Regular	12-18	0.21 U	**2.1 J**	**3.8**	**3.9**	**10**
MG13	SB078	10/15/2011	Regular	12-18	0.21 U	**2.7 J**	**4.4**	**3**	**9.8**
MG14	SB080	10/15/2011	Regular	12-17	0.22 U	**2.3 J**	**5.5**	**3**	**14**
MG15	SB082	10/15/2011	Regular	12-18	**0.015 J**	**2.2 J**	**9.8**	**2.3**	**7.1**
MG16	SB084	10/15/2011	Regular	12-18	0.2 U	**1.2 J**	**3**	**1.6**	**4.7**
MG17	SB086	10/15/2011	Regular	12-18	0.2 U	**1.9 J**	**6.5**	**2.7**	**7.1**
MG17	SB087	10/15/2011	FD	12-18	0.2 U	**2.2 J**	**6.6**	**2.9**	**8.2**
MG18	SB089	10/15/2011	Regular	12-18	0.22 U	**1.4 J**	**3.9**	**3.5**	**7.8**
MG20	SB091	10/13/2011	Regular	12-18	0.023 U	**2.2 J**	**4.5**	**2.9**	**8**
MG21	SB093	10/14/2011	Regular	12-18	0.022 U	**2.5 J**	**2.9**	**1.9**	**6.3**
MG22	SB095	10/13/2011	Regular	12-18	0.02 U	**2.2 J**	**4**	**3.1**	**6.4**
MG22	SB096	10/13/2011	FD	12-18	0.023 U	**2.1 J**	**4.8**	**2.2**	**7**
MG23	SB099	10/14/2011	Regular	12-18	0.02 U	**1.9 J**	**3.7**	**2.3**	**17**

Table 5-6. Subsurface Soil Sample Results Summary (continued)
Former Moving Target Machine Gun Range at South Beach Investigation Area

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth Interval (inches)	Metals by 6020A				
					Antimony	Copper	Lead	Nickel	Zinc
Human Health Screening Criterion[1]					20	3100	300	20	2500
Ecological Screening Criterion[2]					0.27	28	11	38	46
Results are presented in milligrams per kilogram (mg/kg)									
MG24	SB101	10/14/2011	Regular	12-18	**0.018 J**	**2.2 J**	**3.3**	**3.4**	**9.2 J**
MG25	SB103	10/14/2011	Regular	12-18	0.023 U	**2 J**	**4.3**	**1.9**	**6.2**
MG26	SB105	10/14/2011	Regular	12-18	0.024 U	**1.4 J**	**3.8**	**3.1**	**6.6**
MG27	SB107	10/14/2011	Regular	12-18	0.023 U	**1.2 J**	**3.8**	**2.7**	**6.1**
MG29	SB110	10/15/2011	Regular	12-18	**0.014 J**	**2.5**	**4**	**3.3**	**9**
MG30	SB112	10/15/2011	Regular	12-18	**0.014 J**	**4.3**	**4.5**	**4.7**	**13**
MG31	SB114	10/15/2011	Regular	12-16	0.21 U	**3.3**	**4.1**	**4.8**	**12**
MG32	SB116	10/14/2011	Regular	13-18	0.21 U	**1.7 J**	**4.4**	**3.5**	**9.5**
MG33	SB118	10/15/2011	Regular	14-18	0.2 U	**2.1 J**	**4**	**3.7**	**12**
MG34	SB122	10/15/2011	Regular	12-18	**0.015 J**	**4.3**	**5.7**	**6.6**	**13**
MG35	SB124	10/14/2011	Regular	12-18	**0.014 J**	**2.4**	**3.5**	**3.8 J**	**9.1**
MG35	SB125	10/14/2011	FD	12-18	0.22 U	**2.8**	**4**	**3.8**	**9.7**
MG35	SB124A	10/20/2011	Regular	12-18	0.19 UJ	**3.1 J**	**3.9 J**	**3.8 J**	**9.5 J**
MG36	SB127	10/14/2011	Regular	12-14	0.23 U	**2.2 J**	**3.8**	**2.8**	**8.5**

Notes:
[1] Criteria for human health were identified as the lower of 1) U.S. Environmental Protection Agency Risk Screening Level (residential selected as the most stringent) 2) Massachusetts Department of Environmental Protection Method 1 Soil Standard (SI value selected for the greatest stringency).
[2] Criteria for ecological were identified using the U.S. Environmental Protection Agency Ecological Soil Screening Level (lowest of avian, mammalian, plant or invertebrate).

Detected concentration is greater than ecological screening criterion.

Acronyms

FD - field duplicate
J - quantitation estimated
U - not detected
UJ - not detected, quantitation estimated

Table 5-7. Subsurface Soil Data Statistical Summary
Former Moving Target Machine Gun Range at South Beach Investigation Area

Constituent	HHSC[1] (mg/kg)	ECOSC[2] (mg/kg)	Analyzed	Detected	Percent of Detection	Exceeded HHSC	Exceeded ECOSC	Percent Exceeded ECOSC	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Maximum Detection Location
Antimony	20	0.27	37	12	32	0	0	0	0.013	0.024	MG06 SB064
Copper	3100	28	37	37	100	0	0	0	1.2	4.3	MG30 SB112, MG34 SB122
Lead	300	11	37	37	100	0	0	0	2.5	9.8	MG15 SB082
Nickel	20	38	37	37	100	0	0	0	1.6	6.6	MG34 SB122
Zinc	2500	46	37	37	100	0	0	0	4.7	18	MG02 SB055
1,3,5-Trinitrobenzene	2200	0.376	37	0	0	0	0	0	n/a	n/a	n/a
1,3-Dinitrobenzene	6.1	0.073	37	0	0	0	0	0	n/a	n/a	n/a
2,4,6-Trinitrotoluene	19	6.4	37	0	0	0	0	0	n/a	n/a	n/a
2,4-Dinitrotoluene	0.7	1.28	37	0	0	0	0	0	n/a	n/a	n/a
2,6-Dinitrotoluene	61	0.0328	37	0	0	0	0	0	n/a	n/a	n/a
2-Amino-4,6-dinitrotoluene	150	10	37	0	0	0	0	0	n/a	n/a	n/a
2-Nitrotoluene	2.9	9.9	37	0	0	0	0	0	n/a	n/a	n/a
3-Nitrotoluene	2.9	12	37	0	0	0	0	0	n/a	n/a	n/a
4-Amino-2,6-dinitrotoluene	150	3.6	37	0	0	0	0	0	n/a	n/a	n/a
4-Nitrotoluene	30	22	37	0	0	0	0	0	n/a	n/a	n/a
HMX	1	27	37	0	0	0	0	0	n/a	n/a	n/a
Nitrobenzene	4.8	1.31	37	0	0	0	0	0	n/a	n/a	n/a
Nitroglycerin	6.1	71	37	0	0	0	0	0	n/a	n/a	n/a
PETN	120	100	37	0	0	0	0	0	n/a	n/a	n/a
RDX	1	7.5	37	0	0	0	0	0	n/a	n/a	n/a
Tetryl	240	0.99	37	0	0	0	0	0	n/a	n/a	n/a

Notes:
[1] Criteria for human health were identified as the lower of 1) U.S. Environmental Protection Agency Regional Screening Level (residential selected as the most stringent) 2) Massachusetts Department of Environmental Protection Method 1 Soil Standard (SI value selected for the greatest stringency).
[2] Criteria for ecological were identified using the U.S. Environmental Protection Agency Ecological Soil Screening Level (lowest of avian, mammalian, plant or invertebrate).
ECOSC - Ecological Screening Criterion **n/a** – not applicable
HHSC - Human Health Screening Criterion
mg/kg - milligrams per kilogram

5.2.2 Groundwater

5.2.2.0.1 Groundwater samples were collected from three sample locations at the Investigation Area. Analytical results from groundwater sampling are presented in Table 5-8. A statistical summary of groundwater data collected at the site is presented in Table 5-9. Groundwater sample locations are presented on Figure 4-5. Analytical Laboratory Reports are included in Appendix G. A summary of the results is presented below.

Metals

5.2.2.0.2 Metals were analyzed in groundwater samples collected at three sample locations. Antimony and lead were not detected in any groundwater samples. Copper was detected at two locations and nickel and zinc were detected at each of the three groundwater sample locations. None of the metals were detected at concentrations exceeding human health groundwater screening criterion.

Explosives

5.2.2.0.3 2-nitrotoluene, 3-nitrotoluene, and 4-nitrotoluene were detected in sample MG37 GW010; however, their concentrations were below human health screening criterion. No other explosives were detected in groundwater samples.

Table 5-8. Groundwater Sampling Results Summary
Former Moving Target Machine Gun Range Investigation Area

Location ID	Sample ID	Sample Date	Sample Type	Sample Depth Interval (feet)	Metals by 6020A							
					Antimony	Copper	Lead	Nickel	Zinc	2-Nitrotoluene	3-Nitrotoluene	4-Nitrotoluene
Human Health Screening Criterion[1]					6	1300	10	100	11000	0.31	3.7	4.2
Ecological Screening Criterion[2]					NA	NA	NA	NA	NA	NA	NA	NA
Results are presented in micrograms per liter (µg/L)												
MG37	GW006	11/2/11	Regular	8-12	6 U	**1.5 J**	3 U	**12**	**7.4 J**	0.1 U	0.1 U	0.1 U
MG37	GW010	11/2/11	FD	8-12	6 U	**0.99 J**	3 U	**9**	**4.3 J**	**0.15 J**	**0.026 J**	**0.17 J**
MG38	GW007	11/2/11	Regular	12-16	6 U	2 U	3 U	**7.4**	**5.8 J**	0.098 U	0.098 U	0.098 U
MG40	GW009	11/2/11	Regular	12-16	6 U	**0.57 J**	3 U	**5.5**	**9 J**	0.1 U	0.1 U	0.1 U

Notes:
[1] Criteria for human health were identified as the lower of 1) USEPA MCLs, 2) USEPA RSL, 3) MADEP Method 1 Groundwater Standards (GW1 value selected for the greatest stringency).
[2] USEPA ecological criteria for groundwater were not identified. MADEP GW-3 standards are intended to protect surface water; so selecting the lowest groundwater standard is protective of surface water.

Acronyms
FD - field duplicate
NA - not available
J - quantitation estimated
U - not detected

Table 5-9. Groundwater Data Statistical Summary
Former Moving Target Machine Gun Range Investigation Area

Constituent	HHSC[(1)] (µg/L)	ECOSC[(2)] (µg/L)	Analyzed	Detected	Percent of Detection	Exceeded HHSC	Exceeded ECOSC	Percent Exceeded ECOSC	Minimum Detection (µg/L)	Maximum Detection (µg/L)	Maximum Detection Location
Antimony	6	NA	4	0	0	--	--	--	--	--	--
Copper	1300	NA	4	3	75	0	0	0	0.57	1.5	MG37, GW006
Lead	10	NA	4	0	0	--	--	--	--	--	--
Nickel	100	NA	4	4	100	0	0	0	5.5	12	MG37 GW006
Zinc	11000	NA	4	4	100	0	0	0	4.3	9	MG40 GW009
1,3,5-Trinitrobenzene	1100	NA	4	0	0	--	--	--	--	--	--
1,3-Dinitrobenzene	3.7	NA	4	0	0	--	--	--	--	--	--
2,4,6-Trinitrotoluene	2.2	NA	4	0	0	--	--	--	--	--	--
2,4-Dinitrotoluene	0.22	NA	4	0	0	--	--	--	--	--	--
2,6-Dinitrotoluene	37	NA	4	0	0	--	--	--	--	--	--
2-Amino-4,6-dinitrotoluene	73	NA	4	0	0	--	--	--	--	--	--
2-Nitrotoluene	0.31	NA	4	1	25	0	0	0	0.15	0.15	MG37 GW010
3-Nitrotoluene	3.7	NA	4	1	25	0	0	0	0.026	0.026	MG37 GW010
4-Amino-2,6-dinitrotoluene	73	NA	4	0	0	--	--	--	--	--	--
4-Nitrotoluene	4.2	NA	4	1	25	0	0	0	0.17	0.17	MG37 GW010
HMX	200	NA	4	0	0	--	--	--	--	--	--
Nitrobenzene	0.12	NA	4	0	0	--	--	--	--	--	--
Nitroglycerin	3.7	NA	4	0	0	--	--	--	--	--	--
PETN	17	NA	4	0	0	--	--	--	--	--	--
RDX	0.61	NA	4	0	0	--	--	--	--	--	--
Tetryl	150	NA	4	0	0	--	--	--	--	--	--

Notes:
(1) Criteria for human health were identified as the lower of 1) USEPA MCLs, 2) USEPA RSL, 3) MADEP Method 1 Groundwater Standards (GW1 value selected for the greatest stringency).
(2) USEPA ecological criteria for groundwater were not identified. MADEP GW-3 standards are intended to protect surface water; so selecting the lowest groundwater standard is protective of surface water.

ECOSC - Ecological Screening Criterion **HHSC** - Human Health Screening Criterion **µg/L** - micrograms per kilogram **n/a** – not applicable

5.3 Revised Conceptual Site Model

5.3.0.1 The preliminary CSM presented in Section 3.1 was reviewed and revised based upon the results of MEC and MC characterization activities. The key findings of the investigations conducted at the Investigation Area include:

- At the Former Moving Target Machine Gun Range:
    - A 300 m firing line was confirmed through visual inspection of a concrete pad with stanchions for mounting machine guns.
    - The 150 m firing line and suspected firing line and impact berm were not confirmed through visual inspection. The areas are residential and have been disturbed by building and landscaping activities.
    - MEC was not identified during the RI at the Moving Target Machine Gun Range.
- At the Former Katama Rocket Range:
    - While the former target areas are currently underwater, the limits of the rocket training range and the distribution of munitions debris have been confirmed through geophysics and intrusive investigation.
    - MEC has not been identified at the former rocket target area. MD has been identified in ocean, land, and beach areas.
    - A transport study conducted at South Beach demonstrates that ferrous items are moving into these two grid areas, with a measurable change after storm events.
    - Due to significant beach erosion and deeper water depths in the surf zone, ferrous items including rocks with ferrous signatures previously buried below sensor detection depth may have become detectable/ exposed and migrated into the previously cleared grids; all items were within 400 feet of the water's edge as measured from the mean low-tide mark.
    - The distribution of MD concentrations is further east of the former target areas indicating a strong prevailing easterly ocean current; this is further confirmed by the acoustic pinger which broke free from one of the seed items in the transport study which washed ashore approximately one mile east of where it was emplaced.
- At Wasque Point:
    - Two 100 pound bombs have been reported at two instances (one in 2008 and one in 2009) prior to the RI at Wasque point, approximately 2.1 miles from where the majority of MD was identified.

- MC sampling indicated that human health screening criterion were not exceeded in soil or groundwater.
- Lead was identified in surface soil at concentrations exceeding ecological screening criterion.

5.3.0.2 These findings build upon data gathered from historical records, previous investigation, removal actions, and interviews with long-term residents and former military personnel. Table 5-10 summarizes the revised CSM including facility, physical, release, land use and exposure, and ecological profiles for MEC and MCs.

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Table 5-10. Revised Conceptual Site Model Summary
Former Moving Target Machine Gun Range at South Beach Investigation Area

Facility Profile	Physical Profile	Release Profile	Land Use and Exposure Profile	Ecological Profile

Facility Description:
• Investigation Area is ~ 478 acres.(1)
• FUDS boundary is 4,2014.85 acres
• Located south of Edgartown along the southern edge of Martha's Vineyard, Massachusetts.
• Historical structures used by the U.S. Navy on the site include a moving target machine gun range track, three former firing lines, a concrete storage area, and two rocket target areas (2)
Site History:
• Former Moving Target Machine Gun Range and Katama Rocket Range
  ○ The site was used from 1944 to 1947 by the Naval Air Station Quonset Point, Rhode Island for the purpose of a gunnery and rocket firing range. (2)
  ○ Rockets, bombs, and bomb fragments have been observed on the property. (2)
• Wasque Point
  ○ On two occasions, 2008 and 2009, 100 lb bombs were discovered at Wasque Point.
Munitions Potentially Used:
• 0.30 and 0.50 caliber ammunition
• MK 1 rockets
• 2.25 in. to 5 in. rockets(1)
	Site Characteristics:
	• Approximately 18.7 acres of land
	• Approximately 190.4 acres of beach
	• Approximately 268.7 acres of ocean
	• Due to extensive beach erosion, the former rocket targets are now approximately 150 yards seaward of South Beach. (1) The eastern end of the investigation area (Wasque Point) lost ~575 ft of land and beach within one year. (2009- 2010).
	Topography:
	• The site is relatively flat.
	• The beach portion of the site is dynamic with surf continuously eroding and depositing sand. (1)
	Vegetation:
	• Low grass vegetation.
	Surface Water:
	• Mattakeset Herring Creek, an intermittent stream, flows through the site between two former firing lines and the former moving target track.
	• Surface water runoff is not expected in upland areas.
	Soils:
	• Soils located on the sand dunes consist of medium to coarse sands and are excessively drained.
	Geology:
	• Glacial deposits consisting of recent beach and marsh sediments, glacial deposits, interglacial deposits, and glacially deformed ancient coastal plain sediments (3).
	• Bedrock is encountered at approximately 500 ft below ground surface and is comprised of metamorphic and igneous rocks.(3)
	Hydrogeology:
	• Depth of groundwater ranges from 0 to greater than 6 ft bgs.(4)
	• Groundwater on Martha's Vineyard is primarily discharged directly to the ocean and surrounding bays. (3)
	Meteorology:
	• Average Annual Rainfall = 46 in. per year (3).
		Contaminants of Potential Concern:
		• lead in soil
		Media of Potential Concern:
		• Surface soil, subsurface soil, and groundwater.
		Confirmed MEC Locations:
		  ○ Historical evidence and RI results indicate there is no MEC associated with the Former Moving Target Machine Gun Range and Katama Rocket Range. Prior to the RI, two suspected 100 lb bombs, were reported at Wasque Point, however, there is no supporting evidence that they were the cause of historical operations at South Beach.
		Confirmed Munitions Debris Locations:
		  ○ During the 1988-1989 unexploded ordnance removal action, 1,655 munitions debris items were successfully recovered with approximately 99 of those items being warheads.(5)During the 2009 Time-Critical Removal Action, 617 muniti[ons] debris items were identified and removed. Items included 2.25 to 5 in. sub-caliber aircraft rockets, 5 in. rocket warheads, 1 to 3.5 in. rocket warheads, 3 to 3.25 in. rockets with warheads, and 3 to 3.25 in. rockets with 5 in. warheads.
		  ○ During the 2010-2011 Remedial Investigation, nature and extent of MD was delineated. 0 MEC items and 98 MD items were recovered. Recovered items included practice rockets. These items were concentrated in the ocean near the target areas and to the east.
		MC Results:
		• Former Moving Target Machine Gun Range
		  ○ During the 2010-2011 RI, surface soil, subsurface soil, and groundwater samples were collected within the area of the former firing lines and impact berms. Sample results indicate that MC concentrations do not exceed human health screening criteria. Lead was detected in soil samples at concentrations exceeding ecological screening criteria.
		Identified Pathways:
		• Former Moving Target Machine Gun Range and Katama Rocket Range
		  ○ Lead detected in soil at concentration above ecological screening criterion. Results indicate that adsorption of MCs to surface soil particles have been the primary mechanism influencing the extent of MCs in the environment.
		  ○ MD items are transported by various physical factors/transport processes that include: ocean currents; natural erosion of soil by wind and water exposing buried MD items; and, removal or relocation by the public.
			Current Landowners:
			• South Beach is owned and managed by the Commonwealth of Massachusetts, Department of Conservation and Recreation (MADCR), and managed by the Edgartown Parks and Recreation Department from the first of May through Labor Day of each year. (1)
			• Private landowners in the vicinity of the former Moving Target Machine Gun Range firing lines and suspected impact berm occupy small portions of the property. (1)
			Current Land Use:
			• The former range encompasses an area that is currently a public beach used for recreational purposes such as hiking, canoeing, kayaking, fishing, clamming, crabbing, wildlife observation, photography, education, and other water related activities. (1)
			• The northern portion of the site is developed with single-family residential homes, and asphalt roads.
			Future Land Use:
			• Land use is not expected to change in the future.
			Potential Receptors:
			• Potential receptors associated with current and future land use include residents, recreation users, onsite workers, and biota.
			• There is concern for public safety due to munitions items washing onto the shore at South Beach. (1)
				Property Description:
				• The former site consists of uplands that contain residential and commercial development, a small strip of beach, and the Atlantic Ocean.
				• The primary use of the property is residential use and recreational use, with a moderate degree of disturbance.
				Potential Ecological Receptors:
				• Inland and marine plant species, fish, birds, insects, soil invertebrates, and mammals that inhabit or migrate through the site. Associated threatened and endangered species are included.
				Threatened and Endangered Species:
				• There are approximately 37 federal/state threatened, endangered, and/or special concern species that could be present at the site. (1)
				• Avoidance techniques were used during the field investigation to minimize the potential for encountering threatened or endangered species. No threatened or endangered species were observed during the field work at the Investigation Area.
				Relationship of Munitions Debris to Habitat:
				• Munitions items may be located within and/or adjacent to habitat areas

Notes:

(1) UXB International, Inc., 2011. *Final Revision 1, Remedial Investigation Work Plan, Former Cape Poge Little Neck Bomb Target MRS, Former Moving Target Machine Gun Range at South Beach MRS, & Tisbury Great Pond MRS, Martha's Vineyard, Massachusetts*. January.

(2) U.S. Army Corps of Engineers, 2010. *Draft Final Site Specific Final Report For The Time Critical Removal Action (TCRA) at Former Cape Poge Little Neck Bomb Target Site, Chappaquiddick Island, Dukes County, Massachusetts, and Former Moving Target Machine Gun Range at South Beach, Martha's Vineyard, Edgartown, Massachusetts*. January.

(3) U.S. Army Corps of Engineers St. Louis District, 2009b. *Draft Report, Preliminary Assessment, Cape Poge Little Neck Bomb Target Site, Chappaquiddick Island, MA, FUDS Property – D01MA0595*. February.

(4) United States Department of Natural Resources-Soil Conservation Service (USDA-SCS), 1986. *Soil Survey of Dukes County, Massachusetts*. September.

(5) Department of the Army, 1989. *After Action Report – Ordnance Clearance Operation on Martha's Vineyard, MA; 14 March 1989 – 12 May 1989.* May.

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6.0 CONTAMINANT FATE AND TRANSPORT

6.0.1 The source of MEC and MCs are evaluated in relation to historic and current site activities and processes, lateral and vertical distribution, and the physical and chemical properties that act to concentrate or degrade the mass and concentration of the chemicals in the environment. Constituent fate and transport are also affected by the physical and chemical properties of MEC and MCs, the nature and extent of the release, as well as physical and chemical properties of the medium in which MEC and MCs are present. For example, MEC may be found on the surface or buried in the subsurface; however, it is possible for natural processes to result in the movement, relocation, or unearthing of MEC, increasing the chance of subsequent exposure to receptors.

6.1 Fate and Transport Processes for MEC

6.1.0.1 As presented in Section 3.1.3, the ultimate fate of MEC items within the Investigation Area is governed by various physical factors/transport processes that include:

- Transport by ocean currents;
- Natural erosion of soil by wind and water exposing buried MEC items; and,
- Transport via removal or relocation of MEC.

6.1.0.2 The results of the geophysical and intrusive investigations conducted as part of this RI and historical investigations indicate that while large numbers of MD (practice rockets) were found conducting the ocean transects, there were no MEC items found within the Investigation Area other than the previously reported bombs discovered at Wasque Point.

6.2 Fate and Transport Processes for MCs

6.2.0.1 As discussed in Section 3.1.3, the fate and transport of metals in the environment is governed by a number of interrelated processes, including oxidation/reduction conditions, the degree of inorganic and organic complexation, and pH conditions of the soil and groundwater. Adsorption of metal cations has been correlated with such soil properties as pH, redox potential, clay and/or soil organic matter content, iron and manganese oxides, and calcium carbonate content. Typically, as these soil properties increase, the adsorption capacity of cationic metals will also increase.

6.2.0.2 MC sampling results indicate that lead has exceeded the ecological screening criterion in soil. Based upon the fate and transport processes of cationic metals as well as the distribution and concentration of the evaluated metals, it appears that these metals have adsorbed to soil particles and are bound to surface soil and near surface soil.

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7.0 MEC HAZARD ASSESSMENT AND MC BASELINE RISK ASSESSMENT

7.1 MEC Hazard Assessment

7.1.0.1 In the RI phase of the CERCLA process, the MEC Hazard Assessment (HA) is developed to support the hazard management decision making process by analyzing site-specific information to assess existing explosives hazards. The MEC HA addresses human health and safety concerns associated with potential exposure to MEC at a site. It does not directly address environmental or ecological concerns that might be associated with MEC, including the risks associated with exposure to MCs as environmental contaminants.

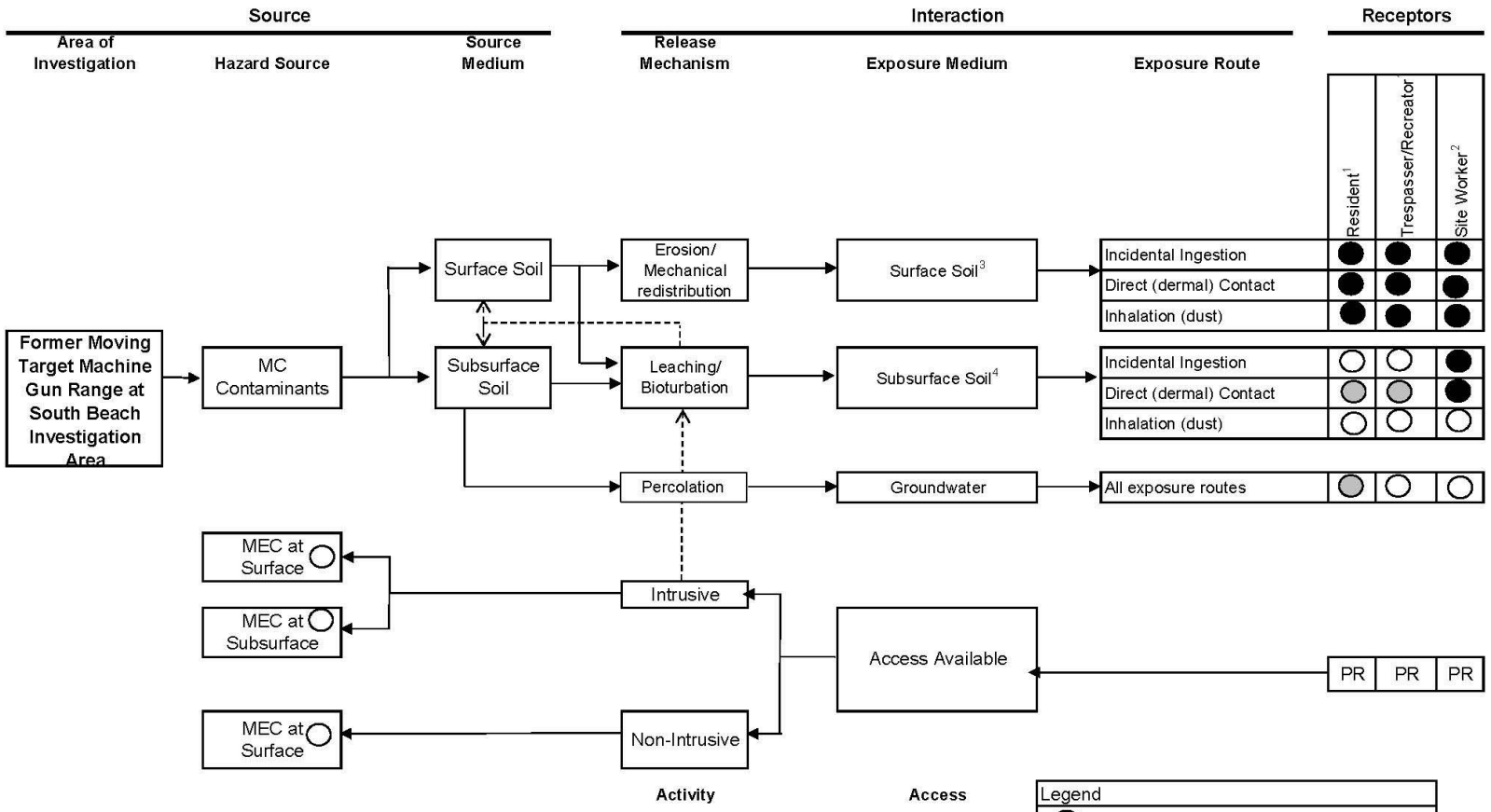
7.1.0.2 An explosive hazard exists at a site if there is a potentially complete MEC exposure pathway. A potentially complete MEC exposure pathway is present any time a receptor can come near or into contact with MEC and interact with it in a manner that might result in its detonation. The three elements of a potentially complete MEC exposure pathway, which include a source of MEC, a receptor, and the potential for interaction between the MEC source and the receptor, but all three elements must be present for a potentially complete MEC exposure pathway to exist. Because MEC associated with the historical activities identified at South Beach has not been identified in surface and subsurface media, the pathway for surface and subsurface media is considered incomplete (Figure 7-1), and a MEC HA was not necessary.

7.2 Munitions Response Site Prioritization Protocol

7.2.0.1 The DoD proposed the MRSPP (32 CFR Part 179) to assign a relative risk priority to each defense site in the MMRP Inventory for response activities. These response activities are based on the overall conditions at each location and taking into consideration various factors related to explosive safety and environmental hazards. The application of the MRSPP applies to all locations that:

- Are or were, owned, leased to, or otherwise possessed or used by the DoD;
- Are known to, or suspected to, contain MEC or MC; and,
- Are included in the MMRP Inventory.

7.2.0.2 Because the MRSPP worksheets are considered Draft until review by the public and undergo a Quality Assurance review by the DoD, they will be submitted as a separate deliverable from the RI Report. The public will be notified when the MRSPP is available for public review and comment. The MRSPP worksheets will be included in the information repository and administrative record for this site.



Notes:

1. Includes anglers and clammers.
2. Employee of Trust or other authorized entrant for inspection or observational purposes; no physical/intrusive activities or contact with the aquatic zone assumed.
3. Surface soil represented by soil samples collected from 0 - 2 inches and 2 - 12 inches below ground surface (bgs).
4. Subsurface soil represented by soil samples collected between 12 and 18 inches bgs.
5. Includes shellfish consumed by humans and those serving as food sources in the food chain.

Figure 7-1
Human Health Conceptual Site Model for the Moving Target Machine Gun Range Investigation Area

7.3 MC Baseline Human Health Risk Assessment

7.3.0.1 This HHRA has been performed in accordance with CERCLA guidelines and the RI WP (UXB, 2011), reviewed and approved by the MADEP and the USACE. The HHRA process is intended to provide a comprehensive assessment of potential risks to identified receptors that may be exposed to hazardous constituents at or from the Investigation Area.

7.3.0.2 This HHRA was conducted consistent with appropriate portions of the guidance provided by USEPA (RAGS, Volume 1: Human Health Evaluation Manual, Parts A, D, E, and F). USEPA's risk assessment guidance describes a four-step protocol:

- Hazard Identification;
- Toxicity Assessment;
- Exposure Assessment; and,
- Risk Characterization.

7.3.0.3 This HHRA consists of a semi-quantitative assessment that identifies the receptors, potential exposure pathways, and compares the data to risk-based screening levels to identify chemicals of potential concern (COPCs) at the Site. No COPCs were identified in the screening process; therefore a full quantitative HHRA was not required nor performed.

7.3.1 Hazard Identification

7.3.1.0.1 The Hazard Identification step of the HHRA is used to identify the COPCs in each environmental medium to which human receptors may be exposed. The analytical data collected for the Investigation Area includes metals and explosives analytical results for soil samples collected from between 0 to 1.5 ft bgs; and groundwater samples.

7.3.2 Conceptual Site Model

7.3.2.0.1 Section 3.1 presents a preliminary CSM based on the identified receptors described in Section 2.2.3. The updated CSM based on the results of the RI appears in Section 5.3. The key finding that distinguished the preliminary from final CSM was the absence of MCs detected above human health risk-based screening levels in environmental media. Although they were not detected above human health screening levels, MC were detected in soil and groundwater. These constituents could have reached soil and/or groundwater via the following processes: MC could leach through the soil into the groundwater; MC could also adsorb to soil particles and/or be transported via storm events.

7.3.2.0.2 Figure 7-1 summarizes the CSM for human exposure to media potentially impacted by the Investigation Area. The potential exposure pathways and receptors are described further in the following sections.

7.3.3 Receptors and Pathways

7.3.3.0.1 Environmental media at the Investigation Area that present a potential for human exposure are soil and groundwater.

7.3.3.0.2 The Investigation Area is owned by Dukes County (MADCR), private landowners, and the Commonwealth of Massachusetts (some beach property as well as inland and coastal waters). The former range encompasses an area that is currently a public beach used for recreational purposes such as hiking, canoeing, kayaking, recreational fishing, clamming, crabbing, wildlife observation, photography, education, and other water-related activities. Land use is not expected to change in the future (UXB, 2011). Current and future receptors include nearby residents, recreators, trespassers, and site workers. Activities include but are not limited to sunbathing, hiking, swimming, fishing and clamming. The following paragraphs detail the exposure pathways applicable for humans.

Direct Contact with Surface Soil

7.3.3.0.3 Surface soils include samples collected generally from the 0 to 1 ft depth interval. Subsurface soil includes samples collected generally from the 12 to 18 in. depth interval. The sampling intervals, per sample, are shown in Tables 5-4 and 5-6, respectively for surface and subsurface soils. It is possible that residents, recreators/trespassers and site workers may come into contact with both of these depth intervals. Therefore, for purposes of the screening evaluation these soils were grouped together. Pathways of exposure include incidental ingestion, dermal contact, and inhalation of dust. These pathways are assumed to be complete pathways for both current and future Site use. Exposure to soil greater than 1.5 ft. is considered incomplete as the existing receptors are not expected to engage in intrusive activities deeper than 2 ft bgs, and no future construction is planned. Volatilization-related inhalation exposures are also incomplete as no volatile organic compounds (VOCs) have been identified associated with munitions releases.

7.3.3.0.4 Future use of the Investigation Area is expected to remain consistent with current and use.

Use of Groundwater

7.3.3.0.5 Groundwater at the Investigation Area is currently used for a potable water supply; some residences in the vicinity of the Investigation Area are supplied by well water. Additionally, groundwater under the Investigation Area meets the criteria as a potential drinking water source area under the MCP (it is designated as a sole source aquifer). Therefore, exposures to contaminants in groundwater used as a potable water supply would be intentional ingestion and dermal contact. Since groundwater in the beach area is shallow, the identified receptors could also come into contact with groundwater via incidental ingestion and dermal contact. Inhalation is not a pathway of concern due to the absence of VOCs.

7.3.4 Data Screening

Selection of Screening Criteria

7.3.4.0.1 Because the Investigation Area is close to a residential area and groundwater underneath the Investigation Area is used for potable use, the most stringent screening levels for soil and groundwater are assumed applicable. These values have been identified for soil as the USEPA Residential RSLs[1] and the lowest of the USEPA Maximum Contaminant Level (MCL) and the USEPA tapwater RSLs. While not typically used for screening under CERCLA, the MADEP Method 1 S-1 Standards and published MADEP background concentrations were used for comparison purposes in the process, per the RI WP (UXB, 2011).

7.3.4.0.2 The Method 1 Standards are not actually screening levels, but are promulgated health-based standards in Massachusetts. The excess lifetime cancer risk-based target of one in a million (10^{-6}) used in the Method 1 standard derivation (along with consideration of background) is equivalent to the target cancer risk used in the RSLs. The target hazard of 0.2 is actually more stringent that the target of 1 used in the RSLs. In addition, per the MCP [310 Code of Massachusetts Regulations 40], in a Method 1 Risk Characterization an exposure point concentration less than the applicable S-1 standard must be met to achieve site closure in the absence of an Activity and Use Limitation that formally limits future site use. The Method 1 GW-1 standards would also be applicable to this site, as it meets the criteria for a potential drinking water source area. Therefore, the Method 1 S-1/GW-1 and GW-1 standards are considered appropriate for use in screening the Investigation Area data. The S-1/GW-1 soil standards are intended to be protective of direct contact as well as leaching to potable use groundwater. For the groundwater data, the Method 1 GW-1 standards were used for comparison purposes as well.

7.3.4.0.3 Background comparisons are not typically included in the COPC screening process for a CERCLA project. However, MADEP published background concentrations were included in the screening tables for comparison purposes. All detected concentrations in soil are below published background concentrations.

7.3.4.0.4 COPC selection consists of determining if any analytes were detected above the lowest of the USEPA Residential RSLs and MADEP Method 1 S-1/GW-1 Standards for soil, and the USEPA MCLs, USEPA tapwater RSLs, and MADEP Method 1 GW-1 standards for groundwater. Additionally, maximum detected concentrations were compared to published background concentrations. The findings of this screening are presented in the sections below.

[1] http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

Results of Screening Evaluation

7.3.4.0.5 Five metals (antimony, copper, lead, nickel and zinc) were detected in one or more of the soil samples. Maximum detected concentrations were below the Residential RSLs, the Method 1 S-1/GW-1 Standards, and published background concentrations. Therefore, no COPCs were identified in soil. Refer to Table 7-1 for a tabular depiction of the screening process for soil.

7.3.4.0.6 Copper was detected at two locations and nickel and zinc were detected at each of the three groundwater sample locations. 2-nitrotoluene, 3-nitrotoluene, and 4-nitrotoluene were detected in one groundwater sampling location. None of the constituents were detected at concentrations exceeding human health groundwater screening criterion." Therefore, no COPCs were identified in groundwater. Refer to Table 7-2 for a tabular depiction of the screening process for groundwater.

7.3.4.0.7 In accordance with CERCLA related HHRA guidance, no COPCs were identified within the Investigation Area. Therefore, no further human health risk evaluation is required.. There is no unacceptable risk to human health. All detected concentrations are less than the applicable Method 1 standards.

7.4 MC Environmental Evaluation

7.4.0.1 The purpose of this screening level ERA is to determine whether potentially unacceptable risks are posed to ecological receptors due to exposures to residual MCs at the Investigation Area and to identify the specific chemicals contributing to that risk. As per the *Final United States Army Military Munitions Response Program RI/FS Guidance* (USACE, 2009b), ERAs for MMRP sites are to be performed based on USEPA guidance for conducting ERAs at CERCLA-regulated sites, principally *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Draft* (USEPA, 1997, as implemented by USEPA, 1999), and supplemental guidance was from the Tri-Services Environmental Risk Assessment Work Group (TSERAWG) document *A Guide to Screening Level Ecological Risk Assessment* (TSERAWG, 2008). Because this site is located within the State of Massachusetts, the approach used in evaluating potential ecological risk is also consistent with a Method 3 Risk Characterization as specified by the MADEP (MADEP, 1996) under the MCP.

7.4.0.2 The ERA process under CERCLA is separable into two general phases: the screening level ERA and the Baseline ERA. The purpose of the screening level ERA is to (1) evaluate the conditions of the site to determine whether complete exposure pathways may exist between constituents of potential concern and ecological receptors, (2) identify specific ecological receptors or resources of concern and the media through which they may be exposed to site constituents, and (3) conservatively evaluate the existing data for these media to determine

Table 7-1. Summary of COPC Screening for Soils
Former Moving Target Machine Gun Range at South Beach Investigation Area

Analyte	CAS #	USEPA Residential RSL (mg/kg)	MADEP S1/GW-1 Standard (mg/kg)	Human Health Screening Level[1] (mg/kg)	MADEP Background[2] (mg/kg)	N[3]	FOD	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Location of Maximum
Antimony	7440-36-0	31	20	20	1	75	49%	0.013	0.043	MG19 IS018
Copper	7440-50-8	3100	--	3100	40	75	99%	1.2	5.4	MG08 SB067
Lead	7439-92-1	400	300	300	100	75	100%	2.5	16	MG32 SB115
Nickel	7440-02-0	1500	20	20	20	75	100%	1.2	6.6	MG34 SB122
Zinc	7440-66-6	2300	2500	2300	100	75	100%	4.7	18	MG02 SB055
1,3,5-Trinitrobenzene	99-35-4	2200	--	2200	--	75	0%	--	--	--
1,3-Dinitrobenzene	99-65-0	6.1	--	6.1	--	75	0%	--	--	--
2,4,6-Trinitrotoluene	118-96-7	19	--	19	--	75	0%	--	--	--
2,4-Dinitrotoluene	121-14-2	1.6	0.7	0.7	--	75	0%	--	--	--
2,6-Dinitrotoluene	606-20-2	61	--	61	--	75	0%	--	--	--
2-Amino-4,6-dinitrotoluene	35572-78-2	150	--	150	--	75	0%	--	--	--
2-Nitrotoluene	88-72-2	2.9	--	2.9	--	75	0%	--	--	--
3-Nitrotoluene	99-08-1	6.1	--	6.1	--	75	0%	--	--	--
4-Amino-2,6-dinitrotoluene	19406-51-0	150	--	150	--	75	0%	--	--	--
4-Nitrotoluene	99-99-0	30	--	30	--	75	0%	--	--	--
HMX	2691-41-0	3800	2	2	--	75	0%	--	--	--
Nitrobenzene	98-95-3	4.8	--	4.8	--	75	0%	--	--	--
Nitroglycerin	55-63-0	6.1	--	6.1	--	75	0%	--	--	--
PETN	78-11-5	120	--	120	--	75	0%	--	--	--
RDX	121-82-4	5.6	1	1	--	75	0%	--	--	--
Tetryl	479-45-8	240	--	240	--	75	0%	--	--	--

Notes:
[1] Criteria for human health were identified as the lower of 1) USEPA Risk Screening Level (RSL; residential selected as the most stringent) 2) MADEP Method 1 S-1/GW-1 Standard.
[2] Background concentrations obtained from the Technical Update: Background Levels of Polycyclic Aromatic Hydrocarbons and Metals in Soil. MADEP, 2002.
[3] This table includes all samples collected from between 0 and 1.5 ft bgs, including QA/QC samples

mg/kg - milligrams per kilogram
N - number of samples
FOD - frequency of detection
% - percent
COPC - contaminant of potential concern
-- Value not published or not applicable

Table 7-2. Summary of COPC Screening for Groundwater
Former Moving Target Machine Gun Range at South Beach Investigation Area

Analyte	CAS #	USEPA MCL (ug/L)	USEPA Tapwater RSL (ug/L)	MADEP GW-1 Standard (ug/L)	Human Health Screening Level [1] (ug/L)	N[2]	FOD	Minimum Detected Concentration (ug/L)	Maximum Detected Concentration (ug/L)	Location of Maximum
Antimony	7440-36-0	6	6	6	6	4	0%	--	--	--
Copper	7440-50-8	1300	620	--	620	4	75%	0.57	1.5	MG37 GW006
Lead	7439-92-1	15	NA	15	15	4	0%	--	--	--
Nickel	7440-02-0	--	300	100	100	4	100%	5.5	12	MG37 GW006
Zinc	7440-66-6	--	4700	5000	4700	4	100%	4.3	9	MG40 GW009
1,3,5-Trinitrobenzene	99-35-4	--	460	--	460	4	0%	--	--	--
1,3-Dinitrobenzene	99-65-0	--	1.5	--	1.5	4	0%	--	--	--
2,4,6-Trinitrotoluene	118-96-7	--	2.2	--	2.2	4	0%	--	--	--
2,4-Dinitrotoluene	121-14-2	--	0.2	30	0.2	4	0%	--	--	--
2,6-Dinitrotoluene	606-20-2	--	15	--	15	4	0%	--	--	--
2-Amino-4,6-dinitrotoluene	35572-78-2	--	30	--	30	4	0%	--	--	--
2-Nitrotoluene	88-72-2	--	0.27	--	0.27	4	25%	0.15	0.15	MG37 GW010
3-Nitrotoluene	99-08-1	--	1.3	--	1.3	4	25%	0.026	0.026	MG37 GW010
4-Amino-2,6-dinitrotoluene	19406-51-0	--	30	--	30	4	0%	--	--	--
4-Nitrotoluene	99-99-0	--	3.7	--	3.7	4	25%	0.17	0.17	MG37 GW010
HMX	2691-41-0	--	780	200	200	4	0%	--	--	--
Nitrobenzene	98-95-3	--	0.12	--	0.12	4	0%	--	--	--
Nitroglycerin	55-63-0	--	1.5	--	1.5	4	0%	--	--	--
PETN	78-11-5	--	16	--	16	4	0%	--	--	--
RDX	121-82-4	--	0.61	1	0.61	4	0%	--	--	--
Tetryl	479-45-8	--	61	--	61	4	0%	--	--	--

Notes:
[1] Criteria for human health were identified as the lower of 1) USEPA Maximum Contaminant Levels (MCLs), 2) USEPA Risk Screening Level (RSL), 3) MADEP Method 1 GW-1 standard.
[2] This table includes all samples collected including QA/QC samples.

-- Value not published or not applicable
N - number of samples
µg/L - micrograms per liter
FOD - frequency of detection
% - percent

whether any of these constituents occur at levels that could pose an unacceptable risk to ecological receptors or resources. Constituents found to be at such levels are identified as chemicals of potential ecological concern (COPECs) for the site and a scientific/management decision is made as to whether or not these constituents warrant further investigation under the Baseline ERA), or whether a risk management or remedial action should be implemented in lieu of the Baseline ERA.

7.4.0.3 Site constituents found in the screening level ERA to pose a negligible potential for ecological risk, either by lack of a complete exposure pathway or by lack of a sufficient concentration in ecologically-relevant media to pose a potential risk, are eliminated from further consideration in the ERA process. If all site constituents are found in the screening level ERA to pose no significant risk, the ERA process is concluded with a finding of no risk and no further action based on ecological risk is required.

7.4.0.4 Because screening level ERAs are designed to be highly conservative in nature, they are likely to significantly overestimate the level of risk for some receptors. For this reason, the highly conservative initial screening of the data (as per USEPA guidance) is followed by a more realistic (i.e., less conservative) refinement of the evaluation of potential risk for constituents that do not pass the initial risk screening. The purpose of this step is to reduce the possibility that one or more COPECs are carried into the Baseline ERA when sufficient information currently exists to support a conclusion that they do not pose significant risk.

7.4.0.5 The MADEP process is similar in structure to the USEPA CERCLA process. In the Stage I screening characterization, the potential for complete exposure pathways is evaluated. Contaminant concentrations in media associated with complete pathways are then compared to published effects-based benchmarks. If the concentrations exceed the benchmarks, the process proceeds to a Stage II environmental risk characterization which can vary in scope but generally follows the USEPA guidance for a Baseline ERA. If concentrations do not exceed screening levels, no further evaluation is required and a condition of "No Significant Risk to the Environment" is concluded. Key differences between the federal and Massachusetts processes are that the MCP allows consideration of background in eliminating media from further concern, and that the Stage I process considers screening benchmarks only and does not evaluate dose as the screening level ERA may.

7.4.0.6 Due to the historical use of the Investigation Area as a target range for machine gun and rocket practice, the constituents of potential concern for this evaluation are limited to MC, including selected metals (antimony, copper, lead, nickel, and zinc), explosives and their by-products. This assessment assumes that all of these constituents have potentially toxic characteristics to ecological receptors if certain threshold levels in the environment are exceeded. Although the sampling of environmental media at the Investigation Area for MC included both

soil and groundwater, only the soil data (ranging in depth from 0 to 18 in. bgs) were considered ecologically relevant and were included in the screening level ERA.

7.4.0.7 The presentation of this screening level ERA is structured in accordance with the three-step paradigm for ERAs (USEPA, 1998). These are:

1. Preliminary Problem Formulation;
2. Analysis; and,
3. Risk Characterization.

7.4.0.8 The following sections describe the purpose and goal of each of these steps and present the results as are applicable and relevant to the assessment of ecological risk at the Investigation Area.

7.4.1 Preliminary Problem Formulation

7.4.1.0.1 In the Preliminary Problem Formulation, the potentially affected environment is described and a CSM is developed to identify fate and transport mechanisms that could lead to potentially complete exposure pathways to ecological receptors at the site. Key ecological resources are identified and assessment and measurement endpoints are developed for the protection of those resources. The elements of the Problem Formulation for the Investigation Area are described in the following sections.

7.4.1.1 Site Description and Ecological Resources

7.4.1.1.0.1 The Investigation Area is located within the town of Edgartown along the southern shore of Martha's Vineyard, Massachusetts. The Investigation Area encompasses approximately 478 acres: 1) 18.7 acres of upland habitat; 2) 182.7 acres of beach; 3) 7.7 acres of inland water; and 4) 268.7 acres of ocean. Due to extensive beach erosion, elements of the former ranges are thought to be as much as 150 yards off of South Beach (*Draft Preliminary Assessment Cape Poge Little Neck Bomb Target Site Chappaquiddick Island, MA [USACE, 2009a]*). Military ordnance used at the former Moving Target Machine Gun Range included 0.30 and 0.50 caliber ammunition. Ordnance at the former Katama Range included MK1 rockets and 2.25- to 5-in. rockets.

7.4.1.1.0.2 As detailed in Table 2-1, the Investigation Area contains significant ecological resources and is potential habitat for threatened, endangered, or other sensitive or protected species.

7.4.1.1.0.3 Based on the geophysical and intrusive investigation results, the investigation of MC within the Investigation Area was focused on three distinct historical features—the former 300 m firing line, the former 150 m firing line, and a former firing line and impact berm located approximately 1,500 ft east of the these two sites. It should be noted that these three sites are

entirely within the upland habitat and do not contain marine, beach, or inland water habitats. Further, both the 150 m firing line and the eastern firing line and berm are within residential areas. The 150 m firing line is entirely within a residentially developed area while only portions of the eastern firing line and berm site intersect residentially developed property with other portions crossing undeveloped areas with more natural habitat. The former 300 m firing line is within a former agricultural field which is considered to be a priority natural community and priority habitat for rare species (MassGIS, 2012). Because the MC investigation was limited to these upland areas, soil (surface and subsurface) was considered to be the primary exposure medium and exposures of aquatic receptors (marine or freshwater) to MC were not evaluated in this SLERA.

7.4.1.2 Conceptual Site Model

7.4.1.2.0.1 A detailed CSM for ecological exposures at the Investigation Area is presented in Figure 7-2. The media of primary ecological concern at this site are surface (0-12 in.) and subsurface (12-18 in.) soil. For plants and soil/benthic invertebrates within these habitats, primary exposures to MC are through direct contact with the soil. For wildlife receptors, the primary complete exposure pathways are the incidental ingestion of contaminated soil and transfers through the foodweb.

7.4.1.3 Data Summary and Initial Screening

7.4.1.3.0.1 The MC sampling strategy for the Investigation Area was based on the results of geophysical surveys and subsequent intrusive investigations of the site. The sampling points for the three former firing lines described above are shown in Figure 4-2. At the former 300 m firing line, one IS of the top 2 in. was collected from the rectangular area shown in Figure 4-2 as MG19. This was followed by eight discrete surface samples (2-12 in.) and eight discrete subsurface samples (12-18 in.). Eight discrete surface samples and eight discrete subsurface samples were also collected from the each of the following areas: the former 150 m firing line, the eastern former firing line, and the eastern former impact berm. Although groundwater samples were also collected from this MRS, groundwater was not considered to be an ecologically-relevant medium.

7.4.1.3.0.2 The soil samples were analyzed for metals (USEPA Method 6020A) and high explosives and their by-products (USEPA Method 8321B). The metals analyses were limited to five analytes: antimony, copper, lead, nickel, and zinc. Data from duplicate discrete samples (collected for QA purposes) were combined as a single point based on the following rules:

- If both values were detects, the arithmetic mean of the two was used;
- If both values were non-detects, the lower of the two ½ reporting limit values was used; and,

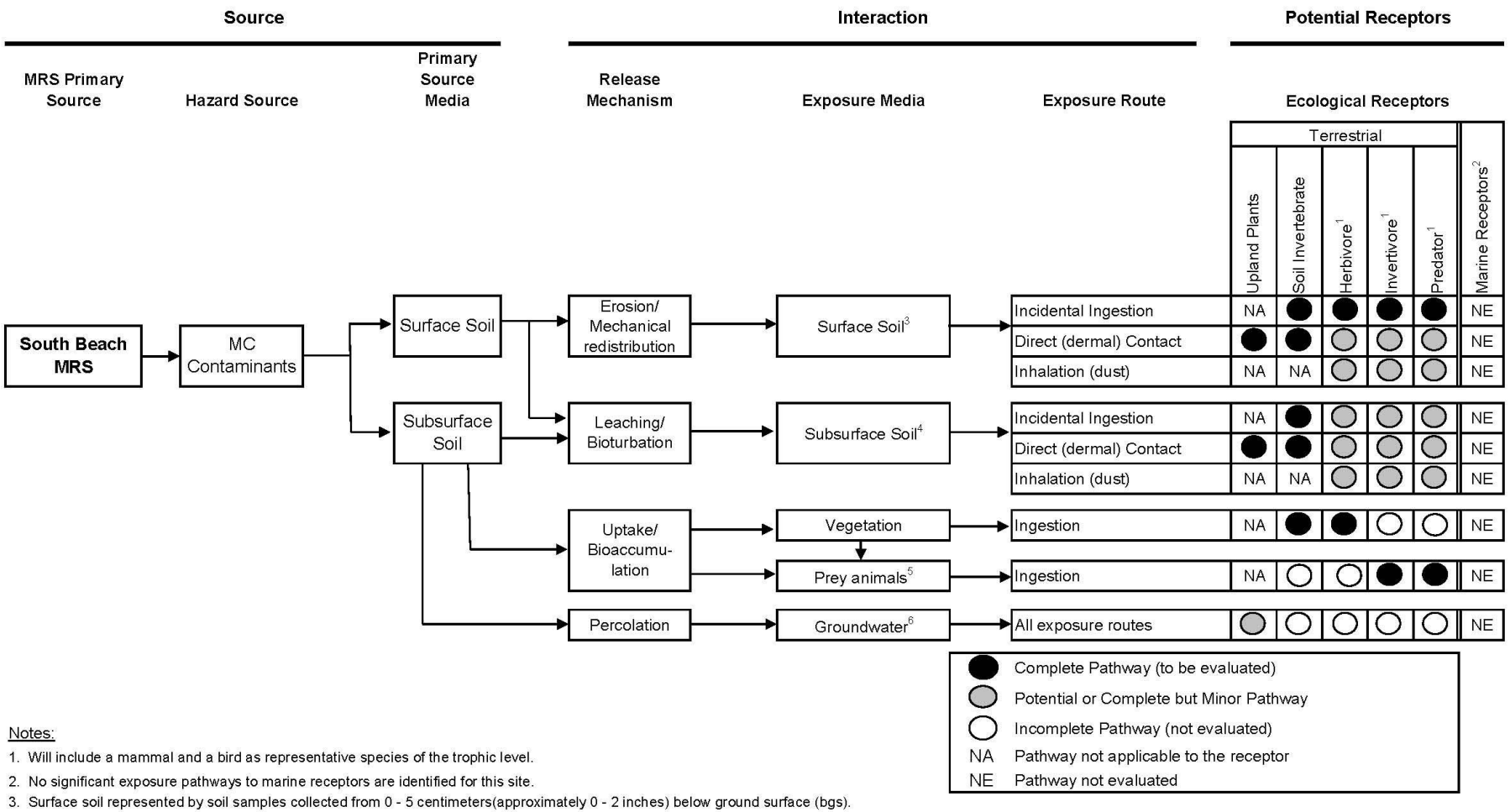
- If one value was detected and the other was a non-detect, the final result was calculated as the arithmetic mean of the detected value and ½ the reporting limit of the nondetect. If ½ the reporting limit value was greater than the detect, however, only the detected concentration was used.

7.4.1.3.0.3 Note that the IS sample and associated replicate QC samples were treated as distinct samples, not as replicates. The resulting data were combined across the site, keeping the three distinct sampling intervals separate (0-2 in. [the IS samples], 2-12 in., and 12-18 in. bgs). These data sets are summarized in Table 7-3 (metals) and Table 7-4 (explosives). In some cases (e.g., sample MG32 SB115, which was collected from 8 to 13 in. bgs), the sampling depth did not match the nominal intervals of 2-12 in. and 12-18 in. In these cases, assignment of the sample to an interval was based in the interval that contained the majority of the sample. These data were screened for preliminary COPECs based on the following criteria:

- The analyte was detected in more than 5 percent of the samples for each medium sampled (if less than 20 data points are available for the analyte, at least one must be a detection);
- The maximum analyte concentration exceeds an identified background screening level for that medium; and,
- The maximum analyte concentration exceeds the corresponding ecologically-based screening criterion.

7.4.1.3.0.4 As shown in Table 7-3, all five metals (antimony, copper, lead, nickel, and zinc) were detected in 33% or more of the samples in all depth intervals; therefore, none of the five metals was eliminated from further consideration based on low frequency of detection. However, the results from the explosives analyses (Table 7-4) showed all 16 analytes to be below detectable levels in soil (all intervals). With only a few exceptions in each of these media, the RLs for these analyses are less than the ecological screening levels for the analytes. Because the screening levels in those exceptional cases are relatively close to the RLs and RLs exceed that actual limit of detection, it can be concluded that these exceptions do not represent a significant potential for ecological risk from undetected levels of explosives residues in soil. Therefore, none of the 16 explosive compounds is considered a COPEC and all were eliminated from further evaluation in this assessment.

7.4.1.3.0.5 As previously stated, the MCP allows consideration of natural background levels in the elimination of analytes from further concern in the risk process. To this end, the maximum detected concentrations of the five metals were compared against the MADEP accepted state-wide background concentrations for natural soils (MADEP, 2002). As seen in Table 7-3, none of these maxima exceeded the corresponding MADEP accepted background concentration as based on the 90th percentile of natural background. Further, all maxima except those for nickel in the 2-12 and 12-18 in. intervals were less than the 50th percentile of natural background levels for the State, and those exceedences were only slight. Therefore, based on



Notes:

1. Will include a mammal and a bird as representative species of the trophic level.
2. No significant exposure pathways to marine receptors are identified for this site.
3. Surface soil represented by soil samples collected from 0 - 5 centimeters(approximately 0 - 2 inches) below ground surface (bgs).
4. Subsurface soil represented by soil samples collected between 12 and 18 inches bgs.
5. Prey animals include soil invertebrates for the invertivores and herbivorous mammals for the predators.
6. Significant migration of MC to groundwater at this site is not anticipated.

Figure 7-2
Ecological Conceptual Site Model for the Moving Target Machine Gun Range at South Beach Investigation Area

these comparisons, it is highly likely that the metal concentrations at the three firing line sites represent natural background conditions.

7.4.1.3.0.6 Finally, the maximum concentrations of these metals were compared to the most conservative (i.e., minimal) USEPA Ecological Soil Screening Levels (Eco-SSLs) (USEPA, 2005a,b; 2007a,b,c) as shown in Table 7-4. (It should be noted that MADEP does not publish screening levels for soil.) The maximum detected concentrations of antimony, copper, nickel, and zinc were less than their corresponding Eco-SSLs for all depth intervals. For lead, however, the maximum concentration (16 mg/kg measured in the 2-12 in. depth interval) exceeded the Eco-SSL (11 mg/kg). Additionally, two of the three IS sample results (12 mg/kg and 14 mg/kg) exceeded this Eco-SSL while the third equaled it. The maximum concentration of lead in the 12-18 in. interval (9.8 mg/kg) did not exceed the Eco-SSL. Therefore, due to the possibility that lead in the surface soil at this Investigation Area could be at levels that pose a potential risk to ecological receptors, lead was retained as a preliminary COPEC for surface soils and was further evaluated in the screening level ERA.

7.4.1.4 Assessment and Measurement Endpoints

7.4.1.4.0.1 Assessment endpoints represent an explicit expression of the actual environmental values to be protected at each site. Measurement endpoints represent quantifiable ecological characteristics that can be measured, interpreted, and related to the valued ecological component(s) chosen as the assessment endpoints. The preliminary assessment and measurement endpoints for this screening level ERA are presented in Table 7-5. Because the evaluation of MC at the Investigation Area was limited to the upland habitat, all assessment and measurement endpoints are directed toward this habitat. For each measurement endpoint shown in Table 7-5, the key ecological receptors associated with that endpoint are identified. These receptors reflect the ecosystem components and trophic levels used by USEPA (i.e., plants; soil invertebrates; herbivorous, insectivorous, and carnivorous birds; and herbivorous, insectivorous, and carnivorous mammals) to derive the Eco-SSLs for the identified COPEC (lead).

7.4.2 Analysis

7.4.2.0.1 The Analysis phase of the screening level ERA involves two steps: estimation of potential exposures (Exposure Assessment) and identification of thresholds of effects, such as toxicologically based benchmarks or established ecological screening values (Effects Evaluation), which are described in the following sections.

Table 7-3. Summary of Metals Analysis Results for Soils of the Upland Habitats
Former Moving Target Machine Gun Range, South Beach Investigation Area

Analyte	CAS #	Massachusetts Soil Background[1] (mg/kg)		USEPA EcoSSL[2] (mg/kg)	n	FOD	RL Range (mg/kg)		Range of Detections (mg/kg)		Location of Maximum Detection
		90th %'tile	50th %'tile				Min	Max	Min	Max[3]	
Surface Soil (0-2 inches) - Incremental Sampling											
Antimony	7440-36-0	1	0.34	0.27	3	100%	NA	NA	0.034 J	0.043 J	MG19
Copper	7440-50-8	40	7.3	28	3	100%	NA	NA	3.4 J	3.9 J	MG19
Lead	7439-92-1	100	19.1	11	3	100%	NA	NA	11	**14**	MG19
Nickel	7440-02-0	20	5.1	38	3	100%	NA	NA	2.5	2.6	MG19
Zinc	7440-66-6	100	27.7	46	3	100%	NA	NA	12 J	15 J	MG19
Surface Soil (2-12[4] inches) - Discrete Samples											
Antimony	7440-36-0	1	0.34	0.27	33	60.6%	0.022	0.22	0.013 J	0.025 J	MG16
Copper	7440-50-8	40	7.3	28	33	97.0%	2.3	2.3	1.5 J	5.4	MG08
Lead	7439-92-1	100	19.1	11	33	100%	NA	NA	3.7	**16**	MG32
Nickel	7440-02-0	20	5.1	38	33	100%	NA	NA	1.2	6.2	MG34
Zinc	7440-66-6	100	27.7	46	33	100%	NA	NA	5.0	17	MG34
Subsurface Soil (12-18 inches) - Discrete Samples											
Antimony	7440-36-0	1	0.34	0.27	33	33.3%	0.020	0.23	0.013 J	0.020 J	MG06
Copper	7440-50-8	40	7.3	28	33	100%	NA	NA	1.2 J	4.3	MG30 & MG34
Lead	7439-92-1	100	19.1	11	33	100%	NA	NA	2.5	9.8	MG15
Nickel	7440-02-0	20	5.1	38	33	100%	NA	NA	1.6	6.0	MG34
Zinc	7440-66-6	100	27.7	46	33	100%	NA	NA	4.7	18	MG02

Notes:

[1]Background for natural soils as established by Massachusetts Department of Environmental Protection (2002)

[2]from U.S. Environmental Protection Agency (USEPA) (2005a, b; 2007a, b, c)

[3]Shaded cells indicate the value exceeds the 50th percentile of background. Values in **BOLD** exceed the USEPA Ecological Soil Screening Levels.

[4]Nominal ending depth. Two samples (MG32 and MG33) had ending depths at 13 and 14 inches, respectively.

Acronyms and Abbreviations:

Eco-SSL = ecological soil screening level
FOD = frequency of detection
J = estimated value
n = number of samples
NA = not applicable
RL = reporting limit
% = percent
%'tile = percentile
mg/kg – milligrams per kilogram

Table 7-4. Summary of Explosives Analysis Results for Soils
Former Moving Target Machine Gun Range, South Beach Investigation Area

Analyte	CAS #	ESL (soil)[1] (mg/kg)	Surface Soil-IS (0-2 inches)				Surface Soil (2-12[2] inches)				Subsurface Soil (12-18 inches)			
			n	FOD	RL-min (mg/kg)	RL-max (mg/kg)	n	FOD	RL-min (mg/kg)	RL-max (mg/kg)	n	FOD	RL-min (mg/kg)	RL-max (mg/kg)
1,3,5-Trinitrobenzene	99-35-4	0.376 (B)	3	0%	0.095	0.098	33	0%	0.092	0.10	33	0%	0.092	0.10
1,3-Dinitrobenzene	99-65-0	0.073 (A)	3	0%	0.095	0.098	33	0%	0.092	0.10	33	0%	0.092	0.10
Nitrobenzene	98-95-3	1.31 (B)	3	0%	0.095	0.098	33	0%	0.092	0.10	33	0%	0.092	0.10
2,4,6-Trinitrotoluene	118-96-7	6.4 (A)	3	0%	0.095	0.098	33	0%	0.092	0.10	33	0%	0.092	0.10
2-Amino-4,6-dinitrotoluene	35572-78-2	10 (A)	3	0%	0.095	0.098	33	0%	0.092	0.10	33	0%	0.092	0.10
4-Amino-2,6-dinitrotoluene	19406-51-0	3.6 (A)	3	0%	0.095	0.098	33	0%	0.092	0.10	33	0%	0.092	0.10
2,4-Dinitrotoluene	121-14-2	1.28 (B)	3	0%	0.095	0.098	33	0%	0.092	0.10	33	0%	0.092	0.10
2,6-Dinitrotoluene	606-20-2	0.0328 (B)	3	0%	0.095	0.098	33	0%	0.092	0.10	33	0%	0.092	0.10
2-Nitrotoluene	88-72-2	9.9 (A)	3	0%	0.095	0.098	33	0%	0.092	0.10	33	0%	0.092	0.10
3-Nitrotoluene	99-08-1	12 (A)	3	0%	0.095	0.098	33	0%	0.092	0.10	33	0%	0.092	0.10
4-Nitrotoluene	99-99-0	22 (A)	3	0%	0.095	0.098	33	0%	0.092	0.10	33	0%	0.092	0.10
Nitroglycerin	55-63-0	71 (A)	3	0%	0.095	0.098	33	0%	0.092	0.10	33	0%	0.092	0.10
HMX	2691-41-0	27 (A)	3	0%	0.095	0.098	33	0%	0.092	0.10	33	0%	0.092	0.10
PETN	78-11-5	100 (A)	3	0%	0.095	0.098	33	0%	0.092	0.10	33	0%	0.092	0.10
RDX	121-82-4	7.5 (A)	3	0%	0.095	0.098	33	0%	0.092	0.10	33	0%	0.092	0.10
Tetryl	479-45-8	0.99 (A)	3	0%	0.095	0.098	33	0%	0.092	0.10	33	0%	0.092	0.10

Notes:
[1]Ecological screening values from (A) LANL 2011 and (B) USEPA Region 5 2003. Shaded cells indicate ESL < Min RL.
[2]Nominal ending depth. Two samples (MG32 and MG33) had ending depths at 13 and 14 inches, respectively

Acronyms and Abbreviations:
ESL = ecological screening level
FOD = frequency of detection
IS = Incremental Sampling
mg/kg – milligrams per kilogram
n = number of samples
RL-min = minimum reporting limit
RL-max = maximum reporting limit

Table 7-5. Assessment and Measurement Endpoints, SLERA
Former Moving Target Machine Gun Range, South Beach Investigation Area

Habitat Type	Assessment Endpoint	Measurement Endpoint	Key Ecological Receptor
Upland (terrestrial)	Protection of terrestrial plant populations from exposures to MC residues that could adversely affect growth, reproduction, or survival.	Comparison of soil exposure point concentration (EPC) to established plant toxicity benchmark.	Terrestrial plants (generic)
	Protection of soil invertebrate populations from exposures to MC residues that could adversely affect growth, reproduction, or survival.	Comparison of soil EPC to established soil invertebrate toxicity benchmark.	Earthworms
	Protection of herbivorous wildlife populations from exposures to MC residues that could adversely affect growth, reproduction, or survival.	Comparison of soil EPC to established avian and mammalian toxicity benchmarks.	Dove (bird) Vole (mammal)
	Protection of insectivorous wildlife populations from exposures to MC residues that could adversely affect growth, reproduction, or survival.	Comparison of soil EPC to established avian and mammalian toxicity benchmarks.	Woodcock (bird) Shrew (mammal)
	Protection of carnivorous wildlife populations from exposures to MC residues that could adversely affect growth, reproduction, or survival.	Comparison of soil EPC to established avian and mammalian toxicity benchmarks.	Hawk (bird) Weasel (mammal)

7.4.2.1 Exposure Assessment

7.4.2.1.0.1 An Exposure Assessment is the process of estimating the magnitude of potential exposures of selected ecological receptors to COPECs present at the site. This includes identification of the exposure point concentration (EPC) in each relevant medium that reasonably represents the expected level of exposure that would be experienced by an individual of the receptor species using the site. For initial data screening, a potential exposure level was conservatively estimated as the maximum measured concentration. However, a more realistic estimate of the EPC within the target area (i.e., representing exposure in a typical individual within the exposed population) would be the mean of these samples, which can be conservatively estimated by its 95 percent upper confidence limit (UCL) of the mean. The USEPA Pro-UCL Version 4.1.01 software package (USEPA, 2011) was used to estimate the 95 percent UCLs for antimony and lead in soil (Table 7-6). These 95 percent UCL estimates were used as EPCs for risk characterizations in this screening level ERA. For reference purposes, the means of the data sets (as based on the use of one half the RL for non-detections) are also presented in Table 7-3.

7.4.2.1.0.2 Because the 0-2 in. depth interval is only represented by a triplicate set of IS samples, there was insufficient data to calculate a 95% UCL for the mean. Therefore, the maximum of the triplicate samples (14 mg/kg) was used as the EPC. It should be noted that this value is only marginally greater than the mean of the triplicates (12 mg/kg) (Table 7-6).

Table 7-6. Calculation of 95 Percent UCLs for Metals in Soils of the Upland Habitats Former Moving Target Machine Gun Range, South Beach Investigation Area

Analyte	CAS #	USEPA EcoSSL[1] (mg/kg)	Approximate Distribution[2]	Arithmetic Mean[3] (mg/kg)	95% UCL of the Mean[4,5] (mg/kg)	Basis of 95% UCL[2]
Surface Soil (0-2 inches) - Incremental Sampling						
Lead	7439-92-1	11	NA	**12**	**14**	Maximum
Surface Soil (2-12 inches) - Discrete Samples						
Lead	7439-92-1	11	Gamma	6.2	6.8	Approx. gamma

Notes:
[1] USEPA (2005b).
[2] As per USEPA Pro-UCL version 4.1.01 (USEPA, 2011), except for the 0-2 inch interval.
[3] Based on 95% UCL estimate recommended by USEPA Pro-UCL version 4.1.01 (USEPA, 2011). Because insufficient incremental samples were collected from the 0-2 inch depth interval to calculate a 95% UCL, the maximum of the triplicate samples was used to represent the EPC..
[4] Values in **BOLD** exceed the USEPA EcoSSL.
Acronyms and Abbreviations: Eco-SSL = ecological soil screening level
mg/kg – milligrams per kilogram UCL = upper confidence limit

7.4.2.2 Effects Evaluation

7.4.2.2.0.1 The Effects Evaluation establishes the toxicity benchmarks against which the EPCs are compared to screen for the potential risk to specific receptors. The USEPA Eco-SSL of 11 mg/kg for lead (USEPA 2005b) was used in this screening level ERA for that purpose. This Eco-SSL is based on exposure to an insectivorous bird, specifically the American woodcock (*Scolopax minor*), which primarily consumes earthworms and therefore has a high rate of incidental soil ingestion. It should also be noted that this EcoSSL is less than the MADEP 50th percentile of statewide natural background for lead (19.1 mg/kg). Table 7-7 provides EcoSSLs for metals for the receptors classes (plant, invert, bird, mammal) and illustrates that the most conservative value was selected for use in the SLERA.

Table 7-7. Receptor-specific Ecological Soil Screening Levels1,2 for Metals Identified as Potential Munitions Constituents, Former Moving Target Machine Gun Range, South Beach Area of Investigation

Analyte	CAS #	Plants	Soil Invertebrates	Birds			Mammals		
				Herbivore	Insectivore	Carnivore	Herbivore	Insectivore	Carnivore
Antimony	7440-36-0	--	78	--	--	--	10	**0.27**	4.9
Copper	7440-50-8	70	80	76	**28**	1600	1100	49	560
Lead	7439-92-1	120	1700	46	**11**	510	1200	56	460
Nickel	7440-02-0	**38**	280	210	--	2800	340	--	130
Zinc	7440-66-6	160	120	950	**46**	30000	6800	79	10000

Notes: [1]From USEPA (2005a, b; 2007a, b, c). Values in **BOLD** are the minimum Eco-SSL for that metal.
[2]All Eco-SSLs are in mg/kg dry soil.
Acronyms and Abbreviations: Eco-SSL = ecological soil screening level
mg/kg = milligrams per kilogram
-- = not available

7.4.3 Risk Characterization

7.4.3.0.1 According to the MCP, Method I Standards (i.e., MADEP background concentrations) are protective of the environment. Therefore, per MADEP guidance, the soil concentrations at the South Beach MRS are consistent with a condition of No Significant Risk. The additional evaluation below explores the potential for soil-related ecological risk to address federal guidance.

7.4.3.0.2 Based on the evaluation of the soil data from the Investigation Area, only lead was identified as a preliminary COPEC requiring further evaluation for potential ecological risk. The risk characterization of this metal was based on the calculation of hazard quotients of the form:

$$HQ = \frac{EPC}{EcoSSL}$$

Where:

HQ = Hazard quotient (unitless)

EPC = Exposure point concentration (mg/kg)

EcoSSL = Ecological soil screening level (mg/kg)

7.4.3.0.3 A HQ less than or equal to 1 indicates that the EPC is less than or equal to the EcoSSL and therefore, the conclusion can be drawn that potential for significant risk is negligible for that COPEC in that medium and the COPEC can be eliminated from further consideration. If, however, the calculated HQ is greater than 1, then a conclusion of negligible risk cannot be drawn and the COPEC is retained for further evaluation. Note that it is not concluded that the COPEC poses a risk when the HQ exceeds 1 since this could be the result of multiple conservatisms built into both the EPC and the EcoSSL. Such conservatisms are evaluated in the refined risk screening for those COPECs showing HQs greater than 1 and discussed in the uncertainty analysis.

7.4.3.0.4 The EPCs used in the risk characterization are the maximum of the triplicate IS samples for the 0-2 in. interval and the 95% UCLs for the 2-12 in. intervals presented in Table 7-11. The results of the initial screening of lead in the surface soil at the Investigation Area are as follows:

Lead (0 to 2 in.): $HQ_{initial} = \frac{14\ mg/kg}{11\ mg/kg} = 1.3$

Lead (2 to 12 in.): $HQ_{initial} = \frac{6.82\ mg/kg}{11\ mg/kg} = 0.6$

7.4.3.0.5 These results indicate that lead can be eliminated from further consideration as a COPEC for the 2-12 in. interval. Because the HQ for lead in the 0-2 in. interval exceeds 1 (although only slightly), it is further evaluated in the refined risk screening.

7.4.3.1 Refined Risk Screening

7.4.3.1.0.1 In the refinement of the initial risk screening, the HQs are recalculated based on a less conservative estimate of the threshold of adverse effects (i.e., the Eco-SSL) for lead. To this end, it should again be noted that the Eco-SSL for lead (11 mg/kg) is based on exposure in the American woodcock. The next smallest Eco-SSL derived by USEPA (2005b) for lead is 56 mg/kg for an insectivorous mammal (see Table 7-7),which is greater than the maximum measured concentration of lead in the soil at the Investigation Area. Therefore, this refinement of risk estimation for lead is focused on the conservative assumptions used to derive the Eco-SSL for the woodcock.

7.4.3.1.0.2 The EcoSSLs for wildlife receptors are based on the solution of the following equation under the condition that HQ=1 (USEPA, 2005b):

$$HQ = FIR \cdot (C_s \cdot P + B)/TRV$$

Where:

HQ = the hazard quotient (set at 1)
FIR = food ingestion rate of the receptor (in kg dry weight of food per kg body weight per day [kg dw/kg-day])
C_s = the soil concentration of the COPEC (in mg/kg)
P = the ingestion rate of soil as a proportion of FIR (unitless)
B = the concentration of the COPEC in the food of the receptor (i.e., earthworms) (in mg/kg dw)
TRV = the toxicity reference value for the receptor based on chronic oral exposure to the COPEC (in mg per kg body weight per day [mg/kg-day])

7.4.3.1.0.3 The concentration of lead in earthworm tissue (B) is estimated by the relationship (USEPA, 2005b):

$$\ln(B) = 0.807 \cdot \ln(C_s) - 0.218$$

Where:

B = the concentration of the COPEC in the earthworm tissues (in mg/kg dw)
C_s = the soil concentration of the COPEC (in mg/kg)
ln(X) = the natural logarithm of X

7.4.3.1.0.4 The Eco-SSL is defined as the value of C_s that results in a HQ of 1 in the first equation. The TRV for oral lead exposure in birds was derived by USEPA (2005b) to be 1.63 mg/kg-day, which is based on no observed adverse effect level (NOAEL) for chronic exposure. This TRV was not changed in the refined assessment of risk.

7.4.3.1.0.5 Both the FIR and P values used in the derivation of Eco-SSL are based on conservative estimates of these two exposure factors. The value used as FIR is based on the maximum food ingestion rate of the American woodcock of 1.43 kg wet weight (ww) per kg body weight per day (kg ww/kg-day) as reported in the USEPA Wildlife Exposure Factors Handbook (USEPA, 1993). When converted to a dry weight basis (assuming a water content in earthworms of 85% [USEPA, 1993]), the FIR used in the Eco-SSL (0.214 kg dw/kg-day) is obtained. The mean food ingestion rate for the woodcock, however, is 0.77 kg ww/kg-day (USEPA, 1993), which converts to a dry weight FIR of 0.116 kg dw/kg-day. In the case of P, 16.4% is used in the derivation of the Eco-SSL to estimate incidental soil ingestion by the woodcock. USEPA (1993), however, presents a lesser value of 10.4% for this species. Substituting these two less conservative exposure factors (i.e., FIR = 0.116 kg dw/kg-day and P = 10.4%) into the equations above and solving for C_s under the condition that HQ =1, a refined SSL of 26.4 mg/kg is obtained. This results in the following changes to the HQs for lead in the surface soil:

Lead (0 to 2 in.): $$HQ_{refined} = \frac{14\ mg/kg}{26.4\ mg/kg} = 0.53$$

7.4.3.1.0.6 Thus, these two modifications in the exposure factors used to derive the EcoSSL for lead in the American woodcock are sufficient to eliminate lead as a COPEC at this site.

7.4.3.2 Uncertainty Analysis

7.4.3.2.0.1 Throughout the risk assessment process, there are many uncertainties stemming from imperfect knowledge and data gaps that necessitate the implementation of assumptions that allows the process to proceed. Each of these assumptions has the capacity to influence the resulting prediction of potential risk to different degrees and in different direction from the "true" level of risk posed by the site. Thus, these assumptions may lead to either an overestimation of actual site risk, thereby favoring a greater degree of caution and protection of environmental resources (often referred to as "conservatism"), or to an underestimation of actual site risk, which could ultimately lead to an inadequate response.

7.4.3.2.0.2 The ERA process is designed to proceed in an iterative approach from highly conservative estimates of potential risk to estimates that can be accepted as more accurate yet still conservative predictions of actual site risk. Although refinement of exposure factors used to derive the screening level for lead represents a step in the reduction of conservatism inherent in the HQs for this metal, many other assumptions, both implicit and explicit, remain unchanged. In the following sections, some areas of uncertainty and assumptions used to address them in this risk assessment are described as well as their potential effect on the resulting risk prediction.

7.4.3.2.0.3 **Bioavailability.** Because the risk evaluations for metals were all based on total concentrations in soil, an unstated assumption is that each of the metals within those media are in

a bioavailable form (i.e., 100 percent of the measured metal is in a form that can be taken up by plants or absorbed or assimilated through dermal contact, inhalation, or ingestion by animals). Typically, however, metals in soils occur in forms that are not bioavailable (e.g., as a solid metallic fragment, an insoluble mineral, or bound to other minerals or organic matter) and only a fraction of the total measured metal concentration is likely to be in a bioavailable form. Therefore, the assumption of 100 percent bioavailability is conservative and is likely to lead to an overestimation of the actual potential for risk.

7.4.3.2.0.4 **Exposure Point Concentrations.** Based upon the results of geophysical surveys and intrusive investigations, sampling of soil at the Investigation Area was biased toward areas that were most likely to have been affected by historical use of the Investigation Area as a target for machine gun practice. However, soil EPCs for this screening level ERA are meant to represent the entire 18.7 acres of upland habitat of this Investigation Area and therefore represent the expected exposure for the average individual of the population rather than that of the maximally exposed individuals. Because, data upon which EPCs are based represent only a small fraction of the entire Investigation Area and are biased toward the area of highest known concentration, they are likely to overestimate potential exposures in most receptors relative to the site-wide average. For this reason, it is highly likely that estimates of potential for risk represented by these EPCs also overestimate actual potential for risk from the Investigation Area as a whole.

7.4.3.2.0.5 EPCs in this screening level ERA were represented by either the 95% UCL of the mean or the maximum value of the data for the specific soil depth intervals. Both of these provide a more conservative estimate of the true mean concentrations in the soil than the arithmetic mean (i.e., the simple average). Therefore, the EPCs result in conservative estimates of potential risk.

7.4.3.2.0.6 **Area and Seasonal Use.** For the wildlife receptors, no adjustment is made to the exposure estimation for time potentially spent foraging outside of the Investigation Area. This adjustment can be done through the application of an Area Use Factor (AUF) and/or a Seasonal Use Factor (SUF) to the exposure estimate (both are expressed as fractions ranging from 0 to 1). It is therefore assumed in this assessment that both of these factors are equal to 1, implying that the wildlife receptors spend the entire year confined to the area of the Investigation Area, or more accurately, to the area of the Investigation Area that is represented by the data (which a small fraction of the entire upland area and is biased toward the area of greatest MC concentration). Although this assumption may be acceptable for some individuals of some species (e.g., the vole and the shrew), it is probably highly conservative for others, such as the hawk and, most notably, the woodcock. American woodcocks are migratory, arriving at their breeding grounds in late March or early April and leaving in the fall, typically with the first

heavy frost (USEPA, 1993). Therefore, an SUF of 0.5 or 0.6 (corresponding to 6 or 7 months in the breeding area) could be applied to the estimated exposures for this species.

7.4.4 Conclusions

7.4.4.0.1 Based on this screening level ERA for the Investigation Area, the following conclusions can be drawn:

- No high explosive compounds or by-products occur in the soil at detectable levels; therefore, none of these compounds pose a potential risk to ecological receptors resources at this site.
- None of the key metals (antimony, copper, lead, nickel, and zinc) occur in soil at levels that exceed MADEP-specified background concentrations; therefore, all are consistent with a condition of No Significant Risk based on the MCP Method I Standards.
- Although concentrations of lead in surface soil exceeded the USEPA Eco-SSL for that metal, its potential for risk was found to be negligible based on the 95% UCL concentration for the 2-12 in. soil depth interval and a refinement of the ecological soil screening level based on less conservative exposure assumptions for the 0-2 in. depth interval.

7.4.4.0.2 Therefore, it can be concluded that none of the MCs evaluated at the Investigation Area pose a potential for risk to ecological receptors.

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8.0 CONCLUSIONS AND RECOMMENDATIONS

8.0.1 The objective of the RI, to delineate the nature and extent of MEC, MD, and MCs impacted from historic training activities conducted at the Investigation Area, has been achieved. RI activities including geophysical surveying, intrusive investigations, and environmental sampling for analysis of MCs was conducted within land, beach, and ocean Investigation Area sub-areas.

8.0.2 Key findings of the RI include:

- During the RI, 97 MD items and 98 non-MD items were identified. No MEC items were identified during the field investigation.
- At the Former Moving Target Machine Gun Range:
    - A 300m firing line was confirmed through visual inspection of a concrete pad with stanchions for mounting machine guns.
    - The 150m firing line and suspected firing line and impact berm were not confirmed through visual inspection. The areas are residential and have been disturbed by building and landscaping activities.
    - MEC was not identified during the RI at the Former Moving Target Machine Gun Range.
- At the Former Katama Rocket Range:
    - While the former target areas are currently underwater, the limits of the rocket training range and the distribution of munitions debris have been confirmed through geophysics and intrusive investigation.
    - MEC was not identified during the RI at the former Katama Rocket Range. MD has been identified in ocean, land, and beach areas.
    - A transport study conducted in the vicinity of the historic rocket targets demonstrates that ferrous items are moving into these two grid areas, with a measurable change after storm events.
    - Due to significant beach erosion and deeper water depths in the surf zone, ferrous items including rocks with ferrous signatures previously buried below sensor detection depth may have become detectable/ exposed and migrated into the previously cleared grids; all items were within 400 feet of the water's edge as measured from the mean low-tide mark.
    - The distribution of MD concentrations is further east of the former target areas indicating a strong prevailing easterly ocean current; this is further confirmed by the acoustic pinger which broke free from one of the seed items in the transport

study which washed ashore approximately one mile east of where it was emplaced.

  - MEC was not identified during the RI at the Former Katama Rocket Range.

- During emergency reponses, two 100 pound bombs were reported at two instances (one in 2008 and one in 2009) at Wasque point, approximately 2.1 miles from where the majority of MD was identified. No additional MEC or MD was identified during the RI at Wasque Point. There is no supporting evidence through historical research or the RI that they were part of historical military operations conducted at South Beach and are considered isolated finds unrelated to the site.
- MC sampling indicated that human health screening criterion were not exceeded in soil or groundwater.
- No high explosive compounds or their by-products were detected in soil; therefore, none of these compounds pose a potential risk to ecological receptors resources at this site.
- None of the key metals (antimony, copper, lead, nickel, and zinc) were detected in soil at levels that exceed MADEP-specified background concentrations; therefore, all are consistent with a condition of No Significant Risk based on the MCP Method I Standards.
- Although concentrations of lead in surface soil exceeded the USEPA Eco-SSL for that metal, its potential for risk was found to be negligible based on the 95% UCL concentration for the 2-12 in. soil depth interval and a refinement of the ecological soil screening level based on less conservative exposure assumptions for the 0-2 in. depth interval. Therefore, it can be concluded that none of the MCs evaluated at the Investigation Area pose a potential for risk to ecological receptors.

8.0.3 Based upon the RI results, the following recommendations are proposed.

- Revise the current MRA Boundary to include the extent of MEC and MD determined through previous investigation, geophysical and intrusive investigation data (Figure 8-1).
- The South Beach MRA should be subdivided into two MRSs, comprising the Former Machine Gun Range and Katama Rocket Range (695 acres) and the Remaining Ocean Area (3,736 acres).

8.0.4 Although no MEC was identified at the investigation area, a FS is recommended to evaluate future response action alternatives with regard to potential MEC hazards at the South Beach MRA. Due to the significant density of MD discovered and estimated to remain within the MRS boundary, coupled with likely public exposure to the practice rockets and the need to employ UXO-certified technicians to make the determination whether a munition is inert or UXO, pursuing an FS is warranted. No further evaluation of MC is warrented.

Proposed MRS	Acres
Former Machine Gun and Katama Rocket Range	695
Remaining Ocean	3,736
MRA TOTAL	4,431

N

Katama Airpark

Katama Farm

Katama Bay

Pocha Pond

Wasque Point

Atlantic Ocean

Location of 5" HVAR found 22-Mar-2011

Approximate location of 5" MK 6 Practice warhead found Feb-2012

PROPOSED FORMER MACHINE GUN AND KATAMA ROCKET RANGE MRS (695 acres)

PROPOSED REMAINING OCEAN MRS (3,736 acres)
(SEE AREAL OVERVIEW INSET FOR FULL EXTENT)

Location of Rocket Motor found during the ESTCP Survey

Location of Rocket Motor found during the ESTCP Survey

Approximate locations of suspected 100 lb bombs found 13-Feb-2009 and 100 lb HE found Dec-2008

PROPOSED MRA

AREAL OVERVIEW

0 1 2 Miles

*Some ocean transects were inaccessible due to environmental conditions during the time of survey. Conditions included eroding beaches and other general safety concerns.

MD
MEC
Former Rocket Target
Moving Target and Machine Gun Range Features
Ocean Transect Inaccessible*
Ocean Transect with MD
Ocean Transect with no MEC, MPPEH, or MD
Proposed MRA
Proposed Former Machine Gun and Katama Rocket Range MRS
Proposed Remaining Ocean MRS
ESTCP Survey Area
South Beach FUDS Boundary
South Beach Investigation Area

US Army Corps of Engineers

FIGURE 8-1

Proposed Revised MRA Boundary - Former Moving Target Machine Gun Range at South Beach Investigation Area, Martha's Vineyard, MA

0 200 400 800 1,200 Meters

0 750 1,500 3,000 4,500 Feet

UXB amec

NOTES:
2009 Aerial Data Source: MassGIS

12/04/2013	Rev:	SBeach_Revised_MRS_Remedial_Inv_Rpt.mxd
Drawn: JBO	Chk: DMS	PROJ: 562910000

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9.0 References

9.0.1 Brannon, James M. and Myers, Tommy E., 1997. Review of Fate and Transport Processes of Explosives. Prepared for the United States Army Corps of Engineers. (Technical Report, IRRP-97-2). March.

9.0.2 Code of Federal Regulations (CFR), Title 40 – *Protection of Environment*, Volume 28, Chapter I, Part 300 – *National Oil And Hazardous Substances Pollution Contingency Plan*, Subpart E – *Hazardous Substance Response*, Section 300.415(j) – *Removal Action*.

9.0.3 Code of Federal Regulations (CFR), Title 40 – *Protection of Environment*, Volume 28, Chapter I, Part 300 – *National Oil And Hazardous Substances Pollution Contingency Plan*, Subpart E – *Hazardous Substance Response*, Section 300.400 – *Removal Action*, Subsection (g)(3).

9.0.4 Department of the Army (Army), 1989. *After Action Report – Ordnance Clearance Operation on Martha's Vineyard, MA; 14 March 1989 – 12 May 1989.* May

9.0.5 Department of Defense (DoD), 2007. *Munitions Response Site Prioritization Protocol Primer.* Office of the Deputy Under Secretary of Defense – Installation and Environment.

9.0.6 Department of Defense (DoD), 2009. Memorandum for the Assistant Secretary of the Army (Installations and Environment); Assistant Secretary of the Navy (Installations and Environment); and Assistant Secretary of the Air Force (Installations, Environment, and Logistics). Subject: Trial Use of the Interim Munitions and Explosives of Concern Hazard Assessment (MEC HA) Methodology. Signed by Wayne Arny, Deputy Under Secretary of Defense (Installations and Environment). Office of the Under Secretary of Defense, 3000 Defense Pentagon, Washington, D.C. January.

9.0.7 Environmental Security Technology Certification Program (ESTCP). 2009. Final Report. Geophysical System Verification (GSV): A Physics-Based Alternative to Geophysical Prove-outs for Munitions Response. Environmental Security Technology Certification Program (ESTCP). July.

9.0.8 Geosoft Oasis Montaj. 2010. "GRIDPEAK GX" Application notes. Version 7.2 SP 1.

9.0.9 Los Alamos National Laboratory (LANL). 2011. *ECORISK Database Release 3.0* (October 2011): http://www.lanl.gov/environment/cleanup/ecorisk.shtml

9.0.10 Martha's Vineyard Chamber of Commerce. http://www.mvy.com/visitor_information/frequently asked_questions.aspx. Accessed 2/15/2012.

9.0.11 Massachusetts Department of Environmental Protection (MADEP). 1996. *Guidance for Disposal Site Risk Characterization, Chapter 9: Method 3 Environmental Risk Characterization. Interim Final* Policy BWSC/ORS-95-141. April.

9.0.12 MADEP. 1999. Standard References for Monitoring Wells, Small Diameter Driven Well Supplement. January.

9.0.13 MADEP. 2002. *Background Levels of Polycyclic Aromatic Hydrocarbons and Metals in Soil.* Technical Update. May.

9.0.14 Massachusetts Geographic Information System (MassGIS). 2012. OLIVER- The MassGIS Online Data Viewer- Version 2.0 (released January 10, 2012. www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/

9.0.15 Town of Edgartown. Correspondence from Pam Dolby with the Town of Edgartown regarding past attempts to destroy the bunker at South Beach. Date Unknown.

9.0.16 United States Army Corps of Engineers (USACE), 1999. *Final, Archives Search Report for the former Tisbury Great Pond, Martha's Vineyard Massachusetts*. November.

9.0.17 USACE, 2003. Engineering Manual (EM) 1110-1-1200, *Conceptual Site Models For Ordnance And Explosives (OE) And Hazardous, Toxic, And Radioactive Waste (HTRW) Projects*. February.

9.0.18 USACE, 2006. *Engineering Pamphlet 1110-1-18, Military Munitions Response Process*. April.

9.0.19 USACE, 2008a. *Final, Site Inspection Report For Tisbury Great Pond*. September.

9.0.20 USACE, 2008b. *Time Critical Removal Action (TCRA) Action Memorandum for Cape Poge Little Neck Bomb Target Site, Chappaquiddick Island, Dukes County, Massachusetts, Formerly Used Defense Site (FUDS) Project Number D01MA0595, MRS Number: D01MA059501R01-1; Former Moving Target Machine Gun Range at South Beach, Martha's Vineyard, Massachusetts, FUDS Project Number D01MA0486, MRS: D01MA048600R01-1*. November.

9.0.21 USACE, 2008c. *Finding and Determination of Eligibility, South Beach at Martha's Vineyard (Moving Target Machine Gun Range), FUDS Property Number D01MA0486, Edgartown, Massachusetts*. July.

9.0.22 USACE, 2009a. *Preliminary Assessment, Cape Poge Little Neck Bomb Target Site, Chappaquiddick Island, Massachusetts, FUDS Property Number – D01MA0595, Draft Report*. February.

9.0.23 USACE, 2009b. *Final Army Military Munitions Response Program (MMRP) Munitions Response Remedial Investigation/Feasibility Study (RI/FS) Guidance*. November.

9.0.24 USACE, 2010. *Draft Final Site Specific Final Report For The Time Critical Removal Action (TCRA) at Former Cape Poge Little Neck Bomb Target Site, Chappaquiddick Island, Dukes County, Massachusetts, and Former Moving Target Machine Gun Range at South Beach, Martha's Vineyard, Edgartown, Massachusetts*. January.

9.0.25 U.S. Census Bureau, 2010. State and County Quick Facts. Data derived from Population Estimates, American Community Survey, Census of Population and Housing, State and County Housing Unit Estimates, County Business Patterns, Nonemployer Statistics, Economic Census, Survey of Business Owners, Building Permits, Consolidated Federal Funds Report Last Revised: Tuesday, 31-Jan-2012 16:52:17 EST.

9.0.26 United States Department of Natural Resources-Soil Conservation Service (USDA-SCS), 1986. *Soil Survey of Dukes County, Massachusetts*. September.

9.0.27 United States Army and Engineering Center, Huntsville (USAECH), 2010. *Explosives Site Plan, Correction 1, Remedial Investigation/Feasibility Study, Former Cape Poge Little Neck Bomb Target Site, Former Moving Target Machine Gun Range, Tisbury Great Pond, Martha's Vineyard, Massachusetts, D01MA0595*. September.

9.0.28 United States Environmental Protection Agency (USEPA), 1989. *Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (Part A), Interim Final*. December.

9.0.29 USEPA, 1992. *Behavior of Metals in Soils*. EPA/540/S-92/018. October.

9.0.30 USEPA, 1993. *Wildlife Exposure Factors Handbook.* EPA/600/R-93/187a. U.S. Environmental *Protection* Agency, Office of Research and Development. Washington, D.C.

9.0.31 USEPA, Office of Research and Development, 1994. *Guidance for the Data Quality Objectives Process*, EPA/600/R-96/055, September.

9.0.32 USEPA. 1997. *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. Interim Final*. EPA 540-R-97-006. Office of Solid Waste and Emergency Response. Washington, D.C.

9.0.33 USEPA. April 1998. *Guidelines for Ecological Risk Assessment*. Final. Risk Assessment Forum. Washington, DC EPA/630/R-95/002F.

9.0.34 USEPA. 1999. *Issuance of Final Guidance: Ecological Risk Assessment and Risk Management Principles for Superfund Sites*. OSWER Directive 9285.7-28P. Office of Solid Waste and Emergency Response. Washington, D.C.

9.0.35 USEPA, 2000. *Data Quality Objectives Process For Hazardous Waste Site Investigations, EPA QA/G-4HW, Final*. January.

9.0.36 USEPA Region 4, 2001. *Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment.* Originally published November 1995. Website version last updated November 30, 2001:

http://epa.gov/region4/superfund/programs/riskassess/ecolbul.html

9.0.37 USEPA, 2003. *RCRA Corrective Action Ecological Screening Levels* August 22, 2003. https://amaccess.amec.com/R5Super/ecology

9.0.38 USEPA, 2005a. *Ecological Soil Screening Level for Antimony. Interim Final*. OSWER Directive 9285.7-61. U.S. Environmental Protection Agency Office of Emergency and Remedial Response.

9.0.39 USEPA, 2005b. *Ecological Soil Screening Level for Lead. Interim Final*. OSWER Directive 9285.7-70. U.S. Environmental Protection Agency Office of Emergency and Remedial Response.

9.0.40 USEPA, 2007a. *Ecological Soil Screening Level for Copper. Interim Final*. OSWER Directive 9285.7-68. U.S. Environmental Protection Agency Office of Emergency and Remedial Response. Issued July 2006, Revised February 2007.

9.0.41 USEPA, 2007b. *Ecological Soil Screening Level for Nickel. Interim Final*. OSWER Directive 9285.7-76. U.S. Environmental Protection Agency Office of Emergency and Remedial Response.

9.0.42 USEPA, 2007c. *Ecological Soil Screening Level for Zinc. Interim Final*. OSWER Directive 9285.7-73. U.S. Environmental Protection Agency Office of Emergency and Remedial Response.

9.0.43 USEPA, 2008. Interim Munitions and Explosives of Concern Hazard Assessment Methodology. October.

9.0.44 USEPA, 2009. *Regional Screening Level (RSLs) Master Table, December 2009*.

9.0.45 USEPA, 2011. ProUCL Version 4.1.01. A Statistical Software. National Exposure Research Lab, http://www.epa.gov/nerlesd1/tsc/software.htm.

9.0.46 United States Fish and Wildlife Service (USFWS). No date. Northeast Coastal Areas Study: Significant Coastal Habitats: Site 40 (MA). Online document at: http://library.fws.gov/pubs5/necas/web_link/40_martha's%20vineyard.htm

9.0.47 UXB International, Inc. (UXB). 2011. *Remedial Investigation Work Plan: Former Cape Poge Little Neck Bomb Target MRS, Former Moving Target Machine Gun Range at*

South Beach MRS, & Tisbury Great Pond MRS, Martha's Vineyard, Massachusetts, Final. September.

9.0.48 UXB, 2012. UXB Form 02-06-2, Daily Report, Revision 1. March.

9.0.49 VRHabilis (VRH), 2008. South Beach Emergency Response Photographs. August.

9.0.50 VRH, 2009. One person response to potential ordnance items, Wasque Point, Chappaquiddick Island. February.

9.0.51 VRH, 2011. UXO Emergency Response, August 1.

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APPENDIX A
SUPPLEMENTAL STUDIES

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APPENDIX B

INSTITUTIONAL ANALYSIS AND INSTITUTIONAL ANALYSIS REPORT

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The Institutional Analysis will be provided in the Martha's Vineyard Former Moving Target Machine Gun Range Feasibility Study.

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APPENDIX C

PERMITS

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APPENDIX D

ANALYTICAL RESULTS AND QA/QC EVALUATIONS

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APPENDIX E

FIELD FORMS

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APPENDIX F

GEOPHYSICAL DATA

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APPENDIX G

DEMOLITION ACTIVITY SUMMATION TABLES

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APPENDIX H

DOCUMENTATION OF DISPOSAL OF MUNITIONS POTENTIALLY PRESENTING AN EXPLOSIVE HAZARD, MUNITIONS DEBRIS, AND WASTES

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APPENDIX I

PROJECT PHOTOGRAPHS

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