Draft Final

WORK PLAN

MILITARY MUNITIONS RESPONSE PROGRAM
REMEDIAL INVESTIGATIONS
U.S. ARMY GARRISON – WEST POINT
WEST POINT, NY

Contract No.: W912DR-09-D-0006

Delivery Order No.: 0001

JANUARY 2011

Prepared For:

West Point
The United States Military Academy

U.S. ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT
Baltimore, MD 21203

U.S. ARMY GARRISON – WEST POINT
West Point, NY 10996

Prepared By:

WESTON SOLUTIONS

DRAFT FINAL
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WEST POINT, NEW YORK

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Prepared For:

U.S. ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT
10 South Howard Street
Baltimore, Maryland 21201-1715

Prepared By:

WESTON SOLUTIONS, INC.
1400 Weston Way
West Chester, Pennsylvania 19380

WESTON PROJECT NO.: 03886.551.001

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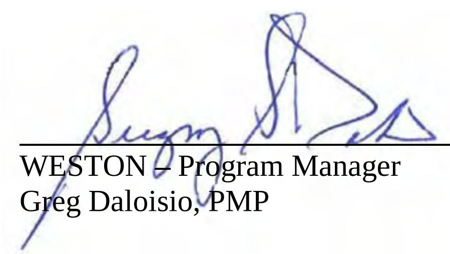
____________________________________ 1/13/2011
WESTON – Project Manager Date
John P. Gerhard



____________________________________ 1/13/2011
WESTON – Program Manager Date
Greg Daloisio, PMP

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LIST OF ACRONYMS

APP/SSHP	Accident Prevention Plan/Site Safety and Health Plan
ASTM	American Society for Testing and Materials
ATF	Bureau of Alcohol, Tobacco and Firearms
ATV	all-terrain vehicle
BERA	Baseline Ecological Risk Assessment
BIP	blow-in-place
BMP	best management practices
CAA	Clean Air Act
CAR	Corrective Action Report
CENAB	USACE, Baltimore District
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CI	Constitution Island
cm	centimeter
CMP	Coastal Management Program
COR	Contracting Officer's Representative
CRP	Community Relations Plan
CSM	conceptual site model
CTT	closed, transferred, and transferring
CZMA	Coastal Zone Management Act
dB	decibel
dBC	C-weighted scale
DDESB	Department of Defense Explosives Safety Board
DERP	Defense Environmental Restoration Program
DGM	digital geophysical mapping
DID	Data Item Description
DMM	discarded military munitions
DoD	Department of Defense
DoDI	Department of Defense Instruction
DOT	U.S. Department of Transportation
DQCR	Daily Quality Control Report
DQO	data quality objective
EE/CA	Engineering Evaluation/Cost Analysis
EHS	Extremely Hazardous Substances

LIST OF ACRONYMS (Continued)

EM	Engineering Manual
EMA	Emergency Management Agency
EOD	Explosive Ordnance Disposal
EOR	explosive ordnance reconnaissance
EPA	U.S. Environmental Protection Agency
EPP	Environmental Protection Plan
ERAGS	Ecological Risk Assessment Guidance for Superfund
ERIS	Environmental Restoration Information System
ESA	Endangered Species Act
ESP	Explosives Site Plan
ESRI	Environmental Systems Research Institute
FGDC	Federal Geographic Data Committee
FS	feasibility study
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 explosive
HHRA	Human Health Risk Assessment
HRR	Historical Records Review
HTW	hazardous or toxic waste
IAP	Installation Action Plan
ICRMP	Integrated Cultural Resource Management Plan
ID	identification
IGD	Interim Guidance Document
INRMP	Integrated Natural Resource Management Plan
IS	incremental sampling
ISO	industry standard object
IT	information technology
IVS	Instrument Verification Strip
KO	Contracting Officer

LIST OF ACRONYMS (Continued)

m	meter
MAMMS	Multiple Award Military Munitions Services
MC	munitions constituents
MCGI	Meridian Consultant Group, Inc.
MEC	explosives of concern
MGFD	munition with the greatest fragmentation distance
MMRP	Military Munitions Response Program
MPPEH	material potentially presenting an explosive hazard
MRSPP	Munitions Response Site Prioritization Protocol
MRS	munitions response site
MSD	minimum separation distance
MSDS	Material Safety Data Sheet
mV	milliVolts
NAAQS	National Ambient Air Quality Standards
NAD	North American Datum
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NMEA	National Marine Electronics Association
NYNHP	New York Natural Heritage Program
NYSDEC	New York State Department of Environmental Conservation
NYSDOS	New York State Department of State
OESS	Ordnance and Explosive Safety Specialist
OSHA	Occupational Safety and Health Administration
PA	Preliminary Assessment
PDA	personal digital assistant
PEL	Permissible Exposure Limit
PM	Project Manager
POC	point of contact
PPE	personal protective equipment
ppm	parts per million
PRGs	preliminary remediation goals
PTTF	Powder Train Time Fuzes
PWS	Performance Work Statement
QA	quality assurance

LIST OF ACRONYMS (Continued)

QAPP	Quality Assurance Project Plan
QASP	Quality Assurance Surveillance Plan
QC	quality control
QCP	Quality Control Plan
RAB	Restoration Advisory Board
RAGS	Risk Assessment Guidance for Superfund
RI	remedial investigation
RIP	Remedy-in-Place
ROE	right of entry
RQ	reportable quantity
SI	Site Inspection
SLERA	Screening-Level Ecological Risk Assessment
SOP	standard operating procedure
SUXOS	Senior UXO Specialist
TCRA	time critical removal action
TPP	Technical Project Planning
U.S.	United States
UFP-QAPP	Uniform Federal Policy for Quality Assurance Project Plan
USACE	U.S. Army Corps of Engineers
USAEC	U.S. Army Environmental Command
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator
UXO	unexploded ordnance
UXOQCS	UXO Quality Control Specialist
UXOSO	UXO Safety Officer
VSP	Visual Sample Plan
WESTON®	Weston Solutions, Inc.
West Point	U.S. Army Garrison - West Point
WWII	World War II

1. INTRODUCTION

1.1 GENERAL

Weston Solutions, Inc. (WESTON®) is performing a remedial investigation (RI) at the U.S. Army Garrison - West Point (West Point) in support of the Active Army Military Munitions Response Program (MMRP). Work is authorized under the United States Army Corps of Engineers (USACE), Baltimore District (CENAB) Multiple Award Military Munitions Services (MAMMS) Contract W912DR-09-D-006, Delivery Order 0001, and will be performed in accordance with the Performance Work Statement (PWS) included in **Appendix A**.

This Work Plan describes the technical approach for the MMRP RI to be conducted at 11 West Point munitions response sites (MRSs). The MRSs comprise 673.5 acres of land associated with former artillery ranges and/or small arms ranges, some of which were used from the Revolutionary War until World War II (WWII). The 11 MRSs were recommended for further investigation in the Final Site Inspection Report (TLI, 2007).

1.2 PURPOSE AND SCOPE

The United States (U.S.) Congress established the MMRP under the Defense Environmental Restoration Program (DERP) to address munitions and explosives of concern (MEC) and munitions constituents (MC) located on current and former defense sites. Properties classified as operational military ranges, permitted munitions disposal facilities, or operating munitions storage facilities are not eligible for the MMRP. The DERP, including the MMRP, typically follows the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The U.S. Army conducted an inventory of closed, transferred, and transferring (CTT) military ranges and defense sites (also known as the Phase 3 CTT), which meets the requirements of a CERCLA Preliminary Assessment (PA). In this Phase 3 CTT, 10 closed ranges and 2 transferred areas with the potential for MEC, which includes both unexploded ordnance (UXO) and discarded military munitions (DMM) and/or MC, were identified as eligible for action under the MMRP. The Phase 3 CTT Range Inventory Report for West Point was completed in August 2004.

The next phase of the CERCLA process at West Point was the Site Inspection (SI). The SI was completed in a two-phase approach. The Historical Records Review (HRR) was the initial step in the MMRP SI. During the HRR, records searches were performed to supplement the information gathered during the Phase 3 CTT and to help facilitate decision-making processes to determine the next step for the SI. The Final HRR Report was presented to the Army and stakeholders in March 2006 (TLI, 2006). Based on the HRR results, one MRS was determined to require no further action. All other MRSs in the Phase 3 CTT required a field inspection. These field inspections were performed in April, May, and September 2006. The results of the SI (TLI, 2007) indicated that multiple MRSs require further investigation through a remedial investigation (RI). The SI report identified 11 MRSs at West Point to be evaluated in the RI phase of the CERCLA process.

The purpose of this MMRP RI at West Point is to perform an investigation to determine the presence or absence of MEC and MC at the 11 MRSs identified in the SI, and if present, to determine the nature and extent of MEC and MC on the ground surface and subsurface. Information collected during the RI will be used to fill data gaps, update the conceptual site model (CSM), evaluate potential human health and ecological risks, conduct an explosive hazard assessment, and update the Munitions Response Site Prioritization Protocol (MRSPP). Results from the RI will be used to develop and evaluate remedial alternatives and to provide recommendations for a feasibility study (FS) if required.

1.3 WORK PLAN ORGANIZATION

This RI Work Plan was prepared using components of the Army guidance documents, EM 1110-1-4009 (USACE, 2007), Data Item Description (DID)-MMRP-09-001 (USACE, 2009a), and the *Final Munitions Response Remedial Investigation/Feasibility Study Guidance* (USAEC, 2009). Work Plan sections are organized as follows:

Section 1 – Introduction
Section 2 – Technical Management Plan
Section 3 – Field Investigation Plan
Section 4 – Reporting
Section 5 – Quality Control Plan
Section 6 – Explosives Management Plan
Section 7 – Explosives Site Plan
Section 8 – Environmental Protection Plan
Section 9 – References

The following information is appended to this Work Plan:

- Appendix A – Performance Work Statement
- Appendix B – Site Maps
- Appendix C – Conceptual Site Models
- Appendix D – Project Points of Contact
- Appendix E – Resumes
- Appendix F – Project Schedule
- Appendix G – MC Sampling Memorandum
- Appendix H – Technical Project Planning 1 Meeting Minutes
- Appendix I – MRS-Specific Field Investigation Plans
- Appendix J – Uniform Federal Policy-Quality Assurance Project Plan
- Appendix K – Contractor Forms
- Appendix L – Accident Prevention Plan/Site Safety and Health Plan
- Appendix M – Explosives Site Plan
- Appendix N – New York Natural Heritage Program Report
- Appendix O – Restoration Procedures
- Appendix P – Protection Procedures for Archaeological or Historical Artifacts

1.4 PROJECT LOCATION

The U.S. Army Garrison – West Point is located in Orange and Putnam Counties, New York, on the west bank of the Hudson River. West Point is approximately 50 miles north of New York City and approximately 13 miles south of Newburgh (see **Appendix B, Figure B-1**). The 15,974 acres of land encompassing West Point are designated as two areas: the Main Post or campus (2,530 acres) and the Military Reservation (13,444 acres). The Main Post includes the majority of the academic, residential, and support facilities. The Military Reservation is largely undeveloped and contains operational training facilities such as firing ranges and bivouac areas used during the summer to house and train cadets.

1.5 SITE INSPECTION RECOMMENDATIONS

Eleven MRSs were identified as requiring further investigation based on the results of the SI (TLI, 2007). **Table 1-1** presents the SI recommendations for each MRS. The location of each MRS is shown in **Appendix B, Figure B-2**. Section 1.7 presents the background and field inspection results for each of the 11 MRSs.

Table 1-1 SI Recommendations (TLI, 2007)

MRS	SI Recommendation	Basis for SI Recommendation (MEC)	Basis for SI Recommendation (MC)
Artillery Firing Range WSTPT-001-R-01 172.4 acres	It is recommended that this MRS be further investigated for MEC. Further evaluation of MC is not warranted at this time for this MRS; however, if further investigation at this MRS identifies MEC, additional sampling may be required.	A subsurface anomaly density of 240 anomalies per acre was identified during the geophysical survey. In addition, a previous geophysical investigation identified subsurface anomalies in the northern end of this MRS.	All explosives and metals concentrations were below the U.S. Environmental Protection Agency (EPA) Region 9 preliminary remediation goals (PRGs), with the exception of iron, which is believed to be naturally occurring in the soils.
Battery Knox-TD – Land WSTPT-004-R-02 141 acres	This MRS encompasses the area on the eastern shore of the Hudson River within Putnam County. During the SI, no evidence of military activities, including MEC, was identified in the Battery Knox-TD – Land MRS nor were any MC identified in the samples at levels above the screening criteria. However, trace amount of explosives were identified in the samples. Because no explanation for the presence of these trace explosives can be determined at this time, the Stakeholders have requested that further investigation of this MRS be performed, including additional soil sampling and possible geophysical investigation.	No MEC was identified within this MRS during the visual survey.	All explosives and metals concentrations were below the EPA Region 9 PRGs, with the exception of iron, which is believed to be naturally occurring in the soils.
Fort Clinton – West WSTPT-008-R-01 14.4 acres	This MRS extends from the western side of the West Point cemetery, through the Lee Housing Area to Highway 218 and the operational range area. It is recommended that this MRS be further investigated for MEC. Further evaluation of MC is not warranted at this time for this MRS; however, if further investigation at this MRS identifies MEC, additional sampling may be required.	A previous geophysical investigation identified subsurface anomalies in the northwestern end of this MRS. Although no MEC was identified during the visual survey, extensive MD was observed and the potential exists for MEC to be found in this MRS.	All explosives and metals concentrations were below the EPA Region 9 PRGs, with the exception of iron, which is believed to be naturally occurring in the soils.

Table 1-1 SI Recommendations (TLI, 2007) (Continued)

MRS	SI Recommendation	Basis for SI Recommendation (MEC)	Basis for SI Recommendation (MC)
Grey Ghost Housing Area WSTPT-010-R-01 24 acres	It is recommended that this MRS be further investigated for MEC. Further evaluation of MC is not warranted at this time for this MRS; however, if further investigation at this MRS identifies MEC, additional sampling may be required.	Although no MEC was identified during the visual survey, MD (including a sand-filled, 3-inch Stokes mortar round) was identified and the potential exists for MEC to be found in this MRS.	All explosives and metals concentrations were below the EPA Region 9 PRGs.
North Athletic Field WSTPT-011-R-01 14 acres	This MRS is recommended for further investigation of MEC to include confirmation sampling of the anomalies identified during the geophysical survey. Further evaluation of MC is not warranted at this time for this MRS; however, if further investigation at this MRS identifies MEC, additional sampling may be required.	A subsurface anomaly density of 262 anomalies per acre was identified during the geophysical survey. Some of the anomalies may be related to fencing and underground utilities at the MRS. However, several anomalies are not associated with these items, and it is difficult to determine whether the anomalies are related to military munitions or other underground structures. During a previous construction project, one military munitions item was found during excavation at the MRS.	All explosives and metals concentrations were below the EPA Region 9 PRGs.
Seacoast Battery WSTPT-013-R-01 2 acres	It is recommended that this MRS be further investigated for MEC. Further evaluation of MC is not warranted at this time for this MRS; however, if further investigation at this MRS identifies MEC, additional sampling may be required.	Although no evidence of munitions was identified within this MRS during the visual survey, the MRS is within close proximity to the location of MD identified within the Siege Battery MRS on Constitution Island.	All explosives and metals concentrations were below the EPA Region 9 PRGs.

Table 1-1 SI Recommendations (TLI, 2007) (Continued)

MRS	SI Recommendation	Basis for SI Recommendation (MEC)	Basis for SI Recommendation (MC)
Siege Battery WSTPT-015-R-01 179.3 acres	It is recommended that this MRS be further investigated for MEC. It is recommended that this MRS be further investigated for MC.	A subsurface anomaly density of 361 anomalies per acre was identified during the geophysical survey. In addition, a previous geophysical investigation identified subsurface anomalies in the northwestern end of this MRS. One MEC item, a 3-inch Stokes mortar round, was identified during the visual survey on Constitution Island. In addition, extensive MD was identified throughout the MRS and the potential exists for MEC to be found in this MRS.	All explosives and metals concentrations were below the EPA Region 9 PRGs, with the exception of iron. One exceedance of iron at the MRS is believed to be related to the presence of MD.
Target Hill WSTPT-017-R-01 14 acres	This MRS is recommended for further investigation of MEC including confirmation sampling of the anomalies identified during the geophysical survey. Further evaluation of MC is not warranted at this time for this MRS; however, if further investigation at this MRS identifies MEC, additional sampling may be required.	A subsurface anomaly density of 238 anomalies per acre was identified during the geophysical survey. Some of the anomalies may be related to fencing and underground utilities at the MRS. However, several anomalies are not associated with these items and it is difficult to determine whether the anomalies are related to military munitions or other underground structures.	All explosives and metals concentrations were below the EPA Region 9 PRGs.
Lusk Reservoir WSTPT-019-R-01 83 acres	It is recommended that this MRS be further investigated for MEC. Further evaluation of MC is not warranted at this time for this MRS; however, if further investigation at this MRS identifies MEC, additional sampling may be required.	No MEC was identified within this MRS during the visual survey. However, during a previous anomaly investigation and removal action conducted in 2001, three "ordnance or ordnance-related items" were identified within the northwest corner of this MRS.	All explosives and metals concentrations were below the EPA Region 9 PRGs.

Table 1-1 SI Recommendations (TLI, 2007) (Continued)

MRS	SI Recommendation	Basis for SI Recommendation (MEC)	Basis for SI Recommendation (MC)
Redoubt No. 2 WSTPT-020-R-01 20 acres	It is recommended that this MRS be further investigated for MEC. Further evaluation of MC is not warranted at this time for this MRS; however, if further investigation at this MRS identifies MEC, additional sampling may be required.	A subsurface anomaly density of 322 anomalies per acre was identified during the geophysical survey. Although no MEC or MD was observed during the visual survey, the potential exists for MEC to be found in this MRS.	All explosives and metals concentrations were below the EPA Region 9 PRGs.
Michie Stadium WSTPT-022-R-01 9.4 acres	It is recommended that this MRS be further investigated for MEC to determine the need to implement land use controls at the MRS, such as requiring construction support during all future excavation activities. Further evaluation of MC is not warranted at this time for this MRS; however, if further investigation at this MRS identifies MEC, additional sampling may be required.	No MEC or MD was found during the visual survey. However, during previous construction projects, 14 Stokes mortar rounds were found during excavation at the MRS.	All explosives and metals concentrations were below the EPA Region 9 PRGs.

1.6 WEST POINT DESCRIPTION

U.S. Army Garrison - West Point, West Point, New York, encompasses nearly 16,000 acres, of which approximately 14,000 acres are classified as operational range. The Phase 3 Range Inventory identified 10 closed ranges and 2 transferred areas, totaling approximately 1,564 acres. The MRSs at West Point include a series of batteries, which fired artillery during training throughout the Revolutionary War and continued to do so until World War II (WWII). The firing from these batteries was mainly directed toward Crows Nest and Target Hill, which were also impact zones for artillery fired from the West Point Foundry at Cold Spring, New York, in the mid to late 1800s. In addition to the batteries, MRSs include artillery ranges and small arms ranges. The total MRS area encompasses 673.5 acres. West Point has been occupied by the U.S. Army since 27 January 1778, and is the oldest occupied military post in America to have continuously flown the nation's flag.

1.6.1 Conceptual Site Model

The Conceptual Site Model (CSM) is a description of a site and its environment that is based on existing knowledge. The CSM describes the sources of MEC or MC hazards at a site, actual or potential pathways, current or proposed use of property, and potential receptors to MC or explosives hazards. The CSM provides a planning tool to integrate site information from a variety of sources, evaluate the information with respect to project objectives and data needs, and respond through an iterative process for further data collection or action. The CSM development should be viewed as a process that reflects the progress of activities at a site from initial assessment through site closeout. Depending on the complexity of the investigation, typical information needs include:

- Facility Profile – Describes man-made features at or near the site.
- Physical Profile – Describes factors that may affect release, fate, and transport.
- Land Use and Exposure Profile – Provides information used to identify and evaluate the applicable exposure scenarios and receptor locations.
- Ecological Profile – Describes the physical relationship between developed and undeveloped portions of the site, use of the undeveloped portions, and ecological use.
- Release Profile – Presents the extent of contaminants or hazards in the environment.

One primary CSM was developed for West Point (**Appendix C, Table C-1**). This CSM outlines characteristics, such as climate and geology, over the entire site. Separate CSMs of MRS-specific information were developed for each MRS. Descriptions and previous investigations conducted at each MRS are presented in the following subsections.

1.7 MUNITIONS RESPONSE SITE PROFILES

Information presented in the following sections was summarized from the Final Site Inspection Report (TLI, 2007).

1.7.1 Artillery Firing Range (WSTPT-001-R-01)

1.7.1.1 MRS Description

The Artillery Firing Range MRS (WSTPT-001-R-01) is a complex of ranges used from 1906 until the late 1930s. The MRS consists of 172.4 acres and is comprised of three overlapping former artillery ranges: Sacred Heart Cemetery Range, the Silver Depository Range, and the Adolphs Pond Range. The MRS includes three parcels of land located to the south and west of the main campus (**Appendix B, Figure B-3**). The two northern parcels of the MRS are adjacent to each other, and the third parcel is a non-contiguous parcel located to the south. The northeastern portions of the former artillery ranges extend beyond the installation boundary into the Crows Nest Formerly Used Defense Site (FUDS) area. In addition, a portion of the eastern edges of the Sacred Heart Cemetery Range and the Adolphs Pond Range are located within the Fort Clinton and Siege Battery MRSs and their northeastern corners extend over the Hudson River and make up a portion of the Siege Battery-TD MRS. Portions of the firing fans associated with the Lusk Reservoir and Redoubt No. 2 MRSs are also contained within the Artillery Firing Range MRS. Historical records indicate that the weapons potentially used at this MRS include the 2.95-inch Mountain Howitzer, 75mm gun M1897, 75mm gun M1907, 6-inch high capacity gun, 15-inch mortar, and 16-inch mortar. The CSM for the Artillery Firing Range MRS is presented in **Appendix C, Table C-2**.

1.7.1.2 Site Inspection Results

The SI field activities at the Artillery Firing Range MRS included a visual survey of approximately 25.2 line miles, a geophysical survey of approximately 3.7 line miles (1.5 acres), and collection of six surface soil samples and three sediment samples.

The following MD was observed during visual surveys:

- One slap flare (expended) was found near the Sacred Heart Cemetery.
- Two signal flares (expended) were found in and adjacent to Highway 218 and south of the golf course.
- Several MD items were found within the main portion of the MRS located along the golf course and to the north toward the Fort Clinton MRS. These items included fragments from Civil War era munitions, signal flares and components, a fuze from a hand grenade, and several small arms blanks.

Iron levels exceeding the U.S. Environmental Protection Agency (EPA) Region 9 preliminary remediation goal (PRG) were detected in two samples collected from within the Artillery Firing Range MRS. One sample was collected near the Sacred Heart Cemetery. The other sample was collected from a drainage area to the south of the Victor Constant Ski Slope. Neither sample was collected at a location where munitions-related materials were identified. The elevated levels of iron are believed to be naturally occurring in the soils at West Point. Because rock located in and around the West Point area has a highly oxidized iron content, it is assumed that the elevated level of iron in the soils is the result of these local geologic conditions. Background data regarding the naturally occurring level of iron in the soil were not available during the SI.

Trace amounts of explosives were detected in several of the samples; however, all results were below the screening criteria.

1.7.1.3 Other Previous Investigations

Several MEC investigations have been conducted in relation to the Crows Nest FUDS area, which is also referred to as Storm King State Park and Palisades Interstate Park. Munitions were fired from firing points located in the Artillery Firing Range MRS towards the Crows Nest impact area. Therefore, it is anticipated that MEC identified during the studies performed in the Crows Nest area may potentially be found within the Artillery Firing Range MRS.

In a 1994 survey of Crows Nest and the surrounding area, several types of UXO were identified. These UXO included a 2.25-inch projectile, a 15-inch mortar shell from the Civil War Era, and 75mm projectiles.

A Time Critical Removal Action (TCRA) was conducted from June through October 2000 at Palisades Park to clear trails, trailheads, firebreaks, and highway shoulders resulting in the on-site destruction of 23 UXO items. The items identified included 75mm ejection rounds, 75mm high explosive (HE) rounds, and 1907m Powder Train Time Fuzes (PTTF).

In April 2001, a geophysical survey was conducted in an area near the Lee Gate entrance at West Point. The survey area extended from the north at the intersection of Highway 218 and Lee Road to the West Point Elementary School and the Keller Army Hospital to the southwest. The area is bounded on the northwest by Highway 218 and on the southeast by the Lee Family Housing Area. The area of this study included portions of the Artillery Firing Range, Fort Clinton, and the Siege Battery MRSs. The survey identified 1,539 anomalies within the study area. The U.S. Army Engineering and Support Center in Huntsville, Alabama, evaluated the geophysical survey data and recommended that West Point conduct sampling in the area to determine whether the anomalies were munitions related. Sampling was not conducted because of a lack of funding. However, land use controls were implemented.

A July 2002 Engineering Evaluation/Cost Analysis (EE/CA) report indicates that a geophysical survey identified 7,165 anomalies that were investigated at the Storm King area, which encompasses the entire Palisades Park to the north and west of the Crows Nest area. Of these anomalies, nine were 75mm projectiles (HE and shrapnel), one was a 6-inch MK 34 projectile, and 476 were ordnance-related scrap. The nature of the remaining anomalies was not identified in the supporting documentation.

In addition to the EE/CA, a MEC removal action was completed at the Storm King area in 2004. The final report dated January 2006 (ATI, 2006) documents the recovery and treatment (detonation and venting) of 504 MEC items during the removal action. MEC recovered during the removal action include 75mm HE projectiles, 75mm shrapnel projectiles, M1907 fuzes, 75mm boosters, and 37mm boosters.

A 4-acre TCRA was completed in June 2009 at the Motor Pool and New Water Tower area of this MRS in support of the U.S. Military Academy Preparatory School (USMAPS) Base Realignment and Closure (BRAC) construction project. UXO construction support was also performed during deforestation activities. No MEC was identified during the TCRA. MD including a MK1A1 training hand grenade, M21 practice hand grenade, 30.06 caliber small arms blank, 75mm HE projectile frag, 37 mm HE projectile frag, and an expended carrier for a signal illumination round, were identified. A total of 433 pounds of scrap metal were recovered and recycled at the West Point motor pool. A total of 8 pounds of MD were transferred to Mercer Company, located in Sharon, Pennsylvania, for final disposition. An 8-inch Naval projectile, documented as UXO in the Explosive Ordnance Disposal (EOD) report, was identified during the UXO construction support activities.

1.7.2 Battery Knox – TD Land MRS (WSTPT-004-R-02)

1.7.2.1 MRS Description

The Battery Knox range extended from the west banks of the Hudson River to targets established in the river. The Battery Knox-TD Land MRS (WSTPT-004-R-02) is located across the river on the eastern bank in Putnam County (**Appendix B, Figure B-4**) and encompasses approximately 141 acres of privately owned land.

Battery Knox contained six gun positions and ammunition magazines. The battery was established sometime between 1836 and 1850. The battery was redesigned in 1874, with modifications made to the armament and the orientation of the guns to improve both their defensibility and their ability to cover the river with firepower. The battery was demolished during the WWII era. By 1892, Battery Knox was armed with one 100-pounder Parrott 6.4-inch caliber rifle, one 300-pounder Parrott 10-inch caliber rifle, one 8-inch converted rifle, and four 10-inch Rodman rifles.

The firing point of the battery was located on the bluff of the western bank of the Hudson River to the south of Gees Point. Firing from the battery was conducted to the east towards targets that were placed in the Hudson River; however, projectiles that overshot the targets may have impacted the eastern bank of the Hudson River, which includes the Battery Knox-TD Land MRS. Battery Knox-TD River (WSTPT-004-R-01) is not included in this investigation. The CSM for the Battery Knox – TD Land MRS is presented in **Appendix C, Table C-3**.

1.7.2.2 Site Inspection Results

The SI field activities conducted at the Battery Knox-TD Land MRS included approximately 22 line miles of visual surveys and the collection of 11 surface soil and sediment samples. No evidence of military munitions was observed during the visual survey.

Five sediment and six surface soil samples (including one QA and one quality control (QC) sample) were collected from within the Battery Knox-TD Land MRS. Analytical results for metals indicate iron levels exceeding the EPA Region 9 PRG for one sample collected from parcel 10 within the MRS. The elevated levels of iron are believed to be naturally occurring in the soils at West Point. Because rock at West Point has a highly oxidized iron content, it is assumed that the level of iron in the soils is the result of the local geologic conditions. Background data regarding the naturally occurring level of iron in the soil were not available during the SI.

Analytical results for explosives indicate trace amounts in numerous samples; however, the results were well below the screening criteria.

1.7.2.3 Other Previous Investigations

No previous investigations have been conducted at the Battery Knox-TD Land MRS.

1.7.3 Fort Clinton – West (WSTPT-008-R-01)

1.7.3.1 MRS Description

The Fort Clinton – West MRS (WSTPT-008-R-01) is a 14.4-acre area, which includes a part of the Lee Housing Area as well as undeveloped, heavily wooded terrain (**Appendix B, Figure B-5**).

Construction of Fort Clinton began on March 12, 1778, on the eastern portion of West Point. The fort was designed to provide fortification for the chain that was placed across the Hudson River. Practice firings were routinely conducted from the fort, which was equipped with brass 4-pounder, brass mortars, iron 12-pounder, iron 18-pounder, and 75mm guns. The fort was used for artillery training, with firing conducted to the northwest across the Hudson River through the 1830s. The fort was later used for the practice firing of 75mm guns towards Crows Nest from the mid-1800s until 1927.

The firing point of Fort Clinton was located on the top of the bluff to the southwest of Gees Point and is the eastern terminus of the Fort Clinton – West MRS. The direction of fire was to the northwest towards the Crows Nest Area. There are no known impact or target areas within the Fort Clinton MRS. The CSM for the Fort Clinton – West MRS is presented in **Appendix C, Table C-4**.

1.7.3.2 Site Inspection Results

The SI field activities conducted at the Fort Clinton – West MRS included approximately 6 line miles of visual surveys and the collection of one surface soil sample. Numerous fragments from Civil War era munitions were identified in the Fort Clinton – West MRS. Trace amounts of explosives were detected in one soil sample collected near a fragment found in the western portion of the MRS.

1.7.3.3 Other Previous Investigations

Several investigations for MEC have been conducted in relation to the Crows Nest FUDS area, which is also referred to as Storm King State Park and Palisades Interstate Park. The MEC identified in the Crows Nest FUDS area could have been fired from several locations within West Point, including Fort Clinton, the Artillery Firing Range, and the Siege Battery MRSs. It is anticipated, therefore, that the Fort Clinton – West MRS could contain MEC and MC similar to those identified in the Crows Nest FUDS studies.

In addition, a geophysical survey was conducted in an area near the Lee Gate entrance at West Point in April 2001. The survey area extended from the north at the intersection of Highway 218 and Lee Road to the West Point Elementary School and the Keller Army Hospital to the southwest. The area is bounded on the northwest by Highway 218 and on the southeast by the Lee Family Housing Area. The area of this study included portions of the Artillery Firing Range, Fort Clinton, and the Siege Battery MRSs. The survey identified 1,539 anomalies within the study area. The U.S. Army Engineering and Support Center in Huntsville, Alabama, evaluated the geophysical survey data and recommended that West Point conduct sampling in the area to determine whether the anomalies were munitions related. Sampling was not conducted because of a lack of funding. However, land use controls were implemented.

1.7.4 Grey Ghost Housing Area (WSTPT-010-R-01)

1.7.4.1 MRS Description

The Grey Ghost Housing Area MRS (WSTPT-010-R-01) is approximately 24 acres located in the central campus area, west of the batteries and athletic fields (**Appendix B, Figure B-6**). The MRS is comprised of a range complex that includes a 1,000-inch machine gun range and a rifle/pistol range. The firing points for the ranges were located at the northern end of the MRS and the direction of fire was towards the southwest. The targets for the ranges were located within the MRS near the base of a steep, heavily wooded hill. Operations conducted at the machine gun range occurred from approximately 1920 to 1940. During the 1920s to 1940s, the MRS was used by cadets for small arms training using a variety of weapon types, including .22 and .30 caliber machine guns. In addition, a rifle range was located in the area as early as 1939.

In November 1928, a recommendation was made to renovate the 1,000-inch machine gun range and to construct a pistol range at the same location. The pistol range was to be designed with 12 targets to permit firing at 75, 50, 25, and 15 yards. A rifle range to the west of the machine gun range appears on the 1939 map of West Point. The range was used for training with small arms ammunition no larger than .30 caliber.

Improvements in January 1939 included overhead protection at both the firing points and the target area and the addition of the brick storage facility for the storage of targets, ammunition, and paste for posting targets. Improvements also included the addition of an earth embankment approximately 20-feet high, using approximately 3,200 cubic yards of soil, at the target area for ricochet prevention and a new earth mound at the firing points. After 1950, the area was developed as a housing complex.

The Grey Ghost Housing Area MRS includes single and multi-family housing. In addition, the community includes a playground and limited greenbelts. The southern extent of the MRS is not developed and includes steep, heavily wooded terrain. The CSM for the Grey Ghost Housing Area MRS is presented in **Appendix C, Table C-5**.

1.7.4.2 Site Inspection Results

The SI field activities conducted at the Grey Ghost Housing Area MRS included approximately 8.8 line miles of visual surveys and the collection of two surface soil samples and one sediment sample.

No evidence of the small arms range target areas was observed during the visual surveys. In addition, no small arms debris was observed. Several MD items were identified within the MRS, including a 3-inch Stokes mortar round, fragments from other Stokes mortar rounds, and a fragment from a 37mm round. An Explosive Ordnance Disposal (EOD) unit investigated the Stokes mortar round and determined that it was sand-filled. The EOD unit transported the item from the MRS to the operational range area for disposal.

Metals concentrations in the samples were below the EPA Region 9 PRGs. Trace amounts of explosives were found in several of the samples; however, all results were below the screening criteria.

1.7.4.3 Other Previous Investigations

A March 4, 1997 memorandum from the Chief of the Environmental Division at West Point indicated that four soil samples were collected from the Grey Ghost Housing Area, and the analytical results for lead [ranging from 41 to 138 parts per million (ppm)] were below the allowable limit (400 ppm). However, there is no indication given as to the exact location of the samples. The memorandum further states that "the construction of the Grey Ghost Housing Area, the site disturbance resulting from utility repairs since construction, the file search, and recent test results precludes a high probability of unexploded ordnance within this area."

1.7.5 North Athletic Field (WSTPT-011-R-01)

1.7.5.1 MRS Description

The North Athletic Field MRS (WSTPT-011-R-01) is a 14-acre area located to the southwest of the Hudson River, within the central campus area of West Point (**Appendix B, Figure B-7**).

Maps from 1903 to 1935 delineate the location of target butts assumed to be associated with a rifle range in this area. The 1935 map delineates the target butts located within the area of the North Athletic Field MRS, as well as a 1,000-yard butt located north of the area along the shore of the Hudson River. Although the locations of the firing points for the rifle range are not known, it is assumed that they might have been located in the North Dock area where the direction of fire was to the northwest along the shoreline of the Hudson River.

In 1937, the Army Athletic Association started a project that consisted of the construction and expansion of athletic fields. Expansion of the North Athletic Field was accomplished by removing Target Hill so that the dirt could be used to fill the area toward the river and create the necessary fields. The removal of dirt from Target Hill began in 1944 and was completed in 1945. Approximately 60,000 square yards of level ground were added to the area comprising the North Athletic Field.

Because the North Athletic Field was constructed with fill from Target Hill, the area may contain munitions that were fired into the hill from the early 1800s until the late 1930s. Target Hill served as the impact area for artillery test-fired from the Cold Spring Foundry and heavy guns located in batteries on the north side of West Point. Target Hill continued to be used until the late 1930s, mostly by West Point cadets for short-range artillery training. Munitions associated with training at Target Hill include large caliber HE and practice rounds. In addition, ammunition from the former rifle range at the North Athletic Field may exist in the area.

The North Athletic Field MRS currently encompasses several athletic fields including the softball field complex, track, and a football field. The northern edge of the MRS is bounded by railroad tracks, a road, and the Hudson River. The CSM for the North Athletic Field MRS is presented in **Appendix C, Table C-6**.

1.7.5.2 Site Inspection Results

Activities conducted at the North Athletic Field MRS during the SI field work included approximately 5 line miles of visual survey, approximately 1.0 mile (0.4 acre) of geophysical survey, and the collection of one surface soil sample. No evidence of military munitions was observed at the MRS during the visual survey.

The geophysical survey was conducted across the athletic fields located at the North Athletic Field MRS between Shea Stadium and the softball field.

Metals concentrations in the soil sample were below the screening criteria. Trace amounts of explosives were detected in the sample; however, all results were below the screening criteria.

1.7.5.3 Other Previous Investigations

No previous investigations have been conducted at the North Athletic Field MRS. However, in June 1999, a UXO item identified as a 76mm M339, armor piercing-tracer (AP-T) was found at the MRS. This item was found during bleacher renovations at Shea Stadium, which is located at the North Athletic Field MRS. The item was buried; however, no other information regarding the location or condition of the item is available.

1.7.6 Seacoast Battery (WSTPT-013-R-01)

1.7.6.1 MRS Description

The Seacoast Battery MRS (WSTPT-013-R-01) is a 2-acre area on Constitution Island within the boundaries of West Point (**Appendix B, Figure B-8**). The Seacoast Battery in the North Dock area and the majority of the range fan are incorporated into the Seacoast Battery and Siege Battery MRSs.

Activities that took place on the installation that are associated with the Seacoast Battery MRS included live firing conducted from Seacoast Battery toward the bluffs on Constitution Island. The firing point of the battery was located in the North Dock Area and the direction of fire was to the north. Munitions used at Seacoast Battery included large caliber HE and practice rounds, and mortar rounds. The battery also included two brick buildings that contained instruments for measuring the velocity of projectiles and the recoil of guns. The shots were fired from the battery through parallel line wires at the west end of the battery. West of the battery, a small stone structure set into the hillside was used as a bursting chamber in which explosives were tested. The Seacoast Battery was established sometime between 1836 and 1850 and demolished sometime during WWII. The CSM for the Seacoast Battery MRS is presented in **Appendix C, Table C-7**.

1.7.6.2 Site Inspection Results

The SI field activities conducted at the Seacoast Battery MRS included approximately 4.4 line miles of visual survey and the collection of one surface soil sample. No evidence of military munitions was observed at the site during the visual survey.

Metals concentrations in the sample were below the screening criteria. No explosives were detected in the sample.

1.7.6.3 Other Previous Investigations

No other previous investigations have been conducted at the Seacoast Battery MRS.

1.7.7 Siege Battery (WSTPT-015-R-01)

1.7.7.1 MRS Description

Siege Battery MRS (WSTPT-015-R-01) is 179 acres and includes two non-contiguous areas (**Appendix B, Figure B-9**). The western portion of the MRS includes land located on the slope of the hill below the Battle Monument, at what is now called Trophy Point, and extends to the northwest. The eastern portion of the MRS is located on Constitution Island. A portion of the Siege Battery firing fan overlaps the firing fans of the Seacoast Battery, Rifle Range, Artillery Firing Range, and Fort Clinton, as well as the location of the firing point of the Seacoast Battery.

Activities that took place on the installation that are associated with the Siege Battery MRS included live firing conducted from the Siege Battery firing point located on top of the bluff south of the North Dock area. The direction of fire was to the north toward targets anchored in the Hudson River and to the northwest toward the Crows Nest area. There are no known impact areas within the Siege Battery MRS; however, projectiles that overshot the targets located in the Hudson River may have impacted the Constitution Island portion of the MRS. In addition, target butts for a 1,000-yard Rifle Range were also located within the Siege Battery MRS.

Various munitions were used at Siege Battery, including a 4½-inch rifled gun, 30-pounder Parrott guns, 10-inch smooth bore siege mortars, 8-inch smooth bore siege mortars, 5-inch steel breech-loading guns, 7-inch steel breech-loading howitzers, 7-inch steel breech-loading mortars, and 3.2-inch guns. Full charges were not used in any of the guns. Use of the Siege Battery ended between 1906 and 1910, when Battery Schofield came into service. A map from 1939 indicates that the Siege Battery and Battery Schofield were replaced by an amphitheatre.

The western portion of the Siege Battery MRS is developed and includes roads, parking lots, various buildings, and the Lee Housing Area. Undeveloped areas within the MRS are steep, heavily wooded terrain. The eastern portion of the MRS is located on Constitution Island and is undeveloped. Siege Battery – TD River (WSTPT-016-R-01) is not part of this investigation. The CSM for the Siege Battery MRS is presented in **Appendix C, Table C-8**.

1.7.7.2 Site Inspection Results

Activities conducted at the Siege Battery MRS during the SI field work included approximately 40 line miles of visual surveys, 2.7 line miles (1.1 acres) of geophysical surveys, and the collection of one sediment sample and seven surface soil samples.

One MEC item, a 3-inch Stokes mortar round, was found within the portion of the MRS located on Constitution Island. An EOD unit removed the item from the MRS and transported it to the operational range area where it was detonated.

Numerous MD items were identified within the Constitution Island and the western portions of the MRS. A majority of the MD were fragments related to Civil War Era munitions.

A geophysical survey was conducted in the western portion of the MRS between the Target Hill MRS and the Lee Housing Area.

Metals concentrations in the samples were below the screening criteria with the exception of two soil samples in which iron exceeded the EPA Region 9 PRG. One of these samples was collected on Constitution Island at the location where a cast iron fragment was found. The other sample was collected in the eastern portion of the MRS where no evidence of military munitions was observed. Therefore, it is assumed that this iron detection was the result of the naturally occurring iron content of the soil. Trace amounts of explosives were detected in several samples; however, all results were below the screening criteria.

1.7.7.3 Other Previous Investigations

Several MEC investigations have been conducted in relation to the Crows Nest FUDS area, which is also referred to as Storm King State Park and Palisades Interstate Park. The MEC identified in the Crows Nest FUDS area could have been fired from several locations within West Point including the Siege Battery, the Artillery Firing Range, and Fort Clinton. Thus the Siege Battery Range could contain MEC and MC similar to those identified in the Crows Nest studies, because some of the munitions found in Crows Nest were fired from the firing points within the Siege Battery.

In April 2001, a geophysical survey was conducted in an area near the Lee Gate entrance at West Point. The survey area extended from the north at the intersection of Highway 218 and Lee Road to the West Point Elementary School and the Keller Army Hospital to the southwest. The area is bounded on the northwest by Highway 218 and on the southeast by the Lee Family Housing Area. The area of this study included portions of the Artillery Firing Range, Fort Clinton, and the Siege Battery MRSs. The survey identified 1,539 anomalies within the study area. The U.S. Army Engineering and Support Center in Huntsville, Alabama, evaluated the geophysical survey data and recommended that West Point conduct sampling in the area to determine whether the anomalies were munitions related. Sampling was not conducted because of a lack of funding. However, land use controls were implemented.

1.7.8 Target Hill (WSTPT-017-R-01)

1.7.8.1 MRS Description

The Target Hill MRS (WSTPT-017-R-01) is a 14-acre area located within the West Point campus area north of the athletic fields, near the western bank of the Hudson River. It is bounded on the east by the West Shore Railroad and the Hudson River (**Appendix B, Figure B-10**). This MRS is surrounded by Siege Battery and overlaps both the range fans for Siege Battery and Fort Clinton.

Artillery firing toward Target Hill may have begun as early as the War of 1812 with rounds being fired into the hill from the Cold Spring Foundry located across the Hudson River. By 1890, the hill was used as target practice for batteries located along the north side of the installation. Target Hill continued to be used as an impact area until the late 1930s by West Point cadets for short-range artillery training. Munitions associated with training at Target Hill include large caliber HE and practice rounds. In 1903, 1,000 yard target butts were identified on Target Hill. The firing point associated with these butts was located on Target Flats in the area of the North Athletic Field. Between 1944 and 1945, approximately 60,000 square yards of soil were removed from Target Hill to level the North Athletic Field. This resulted in the removal of the impact area known as Target Hill.

The West Point Rugby Center is located on the northern portion of the Target Hill MRS, and soccer fields are located in the southern portion of the MRS. The eastern edge of the MRS is bordered by a road, railroad tracks, and the Hudson River. The CSM for the Target Hill MRS is presented in **Appendix C, Table C-9**.

1.7.8.2 Site Inspection Results

The SI field activities at Target Hill included approximately 4.4 line miles of visual survey, approximately 1.2 miles (0.5 acre) of geophysical mapping, and the collection of one surface soil sample. No evidence of military munitions was observed at the MRS during the visual survey.

A geophysical survey was conducted across Target Hill in the area south of the Rugby Center construction site.

Metals concentrations in the sample were below the screening criteria. Trace amounts of explosives were detected in the sample; however, all results were below the screening criteria.

1.7.8.3 Other Previous Investigations

No other previous investigations have been conducted at the Target Hill MRS; however, during the construction of the Rugby Center, UXO technicians provided construction support. No evidence of MEC has been reported.

1.7.9 Lusk Reservoir (WSTPT-019-R-01)

1.7.9.1 MRS Description

The Lusk Reservoir MRS (WSTPT-019-R-01) consists of 83.19 acres and is located in the central portion of the West Point campus. The firing point is located to the east of Lusk Reservoir and the fan extends to the northwest to where it intersects with the range fan for the Artillery Firing Range (**Appendix B, Figure B-11**).

Guns were fired from the east side of Lusk Reservoir at targets located on Crows Nest in 1909, 1914, 1915, and 1916. The direction of fire was to the northwest from the firing point. There are no known impact areas within the Lusk Reservoir MRS. The firing in 1915 and 1916 was described as sub-caliber and service target practice. Based on the time period of use for this MRS, it is assumed that the weapons used at Lusk Reservoir were similar to those identified for use at the Artillery Firing Range and might have included 2.95-inch Mountain Howitzers, 75mm gun M1897, 75mm gun M1907, 6-inch high capacity gun, 15-inch mortar, and 16-inch mortar.

The majority of the land within the Lusk Reservoir MRS is undeveloped and includes steep, heavily wooded terrain; however, the western end of the MRS is developed and includes a portion of the Grey Ghost Housing Area and West Point Elementary School. The CSM for the Lusk Reservoir MRS is presented in **Appendix C, Table C-10**.

1.7.9.2 Site Inspection Results

The SI field activities conducted at Lusk Reservoir included approximately 14.5 line miles of visual survey and the collection of one surface soil sample and one sediment sample. No evidence of military munitions was observed at the MRS during the visual survey. However, two metal items were found, one of which was possibly a mold. It is uncertain whether the items were related to military munitions.

Metals concentrations in the samples were below the screening criteria. Trace amounts of explosives were detected in the sediment sample; however, all results were below the screening criteria. No explosives were detected in the surface soil sample.

1.7.9.3 Other Previous Investigations

In September 2000, a digital geophysical mapping project was conducted at the construction site for a gymnasium at the West Point Elementary School. As a follow-up to the geophysical study, an anomaly investigation and UXO removal was conducted in 2001. As reported, three ordnance or ordnance-related items were identified at the MRS: a 6½-inch projectile, rifled; a portion of an 8-inch Parrott round; and a fragment from an 8-inch Parrott round. According to the report compiled following the study, "scouring and deformation on the rear of the 6½-inch projectile indicate it might have deflected at a shallow angle." Also, the report stated that the two 8-inch Parrott fragments appeared to fit together even though they were recovered over 75 feet apart. This may indicate that the projectile exploded in the area. Although the location from which these items were fired could not be determined, it is possible that the source could have been the firing point to the east of Lusk Reservoir.

1.7.10 Redoubt No. 2 (WSTPT-020-R-01)

1.7.10.1 MRS Description

The Redoubt No. 2 MRS (WSTPT-020-R-01) consists of approximately 20 acres located east of the intersection of Highways 218 and 9W and west of Dassori Pond. The firing point is located in the vicinity of historical Redoubt No. 2 and the fan extends to the north to encompass land not addressed by other closed ranges or operational range area (**Appendix B, Figure B-12**).

Field artillery target practice with service ammunition to be fired at targets on Crows Nest from a position near Redoubt No. 2 occurred in 1915 and 1916. The direction of fire was to the north. There are no known impact areas within the Redoubt No. 2 MRS. Based on the time period of use for this MRS, it is assumed that the weapons used at Redoubt No. 2 were similar to those identified for use at the Artillery Firing Range and might have included 2.95-inch Mountain Howitzers, 75mm gun M1897, 75mm gun M1907, 6-inch high capacity gun, 15-inch mortar, and 16-inch mortar.

The Redoubt No. 2 MRS is primarily undeveloped and encompasses steep, heavily-wooded terrain. Several roads cross the MRS and a few buildings are spaced intermittently throughout the MRS. The firing point of the range is located south of the Stony Lonesome Housing Area and adjacent to the historical Redoubt No. 2, which is a cultural site. The CSM for the Redoubt No. 2 MRS is presented in **Appendix C, Table C-11**.

1.7.10.2 Site Inspection Results

Activities conducted at Redoubt No. 2 during the SI field work included approximately 9.5 line miles of visual survey, approximately 2.0 miles (0.8 acre) of geophysical mapping, and the collection of four surface soil samples. No evidence of military munitions was observed at the MRS during the visual survey.

Metals concentrations in the surface soil samples were below the screening criteria. Trace amounts of explosives were detected in the samples; however, all results were below the screening criteria.

1.7.10.3 Other Previous Investigations

No other previous investigations have been conducted at the Redoubt No. 2 MRS. However, in April 1996, eight 105mm artillery casings were found near Building 1245, which is located within Redoubt No. 2. The items were found by a work crew excavating fill dirt from around the building and were buried at a depth of several inches. An EOD unit picked up the items for disposal and determined that no other threat existed in the remainder of the fill. The items were heavily corroded and, according to EOD, did not present a hazard. No one involved with the incident had any knowledge that artillery casings had been disposed in the area.

1.7.11 Michie Stadium (WSTPT-022-R-01)

1.7.11.1 MRS Description

The Michie Stadium MRS (WSTPT-022-R-01) encompasses approximately 9.4 acres in and around Michie Stadium, which is located near the center of the Main Post area and to the west of Lusk Reservoir (**Appendix B, Figure B-13**).

Michie Stadium was constructed in 1924. The area surrounding Michie Stadium includes several athletic complexes (the Holleder Center, Howze Field, the Kimsey Athletic Center, and Randall Hall). During two separate construction projects completed around the stadium in 2001 and 2003, 14 Stokes mortar rounds were identified and disposed by an EOD unit or the Range Control Office at West Point.

A seismic upgrade was completed at the west stands of Michie Stadium during 2001. This project including adding pilings to the west stands to make them more stable. During this project, five 3-inch MI1 Stokes mortar rounds were found in the area. Randall Hall was constructed between the west stands of Michie Stadium and the Kimsey Athletic Center beginning in September 2003. During the construction of Randall Hall, nine additional 3-inch MK1 Stokes mortar rounds round were found.

Although several Stokes mortar rounds have been identified in the area around Michie Stadium, when or how the items were brought to the MRS is not known. Stokes mortars were used by the Army during World War I until just before the beginning of WWII. It does not appear that the mortar rounds found near Michie Stadium had been fired; therefore, it is assumed they are discarded military munitions. It is possible that the items were discarded following training activities that might have occurred at the MRS or the items might have been brought to the MRS in the fill dirt that was used during the construction of the stadium and surrounding structures.

The Michie Stadium MRS is extensively developed with athletic facilities, parking lots, and roads. A small area along the northern edge of the MRS includes wooded, hilly terrain. The CSM for the Michie Stadium MRS is presented in **Appendix C, Table C-12**.

1.7.11.2 Site Inspection Results

The SI field activities conducted at Michie Stadium included approximately 2.2 line miles of visual survey and the collection of one surface soil sample. No evidence of military munitions was observed at the MRS during the visual survey.

Metals concentrations in the surface soil sample were below the screening criteria. Trace amounts of explosives were detected in the sample; however, all results were below the screening criteria.

1.7.11.3 Other Previous Investigations

No other previous investigations have been conducted at the Michie Stadium MRS.

2. TECHNICAL MANAGEMENT PLAN

2.1 PROJECT OBJECTIVES

The goal for this project is to characterize the nature and extent of MEC and MC and achieve a RI at each of the 11 West Point MRSs identified in the SI and PWS. The following project objectives will be met:

- Characterize potential explosive hazards on the surface and in the subsurface at each MRS.
- Characterize MC contamination in soil at each MRS.
- Perform a hazard assessment for MEC.
- Perform a baseline risk assessment for MC.
- Determine whether no further action is warranted or whether a remedial action is required.

For the Michie Stadium (WSTPT-022-R-01) MRS, if the option to achieve Remedy-in-Place (RIP) is exercised by the Army and the data show that remedial action is warranted, WESTON will evaluate various remedial alternatives in a feasibility study (FS), select and document a remedial action in coordination with the stakeholders and the public, and implement the remedy in accordance with the CERCLA process.

For MRSs that achieve site close-out following completion of the RI, WESTON will complete all site close-out documentation, as well as properly abandon all groundwater monitoring wells to meet the requirements of the performance objectives identified in the PWS (**Appendix A**).

2.2 PROJECT ORGANIZATION

The WESTON project team has the technical and administrative abilities required to safely and efficiently complete the RI at West Point. WESTON will staff positions from our West Chester, Pennsylvania office for investigation activities. MC investigation and community relations support will be provided by our team subcontractor, TLI Solutions, for all West Point MRSs.

The following sections describe the roles and responsibilities of the project personnel shown on the organization chart (**Figure 2-1**). All project personnel will meet the necessary training and experience requirements for their assigned positions. Key project personnel will provide guidance and draw support from WESTON field staff. The project support staff also includes administrative personnel, contract administrators, cost controllers, risk assessors, technical editors, and information management specialists. On an as-needed-basis, subcontractors will provide support to the project. Contact information for project personnel is provided in **Appendix D**. Resumes for project personnel are provided in **Appendix E**.

2.2.1 Project Staff - Weston Solutions, Inc.

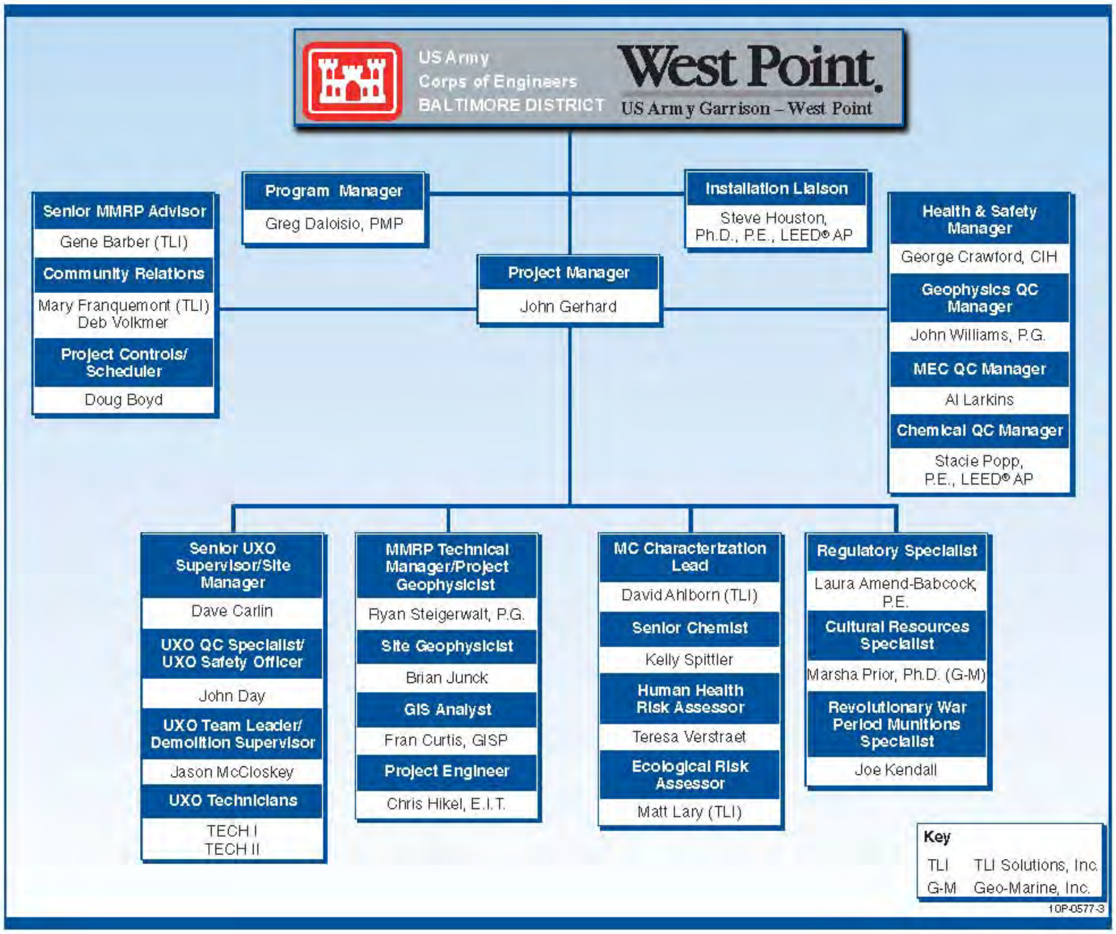
2.2.1.1 Project Manager

John Gerhard, who is the primary point of contact (POC) for the project, has the overall responsibility for the day-to-day management of project activities. He is responsible for interacting with WESTON, USACE, and West Point personnel to ensure that the RI is executed according to the PWS and project plans.

The duties of the Project Manager (PM) include:

- Maintaining the Project Management Plan.
- Supervising the day-to-day activities of resources to achieve project goals.
- Ensuring on-time completion and approval of deliverables.
- Ensuring compliance with the Quality Assurance Surveillance Plan (QASP).
- Notifying management of needed resources and obtaining resource commitment.
- Ensuring implementation of project health and safety and QC procedures.
- Monitoring daily cost and schedule control.
- Maintaining effective communications with stakeholder POCs.
- Preparing project status reports as required.

Figure 2-1 Organizational Chart



2.2.1.2 Geophysical Personnel

The geophysical team consists of the Project Geophysicist, Site Geophysicist, and trained geophysical survey teams.

2.2.1.2.1 MMRP Technical Manager/ Project Geophysicist

Ryan Steigerwalt, P.G., is the MMRP Technical Manager and Project Geophysicist responsible for all technical matters, including project coordination, achieving project objectives, and staff guidance. He is also responsible for determining geophysical methods that will be employed on this project. His duties include selecting proper instrumentation and navigational equipment, design and implementation of a geophysical investigation plan to accomplish the project's objectives, oversight of field geophysical activities, and assurance of the overall quality and integrity of the geophysical effort. Mr. Steigerwalt will also be responsible for analyzing and directing anomaly selection for reacquisition and digital geophysical mapping (DGM) QC verification mapping. The MMRP Technical Manager and Project Geophysicist will work in close coordination with the PM, Senior UXO Supervisor (SUXOS), Site Geophysicist, Geographic Information System (GIS) Analyst, and Senior Chemist.

2.2.1.2.2 Site Geophysicist

Brian Junck, the Site Geophysicist. will be responsible for the overall coordination of data acquisition and performing data processing and analysis. The Site Geophysicist will also be responsible for reviewing data, monitoring technical performance of field teams, and coordinating with the field teams in the development of field reports. The Site Geophysicist will be responsible for the preparation of target dig lists and dig sheets, coordination of target reacquisition, and review of the results of excavations.

2.2.1.2.3 Experienced Geophysical Teams

The geophysical survey teams will coordinate with the Site Geophysicist and SUXOS for field activities. The teams will be responsible for following geophysical standard operating procedures (SOPs), recording/logging data collection activities, downloading raw data from personal digital assistants (PDSs) and field computers, and maintaining equipment. The geophysical survey teams will be responsible for coordinating with the Site Geophysicist and SUXOS in planning field data acquisition schedules a day in advance and providing daily field summaries of geophysical activities.

2.2.1.3 UXO Qualified Personnel

2.2.1.3.1 Senior UXO Supervisor

Dave Carlin, the SUXOS, will be the senior subject matter expert in the field during the execution of this RI. The SUXOS responsibilities include:

- Planning, coordinating, and supervising on-site MEC-related activities.
- Implementing procedures and guidance for MEC operations (ensuring compliance with Department of Defense (DoD) directives and federal, state, and local statutes and codes).
- Certifying material potentially presenting an explosive hazard (MPPEH) and/or range scrap as ready for turn-in or disposal.
- Maintaining administrative records of the project.
- Supervising multiple project teams during the RI that are performing MEC and MEC-related activities, such as:
  - UXO escort for vegetation clearance, land surveying, and anomaly avoidance.
  - Mag & dig surveys.
  - Demolition activities.
  - Transporting and storing explosive material.

The SUXOS will report directly to the WESTON PM and will have an open line of communication with the UXO Quality Control Specialist (UXOQCS) and the UXO Safety Officer (UXOSO).

2.2.1.3.2 UXO Quality Control Specialist and UXO Safety Officer

John Day, the UXOQCS and UXOSO, will be the single POC for on-site quality and safety issues. Mr. Day will be responsible for monitoring site activities for compliance with plans, procedures, and regulations relative to the health and safety of employees, project members, land users, residents, and visitors. As the UXOQCS, he is additionally responsible for:

- Monitoring activities affecting quality during clearance activities.
- Ensuring that procedures are being carried out in accordance with established requirements and protocols.

- Understanding WESTON's and the project's quality-related requirements and the plans and procedures that implement them.
- Performing QC activities.
- Preparing the Daily Quality Control Report (DQCR).

As the UXOSO, he is additionally responsible for:

- Monitoring MEC investigation, removal, and demolition activities for compliance with health and safety requirements as established in plans and procedures.
- Understanding WESTON's and the project's requirements, and the plans and procedures to be implemented.

The UXOQCS/UXOSO reports to the WESTON PM for project-specific direction and will have a direct line of communication with the corporate MEC Operations Manager and Program H&S Manager for administrative and technical direction on quality and health and safety matters. Mr. Day will have open frequent communications with the SUXOS and UXOQCS.

2.2.1.3.3 UXO Technicians

UXO technicians will be required to perform mag & dig, reacquisition, removal, and disposal operations at locations where anomalies are detected. The technicians will be responsible for locating, investigating, identifying, removing, and disposing of all MEC, MPPEH, and MD recovered. In addition, they will be responsible for documenting required information identified in this work plan. UXO technicians will meet the qualifications of a UXO Technician I at a minimum and be under the direct supervision of a UXO Technician III. UXO technicians will meet the requirements of U.S. Department of Defense Explosives Safety Board (DDESB) Technical Paper (TP) 18, Minimum Qualifications for Unexploded Ordnance Technicians and Personnel (DoD, 2004).

Mag & dig transect teams will be composed of two UXO technicians managed by at least one UXO Technician III. Each UXO Team participating in intrusive operations will be comprised of one UXO Technician III and one UXO Technician II. One or two additional UXO qualified technicians will supplement the UXO Team based on grid size and location.

2.2.1.3.3.1 UXO Technician III

The UXO Technician III supervises a project team performing work on this project. The UXO Technician III may also serve in the capacity of Demolition Supervisor during demolition and explosive demilitarization operations. The UXO Technician III is responsible for:

- Supervising the team to which he/she is assigned.
- Providing the MEC subject matter expertise to ensure the team's safety and the project's quality.
- Ensuring the team's actions are accomplished safely and efficiently.
- Maintaining administrative records related to the team's operations.
- Implementing the work, safety, and quality plans for this project.
- Supervising the conduct of all on-site evaluations directly related to MEC operations.
- Being familiar with the duties of all assigned personnel and being able to perform all of the functions enumerated for UXO Technicians I and II.

If assigned as a Demolition Supervisor during demolition operations, the UXO Technician III is also responsible for:

- Training all personnel regarding the nature of the materials, hazards, and precautions.
- Coordinating with the SUXOS to ensure all notifications are completed prior to demolition.
- Being present and in direct control during all on-site disposal operations.

The UXO Technician III will report directly to the SUXOS and will have the experience and qualifications documented in DDESB TP-18.

2.2.1.3.3.2 UXO Technicians II or I

The UXO Technician I or II is the primary MEC worker on the site. UXO Technicians I or II will report directly to the UXO Technician III and will have the experience and qualifications documented in DDESB TP-18.

2.2.1.4 GIS Analyst

Fran Curtis, GISP, the Geographic Information System (GIS) Analyst, will be responsible for preparing geophysical survey track maps, tracking MEC, incorporating WESTON's RespondFast^{SM} database tools, and performing database backups. The GIS Manager or her delegate will be responsible for creating, maintaining, and providing GIS databases with accompanying metadata in accordance with Federal Geographic Data Committee (FGDC) standards.

2.2.1.5 Senior Chemist

The Senior Chemist will ensure that the work performed is in accordance with the Quality Assurance Project Plan (QAPP), this Work Plan, SOPs, and other pertinent analytical procedures. The Senior Chemist will be responsible for sample tracking, data management, laboratory coordination, data interpretation, analytical electronic data deliverables, and reports. The Senior Chemist will report to the MMRP Technical Lead and coordinate with the team subcontractor TLI.

2.3 PROJECT COMMUNICATION AND REPORTING

This section describes the coordination of and communication with stakeholders necessary to ensure the successful completion of the RI at West Point. Key stakeholders will be kept informed of project status, existing or potential problems, and changes required to manage the project.

WESTON will promote communication with stakeholders by using the secure, web-based TeamLink^{SM} system to facilitate electronic data-sharing/communication. TeamLink^{SM} provides an organized site for all stakeholders to post and view project information, provides a means of tracking project action items, and establishes various security levels to control which team members can view, access, and/or manipulate posted information. TeamLink^{SM} will provide West Point, the Army, EPA, New York State Department of Environmental Conservation (NYSDEC), and other stakeholders with direct, secure, and reliable electronic access to project-specific documents and data from anywhere they have internet access. If information technology (IT) security requirements present a problem, an ftp site will be utilized for data-sharing/communication.

2.3.1 Monthly Status Reports

WESTON will provide monthly status reports to update USACE on the status of the project. Monthly status reports will be submitted to the Contracting Officer's Representative (COR) and USACE Project Manager by the 15th of the following month and will provide summary information that includes, but is not limited to, work completed, work scheduled, technical issues, regulatory challenges/issues, issues that may hamper project schedule, and any other project-related issues raised by any of the stakeholders.

2.3.2 Daily and Weekly Status Reports

Progress status reports will be provided to USACE on a daily and weekly basis while conducting field work. WESTON will post an electronic version of the daily status report on the West Point TeamLink site on the next business day. Weekly status reports will be provided electronically to the USACE Project Manager early in the following work week. The weekly status report will include a summary of the previous week's daily reports in accordance with USACE DID MMRP-09-016, Periodic Status Report (USACE, 2009b).

2.3.3 Phone Conferences/Informal Site Meetings

Phone conferences and informal site meetings with USACE will be documented appropriately through follow-up email and summaries in the monthly status reports. Only the Contracting Officer (KO) or COR can provide official direction to WESTON.

2.3.4 Installation Action Plan Meetings

Contractors currently do not participate in the Installation Action Plan (IAP) meetings at West Point. If requested by West Point, WESTON will provide site information to support the IAP process, participate in the IAP meetings, and provide input and comments on the draft IAP, as appropriate.

2.3.5 Regulatory Negotiations

All regulatory coordination must be approved by West Point through the COR. The WESTON PM will provide the necessary support to initiate, schedule, and address all regulatory aspects of the project (e.g., organizing discussions with regulators concerning site response objectives and completion requirements, obtaining regulator comments on site documents and appropriately addressing them, and obtaining written documentation of investigation completion from the regulators for all of the sites identified in the PWS).

The COR, or designee, will attend and represent the Army at all meetings with the regulators. WESTON will prepare and submit minutes for all significant meetings attended. With approval of the COR, WESTON may also informally discuss investigative issues with regulators and provide a subsequent report to the COR.

The Army will be the signature authority for all regulatory agreements and investigative documentation.

2.4 PROJECT DELIVERABLES

Documents will be produced in draft (Army Internal Draft), draft-final, and final versions in both hard copy and electronic (PDF) format. The electronic format will have optical character recognition in accordance with the U.S. Army Environmental Command (USAEC) Repository of Environmental Army Documents (READ) requirements. WESTON will provide the number of copies of each submittal as requested by the various project stakeholders.

The COR will provide consolidated Army comments on draft documents to WESTON within 30 business days. Once initial comments are addressed, the Army will review draft-final documents before submission to appropriate regulatory agencies. All documents will be identified as draft-final until completion of stakeholder coordination, when they will be signed and finalized. One copy of the final document will be placed in both the project repository and the Administrative Record (for CERCLA documents).

2.5 PROJECT SCHEDULE

A resource-loaded project schedule is provided in **Appendix F** and shows the project tasks, deliverables, and milestones. This plan also identifies stakeholder involvement, milestones, and deliverables. Changes to the project schedule are likely to occur, and updated schedules will be submitted to USACE with the monthly status reports. Updated schedules will be made available to the project team at all times. Copies of the schedules will be kept at the site trailer and posted to TeamLink.

2.6 PUBLIC INVOLVEMENT

WESTON will not make available or publicly disclose any data or report generated under this contract unless specifically authorized by the KO through the COR. If any person or entity requests information about the subject of this PWS or work being conducted hereunder, WESTON will refer them to the COR. All reports and other information generated under this PWS shall become the property of the Government, and distribution to any other source by the WESTON is prohibited unless authorized by the KO.

All public participation coordination shall be approved by the KO through the COR. WESTON will provide the necessary support to initiate, schedule, and address all public participation aspects of the project (e.g., preparation of briefings, presentations, fact sheets, newsletters, and articles/public notices to news media). WESTON will be responsible for requesting and addressing all public comments consistent with applicable regulatory drivers. The COR, or designee, will attend and represent the Army at all meetings with the public.

West Point does not have an active Restoration Advisory Board (RAB). If a RAB is established, WESTON will be required to provide the necessary support (e.g., preparation and participation of briefings, presentations, fact sheets, newsletters, and notifications to RAB members). An MMRP Community Relations Plan (CRP) for the installation that is consistent with the West Point CRP is being developed for the installation.

2.7 SUBCONTRACTOR MANAGEMENT

The WESTON team includes the following experienced, pre-qualified subcontractors to meet the specific needs on this Delivery Order:

- TLI
  - Community outreach services, including solicitation of RAB interest, fact sheets, public notices, and facilitating public meetings.
  - Community Relations Plan.
  - Work Plan support and development of Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP).
  - MC and background sampling.

- Geophysical and UXO technician support, as needed during field work.
- Development of the RI Report, with MC sampling and ecological risk assessments.
- Participation in Technical Project Planning (TPP) meetings.

▪ Geo-Marine, Inc.
    - Update of the Integrated Cultural Resource Management Plan (ICRMP), relative to the MMRP RI field work if needed.
    - Participation in meetings, as requested.

Other services that will be subcontracted for this project include the following:

▪ Analytical laboratory.
▪ Data validation services.
▪ Professional land surveyors.
▪ Donor explosives vendors.

WESTON will use a pool of prequalified subcontractors and vendors with whom we have prior working relationships, primarily on DoD/USACE projects.

2.8 MANAGEMENT OF FIELD OPERATIONS

During field operations, WESTON will work with USACE and West Point to establish a site field office for the RI activities. The SUXOS will serve as the site manager for field operations. Field operation safety and quality will be monitored by the UXOSO and UXOQCS, respectively.

3. FIELD INVESTIGATION PLAN

3.1 OVERALL REMEDIAL INVESTIGATION APPROACH

The goal of the RI is to conduct an on-site investigation at the 11 West Point MRSs to gather sufficient data necessary to characterize the nature and extent of potential MEC and MC contamination. The overall RI approach includes the following:

- Development of Data Quality Objectives (DQOs) and data needs through the Technical Project Planning (TPP) process.
- Geophysical investigations utilizing both analog mag & dig and digital geophysical mapping (DGM) techniques to delineate the extent of potential MEC.
- Intrusive investigation of anomalies to evaluate the nature and extent of MEC.
- Site-specific media sampling (soil/sediment) and laboratory analysis to evaluate MC against accepted criteria.
- Removal and disposal of MEC, as necessary.
- Reporting of results through the TPP process throughout the RI to gain stakeholder concurrence.
- Update the CSM and MRSPP.
- Submittal of RI Report.

3.1.1 Site Characterization Goals

Analog and digital geophysical surveys will be performed at each of the 11 West Point MRSs to characterize the nature and extent of MEC and MC. Geophysical survey strategies for the RI are based on USACE guidance, Engineering Manual (EM) 1110-1-4009 (USACE, 2007). Statistical tools including UXO Estimator and Visual Sample Plan (VSP) (Pacific Northwest National Laboratory, 2009), aided in developing the survey design and coverage necessary to fully characterize each MRS for MEC. These tools calculate the area requiring geophysical investigation to ensure at a high level of confidence that MEC characterization has been achieved without performing full coverage surveys across each MRS. Geophysical investigations will be both grid and transect based as calculated by the statistical tools and subsequently tailored to the CSM (including former munitions use/MEC release profile, terrain, vegetation, accessibility) for each MRS to achieve coverage requirements. Full coverage surveys were recommended at the Seacoast Battery MRS because the MRS is relatively small in size and UXO Estimator requirements were close to 100% coverage of the Seacoast Battery MRS.

3.1.1.1 UXO Estimator Field Sampling Requirements

UXO Estimator was used to develop field sampling requirements at MRSs with a homogeneous distribution of MEC. The tool calculates the area requiring investigation based on anticipated MEC density, future land use, and the project-specific selected confidence level (selected as 95% for this project). This area calculated by UXO Estimator is the area that will be investigated during the RI to be 95% confident that MEC density is less than or equal to the density determined from the CSMs. This investigation area is randomly distributed across the MRS in order to meet the statistical requirements of the tool. The calculated investigation area will be geophysically surveyed using analog mag & dig and DGM techniques. The surveys will be grid and transect based, and all anomalies will be investigated for potential MEC.

The results of the investigation will be reviewed and confirmed by UXO Estimator to ensure that the confidence level is achieved. If MEC is observed at a greater density than anticipated for a MRS, additional investigations may need to be performed to meet the 95% confidence level. If the greater MEC density is not associated with military munitions related activities as defined by the current CSM of a MRS, the investigation approach may need to be revised to achieve data quality objectives. The density determination and the type and anticipated disposition of MEC will be discussed with the project team prior to revising the UXO Estimator investigation strategy.

Table 3-1 lists the West Point MRSs and anticipated MEC densities that will be investigated based on the UXO Estimator calculations. Data quality objectives and specific investigation strategies for the MRSs are presented in Section 3.1.2 Data Quality Objectives.

Table 3-1 UXO Estimator Input Values

Munitions Response Site	Anticipated MEC Density/Acre Based on Conceptual Site Model
Artillery Firing Range (WSTPT-001-R-01)	0.5 MEC/Acre
Battery Knox – TD Land (WSTPT-004-R-02)	0.5 MEC/Acre
Fort Clinton – West (WSTPT-008-R-01)	0.5 MEC/Acre
Grey Ghost Housing Area (WSTPT-010-R-01)	0.5 MEC/Acre
North Athletic Field (WSTPT-011-R-01)	0.5 MEC/Acre
Siege Battery (WSTPT-015-R-01)	0.5 MEC/Acre
Lusk Reservoir (WSTPT-019-R-01)	0.5 MEC/Acre
Redoubt No. 2 (WSTPT-020-R-01)	0.5 MEC/Acre
Michie Stadium (WSTPT-022-R-01)	0.5 MEC/Acre

3.1.1.2 Visual Sample Plan Field Sampling Requirements

The Visual Sample Plan (VSP) was used to develop field sampling plans at MRSs that have potential MEC releases whose locations are unknown. Transect spacing and placement was calculated to guarantee at a 95% confidence level (at a minimum) that a MEC release of a pre-determined size and shape will be traversed and detected. These transects will be traversed using geophysical surveys. Survey results will be evaluated to identify areas with increased anomaly density. Additional surveys may be performed to further delineate potential MEC releases and to evaluate the nature and type of geophysical anomalies detected. Data quality objectives and specific investigation strategies for the MRS are presented in Section 3.1.2 Data Quality Objectives.

3.1.1.3 Munitions Constituent Field Sampling Requirements

MC sampling will be performed during the RI in conjunction with the geophysical surveys, MEC removal, and MEC disposal. The results of the MC characterization will be used to perform a baseline risk assessment and support MRSPP scoring. Details of the MC investigation approach are provided in Section 3.13 Munitions Constituents Sampling Procedures. A complete MC Sampling Rationale Memorandum is provided in **Appendix G**. This memorandum describes the MC characterization approach and MC anticipated at each MRS based on former military munitions use.

3.1.2 Data Quality Objectives

To achieve these goals, data quality objectives (DQOs) were developed for each MRS based on EPA QA/G-4HW guidance. DQOs are qualitative and quantitative statements that define the type, quantity, and quality of data necessary to support the decision-making process during the RI. The DQO process includes the following seven steps:

1. **State the problem:** Provide a concise description of the problem.
2. **Identify the decisions:** Develop decision statements to solve the problem.
3. **Identify inputs to the decision:** Identify information and measurements needed to make the decisions.
4. **Define study boundaries:** Identify conditions such as spatial and temporal boundaries.
5. **Develop a decision rule:** Qualify the decisions to understand data needs.
6. **Specify tolerable limits on decision errors:** Develop performance criteria.
7. **Optimize the design:** Design an effective data collection strategy based on the previous steps.

On 29 July 2010, the West Point MMRP RI TPP 1 meeting was held to identify and discuss project goals and DQOs with project stakeholders. Representatives/stakeholders from USACE, Army Garrison–West Point, EPA, NYSDEC, WESTON, and TLI participated in the meeting. Details regarding the implementation of the MMRP RI were presented and discussed among the group. Investigation strategies and coverage required for each MRS were also presented as part of the meeting. TPP 1 meeting minutes are provided in **Appendix H**. Based on the results of the TPP 1 meeting, details of the individual investigation approaches for each MRS, including coverage area, survey type (grid or transect), and quantities, are provided in the MRS-specific field investigation plans presented in **Appendix I**. Development of the MRS DQOs are presented in the following sections.

3.1.2.1 Artillery Firing Range (WSTPT-001-R-01) Data Quality Objectives

1. State the problem: This MRS is associated with five overlapping former artillery ranges. The target area for these ranges was located north of West Point and not in this MRS. The land area associated with this MRS is located in the artillery range fans near the former firing points. MD was observed in the MRS; however, the approximate density of MEC, if present, has not been verified. MC may also be present if a MEC release is detected within the MRS.

Two former firing points are also located within the MRS. There is a potential for MC to be present at these locations because of former training activities. Burial of unused munitions was sometimes practiced during training. Buried MEC may be present at each of the firing points.

2. Identify the decisions: The primary decisions for this MRS include:

- Determine the approximate MEC density in the MRS based on UXO Estimator coverage requirements.
- If a MEC release is observed in the MRS, characterize the nature and extent of MEC and evaluate MC.
- Characterize the nature and extent of MC if it is detected at the two firing points.
- Detect and investigate the potential burial features associated with munitions disposal at the two firing points.

3. Identify inputs to the decision: Several inputs will be acquired during the course of the RI to support the decision. UXO Estimator requires that 5.78 acres be investigated to determine at a 95% confidence level that less than 0.5 MEC/acre is present within the MRS. DGM and mag & dig surveys will be performed along transects and in grids to accomplish the UXO Estimator requirements. All anomalies will be investigated. Intrusive results for MEC, MD, and non-MD will be evaluated in the project GIS. If a MEC release is detected, discrete or incremental soil and sediment sampling will be performed to determine whether MC is present. Incremental sampling will be performed at the firing points to determine the nature and extent of potential MC. DGM and intrusive investigations as necessary will be used to detect burial features at the firing points.

4. Define study boundaries: This MRS is a 172-acre area bounded to the north and south by operational range areas. The MRS also intersects with the Fort Clinton West and Lusk Reservoir MRSs. The extent of potential MEC and MC observed during the RI will be delineated using DGM, mag & dig, discrete MC sampling, and incremental MC sampling; however, operational range areas will not be accessed.

5. Develop a decision rule: The results of the RI at the Artillery Firing Range MRS will be used to:

- Assess, based on intrusive anomaly investigations, whether MEC density is less than 0.5 MEC/acre across the MRS.
- Reassess the characterization approach if MEC density is found to be greater than 0.5 MEC/acre or if the CSM is not valid.
- Determine whether MC is present at the firing points and fully characterize the nature and extent of MC.
- Determine whether MEC burial features are present at the firing points and determine the nature and extent of MEC at burial sites.

6. Specify tolerable limits on decision error: It is anticipated that a low density of MEC exists at this MRS because of its location near the firing points of the overall range fan complex. The characterization approach will confirm that less than 0.5 MEC/acre is present at the MRS. If there is less than 0.5 MEC/acre within the MRS, no additional MEC investigations will be required to validate MEC density. If MEC is identified during intrusive work within the MRS, additional sampling may be warranted to achieve the desired confidence level. Additional sampling will be performed only if the MRS is still assumed to have a low density of MEC consistent with the CSM for the MRS. Additional coverage requirements will be determined by UXO Estimator.

7. Optimize the design: DGM surveys using an EM61-MK2 and mag & dig surveys using White's XLT all metals detectors will be performed across the required 5.78 acres consistent with UXO Estimator assumptions. This includes ten 100 ft by 100 ft grids and approximately 2.9 miles of transects. Mag & dig surveys will be used in areas inaccessible to the DGM instrumentation. All anomalies will be investigated to determine the approximate MEC density. Survey locations are provided in **Appendix I-1**.

Sampling units will be established at each firing point. The size of the sampling units will be based on terrain and accessibility. Between 30 and 50 increments will be collected in each unit. Additional sampling will be performed at MEC release locations as necessary based on the geophysical survey and intrusive investigation results.

3.1.2.2 Battery Knox – TD Land (WSTPT-004-R-02) Data Quality Objectives

1. State the problem: This MRS is the land portion of the former Battery Knox Range located on the eastern side of the Hudson River. The direction of fire at the range was east at established targets within the river. Potential munitions overshots from training activities may have impacted the area of the Battery Knox Range fan where this MRS is located. No MEC or MD has been observed in this MRS; however, trace amounts of explosives were detected in soil samples collected during the SI. The explosives levels were below the USEPA Region 9 PRGs. Further investigation of MC was recommended in the SI. Also, the approximate density of MEC, if present, has not been verified. MC may also be present if a MEC release is detected within the MRS.

2. Identify the decisions: The primary decisions for this MRS include:

- Determine the approximate MEC density in the MRS based on UXO Estimator coverage requirements.
- If a MEC release is observed in the MRS, characterize the nature and extent of MEC and evaluate MC.
- Evaluate explosives concentrations in soils across the MRS based on SI analytical results.

3. Identify inputs to the decision: Several inputs will be acquired during the course of the RI to support the decision. UXO Estimator requires that 5.78 acres be investigated to determine at a 95% confidence level that less than 0.5 MEC/acre is present within the MRS. DGM and mag & dig surveys will be performed along transects and in grids to accomplish the UXO Estimator requirements. All anomalies will be investigated. Intrusive results for MEC, MD, and non-MD will be evaluated in the project GIS. If a MEC release is detected, discrete or incremental soil and sediment sampling will be performed to determine whether MC is present. Incremental sampling units will be placed across the MRS to evaluate the potential MC.

4. Define study boundaries: This MRS is a 141-acre area bounded to the west by the Hudson River. The eastern MRS boundary is defined by the topography where potential munitions overshots did not reach. The extent of potential MEC and MC observed during the RI will be delineated using DGM, mag & dig, discrete MC sampling, and incremental MC sampling.

5. Develop a decision rule: The results of the RI at the Battery Knox – TD Land MRS will be used to:

- Assess, based on intrusive anomaly investigations, whether MEC density is less than 0.5 MEC/acre in the MRS.
- Reassess the characterization approach if MEC density is found to be greater than 0.5 MEC/acre or if the CSM is not valid.
- Evaluate incremental sampling results for explosives to determine whether MC at this MRS will or will not require further response action.

6. Specify tolerable limits on decision error: It is anticipated that a low density of MEC exists at this MRS because no reported findings of MEC have been documented. The characterization approach will confirm that less than 0.5 MEC/acre is present at the MRS. If there is less than 0.5 MEC/acre within the MRS, no additional MEC investigations will be required to validate MEC density. If MEC is identified during intrusive work within the MRS, additional sampling may be warranted to achieve the desired confidence level. Additional sampling will be performed only if the MRS is still assumed to have a low density of MEC consistent with the CSM for the MRS. Additional coverage requirements will be determined by UXO Estimator.

Elevated MC (explosives) levels in soils across the MRS are not anticipated. Incremental sampling results will support this assumption. If MC concentrations above reporting limits are detected, additional sampling will be performed to determine the nature and extent of MC.

7. Optimize the design: DGM surveys using an EM61-MK2 and mag & dig surveys using White's XLT all metals detectors will be performed across the required 5.78 acres consistent with UXO Estimator assumptions. This includes six 100 ft by 100 ft grids and approximately 3.6 miles of transects. Mag & dig surveys will be used in areas inaccessible to the DGM instrumentation. All anomalies will be investigated to determine the approximate MEC density. Survey locations are provided in **Appendix I-2**.

Eleven incremental sampling units will be distributed across the MRS. Placement of the sampling units will be based on terrain and accessibility. Sampling units will not exceed 1 acre. Each sampling unit will consist of 50 increments. Additional sampling will be performed at MEC release locations as necessary based on the geophysical survey and intrusive investigation results.

3.1.2.3 Fort Clinton – West (WSTPT-008-R-01) Data Quality Objectives

1. State the problem: This MRS is associated with the former Fort Clinton artillery range. The firing point for this range was located to the south and east of the MRS. The target area for this range was located north of West Point and not in this MRS. MD has been observed in the MRS; however, the approximate density of MEC, if present, has not been verified. MC also may be present if a MEC release is detected within the MRS.

2. Identify the decisions: The primary decisions for this MRS include:

- Determine the approximate MEC density in the MRS based on UXO Estimator coverage requirements.
- If a MEC release is observed in the MRS, characterize the nature and extent of MEC and evaluate MC.

3. Identify inputs to the decision: Several inputs will be acquired during the course of the RI to support the decision. UXO Estimator requires that 4.26 acres be investigated to determine at a 95% confidence level that less than 0.5 MEC/acre is present within the MRS. DGM and mag & dig surveys will be performed along transects and in grids to accomplish the UXO Estimator requirements. All anomalies will be investigated. Intrusive results for MEC, MD, and non-MD will be evaluated in the project GIS. If a MEC release is detected, discrete or incremental soil and sediment sampling will be performed to determine whether MC is present.

4. Define study boundaries: This MRS is a 14.4-acre area bounded to the north and south by the Artillery Firing Range and Siege Battery MRSs. The northernmost extent of the MRS intersects with the operational range area. The extent of potential MEC and MC observed during the RI will be delineated using DGM, mag & dig, discrete MC sampling, and incremental MC sampling; however, the operational range areas will not be accessed.

5. Develop a decision rule: The results of the RI at the Fort Clinton – West MRS will be used to:

- Assess, based on intrusive anomaly investigations, whether MEC density is less than 0.5 MEC/acre in the MRS.
- Reassess the characterization approach if MEC density is found to be greater than 0.5 MEC/acre or if the CSM is not valid.

6. Specify tolerable limits on decision error: It is anticipated that a low density of MEC exists at this MRS because of its location near the firing points of the overall range fan complex. The characterization approach will confirm that less than 0.5 MEC/acre is present at the MRS. If there is less than 0.5 MEC/acre within the MRS, no additional MEC investigations will be required to validate MEC density. If MEC is identified during intrusive work within the MRS, additional sampling may be warranted to achieve the desired confidence level. Additional sampling will be performed only if the MRS is still assumed to have a low density of MEC consistent with the CSM for the MRS. Additional coverage requirements will be determined by UXO Estimator.

7. Optimize the design: DGM surveys using an EM61-MK2 and mag & dig surveys using White's XLT all metals detectors will be performed across the required 4.26 acres consistent with UXO Estimator assumptions. This includes ten 100 ft by 100 ft grids and approximately 1.6 miles of transects. Mag & dig surveys will be used in areas inaccessible to the DGM instrumentation. All anomalies will be investigated to determine the approximate MEC density. Survey locations are provided in **Appendix I-3**.

MC sampling will be performed at MEC release locations as necessary based on the geophysical survey and intrusive investigation results. Incremental and discrete sampling may be used. Incremental sampling will be used to characterize major MEC releases such as impact areas, and discrete sampling will be used where individual MEC appear to be releasing constituents because of low order detonation or corrosion.

3.1.2.4 Grey Ghost Housing Area (WSTPT-010-R-01) Data Quality Objectives

1. State the problem: This MRS is associated with a small arms range complex used by cadets between the 1920s and 1940s. Firing was directed from north to south into the steep hillside. Evidence of small arms training has not been observed during previous investigations. The northern section of the MRS is currently developed. MD has been observed in the MRS; however, the approximate density of MEC, if present, has not been verified. MC may also be present if a MEC release is detected within the MRS.

2. Identify the decisions: The primary decisions for this MRS include:

- Determine the approximate MEC density in the MRS based on UXO Estimator coverage requirements.
- If a MEC release is observed in the MRS, characterize the nature and extent of MEC and evaluate MC.

3. Identify inputs to the decision: Several inputs will be acquired during the course of the RI to support the decision. UXO Estimator requires that 4.78 acres be investigated to determine at a 95% confidence level that less than 0.5 MEC/acre is present within the MRS. DGM and mag & dig surveys will be performed along transects and in grids to accomplish the UXO Estimator requirements. All anomalies will be investigated. Intrusive results for MEC, MD, and non-MD will be evaluated in the project GIS. If a MEC release is detected, discrete or incremental soil and sediment sampling will be performed to determine whether MC is present.

4. Define study boundaries: This MRS is a 24-acre area bounded to the north by the Lusk Reservoir MRS. The southernmost extent of the MRS intersects with the operational range area. The extent of potential MEC and MC observed during the RI will be delineated using DGM, mag & dig, discrete MC sampling, and incremental MC sampling; however, operational range areas will not be accessed.

5. Develop a decision rule: The results of the RI at the Grey Ghost Housing Area MRS will be used to:

- Assess, based on intrusive anomaly investigations, whether MEC density is less than 0.5 MEC/acre in the MRS.
- Reassess the characterization approach if MEC density is found to be greater than 0.5 MEC/acre or if the CSM is not valid.

6. Specify tolerable limits on decision error: It is anticipated that a low density of MEC exists at this MRS because its former use was related to small arms training. The characterization approach will confirm that less than 0.5 MEC/acre is present at the MRS. If there is less than 0.5 MEC/acre within the MRS, no additional MEC investigations will be required to validate MEC density. If MEC is identified during intrusive work within the MRS, additional sampling may be warranted to achieve the desired confidence level. Additional sampling will be performed only if the MRS is still assumed to have a low density of MEC consistent with the CSM for the MRS. Additional coverage requirements will be determined by UXO Estimator.

7. Optimize the design: DGM surveys using an EM61-MK2 and mag & dig surveys using White's XLT all metals detectors will be performed across the required 4.78 acres consistent with UXO Estimator assumptions. This includes nine 100 ft by 100 ft grids and approximately 2.2 miles of transects. Mag & dig surveys will be used in areas inaccessible to the DGM instrumentation. All anomalies will be investigated to determine the approximate MEC density. Survey locations are provided in **Appendix I-4**.

MC sampling will be performed at the MEC release locations as necessary based on geophysical survey and intrusive investigation results. Incremental and discrete sampling may be used. Incremental sampling will be used to characterize major MEC releases such as impact areas, and discrete sampling will be used where individual MEC appear to be releasing constituents because of low order detonation or corrosion.

3.1.2.5 North Athletic Field (WSTPT-011-R-01) Data Quality Objectives

1. State the problem: Soil used as fill material was transported to this MRS from a former impact area known as Target Hill. The fill material may potentially include MEC. The fill material was used throughout the North Athletic Field MRS to level and increase the overall surface area. MEC was observed at this MRS during bleacher renovations. The approximate MEC density has not been verified. MC may also be present if a MEC release is detected within the MRS.

2. Identify the decisions: The primary decisions for this MRS include:

- Determine the approximate MEC density in the MRS based on UXO Estimator coverage requirements.
- If a MEC release is observed in the MRS, characterize the nature and extent of MEC and evaluate MC.

3. Identify inputs to the decision: Several inputs will be acquired during the course of the RI to support the decision. UXO Estimator requires that 4.36 acres be investigated to determine at a 95% confidence level that less than 0.5 MEC/acre is present within the MRS. DGM will be performed in grids to accomplish the UXO Estimator requirements. All anomalies will be investigated. Intrusive results for MEC, MD and non-MD will be evaluated in the project GIS. If a MEC release is detected, discrete or incremental soil and sediment sampling will be performed to determine whether MC is present.

4. Define study boundaries: This MRS is a 14-acre area bounded to the north and east by the Siege Battery MRS. The extent of potential MEC and MC observed during the RI will be delineated using DGM, discrete MC sampling, and incremental MC sampling.

5. Develop a decision rule: The results of the RI at the North Athletic Field MRS will be used to:

- Assess, based on intrusive anomaly investigations, whether MEC density is less than 0.5 MEC/acre in the MRS.
- Reassess the characterization approach if MEC density is found to be greater than 0.5 MEC/acre or if the CSM is not valid.

6. Specify tolerable limits on decision error: It is anticipated that a low density of MEC exists at this MRS because its former use was related to small arms training. The characterization approach will confirm that less than 0.5 MEC/acre is present at the MRS. If there is less than 0.5

MEC/acre within the MRS, no additional MEC investigations will be required to validate MEC density. If MEC is identified during intrusive work within the MRS, additional sampling may be warranted to achieve the desired confidence level. Additional sampling will be performed only if the MRS is still assumed to have a low density of MEC consistent with the CSM for the MRS. Additional coverage requirements will be determined by UXO Estimator.

7. Optimize the design: DGM surveys using an EM61-MK2 will be performed across the required 4.36 acres consistent with UXO Estimator assumptions. This includes nineteen 100 ft by 100 ft grids. All selected anomalies will be investigated to determine the approximate MEC density. Survey locations are provided in **Appendix I-5**.

MC sampling will be performed at MEC release locations as necessary based on the geophysical survey and intrusive investigation results. Incremental and discrete sampling may be used. Incremental sampling will be used to characterize major MEC releases such as impact areas, and discrete sampling will be used where individual MEC appear to be releasing constituents because of low order detonation or corrosion.

3.1.2.6 Seacoast Battery (WSTPT-013-R-01) Data Quality Objectives

1. State the problem: This MRS is the land area on Constitution Island that was part of the Seacoast Battery Range fan between the firing point located at the North Dock Area and the impact area on the bluffs of Constitution Island. No MEC or MD has been observed in the MRS. The approximate density of MEC, if present, has not been verified. MC may also be present if a MEC release is detected within the MRS.

2. Identify the decisions: The primary decisions for this MRS include:

- Determine the approximate MEC density in the MRS.
- If a MEC release is observed in the MRS, characterize the nature and extent of MEC and evaluate MC.

3. Identify inputs to the decision: Several inputs will be acquired during the course of the RI to support the decision. Mag & dig surveys will be performed in all accessible areas throughout the 2-acre MRS to provide a full coverage survey. All anomalies will be investigated.

Intrusive results for MEC, MD, and non-MD will be evaluated in the project GIS. If a MEC release is detected, discrete or incremental soil and sediment sampling will be performed to determine whether MC is present.

4. Define study boundaries: This MRS is a 2-acre area bounded to the south by the Hudson River and to the north by undeveloped recreational area of Constitution Island. The extent of potential MEC and MC observed during the RI will be delineated using mag & dig, discrete MC sampling, and incremental MC sampling.

5. Develop a decision rule: The results of the RI at the Seacoast Battery MRS will be used to:

- Assess, based on intrusive anomaly investigations, the MEC density in the MRS.

6. Specify tolerable limits on decision error: Full coverage mag & dig surveys will be performed in accessible areas of this MRS. Areas inaccessible to the mag & dig surveys will be tracked using GPS.

7. Optimize the design: Mag & dig surveys using White's XLT all metals detectors will be performed across the 2 acres to achieve full coverage. Mag & dig surveys will be performed in all accessible areas. All anomalies will be investigated to determine the approximate MEC density. Survey locations are provided in **Appendix I-6**.

MC sampling will be performed at MEC release locations as necessary based on the geophysical survey and intrusive investigation results. Incremental and discrete sampling may be used. Incremental sampling will be used to characterize major MEC releases such as impact areas and discrete sampling will be used where individual MEC appear to be releasing constituents because of low order detonation or corrosion.

3.1.2.7 Siege Battery (WSTPT-015-R-01) Data Quality Objectives

1. State the problem: This MRS is associated with the former Siege Battery range fan. The target area for this range was located north of West Point and not in this MRS. MEC and MD were observed in the MRS; however, the approximate density of MEC has not been verified. MC may also be present if a MEC release is detected within the MRS.

A former firing point is also located within the MRS. There is a potential for MC to be present at this location because of former training activities. Burial of unused munitions was sometimes practiced during training. Buried MEC may be present at the firing point.

Target butts for the former 1,000 yard rifle range were located within the MRS. No evidence of the target butts was identified during the SI visual surveys. The area in which these target butts may have been located has been developed for residential and Military Academy housing, classrooms, and recreation.

2. Identify the decisions: The primary decisions for this MRS include:

- Determine the approximate MEC density in the MRS based on UXO Estimator coverage requirements.
- If a MEC release is observed in the MRS, characterize the nature and extent of MEC and evaluate MC.
- Characterize the nature and extent of MC if it is detected at the firing point.
- Detect and investigate the potential burial features associated with munitions disposal at the firing point.
- Delineate potential MC if evidence of small arms range target butts is observed.

3. Identify inputs to the decision: Several inputs will be acquired during the course of the RI to support the decision. UXO Estimator requires that 5.86 acres be investigated to determine at a 95% confidence level that less than 0.5 MEC/acre is present within the MRS. DGM and mag & dig surveys will be performed along transects and in grids to accomplish the UXO Estimator requirements. All anomalies will be investigated. Intrusive results for MEC, MD, and non-MD will be evaluated in the project GIS. If a MEC release is detected, discrete or incremental soil and sediment sampling will be performed to determine whether MC is present. Incremental sampling will be performed at the firing point to determine the nature and extent of potential MC. DGM and intrusive investigations as necessary will be used to detect burial features at the firing point.

4. Define study boundaries: This MRS is 179.3 and split by the Hudson River. The eastern half of the MRS is located on Constitution Island, and the western half is located in the main part of the Garrison. The MRS encompasses the Target Hill MRS and part of the North Athletic Field MRS. The northern MRS boundary intersects with the operational range area. The extent of potential MEC and MC observed during the RI will be delineated using DGM, mag & dig, discrete MC sampling, and incremental MC sampling; however, operational range areas will not be accessed.

5. Develop a decision rule: The results of the RI at the Siege Battery MRS will be used to:

- Assess, based on intrusive anomaly investigations, whether MEC density is less than 0.5 MEC/acre in the MRS.
- Reassess the characterization approach if MEC density is found to be greater than 0.5 MEC/acre or if the CSM is not valid.
- Determine whether MC is present at the firing point and fully characterize the nature and extent of MC.
- Determine whether MEC burial features are present at the firing points and determine the nature and extent of MEC at burial sites.

6. Specify tolerable limits on decision error: It is anticipated that a low density of MEC exists at this MRS because of its location near the firing point of the overall range fan. The characterization approach will confirm that less than 0.5 MEC/acre is present at the MRS. If there is less than 0.5 MEC/acre within the MRS, no additional MEC investigations will be required to validate MEC density. If MEC is identified during intrusive work within the MRS, additional sampling may be warranted to achieve the desired confidence level. Additional sampling will be performed only if the MRS is still assumed to have a low density of MEC consistent with the CSM for the MRS. Additional coverage requirements will be determined by UXO Estimator.

7. Optimize the design: DGM surveys using an EM61-MK2 and mag & dig surveys using White's XLT all metals detectors will be performed across the required 5.86 acres consistent with UXO Estimator assumptions. This includes nine 100 ft by 100 ft grids and approximately 3 miles of transects. Mag & dig surveys will be used in areas inaccessible to the DGM instrumentation. All anomalies will be investigated to determine the approximate MEC density. Survey locations are provided in **Appendix I-7**.

Sampling units will be established at the firing point. The size of the sampling units will be based on terrain and accessibility. Between 30 and 50 increments will be collected in each unit.

Additional sampling will be performed at MEC release locations as necessary based on geophysical survey and intrusive investigation results. Incremental and discrete sampling may be used. Incremental sampling will be used to characterize large MEC releases such as impact areas, and discrete sampling will be used where individual MEC appear to be releasing constituents because of low order detonation or corrosion.

3.1.2.8 Target Hill (WSTPT-017-R-01) Data Quality Objectives

1. State the problem: This MRS was a former target areas associated with artillery training activities. Target butts for the former 1,000 yard small arms range fired from the North Athletic Field MRS were also at Target Hill. In 1944, soil was removed from Target Hill and used as fill at the North Athletic Field MRS. The MRS is now used for athletic fields. The current landscape is much different from the appearance of the area when it was used as the Target Hill impact area. No MEC has been reported at the MRS; however, part of the impact area may still be present. MC may also be present if a MEC release is detected within the MRS.

2. Identify the decisions: The primary decisions for this MRS include:

- Determine whether a MEC release is present within the MRS using VSP.
- If a MEC release is observed in the MRS, characterize the nature and extent of MEC and evaluate MC.

3. Identify inputs to the decision: Several inputs will be acquired during the course of the RI to support the decision. Initially, VSP input parameters were determined for the MRS based on historical and current conditions. The entire Target Hill was a former impact area for artillery training. The size of the impact area probably was reduced during the soil removal. Based on the current size of the MRS and the extent of development (e.g., utility corridors.) where no MEC has been reported, a 100-ft radius circular target radius was used as the VSP input. DGM transects will be traversed on a 52-ft spacing to ensure a high probability of detection (greater than 95%) of that circular target area. DGM will be performed in grids to evaluate the anomaly density variation that may be observed along the transects. Selected anomalies will be investigated. Intrusive results for MEC, MD, and non-MD will be evaluated in the project GIS. If a MEC release is detected, discrete or incremental soil and sediment sampling will be performed to determine whether MC is present. **Table 3-2** details the VSP parameters and coverage requirements for the Target Hill MRS.

Table 3-2 VSP Parameters and Coverage Requirements

VSP Parameter	VSP Input and Coverage Requirements
Munitions Response Site	Target Hill (WSTPT-017-R-01)
Shape of Target Area	Circular
Target Radius	100 ft
Anomaly Density Indicator	50 anomalies/acre
Transect Width	3.25 ft
Transect Spacing	48.75 ft (52 ft on centers)
Transect Distance	9,800 linear ft
Transect Acreage	0.74 acres

4. Define study boundaries: This MRS is a 14-acre area that is developed with athletic fields. The MRS is bounded by the Siege Battery MRS. The extent of potential MEC and MC observed during the RI will be delineated using DGM, discrete MC sampling, and incremental MC sampling.

5. Develop a decision rule: The results of the RI at the Target Hill MRS will be used to:

- Determine anomaly densities based on DGM transect surveys.
- Assess, based on intrusive anomaly investigations, whether increased anomaly densities represent MEC releases.

6. Specify tolerable limits on decision error: It is anticipated that a low density of MEC exists at this MRS after the soil removal. The characterization approach will confirm whether a MEC release with a circular 100-ft radius is present at the MRS. Additional surveys will be performed to completely characterize a MEC release if present.

7. Optimize the design: DGM transect surveys using an EM61-MK2 will be performed across the MRS at 52-ft spacings. Anomaly densities will be calculated from the transect surveys. Grids will be placed at varying anomaly densities and digitally mapped using the

EM61-MK2. Intrusive results at selected anomaly locations will be used to determine the nature of the anomalies detected. Four grids are anticipated to be required for this MRS. Survey locations are provided in **Appendix I-8**.

MC sampling will be performed at MEC release locations as necessary based on geophysical survey and intrusive investigation results. Incremental and discrete sampling may be used. Incremental sampling will be used to characterize major MEC releases such as impact areas, and discrete sampling will be used where individual MEC appear to be releasing constituents because of low order detonation or corrosion.

3.1.2.9 Lusk Reservoir (WSTPT-019-R-01) Data Quality Objectives

1. State the problem: This MRS is associated with the former Lusk Reservoir artillery range. The target area for this range was located north of West Point and not in this MRS. MEC and MD have been observed in the MRS; however, the approximate MEC density has not been verified. MC may also be present if a MEC release is detected within the MRS.

A former firing point is located within the MRS. There is a potential for MC to be present because of former training activities. Burial of unused munitions was sometimes practiced during training. Buried MEC may be present at the firing point.

2. Identify the decisions: The primary decisions for this MRS include:

- Determine the approximate MEC density in the MRS based on UXO Estimator coverage requirements.
- If a MEC release is observed in the MRS, characterize the nature and extent of MEC and evaluate MC.
- Characterize the nature and extent of MC if it is detected at the firing point.
- Detect and investigate the potential burial features associated with munitions disposal at the firing point.

3. Identify inputs to the decision: Several inputs will be acquired during the course of the RI to support the decision. UXO Estimator requires that 5.75 acres be investigated to determine at a 95% confidence level that less than 0.5 MEC/acre is present within the MRS. DGM and mag & dig surveys will be performed along transects and in grids to accomplish the UXO Estimator requirements. All anomalies will be investigated. Intrusive results for MEC, MD, and non-MD will be evaluated in the project GIS. If a MEC release is detected, discrete or incremental soil and sediment sampling will be performed to determine whether MC is present. Incremental sampling will be performed at the firing point to determine the nature and extent of potential MC. DGM and intrusive investigations as necessary will be used to detect burial features at the firing point.

4. Define study boundaries: This MRS is 83 acres and intersects the Artillery Firing Range, Grey Ghost Housing Area, and Fort Clinton – West MRSs. Part of the MRS is adjacent to the operational range area. The extent of potential MEC and MC observed during the RI will be delineated using DGM, mag & dig, discrete MC sampling, and incremental MC sampling; however, operational range areas will not be accessed.

5. Develop a decision rule: The results of the RI at the Lusk Reservoir MRS will be used to:

- Assess, based on intrusive anomaly investigations, whether MEC density is less than 0.5 MEC/acre across the MRS.
- Reassess the characterization approach if MEC density is found to be greater than 0.5 MEC/acre or if the CSM is not valid.
- Determine whether MC is present at the firing point and fully characterize the nature and extent of MC.
- Determine whether MEC burial features are present at the firing point and determine the nature and extent of MEC at burial sites.

6. Specify tolerable limits on decision error: It is anticipated that a low density of MEC exists at this MRS because of its location near the firing point of the overall range fan. The characterization approach will confirm that less than 0.5 MEC/acre is present at the MRS. If there is less than 0.5 MEC/acre within the MRS, no additional MEC investigations will be required to validate MEC density. If MEC is identified during intrusive work within the MRS, additional sampling may be warranted to achieve the desired confidence level. Additional sampling will be performed only if the MRS is still assumed to have a low density of MEC consistent with the CSM for the MRS. Additional coverage requirements will be determined by UXO Estimator.

7. Optimize the design: DGM surveys using an EM61-MK2 and mag & dig surveys using White's XLT all metals detectors will be performed across the required 5.75 acres consistent with UXO Estimator assumptions. This includes nine 100 ft by 100 ft grids and approximately 3 miles of transects. Mag & dig surveys will be used in areas inaccessible to the DGM instrumentation. All anomalies will be investigated to determine the approximate MEC density. Survey locations are provided in **Appendix I-9**.

Sampling units will be established at the firing point. The size of the sampling units will be based on terrain and accessibility. Between 30 and 50 increments will be collected in each unit. Additional sampling will be performed at MEC release locations as necessary based on geophysical survey and intrusive investigation results. Incremental and discrete sampling may be used. Incremental sampling will be used to characterize major MEC releases such as impact areas, and discrete sampling will be used where individual MEC appear to be releasing constituents because of low order detonation or corrosion.

3.1.2.10 Redoubt No. 2 (WSTPT-020-R-01) Data Quality Objectives

1. State the problem: This MRS is associated with the former Redoubt No. 2 artillery range. The target area for this range was located north of West Point and not in this MRS. MEC and MD have been observed in the MRS; however, the approximate MEC density has not been verified. MC also may be present if a MEC release is detected within the MRS.

A former firing point is located within the MRS. There is a potential for MC to be present because of former training activities. Burial of unused munitions was sometimes practiced during training. Buried MEC may be present at the firing point.

2. Identify the decisions: The primary decisions for this MRS include:

- Determine the approximate MEC density in the MRS based on UXO Estimator coverage requirements.
- If a MEC release is observed in the MRS, characterize the nature and extent of MEC and evaluate MC.
- Characterize the nature and extent of MC if it is detected at the firing point.
- Detect and investigate the potential burial features associated with munitions disposal at the firing point.

3. Identify inputs to the decision: Several inputs will be acquired during the course of the RI to support the decision. UXO Estimator requires that 4.92 acres be investigated to determine at a 95% confidence level that less than 0.5 MEC/acre is present within the MRS. DGM and mag & dig surveys will be performed along transects and in grids to accomplish the UXO Estimator requirements. All anomalies will be investigated. Intrusive results for MEC, MD, and non-MD will be evaluated in the project GIS. If a MEC release is detected, discrete or incremental soil and sediment sampling will be performed to determine whether MC is present. Incremental sampling will be performed at the firing point to determine the nature and extent of potential MC. DGM and intrusive investigations as necessary will be used to detect burial features at the firing point.

4. Define study boundaries: This MRS is 20 acres, and the northern boundary of the MRS intersects the operational range area. The extent of potential MEC and MC observed during the RI will be delineated using DGM, mag & dig, discrete MC sampling, and incremental MC sampling; however, operational range areas will not be accessed.

5. Develop a decision rule: The results of the RI at the Redoubt No. 2 MRS will be used to:

- Assess, based on intrusive anomaly investigations, whether MEC density is less than 0.5 MEC/acre across the MRS.
- Reassess the characterization approach if MEC density is found to be greater than 0.5 MEC/acre or if the CSM is not valid.
- Determine whether MC is present at the firing points and fully characterize the nature and extent of MC.
- Determine whether MEC burial features are present at the firing points and determine the nature and extent of MEC at burial sites.

6. Specify tolerable limits on decision error: It is anticipated that a low density of MEC exists at this MRS because of its location near the firing point of the overall range fan. The characterization approach will confirm that less than 0.5 MEC/acre is present at the MRS. If there is less than 0.5 MEC/acre within the MRS, no additional MEC investigations will be required to validate MEC density. If MEC is identified during intrusive work within the MRS, additional sampling may be warranted to achieve the desired confidence level. Additional sampling will be performed only if the MRS is still assumed to have a low density of MEC consistent with the CSM for the MRS. Additional coverage requirements will be determined by UXO Estimator.

7. Optimize the design: DGM surveys using an EM61-MK2 and mag & dig surveys using White's XLT all metals detectors will be performed across the required 4.92 acres consistent with UXO Estimator assumptions. This includes eight 100 ft by 100 ft grids and approximately 2.6 miles of transects. Mag & dig surveys will be used in areas inaccessible to the DGM instrumentation. All anomalies will be investigated to determine the approximate MEC density. Survey locations are provided in **Appendix I-10**.

Sampling units will be established at the firing point. The size of the sampling units will be based on the terrain and accessibility. Between 30 and 50 increments will be collected in each unit. Additional sampling will be performed at MEC release locations as necessary based on geophysical survey and intrusive investigation results. Incremental and discrete sampling may be used. Incremental sampling will be used to characterize major MEC releases such as impact areas and discrete sampling will be used where individual MEC appear to be releasing constituents because of low order detonation or corrosion.

3.1.2.11 Michie Stadium (WSTPT-022-R-01) Data Quality Objectives

1. State the problem: The use of military munitions in this MRS is unknown. MEC was recovered in this MRS during construction activities. Michie Stadium occupies the majority of the MRS. The remaining MEC density in undeveloped areas is unknown. MC also may be present if a MEC release is detected within the undeveloped areas of the MRS.

2. Identify the decisions: The primary decisions for this MRS include:

- Determine whether MEC is present in the undeveloped areas of the MRS.
- If a MEC release is observed in the MRS, characterize the nature and extent of MEC and evaluate MC where possible.
- Recommend a future response action for the MRS based on the RI results.

3. Identify inputs to the decision: Several inputs will be acquired during the course of the RI to support the decision. Because the MRS is primarily developed and complete characterization is not possible, all areas accessible to the DGM instrumentation will be digitally mapped. All selected anomalies will be investigated. Intrusive results for MEC, MD, and non-MD will be evaluated in the project GIS. If a MEC release is detected, discrete or incremental soil and sediment sampling will be performed to determine whether MC is present.

4. Define study boundaries: This MRS is a 9.4-acre area that includes Michie Stadium. Based on aerial photography, only approximately 0.23 acre remains undeveloped. The extent of potential MEC and MC observed during the RI will be delineated using DGM, discrete MC sampling, and incremental sampling.

5. Develop a decision rule: The results of the RI at the Michie Stadium MRS will be used to:

- Assess, based on intrusive anomaly investigations, whether MEC is present in accessible areas of the MRS.
- Determine whether remedial action is required based on the RI results.

6. Specify tolerable limits on decision error: The investigative approach will determine whether MEC is present within the accessible areas of the MRS. The investigative approach will not determine whether MEC remains in developed areas of the MRS under or near structures or capped under asphalt and concrete. The DGM survey will cover all accessible areas. If MEC or MC is thought to remain within the MRS, a remedial action will be recommended.

7. Optimize the design: DGM surveys using an EM61-MK2 will be performed across all accessible areas of the MRS. It is estimated that 0.23 acre is accessible for DGM. All anomalies will be investigated to determine the approximate MEC density. Survey locations are provided in **Appendix I-11**.

Additional sampling will be performed at MEC release locations as necessary based on the geophysical survey and intrusive investigation results. Incremental and discrete sampling may be used. Incremental sampling will be used to characterize major MEC releases such as impact areas, and discrete sampling will be used where individual MEC appear to be releasing constituents because of low order detonation or corrosion.

3.1.3 Data Incorporation into the RI Report

Geophysical survey and intrusive investigation information will be entered into the project GIS database. The database will be continually updated and managed as new data become available over the course of the project.

3.1.4 Time Critical Removal Actions

Time critical removal actions (TCRAs) are removal actions intended to address the imminent safety hazard posed by explosives hazards. During the course of the RI, if an area is discovered that poses an imminent danger, USACE will be notified for the purpose of reevaluating the area for a TCRA.

3.2 IDENTIFICATION OF AREAS OF CONCERN

The 11 MRSs identified in the SI will be used to track and quantify coverage requirements during the RI field work. Descriptions and investigation coverage for each MRS are provided in individual field investigation plans presented in **Appendix I**. Decision criteria to identify MEC and MC releases are provided in Section 3.1.2 Data Quality Objectives. Procedures for implementing the field investigation plans are provided in the following sections.

3.3 GEOPHYSICAL SYSTEM VERIFICATION

The geophysical system verification (GSV) approach will be used to monitor and verify mag & dig and DGM equipment functionality during the RI geophysical mapping activities. The GSV approach uses an instrument verification strip (IVS) and is a USACE-accepted alternative to the traditional Geophysical Prove-Out (GPO). The GSV approach capitalizes on the known performance of the geophysical sensors (Naval Research Laboratory [NRL], 2009). It provides the advantage of reallocating resources traditionally devoted to a GPO to support a simplified, yet more rigorous, verification method for geophysical system operations. In addition, it incorporates a seeding program to continually monitor production mapping work within each MRS.

3.3.1 Instrument Verification Strip

The IVS provides a means to verify that the geophysical detection system is operating properly. The seed items placed within the IVS should be observed in the geophysical data with signals consistent with the physics-based instrument response curves developed for the EM61-MK2. Analog mag & dig survey instrumentation also will be tested at the IVS each day.

The IVS will be constructed at an accessible area near the project site trailer. An additional IVS may be established to maximize the efficiency of field activities. If an additional IVS is warranted, the construction location will be approved by West Point and USACE.

For the EM61-MK2, ambient site noise will be measured and evaluated against the instrument response curves to determine the detection depths for items of interest anticipated for each MRS. In addition, this methodology provides an ongoing monitoring of system performance, as well as additional QC of production work by using a blind seeding program.

3.3.1.1 Instrument Verification Strip Design

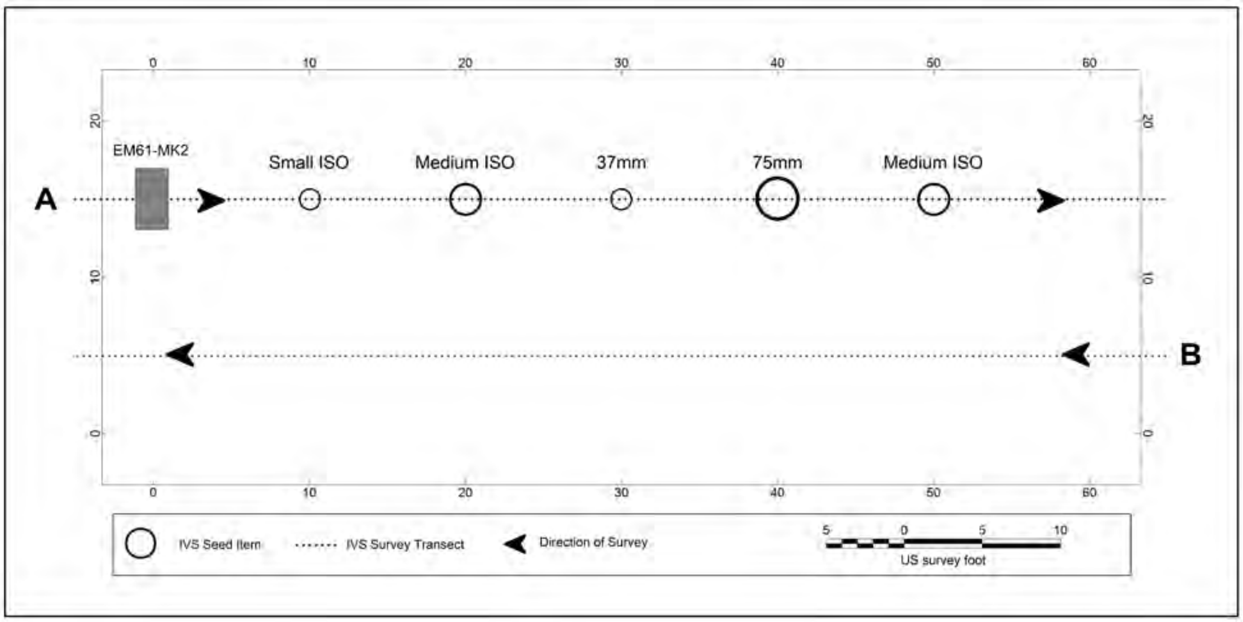
The IVS will be linearly seeded with five items, including one small industry standard object (ISO), two medium ISOs, one inert 37mm projectile, and one inert 75mm projectile. The ISOs listed in **Table 3-3** are schedule 40 pipe nipples, threaded on both ends, made from black welded steel and manufactured to an American Society for Testing and Materials (ASTM) specification.

The seeds will be placed in the IVS to effectively distribute all items sufficiently to prevent overlapping signals. The proposed seed layout of the IVS is detailed in **Figure 3-1**. The items will be buried horizontally (least favorable orientation) with the long axis aligned parallel to the ground surface, and at depths between ground surface and anticipated detection depth near the noise and least favorable orientation response curve intersection. The items will be placed at the discretion of the Site Geophysicist and USACE QA Geophysicist based on site conditions. Item types will be confirmed with the USACE QA Geophysicist prior to mobilization. Seed locations will be surveyed by a New York Professional Licensed Surveyor to a minimum of “third order” accuracy. Item parameters (i.e., surveyed location, size, depth, orientation) will be recorded and entered into the database. An unseeded test strip will be established adjacent to the seeded portion of the IVS to monitor background noise.

Table 3-3 Industry Standard Objects Characterized for Use as Munitions Surrogates (Adapted from NRL/MR/6110_09_99183)

Item	Nominal Pipe Size	Outside Diameter	Length	Part Number*	ASTM Specification
Small ISO	1"	1.315" (33 mm)	4" (102 mm)	44615K466	A53/A773
Medium ISO	2"	2.375" (60 mm)	8" (204 mm)	44615K529	A53/A773
*Part number from the McMaster-Carr catalog. Inert munitions will be seeded based on the MRS CSM.					

Figure 3-1 Proposed IVS Layout and Process



Notes for Figure 3-1:

Transect A: Directly over IVS seeds; used to verify that instrument response is within established response curve metrics.

Transect B: 10-ft offset from seeded IVS transect; used to measure local background noise.

3.3.1.2 Instrument Verification Strip Construction

Prior to the burial of any seed items, a background survey will be conducted within the proposed IVS area to determine the suitability of the site and to assist the site geophysicist in placement of the seed items. Following the background survey, the seed items will be buried in accordance with the proposed IVS layout (**Figure 3-1**), each at a depth between ground surface and the anticipated detection depth (to be determined based on background noise). The location and depths of the seed items will be surveyed and recorded. Each seed item, as well as the start and end points of each IVS transect, will be marked at the surface with PVC pin flags or wooden stakes.

A DGM survey will be performed over the IVS using the EM61-MK2, following the transect pattern detailed in **Figure 3-1**. The data collected will then be evaluated to determine a seed item response baseline to compare against production surveys.

3.3.2 Blind Seeding

The geophysical grids will be seeded with ISOs as indicated in **Table 3-4**. The seed locations will be surveyed by a New York Professional Licensed Surveyor and will be blind to the data collection teams. The objective of the seed program will be to provide ongoing monitoring of the quality of the geophysical data collection and the target selection process related to the production survey for each MRS. Each geophysical grid will include at least one ISO seed item similar to the items used within the IVS.

After each data set is collected, the Site Geophysicist will overlay the locations of the blind seeds on the processed data and verify that the detection and navigation DQOs are met in the data set. The response of each ISO will be compared in relation to the IVS results and the instrument response curves.

Table 3-4 MRS Specific Seeding Program

Munitions Response Site	Seed Item Type
Artillery Firing Range (WSTPT-001-R-01)	Medium ISO (2”x8”)
Battery Knox – TD Land (WSTPT-004-R-02)	Medium ISO (2”x8”)
Fort Clinton – West (WSTPT-008-R-01)	Medium ISO (2”x8”)
Grey Ghost Housing Area (WSTPT-010-R-01)	Small ISO (1”x4”)
North Athletic Field (WSTPT-011-R-01)	Medium ISO (2”x8”)
Siege Battery (WSTPT-015-R-01)	Medium ISO (2”x8”)
Lusk Reservoir (WSTPT-019-R-01)	Medium ISO (2”x8”)
Redoubt No. 2 (WSTPT-020-R-01)	Medium ISO (2”x8”)
Michie Stadium (WSTPT-022-R-01)	Medium ISO (2”x8”)

3.3.3 GSV Procedures

The IVS and unseeded test strip (**Figure 3-1**) will be visited daily before and after DGM surveys. Analog mag & dig instrumentation will be tested each day at the IVS before performing surveys. For each IVS survey event, the EM61-MK2 will first traverse the unseeded area and then the IVS. The data will be processed similarly to the production mapping data.

3.3.4 GSV Results

Initial results of the IVS will be discussed by the WESTON Project and Site Geophysicists and the USACE Quality Assurance (QA) Geophysicist. Peak responses from the IVS seed items will be plotted against their respective instrument response curves. Blind seed items also will be monitored for positional accuracy and response and compared to the IVS results. All seed item responses should plot within 20% of their calculated values along the least favorable orientation response curve. Average noise values across the unseeded test strip and geophysical grids will be calculated and monitored for the life of the project. Seed items detected during the mag & dig surveys will be catalogued and tracked via RespondFast – UXO Investigation in the project GIS database. GSV results will be included for all digital geophysical data packages. The IVS results for each day will include the following:

- As-built drawing of the IVS, including depth and orientation of seeded items.
- Representative photographs of the ISO and inert seed items (initial results).
- Color plots of the DGM data.
- Instrument response curves.
- Seed target list showing comprehensive results.

3.4 LOCATION SURVEYING AND MAPPING

A location survey will be conducted by a New York Professional Licensed Surveyor. A Global Positioning System (GPS) or an instrument with equivalent accuracy will be used to perform the location survey. In areas where the topography or tree canopy prevents the use of GPS, traditional line-of-sight survey methods will be used.

A UXO Technician II or higher will perform a surface sweep of accessible areas within the MRS that will be included in the geophysical investigation in conjunction with the location survey. The UXO technician will also escort survey personnel and provide anomaly avoidance support as needed for intrusive work. Pertinent information related to items recovered during the surface sweep process will be entered into the GIS database and included in the RI Report.

The surveyor will establish control monuments or survey markers with a minimum of third order accuracy. Horizontal control Class I, third order will be established for all new primary control monuments. Horizontal control is referenced to the Universal Transverse Mercator (UTM), North American Datum (NAD) 83, with units of U.S. Survey Feet. Staking of all control points and points of interest will be accomplished by driving wooden stakes for temporary markers. Six-inch steel spikes will also be used to mark temporary survey points for relocation purposes. The surveyed geographic position and UTM coordinates will be accurate to +/-1 ft and will be referenced to the primary control monuments established for the project. Vertical control or topography will not be surveyed.

Survey locations of geophysical grids will be shifted away from large cultural features, as needed, to ensure that coverage requirements are achieved for the MRS. If large, prominent cultural features are observed in a grid during surveyor activities, the location of the object will be recorded. Other cultural features that are observed during DGM operations will be logged by the geophysical team and presented on the grid contour maps for evaluation during target selection processes.

3.5 BRUSH CLEARING

Brush clearing will be conducted within the investigation areas as necessary to perform geophysical transect and grids. Only the minimum amount of vegetation will be removed to facilitate the geophysical surveys. No trees larger than 2 inches will be removed unless coordinated with West Point POCs. The goal is to collect the necessary data without significant impact to the surrounding environment. Brush clearing will be conducted immediately following the location survey and will be mainly within the DGM grid footprints established by the surveyor. A UXO Technician II or higher will escort the brush clearing crew. All areas designated for brush clearance will be approved by USACE and West Point prior to any clearing activities.

3.6 GEOPHYSICAL EQUIPMENT

The White's XLT all-metals detector will be used for mag & dig surveys. The Geonics EM61-MK2 will be used for DGM surveys. The following sections describe the geophysical equipment.

3.6.1 White's XLT All-Metals Detector

The White's XLT all-metals detector consists of a hand-held, two-coil design that utilizes the electromagnetic method to detect ferrous and non-ferrous metals. An audible signal sounds when the sensors are swept over conductive material. The volume and frequency of the signal changes as the sensor pinpoints the center of the source body. The instrument sensitivity can be adjusted to increase or decrease the capability to detect small, metallic materials. The instrument's sensitivity will be adjusted as needed to achieve the IVS requirements.

3.6.2 Geonics EM61-MK2

The EM61-MK2 sensor is battery-powered and operates at a maximum output of 10,000 milliVolts (mV). The EM61-MK2 sensor is a 1 x 0.5 meter (m) air-cored coil that acts as both a transmitter and receiver. The transmitter generates a pulsed magnetic field that induces eddy currents in conductive objects within the subsurface. These currents are proportional to the conductive nature of the material below the instrument. When conductive objects are present below the instrument, the amplitude and decay time of the induced eddy currents vary in response to the size, mass, and orientation of the objects. The receiver measures the amplitude of these eddy currents at 216, 366, 660, and 1260 micro-second intervals during the decay period.

A single EM61-MK2 sensor will be hand pulled on a wheel or sled-mounted cart, or carried in tandem mode. A GPS antenna will be mounted over the center of the sensor and linked to a portable receiver unit attached to the MK2 backpack. This receiver captures the real-time differential corrections from a fixed local base station and outputs a National Marine Electronics Association (NMEA) GGA (a code used by NMEA that provides 3D location and accuracy data from the GPS unit) message directly into the Allegro data logger at 1-second intervals. Direct interfacing between the GPS and EM61-MK2 utilizes a single clock and streams position information directly into the raw MK2 data file.

3.6.3 Production Rates

Based upon past experience in similar terrain, and assuming no delays caused by weather or other unexpected factors, WESTON anticipates achieving the following production rates during the field geophysical surveys:

- Mag & Dig and DGM Transects ―The typical production rate for analog survey transects by using a two-man UXO Team is expected to be 3 to 4 miles per day depending on site conditions. Similarly, DGM transects are expected to be completed at a rate of 3 to 4 miles per day. However, if poor site or weather conditions occur, this production rate may be reduced to 1 to 3 miles per day, per team.
- DGM Grid Surveys ―The production rate is anticipated to be approximately 0.25 to 1.0 acre per day for the DGM grid surveys. Production rates will depend on the size and location of the grids and field conditions encountered.
- Mag & Dig Grid Surveys ―The production rate is anticipated to be approximately 0.75 to 1.25 acres per day for the mag & dig grid surveys. Production rates will depend on the size and location of the grids and field conditions encountered.

3.7 NAVIGATION AND POSITIONING EQUIPMENT

Project personnel will use several types of navigation systems and methods best suited for navigation and positioning along transects and within grids. These include:

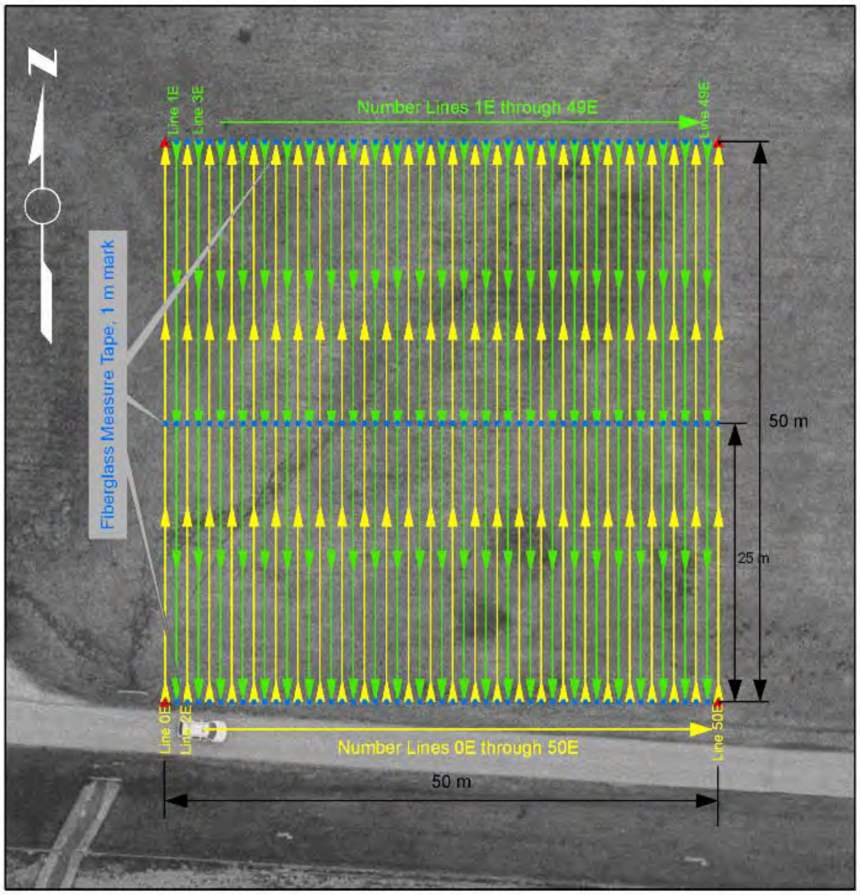
- Trimble Global Positioning Real Time Kinematic Base Station and Rover(s) - Used for extending survey control along transects or grids; DGM data positioning; anomaly reacquisition; and general surveyor tool.
- Handheld GPS Unit (i.e., Garmin) - Capable of meter accuracy and used by the UXO Teams to navigate and track the analog instrument transects, and capture the positions of discovered items.
- Trimble Pro-XRS - Capable of sub-meter accuracy and used by the Site Geophysicist to navigate and track DGM transects. In the event that adequate satellite signal cannot be achieved for the GPS, the alternate approach for positioning and navigation along the DGM transects will be line and fiducial methods method as described below.

3.7.1 Local Navigation Methodology (Line and Fiducial)

For line and fiducial DGM surveying (using Cartesian X, Y grid system), geo-referencing the geophysical data will be accomplished using information recorded on a personal digital assistant

(PDA) (e.g., start and end of line stations, lane spacing, and fiducial mark intervals) and information will be digitally recorded in each geophysical survey data file. An example of line and fiducial navigation is presented in **Figure 3-2**.

Figure 3-2 Line and Fiducial Navigation



The procedure for collecting geophysical data using the line and fiducial method will include the following:

- The geodetic coordinates of the grid corners will be used to geo-reference the geophysical data after the data have been collected.
- Surveyor's tapes (or graduated static ropes) will be laid out in east-west or north-south direction as the terrain allows. Typically, the southwestern corner of the grid surveyed is assigned a relative coordinate of 0E, 0N.

- Range markers (traffic cones or high visibility tripods) will be placed along the line to be surveyed to provide the geophysical operator with a navigation aid that allows him or her to traverse the line in a linear manner.
- Fiducial data markers will be inserted manually by the operator at intervals not to exceed 20 ft. In areas of rough terrain or thick vegetation, smaller intervals will be used. These markers will be used to accurately locate each data measurement point during the post-processing stages.

The geodetic coordinates of the grid corners will be used to transform or "warp" the Cartesian coordinates and associated geophysical data to UTM coordinates in the post-processing step.

3.8 MAG & DIG SURVEYS

Mag & dig surveys will be used in locations where DGM surveys are ineffective for characterizing the nature and extent of MEC. These locations may include rough or inaccessible terrain where surveys could not be performed using digital equipment. Mag & dig transects and grid surveys will be performed in MRSs based on the DQOs presented in Section 3.1.2 Data Quality Objectives and in the MRS-specific field investigation plans provided in **Appendix I**. Quality measurement criteria are presented in the UFP-QAPP (**Appendix J**).

3.8.1 Mag & Dig Transects

Mag & dig transect surveys will be performed by UXO technicians along pre-designated pathways as presented in the MRS-specific field investigation plans (**Appendix I**). Waypoints or transect line features will be taken from the MRS-specific field investigation plans (**Appendix I**) as GIS-compatible SHP files and loaded onto handheld GPS units. These waypoints and/or line features will be used by the UXO technicians to ensure the transect pathways are followed as closely as possible (terrain and obstacle dependent). The GPS will also record the exact pathways the UXO technicians walk. These pathways will be migrated into the project GIS to review investigation coverage.

Each mag & dig transect will be approximately 10 ft wide equating to 5 ft for each UXO technician. All subsurface anomalies detected will be intrusively investigated in real-time to determine the presence of potential MEC. In areas where large amounts of cultural debris (e.g., cans, metal scrap) are identified, the UXO technicians will adjust the intrusive investigation as appropriate based on professional judgment. These locations will be recorded by GPS, tracked and reported to the SUXOS and USACE Ordnance and Explosive Safety Specialist (OESS). Details of the anomaly counts and MEC and MD information obtained during the transect surveys will be logged into RepondFast-UXO Investigation and added to the project GIS for analysis.

3.8.2 Mag & Dig Grids

Focused grids will be placed in accordance with the individual field investigation plans (**Appendix I**). Full coverage mag & dig surveys will be performed across each grid. The UXO Team will mark out 5-ft intervals along the north and south or the east and west bounds of the grid. The 5-ft intervals will then be connected with ropes to delineate the lanes to be surveyed during the mag & dig. In areas of steep or difficult terrain, UXO teams may use marking tape or pin flags to locate survey lanes. The teams will traverse across the grids using the White's XLT detection equipment to detect subsurface anomalies. Anomalies will be investigated as they are detected for potential MEC. Details of anomaly counts and MEC and MD information obtained during the transect surveys will be logged into RepondFast-UXO Investigation and added to the project GIS for analysis.

3.9 DIGITAL GEOPHYSICAL MAPPING SURVEYS

DGM surveys will be used in areas where quality measurement criteria can be achieved. Both DGM transect and grid surveys will be performed based on the DQOs presented in Section 3.1.2 Data Quality Objectives and in the MRS-specific field investigation plans provided in **Appendix I**. Quality measurement criteria are presented in the UFP-QAPP (**Appendix J**).

3.9.1 Data Resolution/Data Spatial Density

For the DGM surveys, the geophysical field crew will use a sampling frequency of no less than 10 Hz, resulting in an average sampling rate of between 3 to 4 measurements per linear foot. DGM grids will be collected using a lane separation spacing of 3 ft.

3.9.2 Data Processing, Corrections, and Analysis

3.9.2.1 Standard Data Analysis

The geophysical teams will provide the *raw* instrument data, digital records, and field notes to the Site Geophysicist at the end of each day's field activities. The digital data will be submitted in an ASCII-delimited file (XYZ) suitable for input into the *Geosoft*™ computer program.

The field crews will initially process the data to correct file name labels, line numbers, survey direction, start and end line locations, and grid identification. Data spikes induced from cultural interference unrelated to subsurface material will be documented and removed where appropriate. Pre- and post-survey QC data will be reviewed real-time and during data download to identify any abnormal readings.

3.9.2.2 Advanced Data Processing, Corrections, Digital Filtering and Enhancement

Once the initial data processing procedures are complete, Geosoft's UX-Detect and QC Geophysical Mapping software will be used to further reduce the data. The following data processes will be performed where appropriate:

- Instrument Latency: Instrument latency will be corrected based on the lags or time differences observed in anomaly peak positions, from the latency test. Corrections will be applied using an appropriate correction routine that accounts for instrument latency time and sensor velocity. Chevron effects should not be visible in the data maps when plotted at the scales used to detect the smallest amplitude signal for a given MEC item.

- Instrument Drift Correction: A drift correction process will be applied to the geophysical data to remove any unwanted signal indicative of instrument drift.

In addition to the standard geophysical data processing procedures, the following statistics will be calculated for each dataset to ensure data collection is meeting DQOs:

- Background Noise: Calculate standard deviation in areas free of anomalous responses to identify background noise levels.

- Average Speed: Data acquisition rates should be <3 mph or consistent with speeds demonstrated on the IVS that achieve along-track sample-separation metrics.

- Along-Track Sampling: Along-track sampling will be evaluated with respect to mean speed. Average along-track sampling will not exceed 0.5 ft between data points. It is anticipated that along-track sampling will average approximately 0.35 ft based on sampling frequency.

- Across-Track Sampling: Across-track sampling will not exceed 3 ft. Minor data gaps may occur if obstructions exist in the DGM grid. Data gaps because of obstructions will be excluded from this metric; however, data gaps will be cumulatively tracked.

3.9.2.2.1 Preliminary Anomaly Selection Criteria

The Site Geophysicist will use the UX-Detect Blakely Test to perform an initial automatic anomaly selection, using parameters determined from the initial IVS results. GX parameters will be refined to produce anomaly selections of all signals above the mean plus 2.5 to 3 times the standard deviation of the background data. Alternative levels may be required for some datasets and will be documented on a case-by-case basis. A review of decay profiles (for all 4 channels) at all suspect and/or low-amplitude anomalies will be performed to remove from the list anomalies not exhibiting response characteristics typical of buried metallic objects. This step may be performed using a scripted routine that will automatically find the nearest peak and compare the values for all associated channels in order to compute, identify, and flag negative time constants. Flagged anomalies, not having decay characteristics of buried metallic objects, will be removed. A manual review of the remaining anomalies will be conducted to center the anomaly response as needed. All corrected geophysical data and anomaly locations will be exported to a database. Throughout the geophysical survey, field personnel will use logbooks to record observations such as variances in the background interference/noise when collecting data, and/or notable changes in soil characteristics. Such observations will provide valuable insight during the selection of anomalies in areas where there are significant variations in background interference/noise.

3.9.2.2.2 Anomaly Selection Decision Criteria

For grids located using UXO Estimator results, anomalies will be selected for excavation based on the electromagnetic noise levels and the least favorable orientation instrument response curves for the smallest anticipated munitions item in the MRS. The intersection of the site noise and the least favorable orientation response curve will provide an estimate of the detection depth for a particular munitions item. All anomalies above this value will be reacquired and investigated.

Focused grids located using VSP results will be selected based on the response and size of the anomalous areas identified following data processing and interpretation. Grid size will depend upon anomaly densities and characteristics. The default grid size will be 50 ft x 50 ft; however, the size of emplaced grids will be increased (100 ft x 100 ft) to encompass anomaly clusters of interest. Grid placement and size will be coordinated with the USACE QA Geophysicist prior to the grid survey. Anomalies will be selected for these grids at a rate of approximately 50 anomalies per acre. The response range and number of anomalies within that range are estimated as follows:

- Background noise to 20 mV (stack response): 20% of target list.
- >20 mV to 150 mV: 40% of target list.
- >150 mV: 40% of target list.
- <50 anomalies per acre in grid: Investigate 100%.

All selected anomalies will be approved by the USACE QA Geophysicist before intrusive investigations occur.

3.9.3 Dig Sheet Development

Following the identification of potential target anomalies from the geophysical data evaluation listed above, the anomaly locations will be digitized based on the position of the target in Universal Transverse Mercator (UTM) Zone 18, NAD coordinates in U.S. Survey Feet. A Target Dig Sheet and Target History Database Form (**Appendix K**) will be completed. The Site Geophysicist will assign each anomaly a unique target identifier and will enter the corresponding information for the target into the database. The Dig Sheet will also include QC target anomalies. At a minimum, the following information will be included in the database for each targeted anomaly:

- Unique Target ID including grid ID (A19-01, {grid ID-target number}).
- Easting and northing position.
- Channel ID.
- Response amplitude of the peak response.

3.9.4 Anomaly Reacquisition and Marking

Anomaly reacquisition will be performed once the geophysical and location data are processed. The location of the selected target will be determined in the field using an RTK GPS system. In areas where the topography or tree canopy prevents the use of GPS, alternative reacquisition methods, such as RTS or tape measures, will be used. The geophysical target location will be marked with a non-metallic pin flag. A UXO technician will refine the location prior to excavation using the peak response detected by the handheld all-metals detector. Offsets between the reacquired location and the excavated location will be entered into the database. In the event that the handheld all-metals detector is unable to resolve the DGM anomaly location, the EM61-MK2 will be used as an alternative.

3.9.5 Anomaly Reporting

WESTON will maintain records of all items recovered on the project. These records will be kept using the RespondFast^{SM} electronic data entry program on a hand-held PDA. Data are kept in accordance with the data requirements specified Attachment C of USACE DID MMRP-09-004 (USACE, 2009c) and presented in **Appendix K**. Data entered into the PDA will be transferred to a computer and project database each day and subsequently loaded into the project GIS so that all anomaly information is included in the project GIS.

3.9.6 Feedback Process

The Project Geophysicist or his designee will review the RespondFast^{SM} database to assess that the physical characteristics of the item(s) found are consistent or appropriate relative to the size and amplitude of detected geophysical anomaly.

If it is determined that the item was likely not the entire source of the anomaly, the anomaly location will be reinvestigated using the instrument utilized during the initial survey. Anomalies of this type will be tracked separately in the database in the event that future analysis is required. In addition, information derived from the feedback process of comparing the dig results to the predicted results will be continually evaluated to identify improvements that can be incorporated into the anomaly selection process. The Project Geophysicist will provide periodic progress reports with recommendations (as needed) to the USACE QA Geophysicist.

3.9.7 Instrument Standardization

To verify instrument accuracy, the EM61-MK2 will be checked at the beginning and end of each workday following the QC criteria (i.e., equipment warm-up, sensor nulling, static, static spike, and cable shake). Additional function checks may be performed throughout the day, as the operator deems necessary. The data from each system test will be compared with data collected on previous days. If there is a significant change in results, the instrument will be rechecked. If the difference in the data cannot be accounted for, the instrument will be taken out of service until repaired.

To facilitate the detection of buried munitions, USACE has defined standard equipment tests and data quality criteria. **Table 3-5** identifies the USACE QC function tests and acceptance criteria for the EM61-MK2.

3.9.7.1 Instrument Function Checks

Prior to conducting QC function tests, spot measurements will be taken at various locations around the proposed DGM survey area to identify the most suitable area to establish a QC station. Static background, static response/spike, and vibration/cable connection tests will be performed daily before and after surveying at the fixed QC station identified from the spot measurements. All QC test statistics will be entered and saved to a database that will be electronically submitted with each data package.

Table 3-5 DGM QC Test Frequency and Acceptance Criteria

Test Description	Acceptance Criteria	Power On	Start of Day	End of Day	1st Day of Project for Each Operator	Review GSV
Equipment Warm-Up	Equipment Specific (5-15 minutes)	X				
Record Sensor Positions	+/- 1 inch (2.54 cm)		X			
Personnel Test	EM61-MK2 2mVp-p		X			
Vibration Test (Cable Shake)	Data profile does not exhibit spikes		X			
Static Background	Background: EM61-MK2 < 2.5 mV std dev		X	X		
Static Spike	+/- 20% of standard item response		X	X		
6-Line Test (man-towed cart)	Repeatable +/- 20 % of response amplitude, +/- 20 cm for positional accuracy				X	
Repeat Data	Repeatable +/- 20 % of response amplitude, +/- 20 cm for positional accuracy					X

The purpose of the static test is to determine the ability of the EM61-MK2 instrumentation to collect stable readings consistently throughout the survey. Instrument functionality and ambient electromagnetic (EM) cultural noise are likely sources of non-repeatable readings.

The static spike test demonstrates the sensor's sensitivity to a chosen test object. A conductive spike item of appropriate size will be used for the EM tests to quantify the instrument response and to document its ability to collect stable readings.

The cable connection test is used to identify mechanical and electrical problems with the EM61-MK2 instrumentation. Large anomalous spikes within the test data indicate poor connectivity between cables and the field data logger.

3.9.7.2 Corrective Measures

One of the primary goals throughout the RI will be to achieve and maintain a high standard of data quality. This will be accomplished by a vigilant process of QC checks and QA reviews on data collection and processing procedures. Any identified deficiencies will require a corrective measure, and a root-cause analysis will be performed to document the issue, analysis, and corrective action. Such root-cause analyses will be submitted to USACE as memorandums.

3.9.8 Geophysical Investigation Performance Goals

The geophysical performance criteria provided in **Table 3-6** are based on EM 1110-1-4009 (USACE, 2007) and the most recent version of the RI/FS Performance Requirements for Geophysical Instrumentation (USACE, 2009d). The geophysical quality measurement criteria establish the specific metrics concerning sensor performance, navigation accuracy, data density, data processing standard, and anomaly selection criteria to meet the minimum goals for the investigation. Metrics will be confirmed or appropriately adjusted based on the TPP and results of the GSV.

3.9.8.1 Horizontal Accuracy

The horizontal accuracy of the geophysical navigation will be determined by comparing the selected target location with the actual surveyed location control point placed along transects and at corners of specified grids. Performance standards for offset distances for dynamic positioning are documented in **Table 3-6**.

Table 3-6 Geophysical Performance Criteria

DQO	Metric	Measurement
Navigation - Global Positioning		
Raw Positional Data	Kinematic positional error at known monuments will not exceed +/- 20 centimeters (cm)	QC audit of positioning system error test records
Navigation - Line and Fiducial		
Grids with Line/fiducial positioning	Grid corners are internally consistent within 30 cm on any leg or diagonal	Geodetic Internal Consistency
Geophysical Equipment – EM61-MK2		
Background Noise	Standard deviation of < 2.5 mV for CH1, CH2, CH3, and CH4.	Window an anomaly free area of data and calculate standard deviation.
Mean Acquisition Speed	Maintain speed of <3 mph to achieve along-track measurement MPC. 95% of data to be within max <3 mph or demonstrated speed based on IVS results.	Run Statistics on velocity between points in each file (created a “velocity channel”).
Along-Track Measurements	Point to point separation <0.5-ft. 95% of data to be within max <0.5-ft or GSV demonstrated separation.	Run statistics on distance between points in each dataset.
Cross-Track Measurements	The across-track line spacing will not exceed 2.5 ft on 95% of the data. 5% of the data may lie between 2.5 and 3 ft. This will allow for variation in spacing reporting caused by rough terrain.	Run statistics on distance between data lines in each dataset and perform a spatial analysis on gridded data between lines.
Coverage (Focused Grids)	>90% coverage at project design spacing	By data set or grid.
	ISO response repeatable to =/- 25%, with allowable variation.	Minimum one ISO QC test item per grid.
Dynamic Positioning	Transects – Demonstrate IVS reacquisition (reac ampl. ~ original & offset <=3.25 ft).	Daily IVS tests.
	Grids – Position offset of test item <=3.25 ft +1/2 line spacing for fiducially positioned data.	Daily IVS and QC Seed program data.
Standard Response	Response above background to standard object will not vary more than +/- 20%	Standardization tests: QC audit of response test records.
Data Processing –Geosoft Oasis Montaj Software – Processing EM61-MK2 Data		
Processing Statement	All leveling and/or filtering routines that are applied to data sets will be evaluated, on a data set by data set basis, to confirm that those routines do not alter the nature of the original measured response.	Use consistent drift correction parameters in Geosoft.
Target Selection	All dig list targets are selected according to project design/selection criteria and classification scheme.	By grid or data set. Visual and manual review by QC Geophysicist.
Anomaly Resolution	Resolved is defined as: (1) there is no geophysical signal remaining at the flagged/selected location; or (2) a signal remains but it is too low or too small to be associated with MEC; or (3) a signal remains but is associated with surface material that when moved results in low, or no signal at the interpreted location; or (4) a signal remains and a complete rationale for its presence exists.	Per anomaly, based on UXOQC findings.

3.9.8.2 False Positives

False positives result when an anomaly is detected at a given location, declared as a significant anomaly to be intrusively investigated or otherwise posted to a dig sheet and no basis for the anomaly is identified in the field. False positives can be a result of low threshold selection of anomalies (i.e., conservative anomaly picking), spikes in the data not successfully removed during processing, instrument jolts resulting from terrain, and heterogeneities in the subsurface. False positives are unavoidable and do not affect the data quality in terms of removing MEC items from the subsurface. The performance goal with respect to false positives is to minimize their occurrences while maintaining the same MEC identification rates.

For the DGM surveys at West Point, a false positive goal of no more than 15% will be established on this project, in accordance with USACE DID MMRP-09-004 (USACE, 2009c). False positives will be minimized to the extent possible through the use of the best available geophysical practices executed by the geophysical field team and data analyst. False positives will be documented in the database so that the 15% false positive metric can be monitored.

False positive rates will be calculated and tracked for each transect or grid. Exceeding 15% false positives (calculated as a running average for each transect or grid) will result in a re-evaluation of the detection methods, data, and project QC. QA targets chosen below the selection criteria will not be considered a false positive. A Corrective Action Report (CAR), if appropriate, will be provided explaining the root cause for the excessive false positive rate. Additional corrective actions may be performed as deemed necessary for false positives less than 15%.

3.9.9 Geophysical Mapping Data

3.9.9.1 Records Management

Data related to the DGM surveys will be managed using Oasis Geosoft software. Descriptive attribute information about the field surveys, targets, and dig lists will be stored and maintained in a centralized, project master database in Microsoft® format. This database will contain QC statistics and processing parameters collected, performed, and calculated on the DGM data. Spatial data will be managed using GIS, and will be stored in Environmental Systems Research Institute (ESRI)-compatible GIS file formats, primarily ArcInfo coverages and ArcView shape files.

Data will be stored in respective site-specific folders breaking down individual field efforts, data type, and file extension. Data will be provided electronically to the USACE QA Geophysicist on compact disc or via the WESTON TeamLink® Website and will be backed up on WESTON's internal network and project workstation.

3.9.9.2 Data Storage and Preliminary Processing

Geophysical field data will be downloaded directly from the data-logger to a work station for processing. Geosoft Oasis Montaj™ software will be used to review and edit the data as necessary, normalize the data to the fiducial control marks, generate profile lines, and convert the DGM data to (*x*,*y*) coordinates for contouring, map generation, and interpretation.

3.10 GEOSPATIAL INFORMATION AND ELECTRONIC SUBMITTALS

Transects and grids will be used to characterize the West Point MRSs. Transects and grids will be uniquely labeled based on MRS name for surveying and tracking purposes. The locations of the proposed grids and transects are presented in **Appendix I**. A licensed surveyor will use traditional surveying techniques to mark the location of each of the survey grid corners intended for DGM. The geophysical team will use GPS or fiducial positioning at control points to reference the geophysical data to the UTM Zone 18 projection, NAD 83 datum, with units of U.S. Survey Feet.

3.10.1 Control Points

The surveyor will establish horizontal control Class I, third order monuments or survey markers used to locate survey grid corners or transect lines. Staking of all control points and points of interest will be accomplished by driving wooden stakes for temporary markers.

3.10.2 GIS Incorporation

MEC and MC investigation results will be referenced to the MRS grid or transect where the item, feature of interest, or sample was recovered. File names for the electromagnetic data will be referenced to the grid in which the data were collected. All MEC and MC investigation results will be logged using WESTON's RespondFast^{SM} – UXO Investigation field data software for seamless integration into a GIS database.

3.10.3 Plotting

The X/Y location and description of all MEC and MEC-related items identified during the course of the RI will be recorded electronically on a PDA. All locations will be compiled, tracked, and plotted in a GIS database. In addition to MEC locations, grid corners and inaccessible areas will be stored in the GIS database. Maps will be generated as applicable. Information overlays on base maps will include, at a minimum, a point referencing the location of the MEC and grid identification (ID). Because of the extensive number of points anticipated, all other data (such as northing, easting, anomaly ID, anomaly description, depth) will be recorded in the Dig Sheet (**Appendix K**) and stored in a database for retrieval at a later date.

3.10.4 Mapping

GIS data are stored and managed using ESRI ArcGIS software, and are spatially referenced to the UTM Zone 18 projection, NAD83 datum, and U.S. Survey Feet units. Metadata are created for all GIS layers managed by WESTON on this project, and conform to Federal Geographic Data Committee metadata standards.

3.10.5 Electronic Submittal

At the close of the project, all GIS data shall be submitted in non-proprietary Spatial Data Transfer Standard format, as well as in the proprietary format used for the execution of the project, specifically AutoCAD 2000 and ESRI ArcGIS geodatabases. Final DGM data will be submitted in accordance with DID MMRP-09-004 in electronic format on DVD. Daily or weekly submittals will be performed via the TeamLink® project website. Pertinent in-progress and field GIS data, design drawings, survey data, relational databases, and other related data will be made available online to the government on the project's TeamLink® Website. All formal GIS data submittals will be made on PC-compatible CD. Each submittal shall be accompanied by a freeware viewer application appropriate for reviewing the proprietary formatted GIS data (e.g., ArcExplorer for ESRI format geodatabases). Instructions will be included with each submittal for loading the data and viewer application. No other additional software shall be required, and no data modification shall be required for viewing the submittal.

3.11 INTRUSIVE INVESTIGATION

3.11.1 General Methodology

Anomalies will be selected for investigation during the initial geophysical mapping effort. Anomaly reacquisition will be performed by an anomaly reacquisition team under the direction of the UXO Team Leader and Site Geophysicist. Anomalies will be intrusively investigated using hand tools. Prior to excavations, each work area will be evaluated for underground utilities by the SUXOS and the UXOSO acting under an active dig permit approved by West Point. All non-essential personnel will be evacuated from the area in accordance with the appropriate minimum separation distance as presented in Section 7 Explosives Site Plan. Evacuation of residences or buildings will be coordinated with USACE and West Point in advance of any intrusive activities. Notice of investigative operations will be provided in accordance with the approved West Point Community Relations Plan.

The UXO Team will excavate at the anomaly location to determine/assess whether MEC or materials potentially presenting an explosive hazard (MPPEH) are present. Depths of excavations will not exceed 4 ft. If the anomaly cannot be uncovered within the specified depth, the UXO Team will conspicuously mark the site with flagging material and continue to the next location. The anomaly will be reported to the SUXOS for documentation and evaluation of the anomaly. The project team will then determine whether additional excavations are required.

If the subsurface contact proves to be MD or cultural debris, the item will be removed and the hole rechecked with a geophysical instrument. If the hole is “clean,” it will be refilled and tamped. If the subsurface contact is MEC, it will be disposed of in accordance with the procedure detailed in Section 3.12 MEC Disposal. Each MEC item will have its condition and identification determined by UXO technicians. The area around the identified anomaly will be checked to ensure that the anomaly was not masking additional anomalies and to ensure that all anomalies have been investigated.

All access/excavation/detonation holes will be backfilled with the soils excavated from the hole. On-site activities at West Point will be strictly coordinated and scheduled with West Point officials. Post-investigation restoration activities will be performed in accordance with Section 8 Environmental Protection Plan.

3.11.2 Accountability and Records Management for Munitions and Explosives of Concern

WESTON will maintain records of all items recovered on the project. These records will be kept using an electronic data entry program on a hand-held PDA. The software program is WESTON's RespondFast^{SM} – UXO Investigation, and has modules for surface and subsurface recovery information. Data acquired during the course of this RI will be maintained in accordance with the data requirements specified in DID MMRP-09-004 (USACE, 2009c). Data entered into the PDA will be transferred to a computer and the project database each day and subsequently loaded into the project GIS so that all anomaly information is contained in the project GIS.

3.11.3 Identification of Munitions and Explosives of Concern

MEC items encountered by UXO technicians will be positively identified using standard explosive ordnance reconnaissance procedures. Physical characteristics and field information about the item will be recorded in WESTON's RespondFast^{SM} – UXO Investigation.

3.11.4 Removal of Munitions and Explosives of Concern

The removal of MEC items from the subsurface will be performed by hand excavation (e.g., shovel, pick). The use of heavy equipment is not anticipated during the West Point RI.

3.11.5 Storage of Munitions and Explosives of Concern

No MEC will be stored on-site during this project. All MEC recovered will be disposed of daily. If an item cannot be destroyed daily, it will be guarded until demolition can be conducted. No magazine will be sited for donor explosives. A local vendor will be utilized for explosive delivery on an as-needed basis.

3.12 MEC DISPOSAL

3.12.1 General Procedures

MEC will be blown-in-place if it is determined to be unsafe to transport. No item will be treated by explosive demolition until it has been positively identified. WESTON will notify the USACE Ordnance and Explosive Safety Specialist (OESS), who will request EOD support if the following circumstances are encountered during the course of this project:

- Demolition activities cannot be performed on MEC because of location or proximity to critical infrastructure.
- MEC cannot be identified as a conventional explosive.
- The fuze cannot be identified by type or function.
- A suspect chemical warfare materiel is located.

Based on coordination with the USACE OESS and EOD, the proper course of action will be determined.

3.12.2 Demolition Activities

WESTON will conduct demolition activities on an as-needed basis and in accordance with the approved ESP provided in Section 7 of this Work Plan. Demolition activities will follow the requirements of EM 385-1-97 (USACE, 2008a), applicable Bureau of Alcohol, Tobacco and Firearms (ATF), and federal, state, and local regulations. Inspection/certification of MEC/MPPEH will be conducted in accordance with Department of Defense Instruction (DoDI) 4140.62 (DoD, 2008) and EM1110-1-4009. MEC and MPPEH will be blown in place. If an item cannot be destroyed on the day that is found, it will be guarded until demolition can be conducted. WESTON will use remote-control detonation to ensure personnel safety. WESTON will coordinate with USACE, West Point, and local authorities prior to demolition activities. Demolition activities will not begin until all parties on the notification roster have been notified. The Demolition Notification Roster is provided in **Table 3-7**.

Table 3-7 Demolition Notification Roster

Call Order	Contact Name	Contact Information
FIRST CALL	Mr. Paul Greene OE Safety Specialist USACE	(410) 962-6741 (work) (410) 320-8175 (work cell) (410) 322-2745 (home cell) Baltimore District, USACE 10 South Howard Street ATTN: CENAB-EN-HI Baltimore, MD 21201-1715
SECOND CALL	Mr. Jeff Sanborn Environmental Engineer United States Military Academy	(845) 938-5041 (work) (518) 963-4106 (cell) (845) 534-9080 (home) (518) 963-4106 (home 2) United States Military Academy, Environmental Engineering Branch, ATTN: IMNE-MIL-PWE-M 667A Ruger Road West Point, NY 10996-1952
ALTERNATE SECOND CALL	Keith Katz West Point Safety Manager	(845) 938-6129 (work) (845) 476-2384 (cell) (845) 569-3053 (home)
ALTERNATE SECOND CALL	West Point Military Police - *Ask for Mr. Plumley*	(845) 938-3312 (845) 938-3333
THIRD CALL	Tom Meyer Project Manager USACE	(410) 962-0032 Baltimore District, USACE 10 South Howard Street ATTN: CENAB-EN-HI Baltimore, MD 21201-1715
ALTERNATE THIRD CALL	Brooke Conway Design Team Leader USACE	(410) 962-6805 Baltimore District, USACE 10 South Howard Street ATTN: CENAB-EN-HI Baltimore, MD 21201-1715
FOURTH CALL	John Gerhard Project Manager WESTON	(610) 701-3793 (work) (610) 513-6897 (cell) J.Gerhard@westonsolution.com Weston Solutions, Inc. West Chester, PA 19380

If MEC is recovered outside the West Point property, the designated demolition supervisor will possess a New York Blaster's License and will be responsible for all aspects of conducting demolition operations. Detonations will be scheduled by the SUXOS in conjunction with the USACE OESS and West Point on the basis of weather and logistical considerations. Detonations will occur only after all personnel have left the area (based on the safe fragmentation distance) and road guards/perimeter guards have been posted as instructed by the SUXOS (based on size, type, and quantity of MEC being disposed). To secure the perimeter, a safety zone will be established at the appropriate distance in one direction (north, south, east, or west) from the detonation area. UXO technicians will walk from the detonation area in the remaining three directions and will keep a line-of-sight between UXO technicians. In addition, trails and access points will have temporary signage alerting the public to demolition activities. During hook-up procedures, a designated project vehicle or equipment will remain in the area to provide emergency egress for the demolition team.

The SUXOS (or his designated assistant) shall make notifications of detonations. The composition of the demolition team will be determined by the SUXOS after consultation with the USACE OESS and UXOSO. Additional demolition teams may be used at the discretion of the SUXOS, if there are large quantities of MEC/MPPEH to detonate. Other non-demolition UXO personnel will provide perimeter safety.

Only the demolition team, SUXOS, UXOSO, UXOQCS, and the USACE OESS will be permitted in the area where demolition operations are being conducted. However, all of the above-authorized personnel should not be in the demolition operations area at the same time.

Demolition materials will be accounted for by the demolition team at all times. Only the estimated amount needed to complete the day's demolition operations will be ordered from a local vender and transported to the work area.

Unique demolition sites will be photographed with a digital camera prior to and after firing of the shot, and the photograph(s) will be saved electronically for the RI Report. At a minimum after each detonation, the detonation points and general demolition site will be inspected to ensure that a misfire, low order, or kick-out has not occurred. The area where demolition operations are being conducted will remain secured until the SUXOS, in consultation with the USACE OESS and UXOSO, gives the "all clear."

3.12.3 Munitions Debris

During the course of this project, MD may be recovered during investigations. No minimum size of scrap is specified in the contract for recovery, so the following guidelines will be applied. All items deemed MD will be recovered. Items identified as potential cultural artifacts will be left in place, photographed, and GPS coordinates taken. Procedures for the protection of archaeological or historical artifacts are provided in Section 8 Environmental Protection Plan. Item information will be available on TeamLink and published within the RI Report. Items considered cultural debris, including items such as tent stakes, survey pins, and railroad spikes, will be removed and recycled to prevent interference with the geophysical surveys. Items too large to move will be left in place.

Recovered MD will be visually inspected for the presence of explosive or other hazardous material and secured in a locked container in accordance with instruction in EM385-1-97. The storage container will be safeguarded under lock and key and will remain locked when not in use. The SUXOS will inspect MD at intervals consistent with the volume accumulated. Additionally, the UXOQCS will inspect MD to verify the process and to ensure that only inert items are stored in the locked container. A final inspection will be conducted immediately prior to the transfer of MD to the designated disposal facility.

Certified MD will be transferred to a certified recycling center with the completed DD Form 1348-1A. The SUXOS will sign the form as follows: "*This certifies and verifies that the material listed has been 100 percent inspected and to the best of our knowledge and belief, is inert and/or free of explosives or related materials.*"

After the DD Form 1348-1A is verified and signed by the SUXOS and USACE OESS (or UXOQCS delegate), a copy will be maintained for the RI report and the original will accompany the MD to its final disposition at a designated recycling facility.

3.13 MUNITIONS CONSTITUENTS SAMPLING PROCEDURES

MC may be present at the West Point MRSs because of military munitions use at former ranges. The results of the MC characterization will be used to perform a baseline risk assessment and support MRSPP scoring. A detailed MC sampling rationale to be used for the West Point MMRP RI is presented in **Appendix G**. This memorandum includes the following information:

- Description of the various MEC and MC release scenarios that may be encountered at West Point during the RI.
- MC investigation tools to ensure full characterization of potential MEC releases.
- Details of the specific MC that may be present at each West Point MRS based on former munitions and weapons systems used during training exercises.

In conjunction with this Work Plan section and the MC sampling rationale memorandum, the UFP-QAPP (**Appendix J**) will be used to guide MC sampling teams and to ensure performance requirements are being achieved. The following sections outline sampling procedures to implement the MC sampling rationale memorandum and the UFP-QAPP.

3.13.1 Surface Soil/Sediment Sample Locations

Information regarding sample locations is presented in Worksheet 18 of the UFP-QAPP. Generally, sample locations will be selected in the field based on the results of the geophysical surveys. The type of samples to be collected at each location will be determined based on the rationale presented in the MC Sampling Rationale Memorandum (**Appendix G**) and Worksheet 17 of the UFP-QAPP. Samples will be analyzed for select metals and explosives based on the munitions recovered. Incremental samples (IS) will be collected at 11 locations within the Battery Knox-TD Land MRS. In addition, incremental samples will be collected at the artillery firing points within the following MRSs: Artillery Firing Range, Siege Battery, Lusk Reservoir, and Redoubt No. 2.

Primarily, samples will be collected from surface soils (0 to 6 inches below ground surface). An incremental sampling (IS) tool will be used to allow samples to be consistently collected from the entire vertical thickness of an IS sampling unit and all sampling units within a decision unit will be sampled in the same manner. If evidence of a subsurface MEC release is identified during the geophysical survey, samples will be collected from the depth at which the item(s) were observed. In the event that a subsurface IS sample is required, all increments within the sampling unit/decision unit will be collected from the same depth.

Where a MEC release is identified during the geophysical survey, additional MC samples will be collected in proximity to the item if it appears that the MEC item partially functioned or is otherwise leaking potential MC. A composite sample (spoke and hub) will be collected at these item locations.

If MEC or MD items are identified in a widespread area covering 0.25 acre or more, an IS sample will be collected. The first step in collecting an IS sample will be to use a GPS to prepare a grid that will encompass the sampling unit. Then, increments will be collected using a systematic random approach based on the following number of increments:

- 0.25 – 0.5 acre – 30 increments.
- 0.51 – 1.5 acres –50 increments.
- 1.51 – 2.5 acres – 100 increments.

If an area greater than 2.5 acres is identified for sampling, multiple sampling units will be prepared using GPS and sampled within the area. All sampling units within a decision unit will be the same size with the same number of increments collected in each sampling unit.

Prior to sampling an additional area where a potential MEC release is identified, a memorandum will be prepared to describe the proposed sampling methodology for the MEC release, based on the information above, item types, and potential MC. The memorandum will be provided to the stakeholders for review and approval prior to sampling.

XRF screening will conducted if berms or target areas for small arms ranges are identified during the geophysical survey. Based on the results of the SI, no small arms berms or target areas are anticipated to be located within the MRSs. However, in the event that one is identified, XRF will be employed to assess the potential for lead contamination.

3.13.2 Soil/Sediment Sampling Equipment

Sampling equipment for each sampling protocol is identified in Worksheet 17 of the UFP-QAPP. An IS tool will be used for the collection of IS. This tool is depicted in **Figure 3-3**.

Figure 3-3 Incremental Sampling Tool

All discrete and ex situ XRF samples will be collected with disposable plastic scoops and disposable resealable plastic bags.

3.13.3 Standard Operating Procedures

SOPs for the field activities and analytical procedures are referenced throughout the UFP-QAPP. In addition, Worksheets 19 and 21 contain a summary of all applicable SOPs.

3.13.4 Anomaly Avoidance

Anomaly avoidance will be performed prior to any intrusive activities (e.g., background sampling). This support will be provided by UXO technicians to prevent accidental exposure to potential MEC while acquiring samples. The UXO technician(s) will accompany field sampling personnel while working within the sampling area to identify potential subsurface anomalies. A UXO Technician II or higher will escort the MC sampling personnel.

3.13.5 Global Positioning System Surveying

Coordinates of all sample locations will be collected using GPS to an accuracy of at least 1 meter. Horizontal coordinates will be measured in the field using a Trimble Pro-XRS unit or equivalent. Coordinates will be reported in the UTM 18N coordinate system and the NAD83.

3.13.6 Laboratory Analysis

The following analytical methods, as identified in Worksheet 19 of the UFP-QAPP, will be used during the West Point RI:

Table 3-8 Analytical Methods

Matrix	**Analytical Group**	**Concentration Level**	**Analytical and Preparation Method / SOP**[3]
Soil / Sediment[1]	Explosives	Low	SW-846 8330B (SOP A-1)
Soil / Sediment[1]	Metals	Low	SW-846 6010B (SOP A-2)[2]
Soil / Sediment[1]	Mercury	Low	SW-846 7471A (SOP A-3)

[1]All sediment samples should have % solids ≥30%. If the % solids is <30%, additional sample needs to be collected and analyzed to ensure that detection limits are met.

[2]Note that IS samples for metals analysis will be prepared in accordance with the USACE protocol in which the sample is first dried and sieved. Next, 30 aliquots will be collected to make up 10 grams for digestion/analyses. These steps will be completed prior to the remainder of the sample being ground and prepared for explosives analysis by Method 8330B.

[3]Specific analytes will be requested under these methods in accordance with the MC Sampling Rationale Memorandum (**Appendix G**) and Worksheet 17 of the UFP-QAPP.

3.13.7 Field Quality Control Samples

Field quality control samples will be collected throughout the West Point RI sampling effort. Worksheet 20 of the UFP-QAPP identifies the types and frequency of field quality control samples.

3.13.8 Sample Documentation

Sample collection data will be recorded in logbooks by the sampling team. The following information will be recorded for each sample:

- Date and time of collection.
- MRS.
- Sample team personnel.
- Sample Identification Number.
- Sample collection method (IS, discrete, XRF).
- Analytical method to be used.
- Sample location and rational for selection.
- Soil conditions (a general description of the soil – e.g., sandy, clay, moist, organic matter).
- GPS coordinates for sample location.
- Photograph number.

Sample collection information will also be recorded on the sample jar label (Figure 27-3, UFP-QAPP). Custody of the samples will be maintained at all times as outlined on Worksheet 27 of the UFP-QAPP. Sample custody information will be documented on the Chain of Custody (COC) record (Figure 27-1, UFP-QAPP).

3.13.9 Sample Packaging and Shipping Requirements

All samples sent to an off-site laboratory will be packaged carefully to avoid breakage or contamination, and will be shipped to the laboratory at proper temperatures. The following sample packaging requirements will be followed:

- Sample bottle lids will not be mixed. All sample lids will stay with the original containers.

- If the sample volume level is low because of limited sample availability, the level will be marked on the outside of the container with a grease pencil. This procedure will help the laboratory determine whether any leakage occurred during shipment.

- Custody seals (Figure 17-2, UFP-QAPP) will be utilized on sample containers or on plastic bags containing multiple sample containers when there is a chance that custody seals or sample containers may be tampered with, such as if the sample container must be stored for any period of time in an unsecured location or refrigerator, or if the sample container must leave the custody of sampling personnel for any reason either unpackaged or in a cooler or shipping container not otherwise custody sealed.

- All glass sample bottles will be wrapped in bubble wrap or equivalent and sealed in resealable plastic bags to minimize the potential for contamination and breakage during shipment. IS, which are in resealable plastic bags, will be double-bagged to prevent leakage.

- All samples will be cooled unless "no cooling" has been specified. The sample containers will be packed in coolers. The coolers will then be filled with ice within resealable bags or frozen gel packs. Sufficient ice shall be included for the samples to arrive at 40 ºC + 20 ºC. A temperature blank will be included in each cooler for temperature determination upon receipt at the laboratory.

- Empty space in the cooler will be filled with inert packing material such as bubble wrap. Under no circumstances will locally obtained material (e.g., sawdust, sand) be used.

- The original COC record (Figure 17-1, UFP-QAPP) will be sealed in a self-sealing plastic bag, taped to the inside lid of the cooler, and transported along with the coolers to the laboratory.

- All samples should be shipped upright.

- All shipping containers will be sealed with packing tape and custody sealed (Figure 17-2, UFP-QAPP) for shipment to the laboratory. The shipping containers will be transported as environmental samples to the laboratory as expeditiously as possible, most likely by Federal Express overnight delivery service or courier.

3.13.10 Data Validation Procedures

WESTON will employ the services of Meridian Consultant Group, Inc. (MCGI) to conduct an independent third-party data validation (Tier III) for this project. Worksheet 35 of the QAPP (**Appendix J**) provides a detailed description of the process for the verification/validation of the sampling data and analysis, and the responsible personnel.

Data that are generated will be sufficient for the data validation in accordance with EPA Region III *Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses and Innovative Approaches to Data Validation* (EPA, 1993, 1995) and *Modifications to National Functional Guidelines for Organic Data Review* (EPA, 1994). This includes 10% manual data validation.

3.14 INVESTIGATION-DERIVED WASTE

No investigation-derived waste (IDW) is expected to be generated by the soil sampling procedures during the West Point RI. All PPE and disposable sampling equipment are considered non-hazardous. PPE and sampling equipment will be placed in a plastic bag and disposed in an appropriate refuse container.

The IS tool will be decontaminated following its use within each sampling unit. A stiff, nylon-bristle brush will be used to remove any dirt adhering to the tool. If additional decontamination is required (e.g., dirt was unable to be removed with the brush), a biodegradable soap solution will be used and then the tool will be rinsed in tap water. Decontamination water will be placed on the ground within the same sampling unit from which it was generated.

If, however, IDW is generated, it will be properly containerized and characterized prior to disposal. For non-explosive soil, containerization will consist of plastic or steel drums or pails with secure covers. For liquids (i.e., water), containerization will consist of a plastic drum or pail with secure cover. Characterization of the wastes will be as required by the receptor site. Storage will be coordinated with West Point POCs if IDW is generated.

4. REPORTING

4.1 RI REPORT

RI reports will be prepared at the conclusion of the field investigations. The RI reports will summarize the findings of the field investigations conducted as part of the MEC and MC characterization, including geophysical and laboratory results. The reports will describe explosive hazards that may influence current and future use of the site and will identify, develop, and analyze various risk management alternatives and cost, including institutional controls. CSMs for each MRS will be updated and provided in the reports.

Three RI reports are anticipated as part of the West Point MMRP RI:

- RI Report 1: Michie Stadium.
- RI Report 2: North Athletic Field, Target Hill, Battery Knox – TD Land and Redoubt No. 2.
- RI Report 3: Artillery Firing Range, Lusk Reservoir, Fort Clinton – West, Siege Battery, Seacoast Battery, and Grey Ghost Housing Area.

A MEC risk assessment utilizing the MEC Hazard Assessment protocol will be included in each RI report. A baseline Human Health Risk Assessment (HHRA) and Screening-Level Ecological Risk Assessment (SLERA), both for MC, will be included in each RI report if MC is detected. An HHRA and SLERA will not be included in the RI report if MC is not detected. Details of the assessments are provided in the following sections.

4.2 ASSESSMENT OF MEC RISKS

Potential explosive hazards to human receptors at each MRS will be assessed using the Interim MEC Hazard Assessment (MEC HA) Methodology guidance document (EPA, 2008). The severity, accessibility, and sensitivity of the MEC found at MRSs will be evaluated in accordance with this guidance so that the project team can compare the effects of explosive hazards to remedial action alternatives and establish a baseline hazard assessment in support of the CERCLA process. The MEC HA will also enable the project team to assess the sites on the most appropriate scale by dividing an MRS into subunits if necessary.

4.3 ASSESSMENT OF MUNITIONS CONSTITUENT RISKS

As part of the RI Report, an HHRA and SLERA will be prepared based on the results of the MC investigation. **Table 4-1** presents the human health and ecological screening values.

4.3.1 Baseline Human Health Risk Assessment

The potential for current and future risks to human health posed by exposure to MC at an MRS will be evaluated by preparation of a baseline HHRA. The HHRA will be prepared in accordance with the EPA Region III guidance and EPA's Risk Assessment Guidance for Superfund (RAGS): Volume I Human Health Evaluation Manual Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments (RAGS Part D) (EPA, 2001) and the most current EPA risk assessment guidance at the time of the assessment. It will be composed of hazard identification, exposure assessment, toxicity assessment, and risk characterization components. The receptors to be evaluated include current site workers and recreationists and future residents and construction workers.

4.3.2 Screening Level Ecological Risk Assessment

A SLERA will be prepared in accordance with the EPA's Ecological Risk Assessment Guidance for Superfund (ERAGS) (EPA, 1997 and updates). The SLERA will include Steps 1 and 2 of ERAGSs and may expand into a Baseline Ecological Risk Assessment (Steps 3 through 8). The objective of the SLERA will be to determine the potential for risk to ecological receptors from exposure to MC detected at the MRS and to prepare a report that facilitates risk management decisions. The SLERA will include screening-level problem formulation/ecological effects evaluation and screening-level preliminary exposure estimates/risk calculation components.

Table 4-1

Soil Human Health and Ecological Screening Values
West Point MMRP, U.S. Army Garrison - West Point, New York

	Human Health Soil Screening Values				Ecological Soil Screening Value					
Analyte	EPA Residential RSL[a]		NYSDEC Residential SCO[b]	NYSDEC Unrestricted Use SCO[b]	NYSDEC[b]	EPA EcoSSL[c]	EPA Region 5 ESL[d]	ORNL Benchmark 1[e]	ORNL Benchmark 2[f]	Recommended Ecological Screening Value[g]
Explosives (mg/kg)										
1,3,5-Trinitrobenzene	220	n	NBA	NBA	NBA	NBA	0.38	NBA	NBA	0.38
1,3-Dinitrobenzene	0.61	n	NBA	NBA	NBA	NBA	0.66	NBA	NBA	0.66
2,4,6-Trinitrotoluene	3.6	n	NBA	NBA	NBA	NBA	NBA	NBA	NBA	NBA
2,4-Dinitrotoluene	1.6	c	NBA	NBA	NBA	NBA	1.28	NBA	NBA	1.28
2,6-Dinitrotoluene	6.1	n	NBA	1.03	NBA	NBA	0.03	NBA	NBA	0.03
2-Amino-4,6-Dinitrotoluene	15	n	NBA	NBA	NBA	NBA	NBA	NBA	NBA	NBA
4-Amino-2,6-Dinitrotoluene	15	n	NBA	NBA	NBA	NBA	NBA	NBA	NBA	NBA
Cyclotetramethylene-tetranitramine (HMX)	380	n	NBA	NBA	NBA	NBA	NBA	NBA	NBA	NBA
Nitrobenzene	4.8	c	NBA	3.70	NBA	NBA	1.31	40	NBA	1.31
Nitroglycerin	0.61	n	NBA	NBA	NBA	NBA	NBA	NBA	NBA	NBA
2-Nitrotoluene	2.9	c	NBA	NBA	NBA	NBA	NBA	NBA	NBA	NBA
3-Nitrotoluene	0.61	n	NBA	NBA	NBA	NBA	NBA	NBA	NBA	NBA
4-Nitrotoluene	24	n	NBA	NBA	NBA	NBA	NBA	NBA	NBA	NBA
Cyclotrimethylenetrinitramine (RDX)	5.5	c	NBA	NBA	NBA	NBA	NBA	NBA	NBA	NBA
Pentaerythritol tetranitrate (PETN)	NBA		NBA	NBA	NBA	NBA	NBA	NBA	NBA	NBA
Tetryl	24	n	NBA	NBA	NBA	NBA	NBA	NBA	NBA	NBA
Metals (mg/kg)										
Aluminum	7,700	n	NBA	NBA	NBA	pH < 5.5	0.14	NBA	50	pH < 5.5 or 0.14
Antimony	3.1	n	NBA	NBA	NBA	0.27	5.7	NBA	5	0.27
Arsenic	0.39	c	16	13.0	13	18	1.04	60	10	13
Barium	1,500	n	350	350	433	330	1.06	NBA	500	433
Beryllium	16	n	14	7.20	10	21	0.0022	NBA	10	10
Cadmium	7	n	2.5	2.50	4	0.36	NBA	20	4	4
Calcium	NBA		NBA	NBA	NBA	NBA	NBA	NBA	NBA	NBA
Chromium (III)	12,000	n	36	30.0	41	26	0.14	NBA	NBA	41
Chromium (VI)	0.29	c	22	1.00	1	130	0.4	0.4	1	1
Cobalt	2.30	n	NBA	30.0	NBA	13	5.4	NBA	20	13
Copper	310	n	270	50.0	50	28	NBA	50	100	50
Iron	5,500	n	NBA	2,000	NBA	NBA	0.0537	NBA	NBA	0.054
Lead	400		400	63.0	63	11	NBA	500	50	63
Magnesium	NBA		NBA	NBA	NBA	NBA	NBA	NBA	NBA	NBA
Manganese	180	n	2000	1,600	1600	220	NBA	NBA	500	1600
Mercury	0.56	n	0.81	0.18	0.18	NBA	0.1	NBA	0.3	0.18
Molybdenum	39.00	n	NBA	NBA	NBA	NBA	NBA	NBA	2	2
Nickel	150	n	140	30.0	30	38	1360	200	30	30
Potassium	NBA		NBA	NBA	NBA	NBA	NBA	NBA	NBA	NBA
Selenium	39	n	36	3.90	3.9	0.52	0.0276	70	1	3.9
Silver	39	n	36	2.00	2	4.2	4.04	NBA	2	2
Sodium	NBA		NBA	NBA	NBA	NBA	NBA	NBA	NBA	NBA
Thallium	NBA		NBA	NBA	NBA	NBA	0.0569	NBA	1	0.057
Vanadium	0.55	n	NBA	100	NBA	7.8	1.59	NBA	2	7.8
Zinc	2,300	n	2200	109	109	46	6.62	200	60	109

Table 4-1

Soil Human Health and Ecological Screening Values
West Point MMRP, U.S. Army Garrison - West Point, New York

[a] Residential Screening Levels were obtained from ORNL Regional Screening Levels for Chemical Contaminants at Superfund Sites Table (May 2010). The RSLs are shown at a target risk (TR) of 1.0E-6 or a target hazard quotient (THQ) of 0.1.

[b] New York Department of Environmental Conservation. 2006. Remedial Program Soil Cleanup Objectives - http://www.dec.ny.gov/regs/15507.html

[c] USEPA. 2005. Ecological Soil Screening Levels - http://www.epa.gov/ecotox/ecossl/, (the lowest screening value was selected from plant, invertebrate, avian, and mammalian benchmarks)

[d] USEPA. 2003. Region 5 RCRA Ecological Screening Levels - http://www.epa.gov/reg5rcra/ca/ESL.pdf

[e] Efroymson, R.A. , M.E. Will, and G.W. Suter II. 1997. Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision. Oak Ridge National Laboratory (ORNL), Oak Ridge, TN. ES/ER/TM-126/R2 – http://www.esd.ornl.gov/programs/ecorisk/documents/tm126r21.pdf (earthworm data used)

[f] Efroymson, R.A. , M.E. Will, G.W. Suter II, and A.C. Wooten. 1997. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/TM-85/R3 - http://www.esd.ornl.gov/programs/ecorisk/documents/tm85r3.pdf

[g] The primary source for the Recommended Screening Value is the NY DEC value. If a NY DEC value was not available, the following hierarchy was used to select the screening value: USEPA EcoSSL, EPA Region 5 ESL, ORNL Benchmark 1, ORNL Benchmark 2.

ARAR = Applicable or relevant and appropriate requirement.
c = Cancer effects at a target risk of 1.0E-06.
mg/kg = Milligrams per kilogram.
n = Noncancer effects, at a target hazard quotient of 0.1.
NBA = No Benchmark Available.
NUT = Essential Nutrient.
RSL = Regional screening level.
SCO = Soil cleanup objectives.

5. QUALITY CONTROL PLAN

5.1 STANDARD QUALITY CONTROL PROCESS

It is WESTON's policy to apply sound and cost-effective quality principles to all of its activities. This policy assists in ensuring the proper execution of work, the management of liability, and the maintenance of WESTON's professional reputation for excellence. The quality policies established within this Work Plan and its implementing plans and procedures are applicable to all participating project personnel and subcontractors. The plan is applicable to all site activities affecting quality, including, but not limited to, MEC investigation and removal, demolition operations, handling of demolition materials, and data management. Regardless of subcontractor or teaming agreements, WESTON is solely responsible for the control of quality and for providing USACE with services and deliverables that conform to contractual requirements.

This Quality Control Plan (QCP) identifies quality requirements to ensure that overall project activities are accomplished using an acceptable level of internal controls and review procedures. The intent of such controls is to eliminate conflicts, errors, and omissions and to ensure the technical accuracy of deliverables.

5.1.1 Daily Field Activity Records

Field activities affecting QC will be performed in accordance with documented procedures identified in the Work Plan or applicable guidance. During field activities, WESTON may use any or all of the following reporting forms (see **Appendix K)** and additional forms and reporting media as necessary:

- Daily Site Health and Safety Meeting Report.
- Daily Quality Control Report (DQCR).
- Quality Assurance Audit Checklist and Audit Form.
- Daily Equipment Checklist.
- Health and Safety Compliance Inspection.
- Site Visitors Logs.

5.1.1.1 Daily Quality Control Reports

DQCRs shall be maintained in the project files for inclusion in the final report. The UXOQCS shall prepare a DQCR (**Appendix K**) including, as a minimum, the following information:

- Preparer (name and signature).
- Date.
- The criteria for and results of any inspection, surveillance, or review performed (attach inspection or surveillance forms as applicable).
- The results of any review of submittals or other items.
- The results of QC inspections of grids and transects.
- Any significant issues or open items.

The UXOQCS will maintain a field logbook of all inspection and testing activities. This daily logbook will be used in preparing the recurring reports and deliverables and the project report.

5.1.1.2 Safety Log

Safety logs shall be maintained in the project files for inclusion in the final report. The UXOSO shall prepare a log including, as a minimum, the following information:

- Preparer (name and signature).
- Date.
- Weather conditions, discussion of any incidents, accidents, or significant site events that may impact safety, and stopping work because of safety issues.
- Signatures of all project personnel and visitors acknowledging that they have participated in a safety briefing.

5.2 QUALITY CONTROL INSPECTION PROCESS

Field performance will be evaluated to ensure that the quality standards and objectives of the Work Plan are met. The evaluation of field performance will be accomplished through audits of the DQCRs. Corrective actions will be implemented when non-conformances or deficiencies are identified. In addition, field audits will be conducted periodically by the Corporate MEC Operations Manager who is responsible for explosives safety and quality throughout the company.

Procedures for auditing activities will be identified prior to implementation of the audits. The audit process involves identifying, documenting, and reporting non-conformances or deficiencies, initiating corrective actions through appropriate channels, and conducting a compliance review. Auditing tasks and findings will be documented utilizing the QC Audit Checklist and notes. Copies of the audit findings will be provided to USACE. Audit inspections of dig sheets and the RespondFast database, in conjunction with the 10% QC checks of each grid performed by the UXOQCS, will be completed to ensure that all subsurface anomalies are removed and to ensure that documentation is being accurately reported.

The field teams involved with site work are responsible for reporting any suspected technical non-conformances or deficiencies to the WESTON PM.

The quality requirements associated with RI field activities are defined in **Table 5-1**. These requirements apply to all field activities that affect the quality of work and work products. QC checks will be conducted as follows:

- **Daily Briefings—**The UXOSO and UXOQCS will ensure that daily safety and operational briefings are conducted with the project team.
- **Communication**s**—**Positive communications with site personnel will be maintained throughout the workday.
  - At a minimum, communication checks will be conducted each morning prior to starting work. Additional checks will be performed as necessary throughout the workday to monitor progress, safety, and/or QC.
  - Teams will not start operations until satisfactory checks have been achieved.
- **Training—**The UXOSO and UXOQCS will ensure that initial site-specific training is provided to all field personnel prior to startup of field activities, and that safety control measures have been established. Training will be accomplished using only approved training materials. The UXOSO and UXOQCS will ensure that all certifications are filed on-site for review.

Table 5-1 Field Activity Quality Requirements

Objective	Activity	Activity Quality Requirement	Quality Control Verification
Prepare Site	Mobilization and Site Preparation	Mobilize equipment and personnel, and prepare site as described in the Work Plan.	▪ Daily Site Health and Safety Meeting Report ▪ Field Logbooks
Site Work	Mag & Dig Operations	UXO technicians and survey technician will mag & dig pre-defined transects and identify all anomalies.	▪ QC Daily Report ▪ Daily Site Health and Safety Meeting Report ▪ Daily Equipment Checklist ▪ Weekly Status Report ▪ QA Audit Checklist and Audit Form. ▪ USACE Equipment Inspection Form ▪ Health and Safety Compliance Inspection ▪ Geophysical Dig Sheet and Target History ▪ Field Logbooks
Site Work	DGM Operations	DGM Teams perform required QC instrumentation and navigation tests. The Project and Site Geophysicists ensure the DQOs are met and review post-dig data.	▪ Field Data Sheet ▪ Daily DGM QC Audit Form ▪ Navigation Function Checks ▪ Processing QC ▪ Geophysical Dig Sheets and Target History
Site Work	Anomaly Removal and Disposal	Site inspection by UXOSO/QCS to inspect a minimum of 10% of the area cleared by the UXO Team to verify thoroughness of MEC removal.	▪ Preparatory/Initial/Follow-up Report ▪ QC Daily Report ▪ Daily Site Health and Safety Meeting Report ▪ Daily Equipment Checklist ▪ Weekly Status Report ▪ QA Audit Checklist and Audit Form. ▪ USACE Equipment Inspection Form ▪ Health and Safety Compliance Inspection ▪ Geophysical Dig Sheet and Target History ▪ Form 1348 ▪ Field Logbooks
Site Work	Demobilization	Demobilize equipment and personnel according to schedule.	▪ Daily Site Health and Safety Meeting Report ▪ Weekly Status Report ▪ Health and Safety Compliance Inspection ▪ Field Logbooks

- **Geophysical System Verification —**The Project and Site Geophysicist will implement an IVS to verify and monitor DGM equipment functionality during the RI.
- **Documentation—**The UXOSO and UXOQCS will ensure the completion of all documentation listed.
- **Review—**The UXOSO, UXOQCS, and/or the SUXOS will be responsible for supervising site activities, including the following:
  - Supervision of WESTON personnel and WESTON subcontractors.
  - QC inspections of the areas investigated. A minimum of 10% of each grid investigated will be inspected to ensure that the target anomalies have been removed. A grid is failed if a MEC item is found. Once a grid has passed the QC check, the USACE representative will be notified for quality assurance (QA) inspection.
  - Compliance with the project's Work Plan, QCP, and Accident Prevention Plan/Site Safety and Health Plan (APP/SSHP).
  - Adherence to the contract schedule.
  - Review and submission of all daily and weekly job status reports and documentation.
  - Daily communication with WESTON's PM.

5.2.1 Geophysical Detection Equipment

Detection equipment, such as analog and digital geophysical sensors, shall be field-tested daily using an IVS of known targets to verify and monitor equipment functionality during the RI. If the equipment does not perform adequately during the daily check, it shall be marked with a red "maintenance" tag and taken out of service until it is repaired or calibrated. The user shall check instruments at a minimum of twice daily. Records shall be maintained of all equipment checks.

5.2.2 Measuring and Test Equipment

In cases where calibration of equipment is not required, documentation shall be maintained that the equipment is functioning in accordance with manufacturer's requirements and checkout protocol.

5.2.3 Receipt Inspection

Materials and items entering the site shall be reviewed for conformance with specification/purchase order requirements as required. Consumables, such as oil and office supplies, shall receive a quantity inspection only. Any discrepancies shall be rectified with the vendor. An inspection report is not required. Equipment shall be inspected upon arriving on-site with the results of the inspections documented on the DQCR, team daily journals, or stand-alone inspection reports, as appropriate. Equipment shall be checked to ensure it meets the purchase order requirements and manufacturer's operating requirements.

5.2.4 Material Inspection

Materials brought on-site shall be inspected to ensure that they are consistent with purchase order/specification requirements, and this inspection shall be documented. In the case of materials of an engineered nature, the UXOQCS shall consult with the SUXOS to prepare an inspection plan and consult with a qualified inspector.

5.2.5 Equipment Inspection

Project personnel shall inspect equipment affecting quality (such as magnetometers) on a daily basis for obvious defects. In addition, the UXOQCS shall perform random inspections of equipment to ensure that that equipment is in proper working order and working consistent with established requirements. These inspections shall be documented on the DQCR.

5.2.6 Explosives Inspection

Upon arrival at the site, all demolition explosives shall be inspected to ensure that they are consistent with the attached paperwork and bill of lading, as well as the purchase order. The results of the inspection shall be documented on the DQCR.

5.2.7 Surveillance

Surveillance will be carried out at the discretion of the PM, SUXOS, or UXOQCS as required. Surveillance may be informal or formal and may be scheduled or unscheduled. At a minimum, the results of the surveillance, including any actions required, shall be documented either in a separate report or in periodic reports such as the DQCR.

5.3 INVESTIGATION FAILURE CRITERIA

An investigation failure results when a performance metric for the grid and transect surveys is exceeded or cannot be achieved. Grid failures occur if there are more than 15% false positives identified or any MEC items found at detectable depth based on the results of the intrusive investigation. Upon completion of intrusive work at a grid by the UXO Team, the UXOQCS shall perform a QC grid inspection encompassing, at a minimum, 10% of the grid surface area. The list of grids completed, checked by QC, and ready for QA inspection shall be updated daily, as required, and forwarded or made available to USACE. The QC process is depicted in **Figure 5-1**. Grid failures will be documented on the DQCR. Any deficiencies that are identified will require a corrective measure, and a root-cause analysis will be performed to document the issue, analysis, and corrective action. Such root-cause analyses will be submitted to USACE as memorandums.

5.4 CORRECTIVE ACTION PROCESS

It is the responsibility of the PM to ensure that procedures for reporting, evaluating, and correcting nonconformance are addressed through planned QC procedures. Nonconforming conditions may be discovered as a result of inspecting items or materials or by observing operations.

Project personnel are responsible for identifying nonconforming conditions and notifying their supervisor or manager as soon as the conditions are identified. Determination of any nonconforming conditions must be supported with objective evidence. Nonconforming conditions will be evaluated and corrected and may be considered as opportunities to improve the process.

Completion and submittal of a CAR (**Appendix K**) represents a request for corrective action.

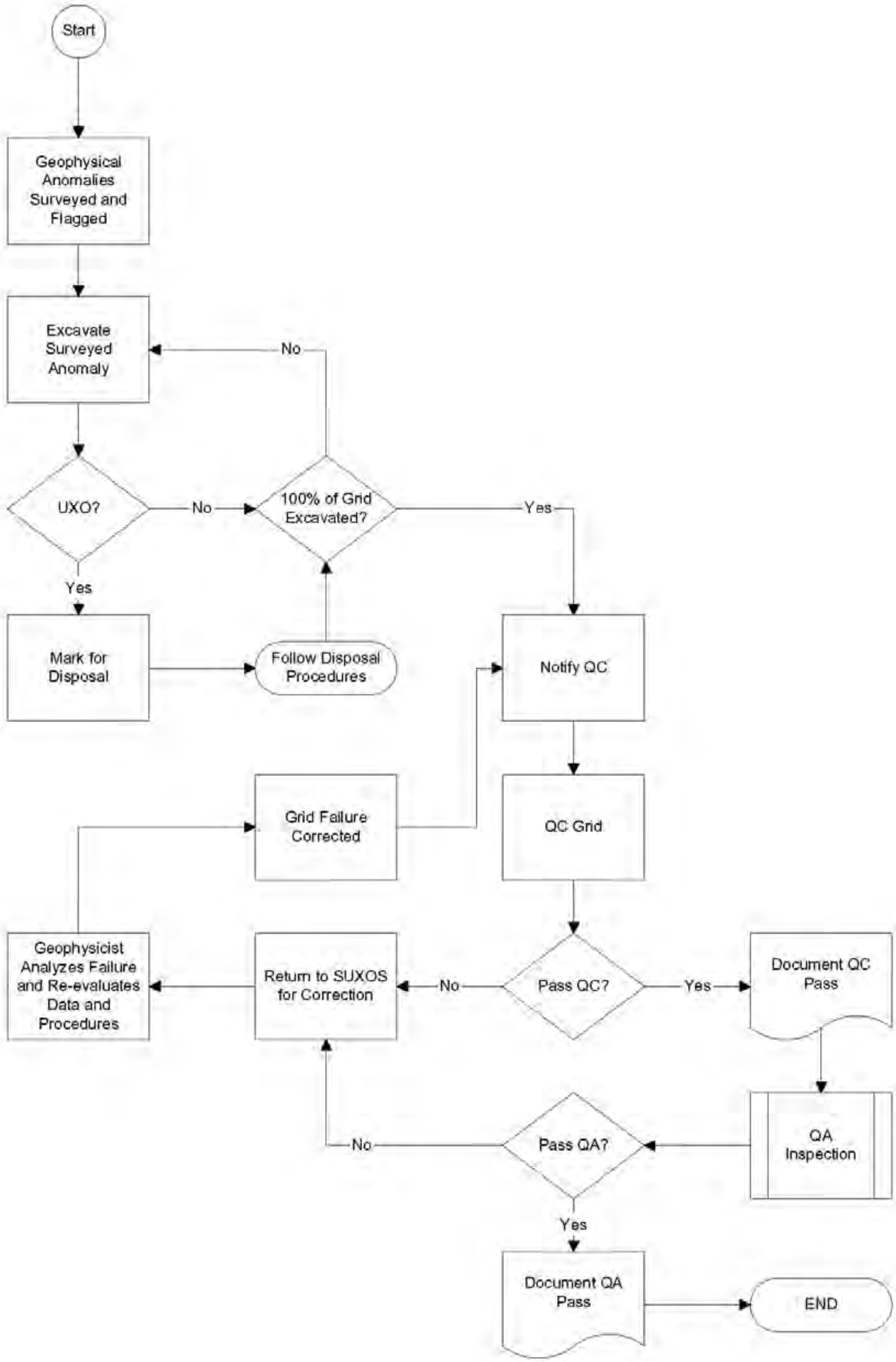


Figure 5-1 Quality Control Process

5.4.1 Identifying and Reporting Nonconforming Conditions

Nonconforming conditions must be identified and documented. Individuals having knowledge of a nonconforming condition must document the condition in a CAR and request assistance from the UXOQCS. Nonconforming items must be marked, tagged, and separated or otherwise identified as nonconforming to prevent use of the item until it is in conformance.

5.4.2 Controlling Nonconforming Conditions

Upon receipt or preparation of a CAR, the UXOQCS or designee must perform the following activities:

- Log in the CAR and assign it a number.
- Notify client representative.
- Review the report to determine the nature of the nonconformance.
- Transmit the report to the appropriate project management staff for review and evaluation.

The UXOQCS will maintain a CAR log will for the project. The CAR log will be used to track and control each nonconforming condition. At a minimum, the CAR log must contain the date each nonconforming condition was discovered, the CAR number, a description of the nonconforming condition, the department/manager responsible for disposition, the recommended disposition, and the CAR closure date.

The UXOQCS or designee, after logging the CAR, will review the CAR to determine its validity. If the CAR is determined to be valid, the UXOQCS will transmit the CAR to the responsible party for resolution of the condition.

5.4.3 Root Cause Analysis

If a product or a process displays a characteristic out of specification with those required by the project specifications or QC objectives, action will be taken to determine the cause. The depth and extent of root cause analysis depends on the situation; it may be as simple as an overlooked step, or it may be a complicated process. Root cause analysis is the responsibility of the PM and may be delegated to other qualified technical and/or QC personnel. The following factors should be considered in the analysis:

- Personnel factors.
- Equipment factors.
- Methodology factors.
- Measurement factors.
- Environmental factors.
- Material factors.

Input may be obtained as necessary from field personnel and technical advisors in order to identify the factors that led to the condition. Any analysis conducted must be documented on the CAR.

5.4.4 Review, Evaluation, and Disposition of Nonconforming Conditions

Upon receipt of a CAR, the responsible person will notify project management staff on the nonconformance and will review the nonconforming condition and document the recommended disposition on the form. The recommended disposition may be "Use as is," "Repair," or "Rework":

- If "Use as is" is recommended, the responsible party must provide technical justification why the item should be used when the item does not meet acceptance criteria.

- If "Repair" or "Rework" is recommended, the responsible party must provide technical justification for the recommendation, and develop repair/rework procedures including appropriate acceptance criteria.

Once the responsible party has completed its evaluation of the nonconforming condition, documented its recommended disposition, and signed and dated the CAR, the CAR will be returned to the UXOQCS for further processing. Upon receipt, the UXOQCS or designee will update the CAR log, evaluate the recommended disposition, and determine whether corrective action is required. The UXOQCS will also indicate on the CAR the affected disciplines or organizations who must review the recommended disposition. The UXOQCS or designee will route the CAR for review, concurrence, or rejection.

Appropriate qualified technical professionals must review and evaluate the nonconformance, decide on the suitability of the recommended disposition, identify appropriate action, and enter the details of the evaluation on the CAR. At a minimum, the PM, MMRP Technical Manager, SUXOS, and UXOQCS will review and evaluate the nonconformance. The PM or UXOQCS may also designate UXO Team Leaders and other field personnel to participate in this process. Each condition adverse to quality and/or each nonconforming characteristic will be compared against acceptance criteria during the evaluation of the recommended disposition. The CAR will then be returned to the UXOQCS or designee.

Upon receipt of the reviewed and evaluated CAR, the UXOQCS or designee will log in the results of the review, indicate acceptance or rejection by signing the CAR, and distribute completed copies to the individuals who reviewed the CAR and to the responsible organization.

CARs will be maintained in the project files and available on-site.

5.5 CORRECTIVE ACTIONS AND PREVENTIVE ACTIONS

Corrective action refers to the specific action or actions taken to correct an immediate situation and to reduce or prevent the likelihood of future occurrences. Examples of corrective action for an immediate situation include rerunning a portion of a test/operation that was not conducted in accordance with procedures, calibrating test equipment found to be out of calibration, and rerunning any required tests.

Procedures for the corrective action of nonconformance are:

- CAR will be routed to the UXOQCS, who will review it for completeness of information, evaluate the probable cause, and recommend the corrective action.
- The UXOQCS will meet with the PM and jointly agree on a probable cause, disposition, and corrective action required to prevent recurrence. The result of this discussion will be documented on the CAR.
- When corrective actions are completed to the satisfaction of the UXOQCS, the CAR will be signed as complete, and the corrective action completion date will be noted on the CAR.

Preventive action refers to the specific action or actions taken to prevent or reduce the likelihood of future occurrences of nonconformance. Examples of preventive actions are clarifying or refining procedures, allowing for additional training, and/or enhancing monitoring.

Preventive action measures will be selected to prevent or reduce the likelihood of future nonconformance occurrences and will address root causes to the extent identifiable. Selected measures will be appropriate in relation to the seriousness of the nonconformance and will be realistic in terms of the resources required to implement them. Preventive actions will also be summarized on the CAR and will be communicated to the project team.

5.6 LESSONS LEARNED PROCESS

The project is designed to identify nonconforming conditions. As required by this program, actions are taken to correct nonconformances and to prevent their recurrence. These conditions will be assessed to determine whether they are systematic or unique occurrences. After informal review and discussion by the project team, those conditions that might aid other projects will be documented as lessons learned, describing the original condition and results, changes made, and the resultant improvements. If no changes were made, but in hindsight should have been, this information will be detailed. Lessons learned will be discussed in the final RI Report.

All personnel are encouraged to continuously review processes and to suggest changes that improve the process, provide benefits, or improve project efficiency, safety, and quality. These suggestions can be either formally submitted (written memo to project leadership) or informally through verbal discussions at project meetings.

5.7 QUALITY CONTROL OF CONTRACT SUBMITTALS

Field data and documents will be reviewed/verified for technical completeness and accuracy by the appropriate WESTON technical/project management prior to transmitting deliverables to USACE. Notes recorded from formal and informal meetings through the duration of the project will be cross-checked to ensure applicable comments were addressed. USACE representatives will review deliverables to ensure that they meet the quality and accuracy objectives as outlined in the PWS.

5.8 EMPLOYEE PROCESS TRAINING PROGRAM

All personnel shall have the experience and training necessary for their assigned tasks. Personnel shall meet the training requirements identified in the APP/SSHP. A copy of the APP/SSHP is provided in **Appendix L**. Prior to beginning field work or new phases of work, the UXOQCS shall review work processes with project personnel to ensure they are adequately trained/refreshed in phase work requirements, standards, and procedures.

All visitors to the site will be required to sign in with the UXOSO and to participate in the health and safety briefing. New project personnel and subcontractors must review the APP/SSHP and receive site-specific training. All visitors must be escorted by project personnel.

5.9 CHEMICAL DATA QUALITY MANAGEMENT PLAN

This information is provided in the QAPP (**Appendix J**).

6. EXPLOSIVES MANAGEMENT PLAN

6.1 GENERAL

This Explosives Management Plan outlines the procedures to be used by UXO personnel to acquire, receive, store, transport, and issue explosives, and report the loss of explosives utilized during the RI. All personnel involved with explosives will comply with all federal, state, and local laws as required.

6.2 LICENSES /PERMITS

WESTON has a Type 33-User of High Explosives Permit from the Department of the Treasury – ATF and will secure a New York permit to use explosives as required by local regulations. A copy of all licenses and permits will be maintained on-site and available to any local, state, or federal authority. Permits will be required only for performing explosives work on privately owned parcels within the Battery Knox – TD Land MRS.

6.3 ACQUISITION

WESTON will purchase explosives on an as-needed-basis from a licensed commercial vendor. Vendor information will be provided as required. Prior to bringing the explosives on-site to West Point property, the SUXOS will coordinate with the USACE OESS, West Point POC, and security.

6.4 INITIAL RECEIPT OF EXPLOSIVES

For this field effort, a magazine will not be established on-site. Explosives that are delivered to the site will be placed in a Day Box mounted in the beds of a truck and will be used the same day. The following procedures will be adhered to upon initial receipt of explosive materials (see **Figure 6-1**):

- Upon arrival at the site, the SUXOS will escort the vendor/supplier to a designated area for loading/unloading.
- An individual authorized to receive the explosives will compare the explosives delivery record to the actual quantity delivered prior to accepting custody for the explosives.
- Once the quantity has been confirmed, the explosive delivery record will be signed and the explosives transferred to and stored in the approved Day Box mounted on the trucks.

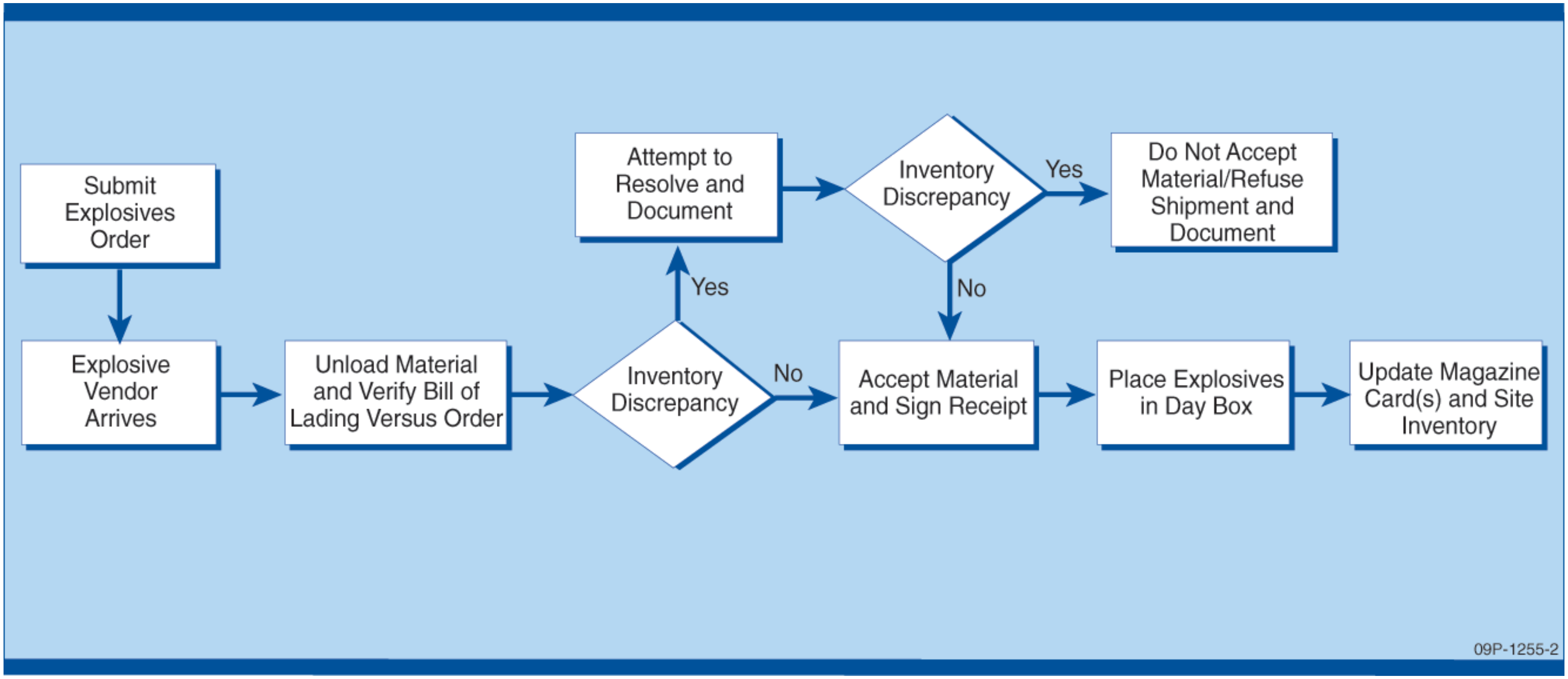


Figure 6-1 Receipt of Explosive Materials Process

- All material introduced or removed from the Day Boxes will be entered on stack cards and explosive records will be updated.
- If it is determined that there is a discrepancy between the quantity delivered and the quantity shipped, the following will occur:
  - Notify the UXOSO.
  - Do not accept shipment.
  - Contact the shipper immediately to resolve the discrepancy.

Note: If the discrepancy cannot be resolved within 24 hours, notify the Local Law Enforcement Agency, ATF, WESTON Program H&S Manager, WESTON MEC Operations Managers, and WESTON PM.

All original receipts, shipping documents, or invoices will be retained on-site as part of records management. Copies of the documentation will be provided in the final report as an appendix.

6.5 EXPLOSIVES STORAGE MAGAZINE

No explosives magazine will be established on-site. All explosives will be consumed the same day received.

6.6 TRANSPORTATION

The transportation of explosives to locations requiring demolition operations will be conducted in the following manner:

- Vehicles transporting explosives to locations requiring demolition operations will stay on roads either improved or unimproved.
- Speeds will be kept to 20 miles per hour or less, depending on road conditions.
- Radio communications will be maintained with the UXOSO.
- Vehicles will have a safety inspection performed prior to loading explosives.
- Vehicles will be equipped with a first aid kit and a minimum of two each 2A10BC fire extinguishers.
- Vehicles will be placarded during the transport of explosives.

6.7 RECEIPT PROCEDURES

Prior to accepting any explosives, the procedures outlined above in the initial receipt procedures section will be followed.

The WESTON SUXOS is authorized to purchase, receive, access, issue, transport, and use explosives for this project. Any other project personnel who will have access, issue, transportation, and use authority for explosives on this project will be annotated on the approved user list, which will be maintained in the explosive management records.

Upon completion of each demolition operation, an ammunition consumption report will be completed. Upon expenditure of all explosives, the authorized person will certify in writing that the explosives were used for their intended purpose.

6.8 INVENTORY

A physical inventory of all explosives will be accomplished in accordance with ATF guidelines.

6.9 REPORTING LOST OR STOLEN EXPLOSIVES

Loss or theft of explosives will be reported as stated in 27 Code of Federal Regulations (CFR) on Commerce in Explosives. **Table 6-1** lists the individuals or organization to be notified upon the discovery of theft or loss of explosives.

Table 6-1 Reporting Lost or Stolen Explosives

Title	Name	Telephone Number
WESTON SUXOS	Dave Carlin	484-753-1778
WESTON UXO Safety Officer	John Day	484-354-0208
WESTON PM	John Gerhard	610-701-3793
WESTON Corporate MEC Operations Manager	Al Larkins	410-696-7260
USACE OESS	TBD	TBD
West Point Representative	Jeff Sanborn	845-938-5041
Local Authorities as directed	Department of Emergency Services	911
ATF		800-461-8841

6.10 RETURN TO STORAGE OF NONEXPLODED EXPLOSIVES

All explosives ordered on an as-needed-basis will be consumed on the same day received.

6.11 DISPOSAL OF REMAINING EXPLOSIVES

All explosives ordered and received will be consumed on the same day received.

7. EXPLOSIVES SITE PLAN

An ESP has been prepared as a standalone document in accordance with the USACE Interim Guidance Document (IGD) 08-01, Explosives Site Plans (ESP) for Military Munitions Response Program (MMRP) Projects (USACE, 2008b). The approved ESP prepared following the requirements of EM 385-1-97, Explosives Safety and Health Requirements Manual, Errata No. 3 (USACE, 2008a) is presented in **Appendix M**.

8. ENVIRONMENTAL PROTECTION PLAN

8.1 GENERAL

This Environmental Protection Plan (EPP) has been prepared in accordance with DID MR-005-12 (Environmental Protection Plan) (USACE, 2003). The objective of this EPP is to provide adequate procedures and methods during site activities to safeguard against detrimental impacts to the surrounding environment and its natural resources to correct any damage done to the environment as a result of site activities and to control noise and dust on-site within reasonable limits. This EPP addresses the known environmental concerns/issues associated with this project; however, during operations, unforeseen concerns/issues may arise. In this event, operations in the affected area will be suspended until the full potential environmental impact is understood and appropriate safeguards can be implemented.

8.2 IDENTIFICATION OF ARARS

Applicable or Relevant and Appropriate Requirements (ARARs) include federal standards, requirements, criteria, and limitations under state environmental or facility siting regulations that are more stringent than federal standards. ARARs are identified on a general and site-specific basis and involve a two-part analysis: first, it is determined whether a given requirement is applicable; if not applicable, it is determined whether the requirement is nevertheless both relevant and appropriate. When a requirement is found to be both relevant and appropriate, that requirement must be complied with to the same degree as if it were applicable. Non-promulgated advisories or guidance documents issued by federal or state governments do not have the status of potential ARARs. However, these to be considered (TBC) criteria may be used in determining the necessary level of cleanup for human safety and protection of the environment.

An initial evaluation of ARARs has been performed. Evaluation of ARARs is an iterative process that will continue throughout the life of the project. **Table 8-1** lists action-specific, location-specific, and chemical-specific ARARs. Other TBC criteria are also evaluated.

Table 8-1 Potential ARARs and TBCs

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Comment
Action-Specific			
National Environmental Policy Act (NEPA)	40 CFR 1500	NEPA is the national charter for the protection of the environment. It establishes policy, sets goals, and provides means for carrying out the policy.	NEPA procedures must ensure that information is available to public officials and citizens before decisions are made and before actions are taken.
National Contingency Plan (NCP)	40 CFR 300	Provides the organizational structure and procedures for preparing for, and responding to, discharges or releases of hazardous substances, pollutants, and contaminants.	
CERCLA cleanup standards	42 U.S.C. 9621	CERCLA cleanup standards	
Department of Transportation (DOT) – shipping containers	49 CFR 178	Prescribes the manufacturing and testing specifications for packaging and containers used for the transportation of hazardous materials in commerce.	
Environmental Protection and Enhancement	AR 200-1, DA PAM 200-1	Requires Army compliance with all environmental statutes and regulations and consultation with federal, state, and local regulatory agencies.	
Dept. of Army Ammunition and Explosive Safety Standards	AR 385-64, DA PAM 385-64	Requires that safety measures be taken for the handling of explosive ordnance.	Army Regulation that establishes Army standards for the storage, handling, transportation, and disposing of munitions.
DoD Ammunition and Explosives Safety Standards	DoD 6055.9-STD	Requires that specialized personnel be employed to detect, remove, and dispose of munitions. This standard also defines the safety precautions and procedures for the detonation or disposal of munitions.	Establishes DoD ammunition and explosives safety standards.
Military Munitions Rule	40 CFR Part 266, Subpart M	Regulates unused munitions, munitions used for intended purposes, and used or fired munitions.	To be considered.
National Ambient Air Quality Standards (NAAQS)	40 CFR Part 50	Establishes primary and secondary NAAQS for ambient air quality to protect public health and welfare, for sulfur dioxide, nitrogen oxide, carbon monoxide, ozone, lead, and particulate matter.	Applicable to alternatives that have the potential to impact ambient air quality from soil excavation/grading.

Table 8-1 Potential ARARs and TBCs (Continued)

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Comment
Environment and Explosives Safety Management	DoD Directive (DoDD) 4715.11	Establishes policy for management of active and inactive military ranges. Includes guidelines for range clearance operations, hazard assessment, and recycling /disposal.	
Division of Water - Classes and Standards of Quality and Purity	6 NYCRR Parts 700-706	Establishes water quality standards including classifications of New York waters and water quality criteria to protect the ground and surface water resources; and controls stormwater and effluent discharges including toxic substances into State waters.	
Endangered and Threatened Species of Fish and Wildlife; Species of Special Concern	6 NYCRR Part 182	Requires action to conserve endangered or threatened species and their critical habitats.	
Division of Water - Tidal Wetlands-Land Use Regulations	6 NYCRR Part 661	Regulates uses of tidal wetlands and areas adjacent to ensure that uses are compatible with the preservation, protection and enhancement of the wetlands' present and potential values.	
Division of Water – Freshwater Wetlands Regulations	6 NYCRR Part 662-665	Regulates uses of freshwater wetlands and areas adjacent to ensure that uses are compatible with the preservation, protection and enhancement of the wetlands' present and potential values.	
Hazardous Waste Manifest System and Related Standards For Generators, Transporters and Facilities	6 NYCRR Part 372	Establishes standards for generators and transporters of hazardous waste and standards for generators, transporters, and treatment, storage or disposal facilities relating to the use of the manifest system and its record keeping requirements.	
Waste Transporter Permits	6 NYCRR Part 364	Protects the environment from mishandling and mismanagement of all regulated waste transported from the site of generation to the site of ultimate treatment, storage or disposal.	Applicable to any off-site transport and disposal of classified hazardous wastes, if present.

Table 8-1 Potential ARARs and TBCs (Continued)

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Comment
Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities	6 NYCRR Subpart 373-2	Establishes minimum state standards that define the acceptable management of hazardous waste.	
Air Quality Classifications and Standards	6 NYCRR Parts 256-257	Designed to provide protection from the adverse health effects of air contamination; intended to protect and conserve the natural resources and environment.	There is the potential to impact ambient air quality from soil excavation/grading.
Solid Waste Management Facilities	6 NYCRR Part 360	Regulates solid waste management facilities, other than hazardous waste management facilities.	Pertains to off-site waste disposal facilities. All wastes generated from a remedial action will be disposed at appropriately licensed and permitted facilities.
Location-Specific			
Endangered Species Act of 1973	16 USC 1531 et seq. 50 CFR 402	Establishes requirements to protect species threatened by extinction and habitats critical to their survival.	
Floodplain Management Executive Order	11988; 40 CFR Part 6, App. A	Establishes federal policy and guidance for activities completed in floodplains.	
Wild and Scenic Rivers Act	16 USC 1271	Establishes the Wild and Scenic River (WSR) System to protect rivers designated for their wild and scenic values from activities that may adversely affect those values.	
Protection of Wetlands	Executive Order 11990	Requires minimization of destruction, loss, or degradation of wetlands.	
Fish and Wildlife Coordination Act	16 USC 661-666; 40 CFR 6.302 [g]	Require consultation when a federal department or agency proposes or authorizes any modification of any stream or other water body; requires adequate provisions for protection of fish and wildlife resources. It also establishes policy for Executive Order 11990, "Protection of Wetlands."	
Endangered and Threatened Species of Fish and Wildlife; Species of Special Concern	6 NYCRR Part 182	Requires action to conserve endangered or threatened species and their critical habitats.	Depends on the presence and location of any identified species.

Table 8-1 Potential ARARs and TBCs (Continued)

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Comment
Division of Water - Tidal Wetlands-Land Use Regulations	6 NYCRR Part 661	Regulates uses of tidal wetlands and areas adjacent to ensure that uses are compatible with the preservation, protection and enhancement of the wetlands' present and potential values.	
Division of Water – Freshwater Wetlands Regulations	6 NYCRR Part 662-665	Regulates uses of freshwater wetlands and areas adjacent to ensure that uses are compatible with the preservation, protection and enhancement of the wetlands' present and potential values.	
Assessing and Mitigating Noise Impacts	NY Environmental Conservation Law - Articles 3, 8, 23, 27	Presents noise impact assessment methods, examines the circumstances under which sound creates significant noise impacts, and identifies avoidance and mitigation measures to reduce or eliminate noise impacts.	Activities could emit noise levels that may need to be monitored.
Air Quality Classifications and Standards	6 NYCRR Part 257	Establishes ambient air quality standards for sulfur dioxide, particulates, and carbon monoxide, among other known pollutants.	
Division of Water - Classes and Standards of Quality and Purity	6 NYCRR Parts 700-706	Establishes water quality standards including classifications of New York waters and water quality criteria to protect the ground and surface water resources; and controls effluent discharges including toxic substances into State waters.	
Erosion and Sediment Control & Stormwater Management	NY Environmental Conservation Law - Article 17, Titles 7, 8, and Article 70	Regulations require the preparation and implementation of erosion and sediment controls for land clearing and other intrusive activities.	Activities during the RI field work will be conducted in a manner to minimize disturbance and in accordance with all applicable regulations
Coastal Erosion Management Regulations	6 NYCRR Part 505	Regulates activities, development, and other actions in erosion hazard areas to promote and preserve the natural protective coastal features.	
Chemical-Specific			
Ambient Water Quality Criteria	40 CFR 131	Establishes discharge standards to maintain the chemical, physical, and biological integrity of the nation's waters.	
Site Specific Reference Values	West Point	Establishes site-specific reference values that are 95% upper prediction limit of West Point background data.	

Table 8-1 Potential ARARs and TBCs (Continued)

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	Comment
Toxicity Reference Values (TRVs) from published literature	See table notes below.	Values representing the threshold above which effects are expected and below which either no effect or a low effect is expected.	
Division of Water - Classes and Standards of Quality and Purity	6 NYCRR Parts 700-706	Establishes water quality standards including classifications of New York waters and water quality criteria to protect the ground and surface water resources; and controls effluent discharges including toxic substances into State waters.	
Other			
DoD Contractors Safety Manual for Ammunition and Explosives	DoD 4145.26M	Manual provides safety requirements for contractual work involving ammunition and explosives.	
Discharges of Dredged or Fill Material into Waters of the U.S.	33 CFR Part 323	Establishes permit requirements for actions that involve dredging or filling in of a navigable waterway or wetland.	

Notes: As part of the RI Report, an HHRA and SLERA will be prepared if MC is detected. Based on the CSMs for the density and distribution of potential MEC and MC, transport mechanisms and migration pathways, a Baseline Ecological Risk Assessment (BERA) is not anticipated at this time. The following human health and ecological screening guidance and literature will be used during the HHRA and SLERA preparation. Refer to Section 4.3 for a more detailed discussion of the HHRA and SLERA and Table 4-1 for the specific human health and ecological screening values.

- Residential Screening Levels were obtained from Oak Ridge National Laboratory (ORNL) Regional Screening Levels for Chemical Contaminants at Superfund Sites Table (May 2010). The RSLs are shown at a target risk (TR) of 1.0E-6 or a target hazard quotient (THQ) of 0.1.
- New York Department of Environmental Conservation. 2006. Remedial Program Soil Cleanup Objectives - http://www.dec.ny.gov/regs/15507.html
- EPA. 2005. Ecological Soil Screening Levels - http://www.epa.gov/ecotox/ecossl/, (the lowest screening value was selected from plant, invertebrate, avian, and mammalian benchmarks)
- EPA. 2003. Region 5 RCRA Ecological Screening Levels - http://www.epa.gov/reg5rcra/ca/ESL.pdf
- Efroymson, R.A. , M.E. Will, and G.W. Suter II. 1997. Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision. ORNL, Oak Ridge, TN. ES/ER/TM-126/R2 – http://www.esd.ornl.gov/programs/ecorisk/documents/tm126r21.pdf (earthworm data used)
- Efroymson, R.A. , M.E. Will, G.W. Suter II, and A.C. Wooten. 1997. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/TM-85/R3 - http://www.esd.ornl.gov/programs/ecorisk/documents/tm85r3.pdf

8.3 IDENTIFICATION OF ENVIRONMENTAL RESOURCES AND EFFECTS

8.3.1 Threatened/Endangered Species

WESTON submitted a request for review by the New York Natural Heritage Program (NYNHP) to determine whether there are records of any known rare, threatened, and endangered species, species of special concern, and/or significant natural communities located within or near the MRSs. The NYNHP correspondence dated 29 December 2010 of rare or state-listed animals and plants, significant natural communities, and other significant habitats is presented in **Appendix N**. Flora and fauna listed in the NYNHP correspondence are also presented in **Table 8-2** and **Table 8-3.**

Table 8-2 lists those federal and state–listed threatened and endangered species documented at West Point, including Constitution Island, as well as those state species of special concern, rare, extinct, and historical resident species. Sections 8.3.1.1 through 8.3.1.4 describe only the federal and state-listed threatened and endangered species; and Section 8.3.1.5 describes the state-listed species of special concern.

Table 8-2 Federal and State Listed Endangered and Threatened Animal Species Found on West Point Including Constitution Island

Scientific Name	Common Name	Location	Federal and State Legal Status	West Point Status
Mammals				
Myotis leibii	Small-footed bat*	West Point (WP)	C, SC	R
Myotis sodalis	Indiana bat	WP	FE, SE	P, V
Neotoma magister	Allegheny Woodrat	WP, Constitution Island	SE, X	X (?), H
Birds				
Accipiter cooperii	Cooper's hawk	WP	SC	R
Accipiter gentilis	Northern goshawk	WP	C, SC	V, P
Accipiter striatus	Sharp-shinned hawk	WP	SC	R
Aquila chryseatos	Golden eagle	WP	SE	V, H (?)
Botaurus lentignosus	American bittern	WP, Constitution Island (CI)	SC	R
Buteo lineatus	Red-shouldered hawk	WP	SC	R (?), V
Caprimulgus vociferous	Whip-poor-will	WP	SC	R
Chordeiles minor	Common nighthawk	WP	SC	P
Dendroica cerulea	Cerulean warbler	WP	C, SC	R
Falco peregrinus anatum	Peregrine falcon	WP	SE	V, H
Gavia immer	Common loon	WP, CI	SC	V
Haliaeatus leucocephalus	Bald eagle*	WP, CI	ST	V, H
Icteria virens	Yellow-breasted chat	WP	SC	V, P
Ixobrychus exilis	Least bittern*	WP, CI	ST	R
Melanerpes erythrocephalus	Red-headed woodpecker	WP	SC	V
Pandion haliaeatus	Osprey	WP, CI	SC	V, R(?)
Podilymbus podiceps	Pied-billed grebe	WP, CI	ST	P, V
Pooecetes gramineus	Vesper sparrow	WP	SC	V, P
Vermivora chrysoptera	Golden-winged warbler	WP	SC	R
Reptiles				
Carphophis amoenus	Eastern wormsnake	WP	SC	R
Clemmys guttata	Spotted turtle	WP, CI	SC	R

Table 8-2 Federal and State Listed Endangered and Threatened Animal Species Found on West Point Including Constitution Island (Continued)

Scientific Name	Common Name	Location	Federal and State Legal Status	West Point Status
Clemmys insculpta	Wood turtle	WP	SC	R
Crotalus horridus	Timber rattlesnake*	WP	ST	R
Heterodon platyrinos	Eastern hognose	WP	SC	R
Terrapene caroliniana	Eastern box turtle	WP, CI	SC	R
Amphibians				
Ambystoma jeffersonianum	Jefferson salamander	WP	SC	R
Ambystoma laterale	Blue-spotted salamander	WP	SC	R(?)
Ambystoma opacum	Marbled salamander	WP	SC	R
Scaphiopus holbrookii	Eastern spadefoot toad	WP (?)	SC	R (?)
Fish				
Acipenser brevirostrum	Shortnose sturgeon*	WP, Hudson River	FE, SE	R (Hudson River)
Acipenser oxyrhynchus	Atlantic sturgeon*	Hudson River	C	R
Menidia menidia	Atlantic silverside*	Lower Hudson River	FCa; SNo	Unknown
Insects, Dragonflies & Damselflies:				
Enallagma laterale	Lateral bluet	WP	C	R
Libellula needhami	Needham's Skimmer*	CI	Unlisted	Unknown

Notes:

* Species identified by NYNHP Correspondence dated 29 December 2010.

Federal Status:	State Status:	West Point Status:
FE=Federal Endangered	SE=State Endangered	R=Resident
FT=Federal Threatened	ST=State Threatened	V=Visitor, Migrant
C=Federal Species of Concern	SC=Special Concern	P=Possible Resident
F=Federal Protected; listed under CITES	X=Extinct/Extirpated	H=Historical Resident
FCa=Federal Candidate	SNo=No Open Season	?=Status Unknown
		X=Locally Extinct

Sources: USMA, 2003; NYNHP Correspondence dated 29 December 2010.

8.3.1.1 Mammals

Small-Footed Bat (Myotis leibii). During the 1999-2000 bat survey, two lactating female small footed bats were captured on West Point. In the 2002 survey, the NYNHP captured two lactating female small-footed bats—one in the Cat Hollow Special Natural Area and the other in the Constitution Island SNA. Currently, this species is listed by NYS as a species of special concern. The USFWS is currently evaluating this bat's status for possible listing under the Endangered Species Act (ESA). This species has been impacted by white nose syndrome (Tetra Tech, Inc., 2010).

Indiana Bat (Myotis sodalis). Evidence suggests that Indiana bats may use some areas within West Point for foraging and resting and that any Indiana bats observed in the area are most likely stopping at West Point on their migration patterns and are not permanent residents.

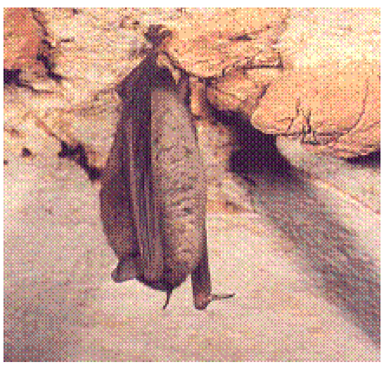


photo source: WPC 2002

A survey for Indiana bats following USFWS protocols was conducted in 2002 at West Point by the New York Natural Heritage Program. Twenty sites within West Point were surveyed, and no Indiana bats were caught during this effort. As a result, the Indiana bat is considered to be a West Point visitor. Because Indiana bats were observed in Zints Mine on one occasion, West Point installed a bat gate over the Zints Mine opening to prevent human disturbance to any hibernating bats using the mine (Tetra Tech, Inc., 2003).

The Indiana bat is vulnerable to human disturbance of its roosting sites, especially during its winter hibernation. In recent years, many thousands of hibernating bats have died in caves and abandoned mines in New York, Massachusetts, and Vermont. The most obvious symptom associated with the die-off is a white fungus encircling the noses of some, but not all, of the bats. This has led to the name "white-nose syndrome," which is actually a collection of related symptoms, including a fungus. It is not clear how this fungus alone can cause bats to die; however, impacted bats deplete their fat reserves months before their normal springtime emergence from hibernation, and starve to death as a result (NYSDEC, 2010a).

Allegheny Woodrat (Neotoma magister). The Allegheny woodrat (*Neotoma magister*), a federal candidate species and a New York endangered species, was historically found at West Point. This animal's preferred habitat in New York is large talus caves near its preferred food, red oak acorns, both of which occur in abundance at West Point. NYSDEC studies concluded that an extreme susceptibility to the nearly ubiquitous raccoon roundworm (*Baylisascaris procyonis*) had doomed the species, and consequently listed the Allegheny woodrat as officially extirpated in the wild (NYSDEC, 1994).

However, because of the relatively recent nature of the apparent extirpation of the woodrat in NY, surveys are still carried out for this species. Since woodrats are known to still exist in remnant populations in the Northeast, and since the habitat for this species remains at West Point, it is conceivable that West Point may contain a hidden population of woodrats. Currently, there are no data to suggest this. In 1994, a follow-up survey at West Point by the NYSDEC Endangered Species Unit could not locate any extant population of woodrats.

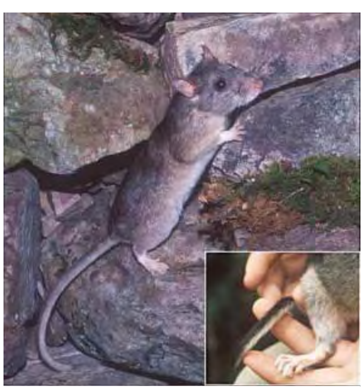


photo source: Cal Butchkowski

8.3.1.2 Birds

Peregrine Falcon (Falco peregrinus anatum) and Golden Eagle (Aquila chryseatos). The peregrine falcon and the golden eagle, both state endangered birds, are infrequently observed at West Point. Usually one or two immature birds are observed a couple of days each winter near Stilwell Lake or the Popolopen Brook valley, and an adult bird is observed only on rare occasions, often corresponding with migration (Tetra Tech, Inc., 2003).

The peregrine falcon was a historical resident of West Point, and its preferred nesting habitat remains available. However, no data suggest that this species has nested on West Point in recent history. Nevertheless, this is a rebounding species; active nests were observed both north and south of West Point at Breakneck Ridge and the Bear Mountain and Newburgh-Beacon Bridges, which indicates a possible return of this bird as a West Point resident. Therefore, the Crows Nest area is also monitored annually for peregrine falcons (Tetra Tech, Inc., 2003).

Bald Eagle (Haliaeetus leucocephalus). The bald eagle has been federally delisted because of its recovery in the majority of the lower 48 states, including New York; however, New York State continues to list the species as threatened. The species continues to be federally protected from takings, including any attempt to hurt, pursue, wound, kill, possess, or transport any bird, nest, egg, or part thereof. Possession and commerce are also prohibited by both the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act.

The West Point Natural Resources Branch has recorded sightings of bald eagles on the Military Reservation and Constitution Island during all months of the year. During the 1990s, eagle sightings on West Point properties have increased in numbers and frequency. Sightings have been recorded at Constitution Island, Brooks Hollow, Stilwell Lake, along Popolopen Brook, Long Pond, Popolopen Lake, lower Cragston Lake, along the Crown Ridge and Long Mountain, and on the Main Academy grounds (Tetra Tech, Inc., 2003). Bald eagles have been documented using parts of West Point for communal winter night roosts; however, it has been over 100 years since an eagle nest has been documented at West Point (Tetra Tech, Inc., 2003). The closest documented nest exists on the St. Basil's Academy property in Garrison, Putnam County, New York, which is located across the river from West Point and north of the Battery Knox MRS.

Constitution Island is also known to serve as a stop-over for migrating eagles. Constitution Island contains two MRSs (Siege Battery and Seacoast Battery).

Appropriate precautions will be taken to ensure that the bald eagles are not disrupted. To minimize interaction and keep distance between identified eagles, field work will be conducted in accordance with the Integrated Natural Resources Management Plan (INRMP) for the United States Military Academy (Tetra Tech, Inc., 2003) and the *National Bald Eagle Management Guidelines* (USFWS, 2007). For work occurring on the Hudson River's eastern shore, foot traffic will be avoided in the area of the nest, and loud noises will be avoided within 660 feet of the nest. Any loud and disruptive noises will be conducted when eagles are not nesting. Use of explosives within one-half mile of communal roosts when eagles are congregating will be subject to prior coordination with USFWS. Additionally, activity between the nest and the nearest foraging area(s) will be minimized to the greatest extent practicable. WESTON will coordinate with the West Point Natural Resources Branch to avoid and minimize all potential impacts to bald eagles.

Least Bittern (Ixobrychus exilis). The state threatened least bittern is known only to occur in the Constitution Island marsh. Breeding for this species has never been confirmed on the island, but it is a confirmed breeder in the adjacent Constitution Marsh Sanctuary, which is managed by the National Audubon Society (Tetra Tech, Inc., 2003; 2010).

Pied-billed Grebe (Podilymbus podiceps). The state threatened pied-billed grebe can occasionally be found in West Point's ponds and sloughs. The grebe has been observed in Mine Lake, Brooks Hollow, Cranberry Pond, and Weyants Pond during the breeding and brood rearing seasons, but has never been observed paired or accompanied by young. The pied-billed grebe is a secretive species, and it is possible that this species is a resident breeder that has not yet been confirmed. The above-mentioned ponds and lake do not fall within any MRSs (Tetra Tech, Inc., 2003).

8.3.1.3 Reptiles

Timber Rattlesnake (Crotalus horridus). The timber rattlesnake is listed as threatened in New York State, and is not a federally protected species. Timber rattlesnakes prefer forested areas to forage for small mammals and talus, and south to southeastern facing rocky slopes for hibernating and other thermoregulatory activities. The timber rattlesnake is threatened by overhunting, poaching, and habitat alteration.

Since 1993, West Point has contracted with a local rattlesnake expert to track and monitor timber rattlesnake populations at West Point. Using radio telemetry equipment and field surveys, hibernacula and high-use summer areas have been identified. Five extant timber rattlesnake dens have been identified within, or very near, the West Point boundary (Tetra Tech, Inc., 2003). To prevent unnecessary encounters with the species, two areas with hibernacula located within West Point are restricted to training. These areas are not within the boundaries of the MRSs.

During summer months, military and civilian personnel occasionally encounter rattlesnakes on West Point. Snakes encountered within the cantonment housing areas are promptly relocated by the West Point Natural Resources Branch. Because of the prime rocky habitat, snakes are commonly found in areas adjacent to the Storm King area. Between 1 April and 31 October, it is likely that contractors could encounter rattlesnakes along Route 218. Because disturbance to any rattlesnake is a violation of law, snakes, if encountered, will be given a wide berth and the survey will be temporarily suspended in the area of the observation until the snake has vacated the area.

8.3.1.4 Fish

Shortnose Sturgeon (Acipenser brevirostrum). This federally and state endangered fish occurs at West Point in the Hudson River adjacent to the cantonment area and Constitution Island. The INRMP has a specific Endangered Species Management Plan for the shortnose sturgeon; however, WESTON will not survey any of the MRSs located within the Hudson River.

Atlantic Sturgeon (Acipenser oxyrinchus). The species is in decline, and although the Hudson River population is one of the healthiest in the nation, stocks of this fish are the lowest in 120 years. Population decline is due to overharvest, both directly and as bycatch, habitat destruction because of dredging and dam building, and pollution. To protect this species, NYS closed the commercial harvest of this species in 1996, and the sturgeon is now a candidate for federal listing (Tetra Tech, Inc, 2010). WESTON will not survey any of the MRSs located within the Hudson River.

8.3.1.5 State-Listed Species of Special Concern

There are 15 state species of special concern that are residents or breeders on West Point and Constitution Island. They include five reptile species (eastern wormsnake, spotted turtle, wood turtle, eastern box turtle, eastern hognose snake), two species of amphibians (Jefferson salamander and marbled salamander), one mammal species (small-footed myotis – *Myotis leibii*), and seven species of birds (Cooper's hawk, sharp-shinned hawk, red-shouldered hawk, American bittern, whip-poor-will, cerulean warbler, and golden-winged warbler) (Tetra Tech, Inc., 2003). WESTON will coordinate with both the NYNHP and the West Point Natural Resources Branch to identify the presence of any species of special concern within the MRSs. In the event that species of special concern are encountered within the MRSs, WESTON will work with the NYSDEC and the West Point Natural Resources Branch to avoid and minimize impacts to the encountered species.

8.3.1.6 Rare Plants

There are no federally threatened or endangered plant species found, or likely to be found at West Point. An inventory of rare plants on West Point conducted in 1994/1995 indicated the presence of 63 special status plant species; a follow-up survey was conducted during the 2000 growing season (4 May to 19 October). Of the 75 species placed on the West Point rare plant list, 62 have been identified as state-rare (NYNHP-listed), whereas 18 have been identified as species rare in the Hudson Highlands region or rare on West Point lands. Of the 62 state-rare species, 13 have been relegated to the NYNHP Watch List, and 7 have been dropped from all NYNHP lists, leaving 22 West Point plant species on the NYNHP Active List. USMA also keeps information on 6 possibly extirpated species in the event they reappear. The total number of sites identified with special status plants is currently 230 (Tetra Tech, Inc., 2003). **Table 8-3** lists the rare plants at West Point, along with their rarity status, habitat, and frequency and distribution. There are several rare plant locations on Constitution Island (Pray, 2010).

Many of the plants listed by the NYNHP are protected by New York State law because they are considered to have a potential for extinction within the state or are species vulnerable to extinction. The NYNHP ranking does not automatically indicate any legal protection for rare species, and the legal protection provided by a New York State listing does not prohibit disturbance by the property owner. However, West Point has proven to be a haven for many rare species because of its unique topography and land use history (Tetra Tech, Inc., 2003). The West Point Rare Plant Management Plan (Deschenes, 2002) was developed for the protection of these rare species and provides management measures for each rare species occurrence.

WESTON will coordinate with the West Point Natural Resources Branch to identify rare plant locations and to work in accordance with the West Point Rare Plant Management Plan. No adverse effects to any population are anticipated.

Table 8-3 Rare Plants at West Point

Species Name	Common Name	NYS Legal Statue	West Point Status
S1 Plants			
Aristolochia serpentaria	Virginia Snakeroot	Endangered	Secured
Carex aggregate	Glomerate Sedge	Endangered	Unknown
Carex straminea	Straw Sedge*	Endangered	Unknown
Carex striatula	Stripe-frutied Sedge or Lined Sedge*	Endangered	Apparently Secure
Crassula aquatic	Water Pigmyweed*	Endangered	Unknown
Elatine Americana	American waterwort	Endangered	Secure
Geranium carolinianum	Carolina Cranesbill	Endangered	Apparently Secure
Juncus debilis	Weak Rush	Endangered	Apparently Secure
Lycopus rubellus	Gypsy-wort*	Endangered	Unknown
Pinus virginiana	Virginia Pine*	Endangered	Unknown
Potamogeton diversifolius	Pondweed	Endangered	Secure
Sabatia campanulata	Slender Marsh-pink*	Endangered (HR)	Unknown
Scripus georgianus	Georgia Bulrush	Endangered	Possible at Risk
Sisyrinchium mucronatum	Michaux's Blue-eyed-grass*	Endangered (HR)	Unknown
S2 Plants			
Bidens laevis	Smooth Bur-marigold*	Threatened	Unknown
Cardamine longii	Long's Bittercress*	Threatened	Secure
Carex abscondita	Thicket Sedge	Endangered	Unknown
Carex mexochoria	Midland Sedget	Endangered	Apparently Secure

Table 8-3 Rare Plants at West Point (Continued)

Species Name	Common Name	NYS Legal Statue	West Point Status
Digitaria filiformis	Slender Crabgrass	Threatened	Secure
Endodeca serpentaria	Virginia Snakeroot*	Endangered	Unknown
Hottonia inflate	Featherfoil	Threatened	Secure
Linum medium var texanum	Texas Wild Flax	Threatened	Declining
Podostemum ceratophyllum	Riverweed	Threatened	Secure
Polygonum careyi	Carey's Smartweed	Threatened	Unknown
Potamogeton pulcher	Pondweed	Threatened	Secure
Ranunculus micranthus	Small-Flowered Crowfoot	Threatened	Secure
Sagittaria montevidensis var. spongiosa	Spongy Arrowhead*	Threatened	Unknown
Symphyotrichum subulatum var. subulatum	Saltmarsh Aster*	Threatened	Unknown
Utricularia radiata	Small-Floating Bladderwort	Threatened	Secure
S2S3 Plants			
Callitriche terrestris	Pigmy Starwort	Threatened	Secure
Carex cumulate	Cluster Sedge*	Threatened	Secure
Oxalis violacea	Violet Wood-sorrel*	Threatened	Secure
S3 Plants			
Asclepias purpurascens	Purple Milkweed	Unprotected	Possibly at Risk
Betula nigra	River Birch	Unprotected	Secure
Carex albicans var. emmonsii	Emmon's Sedge	Unprotected	Secure
Carex bickneliii	Bicknell's Sedge	Threatened	Unknown
Carex bushii	Bush's Sedge	Threatened	Possibly at Risk
Carex Iupuliformis	False Hop Sedge	Rare	Apparently Secure
Carex seorsa	Weak Stellate Sedge	Threatened	Secure
Corydalis flavula	Yellow Harlequin	Unprotected	Secure
Lechea racemulosa	Racemed Pinweed	Rate	Secure
Lespedeza violacea	Violet Bush Clover	Rare	Secure
Polygonum tenue	Slender Knotweed	Rare	Secure
Utricularia geminiscapa	Gemmed Bladderwort	Unprotected	Apparently Secure
Woodwardia aerolata	Netted Chainfern	Unprotected	Secure
Delisted Species			
Aster schreberi	Schreber's Aster	Unprotected	No Longer Monitored
Cares agyrantha	Hay Sedge	Unprotected	No Longer Monitored
Chenopodium standleyanum	Standley's Goosefoot	Unprotected	No Longer Monitored
Cunila origanoides	Dittany	Unprotected	No Longer Monitored
Pilea Fontana	Green-Fruited Clearweed	Unprotected	No Longer Monitored
Uticularia biflora (gibba)	Two-Flowered Bladderwort	Unprotected	No Longer Monitored
Rare in the Hudson Highlands			
Arctostaphylos uva-ursi	Bearberry	Unprotected	Generally, these plants are out of their normal distribution range. They are not formally monitored.
Betula cordifola	Mountain Paper Birch	Unprotected	
Eupetorium altissimum	Tall Bonesett	Unprotected	
Eupetorium sessilfolium	Upland Bonesett	Unprotected	
Lespedeza nuttallii	Nuttall's Busch Cover	Unprotected	
Mtella diphylla	Miterwort	Unprotected	
Mitella nuda	Naked Miterwort	Unprotected	
Sorbus Americana	Mountain Ash	Unprotected	
Rare on the West Point Reservation			
Bartonia virginiica	Bartonia	Unprotected	
Dicentra cucullaria	Dutchman's Breeches	Unprotected	

Table 8-3 Rare Plants at West Point (Continued)

Species Name	Common Name	NYS Legal Statue	West Point Status
Drosera intermedia	Narrow-Leafed Sundew	Unprotected	Generally, these plants are specific to habitats uncommon to West Point.
Drossera rotundifolia	Round-Leaf Sundew	Unprotected	
Glyceria grandis	Grand Manna Grass	Unprotected	
Hedeotis cerulea	Bluets	Unprotected	
Juncus torreyi	Torrey's Rush	Unprotected	
Sencio obovatus	Round-Leaved Ragwort	Unprotected	
Thelipteris simulate	Massachusetts Fern	Unprotected	
Vaccinium oxycoccos	Small Cranberry	Unprotected	
Vaccinum macroarpon	Large Cranberry	Unprotected	

Sources: USMA, 2003; NYNHP Correspondence dated 29 December 2010..

Notes:

S1 Typically 5 or fewer occurrences; very few remaining individuals, acres, or miles of stream; or especially vulnerable to extirpation in New York State for other reasons.

S2 Typically 6 to 20 occurrences; few remaining individuals, acres, or miles of stream; or very vulnerable to extirpation in New York State for other reasons.

S3 Typically 21 to 100 occurrences; limited acreage, or miles of stream in New York State.

* Species identified by NYNHP Correspondence dated 29 December 2010.

8.3.2 Wetlands

The following provides a description of the wetlands at each MRS (TLI, 2007):

- Artillery Firing Range (WSTPT-001-R-01) – None
- Battery Knox- TD Land (WSTPT-004-R-02) – Low-lying wetlands are located along the eastern shore of the Hudson River, which is the western boundary of the MRS.
- Fort Clinton – West (WSTPT-008-R-01) – None
- Grey Ghost Housing Area (WSTPT-010-R-01) – None
- North Athletic Field (WSTPT-011-R-01) – None
- Seacoast Battery (WSTPT-013-R-01) – None
- Siege Battery (WSTPT-015-R-01) – Four wetland areas exist on Constitution Island and total 2.24 acres. Three of the four wetlands are classified as palustrine scrub shrub wetlands and total 2.12 acres. The fourth, a 0.12-acre wetland, is a palustrine forested wetland.
- Target Hill (WSTPT-017-R-01) – None
- Lusk Reservoir (WSTPT-019-R-01) – None
- Redoubt No. 2 (WSTPT-020-R-01) – Two wetlands exist entirely within the Redoubt No 2 MRS. These wetlands are classified as Palustrine Emergent (totaling 0.44 acres) and Palustrine Forested (totaling 0.17 acres). Approximately 0.22 acre of a third, unclassified wetland exists partially within the MRS.
- Michie Stadium (WSTPT-022-R-01) – None

WESTON will coordinate with the West Point Natural Resources Branch and the NYSDEC, as necessary, for work within mapped wetlands. WESTON will obtain all necessary permits for any RI project activities that occur within mapped wetlands. Project activities would likely qualify for Nationwide Permit (NWP) #6 for survey activities, as the total disturbance of wetland areas would not exceed 25 cubic yards; all holes would be fully backfilled; and soil removed from the upper 6-12 inches of the pit will be returned to the upper 6-12 inches of the backfill.

8.3.3 Coastal Zone Resources

New York’s State's Coastal Management Program (CMP) is administered by the New York State Department of State (NYSDOS) and carried out in partnership with local governments and state and federal agencies. The CMP is based on a set of 44 coastal policies that guide coastal management actions at all levels of government in the state and ensure the appropriate use and protection of coasts and waterways (NYSDEC, 2010b).

The federal regulations that implement the consistency provisions of the Coastal Zone Management Act (CZMA) are presented in 15 CFR Part 930. These regulations establish the procedures to be followed in order to ensure that federal agency activities are consistent with the enforceable policies of the New York State CMP. The types of activities that are covered by these regulations are activities directly undertaken by, or on behalf of, federal agencies; activities requiring authorizations or other forms of approval from federal agencies; activities involving financial assistance from federal agencies; and outer continental shelf activities. Any federal agency considering undertaking an activity is required to submit a consistency determination and other necessary information and data to the NYSDOS. The Department of State reviews a federal agency's proposed activity and consistency determination, and renders its own decision regarding the consistency of the activity with the CMP (NYSDOS, 2010).

West Point is located on the west bank of the Hudson River, and Constitution Island is located along the Hudson River's east bank. Both West Point and Constitution Island are located within the mapped Hudson River Coastal Area of New York; however, both areas are also mapped as "federally excluded land" (NYSDOS, 2004). Despite being located on federally excluded land, proposed actions that would be located within the coastal zone will comply with the Coastal Zone Management Act regulations (15 CFR 930). Although it is not anticipated that the proposed project activities will be affected by their location within the mapped coastal zone, the issue will be addressed prior to mobilization through coordination with the West Point Natural Resources Branch and the NYSDOS CMP, as appropriate.

8.3.4 Surface Water Resources

Several smaller bodies of water are located on the installation: Stillwell Lake, Weyents Pond, Popolopen Pond, Long Pond, Dassoir Pond, Lusk Reservoir, and Delafield Pond. On-site sheet flow typically drains to one of these bodies of water, and/or the Hudson River. The nature of the investigation activities described in this work plan is not expected to adversely impact these surface water resources. Project activities will comply with both West Point's Stormwater

Pollution Prevention Plan (SWPPP) (USACE, 2008c) and stormwater management Best Management Practices (BMPs). Additionally, project activities will be conducted in a manner that prevents the discharge of pollutants into adjacent surface water resources. If project activities occur in proximity to where the surface waters could potentially be impacted, WESTON will consult the West Point Natural Resources Branch to determine and implement appropriate measures of protection. The restoration procedures for excavations planned during the RI are provided in **Appendix O**. Surface water resources within these MRSs or nearby are described as follows:

- Artillery Firing Range (WSTPT-001-R-01) – Portions of this MRS drains to Sinclair Pond Brook and Crows Nest Brook. The stretch of Crows Nest Brook, between its junction with Sinclair Pond Brook downstream to the confluence with the Hudson River, is designated as a trout spawning stream.
- Battery Knox-TD Land (WSTPT-004-R-02) – This MRS drains to the Hudson River, which is located to the west of this site.
- Fort Clinton – West (WSTPT-008-R-01) – Portions of this MRS drain to Sinclair Pond Brook and Crows Nest Brook. The stretch of Crows Nest Brook, between its junction with Sinclair Pond Brook, downstream to the confluence with the Hudson River, is designated as a trout spawning stream.
- Grey Ghost Housing Area (WSTPT-010-R-01) – None
- North Athletic Field (WSTPT-011-R-01) – None
- Seacoast Battery (WSTPT-013-R-01) – The Hudson River is located to the west of this MRS.
- Siege Battery (WSTPT-015-R-01) – Portions of this MRS drain to Sinclair Pond Brook and Crows Nest Brook. The stretch of Crows Nest Brook, between its junction with Sinclair Pond Brook downstream to the confluence with the Hudson River, is designated as a trout spawning stream.
- Target Hill (WSTPT-017-R-01) – None
- Lusk Reservoir (WSTPT-019-R-01) – Lusk Reservoir and Delafield Pond are located within this MRS.
- Redoubt No. 2 (WSTPT-020-R-01) – None
- Michie Stadium (WSTPT-022-R-01) – None

8.3.5 Vegetation Removal

Limited vegetation removal will be necessary in the MRSs to aid survey and investigation activities. Wherever possible and where access permits, brush will be removed from the site and chipped. In some locations, where removal is not permitted, or in cases where the location is inaccessible, brush will be slashed so that it lies close to the ground. Additionally, the brush will be cut as low to the ground as possible.

Woody plants with stems greater than 2 inches in diameter will not be treated as brush. Pruning will be considered if necessary to gain access to areas. For woody plants larger than 2 inches, coordination with West Point Natural Resources Branch will be required.

8.3.6 Cultural, Archaeological, and Historical Resources

A description of cultural, archaeological, and historical resources in the MRSs is presented below. When working near these locations, the West Point Cultural Resources Manager will mark the locations of the cultural sites on the ground and a 50-ft buffer will be maintained. No project activities will be conducted within the marked 50-ft buffer. Additionally, the provisions of *SOP16-1: Protection of Archaeological or Historical Artifacts* (USMA, 1995) will be adhered to. Protection procedures for archaeological and historical artifacts are presented in **Appendix P**.

- Artillery Firing Range (WSTPT-001-R-01) – Sacred Heart Cemetery located in southern parcel of MRS. Historical rock walls cross the southern portion of the MRS.
- Battery Knox- TD Land (WSTPT-004-R-02) – None
- Fort Clinton – West (WSTPT-008-R-01) – None
- Grey Ghost Housing Area (WSTPT-010-R-01) – None
- North Athletic Field (WSTPT-011-R-01) – None
- Seacoast Battery (WSTPT-013-R-01) – Several Revolutionary War sites are present along the shoreline of Constitution Island.
- Siege Battery (WSTPT-015-R-01) – Several areas containing historical debris, such as bottles and broken dishes, were found within western portion of the MRS. Several historical sites from the Revolutionary War are located on Constitution Island.
- Target Hill (WSTPT-017-R-01) – None

- Lusk Reservoir (WSTPT-019-R-01) – Several Revolutionary War sites are located near the firing point. Fort Putnam, a Revolutionary War fort, is located along the south side of the MRS.
- Redoubt No. 2 (WSTPT-020-R-01) – Redoubt No. 2, a Revolutionary War site, is located in proximity to the firing point.
- Michie Stadium (WSTPT-022-R-01) – Michie Stadium is a cultural resource.

If the unexpected discovery of potential archeological or historical artifacts occurs during intrusive activities, work will be stopped immediately and the West Point Cultural Resources Manager will be notified.

8.3.7 Existing Waste Disposal Sites

A description of existing waste disposal sites in the MRSs is presented below. RI field activities will not take place at known existing waste disposal sites.

- Artillery Firing Range (WSTPT-001-R-01) – Four closed solid waste landfills including the Motor Pool (current USMAPS construction site area), Ski Lot, Motor Pool East (current USMAPS construction site area), and organic compost landfill.
- Battery Knox- TD Land (WSTPT-004-R-02) – None
- Fort Clinton – West (WSTPT-008-R-01) – One solid waste landfill (Post School Landfill) is adjacent to the eastern boundary on the western portion of the MRS.
- Grey Ghost Housing Area (WSTPT-010-R-01) – None
- North Athletic Field (WSTPT-011-R-01) – None
- Seacoast Battery (WSTPT-013-R-01) – None
- Siege Battery (WSTPT-015-R-01) – One solid waste landfill (Post School Landfill) is located in the western portion of the MRS.
- Target Hill (WSTPT-017-R-01) – None
- Lusk Reservoir (WSTPT-019-R-01) – None
- Redoubt No. 2 (WSTPT-020-R-01) – None
- Michie Stadium (WSTPT-022-R-01) – Michie Stadium Lot A Landfill is located to the west of MRS.

8.4 MITIGATION PROCEDURES

8.4.1 Manifesting, Transportation, and Disposal of Wastes

8.4.1.1 Non-Hazardous Wastes

All generated waste will be properly characterized and disposed of under the direction of the West Point Department of Public Works (DPW) and in accordance with all applicable requirements. It is expected that only non-hazardous material will be generated as a result of this project. All PPE and disposable sampling equipment are considered non-hazardous. PPE and sampling equipment will be placed in a plastic bag and disposed in an appropriate refuse container. Nonhazardous solid waste materials, such as trash and general debris, will be removed and transported off-site for disposal through the municipal waste system.

Although MEC are potentially hazardous, once detonated in place or at the designated demolition area, the only remaining material requiring disposal will be scrap metal. WESTON intends to arrange for recycling of all scrap metal. In accordance with 40 CFR 261.6(a)(3), scrap metal, if recycled, is not subject to parts 262-266, or 268, 270, or 124. WESTON will recycle all scrap metal generated as a result of the RI and maintain records of all recycling.

Transportation of all wastes and materials will be conducted in accordance with applicable U.S. Department of Transportation (DOT) regulations, including labeling, use of placards, and documentation of transportation.

8.4.1.2 Hazardous Wastes

WESTON does not anticipate generating or encountering hazardous wastes during this project. If WESTON encounters any signs of hazardous materials/waste, WESTON will make appropriate attempts to avoid those areas, and the Program Health and Safety Manager and West Point DPW will be notified. Appropriately trained individuals will be tasked with waste removal.

However, in the unlikely event that hazardous materials and wastes are encountered, they will be stored in authorized containers; labeled in accordance with applicable regulations; appropriately manifested; and transported in accordance with applicable NYSDEC, DOT, and EPA regulations. Accumulation, transportation, and disposal of all hazardous waste will be coordinated with the West Point DPW.

8.4.2 Security of Hazardous Materials

WESTON personnel will provide security to control the work area. All hazardous materials associated with the project (primarily explosives) will be secured as discussed in Subsection 6 Explosives Management Plan.

8.4.3 Burning Activities

Burning activities are not planned for this project. Potential ignition around the detonation of MEC will be mitigated in accordance with Section 3 of this work plan and the safety measures presented in the APP. Open fires, such as campfires or fires to dispose of cut brush, will not be permitted during the performance of this project.

Smoking will be restricted to designated areas or within closed automobiles. Smoking areas will be designated by the UXOSO. In all cases, cigarettes butts and matches must be disposed of either in an automobile ashtray or in a metal butt can. Cigarette butts and matches may not be tossed from car windows or discarded onto the ground surface.

8.4.4 Dust and Emission Control

EPA has established National Ambient Air Quality Standards (NAAQS) pursuant to Sections 109 and 301(a) of the Clean Air Act (CAA). These standards, expressed in micrograms per cubic meter, establish safe concentration levels for each criteria pollutant. NAAQS have been set for six pollutants: particulate matter, sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, and lead.

As MEC demolition activities and normal vehicle use are considered minor mobile sources of air emissions, it is not anticipated that project activities will have any significant effect on air quality. All vehicles and equipment will be in good working order and will meet applicable vehicle emissions requirements.

WESTON will employ procedures such as tamping explosives with earth to reduce the amount of particulates resulting from demolition activities. Although MEC detonation may result in a brief suspension of particulates, they will rapidly settle out of the air. Therefore, the activity is not expected to adversely affect air quality.

8.4.5 Noise Control and Prevention

It is expected that this project will generate two primary sources of noise: noise from mechanical equipment (i.e., trucks), and noise from demolition activities. WESTON will control the noise emissions from mechanical equipment by ensuring that the manufacturer's noise control equipment is in place and functioning (i.e., mufflers). To minimize nuisance noise, equipment will be powered off when it is not in use.

The second source of noise will be pulse noises resulting from demolition activities. Both tamping the demolition shot with earth and observing weather conditions on the day of the shot will control this noise. For example, a day with a low cloud ceiling will transmit the nuisance noise more effectively than a clear day. To reduce the nuisance noise on a cloudy day, various options, including possibilities such as not conducting the demolition shot, waiting for a shift in prevailing winds, reducing the net explosive weight of the shot, or some combination of controls, will be assessed. The SUXOS and the Demolition Supervisor will determine the applicable method of noise control.

As noise generated by project activities will be limited to infrequent pulses that are short in duration, WESTON does not anticipate adverse impacts to resident fauna. It is expected that fauna will temporarily avoid areas where noise is being generated until the activities have ceased.

8.4.6 Spill Control and Prevention

WESTON anticipates that unleaded gasoline, diesel fuel #2, and motor oil will be the only substances with hazardous constituents that may be stored on-site and in quantities less than 5 gallons. To decrease the amount of pollutants to be stored on-site, WESTON plans, to the greatest extent possible, to conduct all fueling and repair of vehicles off-site.

Hazardous liquids that are necessary to conduct the PWS will be stored in the smallest quantities possible. Should the storage of hazardous waste, or materials with hazardous constituents be necessary, a storage tank constructed primarily of non-earthen materials, or a stationary device designed to contain an accumulation of hazardous waste would be placed within an approved secondary containment of adequate size to contain a spill (110% of storage tank size). The tank would be managed in accordance with the APP, West Point's SPCC Plan, and 40 CFR Subpart I.

8.4.6.1 Spill Response

Because of the nature of the operations, the potential for a spill of pollutants during operations is low. The highest probability for a spill will occur during re-fueling operations of equipment (i.e. filling a chainsaw's gas and oil tanks). In the event of a spill, WESTON will notify appropriate emergency responders and the West Point Environmental Management Division at (845) 938-3224/5041. The Environmental Management Division would complete any required notifications to the NYSDEC. Additionally, WESTON will be equipped with spill kits on-site for immediate cleanup if a petroleum product is inadvertently spilled. Any spills originating from small containers (e.g., gasoline cans) would be contained using absorbent materials.

If fuel or oil is spilled, the following measures will be taken:

- The spill area will be isolated and contained.
- West Point Environmental Management Division, West Point Fire Department spill response team, NYSDEC Emergency Response, Putnam and/or Orange County Emergency Management Agency (EMA) will be notified during a spill response.
- The liquid and affected soil will be shoveled into a plastic bag and subsequently placed into a DOT-approved shipping container.
- Each container will be labeled to identify its contents.
- The container(s) will be shipped off-site and disposed of at a permitted facility in accordance with the Code of Federal Regulations 260 – 270 and 6 NYCRR 370-376.

8.4.7 Storage Areas and Temporary Facilities

Storage of materials will be in a designated on-site area approved by West Point. The storage area will be designated by West Point and coordinated with USACE and other tenants, if needed.

Scrap metal will be containerized and stored in locked 55-gallon drums. Drums will be disposed of off-site at the conclusion of the project. WESTON does not anticipate the construction or use of a temporary storage area for hazardous materials. Temporary storage of fuel containers will be contained within an established fuel storage area. Unless directed by the POC to do otherwise, all temporary facilities that were erected by WESTON to execute the PWS will be removed during demobilization.

8.4.8 Access Routes

WESTON will use the existing road/trail network inside the facility, and county and private community roads outside the facility to gain access to the necessary MRSs. No environmental impact is anticipated from the use of existing roads and trails since they are currently in use by West Point personnel. County and private roads are used by the general public and private residents.

For safety purposes, a main ingress/egress route will be established through each MRS. This will allow for all-terrain vehicle (ATV) access for emergency situations. Tree and shrub pruning will be avoided as much as possible. Off-road creation of new access routes will not be required.

WESTON and the appropriate West Point POC will be responsible for notifying the Constitution Island Association of project activities that will occur on the island.

8.4.9 Vegetation Protection and Restoration

WESTON shall take all actions necessary to protect and prevent unnecessary damage to vegetation. WESTON personnel will disturb only the vegetation necessary for safe and effective access for investigation activities, and in doing so will work in close coordination with the West Point Natural Resources Branch to ensure that the impacts on all rare and protected floral and faunal species will be avoided and minimized to the greatest extent practicable. Because of the limited vegetation removal activities planned in the MRSs, no tree or shrub restoration is planned after investigation activities are completed.

8.4.10 Site Water Runon and Runoff

Runon and runoff water controls are not necessary because there is no expectation that contaminated soils, water, or waste are present on-site, or that such materials will be generated while activities are conducted. Project activities will comply with both West Point's SWPPP (USACE, 2008c) and stormwater management BMPs. Additionally, project activities will be conducted in a manner that prevents the discharge of pollutants into adjacent waterways; waste disposal will be at an off-site facility. WESTON will consult the West Point Natural Resources Branch to determine and implement appropriate measures of protection for any areas where there are adjacent wetlands; i.e., sandbags or other barrier devices could be used to prevent the spread of potentially contaminated soil or water.

8.4.11 Decontamination Procedures

All operations for the MEC portions of this project will be conducted in Level D PPE. No decontamination of personnel is anticipated to be performed. All PPE are considered non-hazardous. As such, PPE will be placed in a plastic bag, disposed of in an appropriate refuse container, and transported off-site for disposal through the municipal waste system. Equipment used for MC sampling will require decontamination in accordance with the UFP QAPP (**Appendix J**). Equipment and vehicles used for other aspects of the RI field efforts described in this Work Plan are not expected to require decontamination.

8.4.12 Minimizing Areas of Disturbance

To the greatest extent practicable, all activities associated with this project will be conducted in a manner that will avoid and minimize impacts to land resources both within and outside of the project boundaries, and in accordance with the rights-of-entry (ROEs). The area of soil that will be disturbed on this project is not anticipated to be above the threshold that requires an erosion and sediment control plan and provisions.

8.5 POST-ACTIVITY SITE RESTORATION

Restoration activities will be performed in accordance with **Appendix O**. All wastes will be removed from the site immediately upon completion of each day's field activities. Therefore, no post–activity cleanup should be required. A post–activity inspection will be conducted by the SUXOS and the UXOQCS to ensure the location is left clean.

Restoration activities will be approved prior to releasing WESTON from the contract. This will be accomplished by obtaining the West Point POC approval. This will be coordinated by the West Point Environmental Division and USACE, and the restored areas will be visually inspected immediately after completing site restoration.

8.6 AIR MONITORING

Air monitoring is not necessary for the activities planned during this investigation. There is minimal intrusive activity and WESTON does not anticipate finding HTRW-related contamination that would require air sampling.

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APPENDIX A – PERFORMANCE WORK STATEMENT

MMRP Remedial Investigations, Munitions Responses Services
West Point Military Reservation
West Point, NY
PERFORMANCE WORK STATEMENT

Date: 19 February 2010
REV: 2

1.0 Introduction and Background

This requirement is for environmental remediation services for eleven (11) Military Munitions Response Program (MMRP) sites at West Point Military Reservation, located in West Point, NY. The Department of Defense (DoD) established the MMRP under the Defense Environmental Restoration Program (DERP) to address unexploded ordnance (UXO), discarded military munitions (DMM), and munitions constituents (MC) located on current and former military installations.

The United States Military Academy, West Point (West Point) is located in Orange and Putnam Counties, New York, on the west back of the Hudson River. West Point is approximately 50 miles north of New York City and approximately 13 miles south of Newburgh. The 15,974 acres of land encompassing West Point has been designated as two areas: the Main Post or campus (2,530 acres) and the Military Reservation (13,444 acres). The Main Post contains the majority of the academic, residential, and support facilities. The Military Reservation is largely undeveloped and contains operational training facilities such as firing ranges and bivouac areas used during the summer to house and train cadets.

Of this nearly 16,000-acre reservation, 14,101 acres are classified as operational range. The Phase 3 Range Inventory identified 10 closed ranges and 2 transferred areas, totaling approximately 1,564 acres. The MR sites identified in the Range Inventory included a series of batteries, which fired artillery during training throughout the Revolutionary War and continued to do so until World War II (WWII). The firing from these batteries was mostly directed toward Crows Nest and Target Hill, which were also impact zones for artillery fired from the West Point Foundry at Cold Spring, New York in the mid to late1800s. In addition to the batteries that Range Inventory MR sites included artillery ranges and small arms ranges. West Point has been occupied by the U.S. Army since January 27, 1778, and is the oldest occupied military post in America to have continuously flown the nation's flag.

2.0 Requirements

The Contractor shall be responsible for fully executing the Firm Fixed Price Remediation (FFPR) approach under a Performance-Based Acquisition (PBA), by: conducting required environmental investigative and restoration services for which the United States Department of the Army (the "Army") is statutorily responsible; addressing any and all unforeseen environmental, explosive safety, scheduling, and regulatory issues; and, assuming contractual liability and responsibility for the achievement of the performance objectives for the MMRP sites at West Point identified in this Performance Work Statement (PWS), including any sites with off-installation contamination for which the Army is responsible. Contractors should note that "Unforeseen environmental issues" include unknown and/or varied concentrations of contaminants at cleanup sites (off-installation areas included) identified in this PWS, but not unknown sites (e.g., sites not identified in this PWS). For sites addressed under the MMRP, unknown contaminants will be limited to MC and those chemicals reasonably associated with the identified munitions and munitions related activities.

The contractor must possess all the required expertise, knowledge, equipment and tools required to meet or exceed the government's objectives identified in this PWS in accordance with established industry standards. The Contractor must have the capability and experience to perform, or provide, investigative, and restoration services required for hazardous substance and waste sites and munitions and explosives of concern (MEC). Work will include site investigation, site characterization, evaluation of remedial alternatives, remedial design, remedial construction, remediation of contaminated sites, remedial action (operations), and/or long-term management.

Under this contract, the contractor will perform munitions response actions for military munitions (MM) and munitions debris (MD). Activities may involve munitions and explosives of concern (MEC), which includes UXO, DMM, and MC if found in high enough concentrations to cause an explosive threat, non-explosive concentrations of MC and incidental contaminants not related to MM.

To perform munitions responses, the DoD primarily follows the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process. However, CERCLA has no special provisions for dealing with explosive safety. Activities may involve munitions and explosives of concern (MEC), which includes UXO, DMM, and MC if found in high enough concentrations to cause an explosive threat, non-explosive concentrations of MC and incidental contaminants not related to MM. The DoD recently revised the Ammunition and Explosives Safety Standards (DoD 6055.09-STD) (Feb 08) and this document must be adhered to in the investigation and remediation of sites with MEC. Specific requirements concerning explosives safety under the Active MMRP are further clarified in EP-385-1-95b, ER 385-1-95, EM 385-1-97, and EP 385-1-95a.

It is the Contractor's responsibility to comply with all applicable federal, state and local laws and regulations and to fulfill the performance objectives of this PWS in a manner that is consistent with any applicable orders or permits, all existing and future cleanup agreements or guidance for the Installation, and relevant DoD and Army policy, for the duration of the contract. All environmental services will comply with CERCLA, as amended by the Superfund Amendments and Reauthorization Act (SARA); the NCP requirements; the Resource Conservation and Recovery Act (RCRA) and with regulatory coordination, as appropriate, New York State Department of Environmental Conservation (NYSDEC) and the United States Environmental Protection Agency (USEPA) Region II.

Certain pollutants or contaminants (P/C) may be an issue at sites covered by this PWS. Cleanup of P/C may be warranted if the P/C present an imminent and substantial endangerment to the public health or welfare that result in an unacceptable risk. P/C, as defined in CERCLA, typically does not have a federally promulgated maximum contaminant limit (MCL). For any such P/C, or any other chemical, that does not have a federally promulgated MCL, but does have a finalized reference dose (RfD) or slope factor listed in USEPA's Integrated Risk Information System (IRIS) database, that RfD or slope factor should be incorporated in the NCP risk assessment process. However, funding will not be provided for responses that are not in full compliance with CERCLA, the DERP, and DoD and Army policy. Additionally, state standards will only be analyzed through the CERCLA applicable or relevant and appropriate requirement (ARAR) process.

The Contractor shall perform all necessary field activities to meet the overall objective of this PWS and the data quality objectives (DQOs) established for this project. The Contractor shall characterize the nature and extent, per agreed upon requirements during Technical Project Planning (TPP), of MEC and munitions constituents (MC) that are detected above the applicable regulatory criteria and to perform an ecological and human health risk assessment at the required munitions response sites (MRS) for the purpose of developing and evaluating effective remedial alternatives

3.0 Types of Services Required

This PWS includes the following types of services as authorized in Section C.1.2.1 and C.1.2.2 of the basic contract:

- Studies and Reports
- Site Investigation and Characterization
- Remedial Investigation of MEC/MC
- Remedial Action Operations
- Long Term Management

4.0 Task Order Type

This is a firm fixed price task order without environmental insurance. The period of performance on this Task Order is not to exceed 31 May 2015, inclusive of all options.

5.0 Performance Objectives and Standards

The Contractor shall be required to furnish all plant, labor, materials and equipment necessary to meet the performance objectives and standards identified in **Table 1** below. The current status of the remediation efforts for each site can be found in the documents provided in **Table 2** of this Task Order.

Table 1: Performance Requirements Summary.

Performance Objective	*Performance Measure*
Approved Project Management Plan (PMP) and Quality Assurance Surveillance Plan (QASP): • Draft PMP and draft QASP within 30 calendar days of Task Order award, • Final PMP within 15 days calendar of receipt of COR comments on the drafts.	Army approval through the Contracting Officer's Representative (COR).
Achieve Remedial Investigation (RI) at the following site(s) by 31 May 2015: • Artillery Firing Range (WSTPT-001-R-01) • Battery Knox - TD Land MRS (WSTPT-004-R-02) • Fort Clinton – West (WSTPT-008-R-01) • Grey Ghost Housing Area (WSTPT-010-R-01) • North Athletic Field (WSTPT-011-R-01) • Seacoast Battery (WSTPT-013-R-01) • Seige Battery (WSTPT-015-R-01) • Target Hill (WSTPT-017-R-01) • Lusk Reservoir (WSTPT-019-R-01) • Redoubt No. 2 (WSTPT-020-R-01) For sites that will achieve Site Close-Out following completion of the Remedial Investigation (RI), the contractor shall be responsible for completing all site close-out documentation, as well as properly abandoning all groundwater monitoring wells to meet the requirements of the performance objective.	Compliance with the Government provided, DDESB approved Explosives Siting Plan (ESP). Army approval through the COR and Regulator concurrence (e.g., receipt of documentation confirming approval of RI Report).
Achieve Remedial Investigation (RI) at the following site(s) by 31 May 2012: • Michie Stadium (WSTPT-022-R-01)	Compliance with the Government provided, DDESB approved Explosives Siting Plan (ESP). Army approval through the COR and Regulator concurrence (e.g., receipt of documentation confirming approval of RI Report).

OPTION: Achieve Remedy-in-Place (RIP) at the following site by 31 March 2014: • Michie Stadium (WSTPT-022-R-01) Upon achievement of RIP, perform Remedial Action (Operations) (RA(O)) at the above sites for the duration of the Task Order or until achievement of Response Complete (RC), whichever comes first. Upon achievement of RC, perform any necessary Long-Term Management (LTM) at the above sites for the duration of the Task Order.	Compliance with the Government provided, DDESB approved Explosives Safety Submission (ESS), if applicable. Army approval through the COR and Regulator concurrence (e.g., receipt of documentation confirming RIP.

Remedy in Place, Remedial Action Operations, and Long-Term Management are terms used for the Defense Environmental Restoration Program. These terms are defined in **Attachment C**.

RIP or RC will be attained upon the finalization of appropriate written documentation certifying that site remediation has met identified response objectives and no further action is necessary, subject to any requirement for RA(O) and/or LTM. Contractors should note that when RA(O), LTM is necessary as a result of the Contractor's remediation activities at a site, the Contractor shall be responsible for the following:

- Performing the required RA(O) and/or LTM at that site for the duration of the contract.

There may be multiple milestones and/or deliverables for each performance objective (see Section 6.2). Payments will be based on successful completion of the milestones. Final decisions regarding the adequacy of milestone and deliverable completion resides with the COR, with appropriate acceptance and approval of necessary site remediation documentation by regulators, consistent with applicable regulatory drivers listed in Section 2.0 of this PWS. For the duration of the contract, the Contractor shall remain responsible for correction of remedy deficiencies noted during RA(O) and/or LTM.

6.0 Project Management

The PBA approach requires careful coordination of project activities to ensure that all stakeholders are kept informed of the project status, existing or potential problems, and any changes required to prudently manage the project and meet the needs of the Installation's project stakeholders and decision-makers. The Contractor shall be responsible for the following project management activities:

6.1 Project Management Plan and Schedule

The Contractor will develop and maintain a detailed Project Management Plan (PMP). The PMP, based on the schedule prepared as part of the Contractor proposal, will specify the schedule, technical approach, and resources required for the planning, execution, and completion of the performance objectives. The first draft of the PMP will be due within thirty (30) calendar days of contract award. The draft PMP and subsequent revisions will be subject to Army review and approval through the Contracting Officer's Representative (COR). The final PMP will be due within fifteen (15) calendar days of comments received from the COR. A payment milestone will be established for Army approval of the final PMP through the COR.

As part of the PMP, the Contractor will develop and maintain an activity-based schedule that fully supports the technical approach and outlines the due dates for all milestones and payable deliverables. A payment plan will be included with the schedule that allows for payments to the Contractor based on successful completion of interim milestones proposed by the Contractor. It is the Army's intent to make all payments after verification of progress in accordance with this schedule. The Contractor will coordinate activities with the COR to ensure that the proposed project schedule does not conflict with other contractor activities on site, or interrupt Installation mission activities.

As part of the PMP, the Contractor will identify and implement a means for providing project status reports to the COR. The PMP will address the frequency and content of status reports.

6.2 Milestone Presentations

Milestone presentations shall be made to the COR at the completion of each milestone below to provide analysis and lessons learned, and to present approaches for completion of future milestones. At the COR's request, the Contractor may also make milestone presentations to the other project stakeholders, consistent with the applicable regulatory drivers listed in **Section 2.0** of this PWS, to show achievement of the performance objectives. This includes participation in annual Installation Action Plan (IAP) meetings, if requested by the COR.

The Contractor may propose a revision of the milestones below to reflect their PMP and provide for interim milestones. Interim milestones will only be accepted if they represent significant progress toward milestone completion, and completion of these interim steps can be measured and demonstrated. As noted in **Section 6.2**, payments will be tied to the successful completion major milestones listed below or an interim milestone plan approved by the Army, through the COR. To that end, all proposed interim milestones should be associated with easily demonstrated metrics tied to performance measurements (e.g., resolution of comments on a draft, acceptance of a final report, or acceptance of a data submittal or meeting minutes). All milestones must have a defined means for demonstrating completion in order to facilitate certification and approval (see **Section 8.3**, *Certification and Approval of Project Milestones and Deliverables*).

Major Milestones

- Approval of the Project Management Plan.
- Achievement of (acceptance/approval of) RI at WSTPT-001-R-01 by 31 May 2015.

- Achievement of (acceptance/approval of) RI at WSTPT-004-R-02 by 31 May 2015.
- Achievement of (acceptance/approval of) RI at WSTPT-008-R-01 by 31 May 2015.
- Achievement of (acceptance/approval of) RI at WSTPT-010-R-01 by 31 May 2015.
- Achievement of (acceptance/approval of) RI at WSTPT-011-R-01 by 31 May 2015.
- Achievement of (acceptance/approval of) RI at WSTPT-013-R-01 by 31 May 2015.
- Achievement of (acceptance/approval of) RI at WSTPT-015-R-01 by 31 May 2015.
- Achievement of (acceptance/approval of) RI at WSTPT-017-R-01 by 31 May 2015.
- Achievement of (acceptance/approval of) RI at WSTPT-019-R-01 by 31 May 2015.
- Achievement of (acceptance/approval of) RI at WSTPT-020-R-01 by 31 May 2015.
- Achievement of (acceptance/approval of) RI at WSTPT-022-R-01 by 31 May 2012.
- OPTION: Achievement of (acceptance/approval of) RIP at WSTPT-022-R-01 by 31 May 2014.

6.3 Environmental Requirements

The Contractor will identify: applicable Federal, State and local rules, laws, and regulations; applicable Installation-specific orders, agreements, or rules; as well as Army and DOD requirements, such as those established by the DoD Explosive Safety Board; and perform its work in accordance with said authorities. The Contractor will ensure that all activities performed by its personnel, subcontractors and suppliers are executed in accordance with said authorities. Any incident of noncompliance noted by the Contractor will immediately be brought to the attention of the COR and Installation telephonically and then by written notice. Nothing in this contract will relieve the Contractor of its responsibility to comply with applicable laws and regulations. The Contractor will obtain all approvals and permits (i.e., excavation, wetlands, NPDES, etc), necessary to accomplish the work. When the work to be performed requires facility clearances, the Contractor will obtain them with the assistance of the Installation point of contact (POC) prior to any work and coordinate all work with that POC prior to initiation. Contractors are required to perform their own utility checks. The Contractor will comply with all Installation or site-specific time and procedural requirements (federal, state, and local) described in the approvals obtained. The Army technical experts will also independently review Contractor work to ensure compliance with all applicable requirements. POCs for questions on this PWS are listed in **Attachment D**.

The Army is in the process of establishing a Geographic Information System (GIS)-based tracking system to ensure the Land Use Controls (LUCs) are enforced. The LUCs will/have been incorporated into the post-wide Master Plan and compliance with LUCs will/shall be reported in the Monitoring Reports for each site. The LUC policy applies to all units and activities, Military and Civilian Support Activities, tenant organizations and agencies and Government and Civilian Contractors. The Contractor is required to comply with the LUC policy in all RA(O).

The Contractor shall review and fully understand "Executive Order 13423 -- Strengthening Federal Environmental, Energy, and Transportation Management," in particular those requirements pertaining to environmental management system (EMS). The Contractor shall also be required to review and adhere to the installation's environmental management system, including the environmental policy and significant aspects / impacts.

The Contractor shall consider and implement green response/remediation strategies and applications to maximize sustainability, reduce energy and water usage, promote carbon neutrality, promote industrial materials reuse and recycling, and protect and preserve land resources, consistent with DOD's Policy on Consideration of Green and Sustainable Remediation Practices in the Defense Environmental Restoration Program. The contractor shall present green remediation options and approaches in its work plans, maintain records of "green-related" activities, and report this information to the COR in its project status reports.

6.4 MEC Related Guidance

MEC related guidance includes, but may not be limited to, the following:

MEC includes: UXO, as defined in 10 U.S.C. 101(e)(5); DMM, as defined in 10 U.S.C. 2710(e)(2); or Munitions Constituents (MC), as defined in 10 U.S.C. 2710(e)(3), present in high enough concentrations to pose an explosive hazard.

MEC distinguishes specific categories of military munitions that may pose unique explosives safety risks. Because MEC that is being actively managed may be determined to be hazardous wastes, 29 Code of Federal Regulations (CFR), Hazardous Waste Operations and Emergency Response, Section 1910.120 may apply.

The Contractor will comply with all Installation or site-specific time and procedural requirements (federal, state, and local) described in the approvals obtained.

UXO qualified personnel will be responsible for determining the explosive safety status of any material recovered that may pose an explosive hazard (i.e., material potentially presenting an explosive hazard (MPPEH)).

Should MEC be encountered during this response, UXO-qualified personnel will evaluate the explosive hazard and remove it, including by open detonation in place. This response will be conducted per the CERCLA and the NCP, applicable state and federal regulations, and applicable DOD, U.S. Army, and U.S. Army Corps of Engineers (USACE) standards.

6.5 Health and Safety Requirements

Prior to beginning any fieldwork, the Contractor shall implement a written Safety and Health Program compliant with federal, state, and local laws and regulations and approved by the COR. The Contractor shall ensure that its subcontractors, suppliers and support personnel comply with the approved Site Safety and Health Plan (SSHP). The Army reserves the right to stop work under this contract for any violations of the SSHP at no additional cost to the Army. Once the Army verifies through the COR that the violation has been corrected, the Contractor shall be able to continue work. As a minimum, the SSHP shall contain the following elements: site description and contaminant characterization, safety and health hazard(s) assessment and risk analysis, safety and health staff organization and responsibilities, site specific training and medical surveillance parameters, personal protective equipment (PPE) and decontamination facilities and procedures to be used, monitoring and sampling required, safety and health work precautions and procedures, site control measures, on-site first aid and emergency equipment, emergency response plans and contingency procedures (on-site and off-site), logs, reports, and record keeping. Training and medical screening per 29 CFR 1910.120(e) is required for the contract.

The Government will provide an approved Conventional Explosives Siting Plan (ESP) that will be prepared IAW EP 385-1-97 Errata 3 and DOD 6055.09-STD, for this project. The ESP will describe, in detail, the appropriate safety criteria involved for the work included in this PWS. The contractor will be responsible for conducting all work in accordance with the approved ESP. Additionally, the Contractor must adhere to all DoD and DA policies, procedures and regulations for munitions response. This includes but is not limited to DOD 6055.09-STD, Ammunition and Explosives Safety Standards; Army Regulation 385-10, the Army Safety Program; Department of the Army Pamphlet 385-63, Range Safety; and Department of the Army Pamphlet 385-64, Ammunition and Explosives Safety Standards.

Personnel involved in certain munitions response activities will, as required, meet the qualifications of Department of Defense Explosives Safety Board (DDESB), Technical Paper (TP) 18, Minimum Qualifications for Unexploded Ordnance (UXO) Technicians and UXO-Qualified Personnel. Per EP 1110-1-18, The contractor will propose a workweek schedule for each project. The proposed schedule will be submitted to the KO for approval. The KO will seek the concurrence of the PDT and resolve any other comments before making the decision to accept or reject the schedule. If the schedule is rejected, the contractor will propose a new schedule and the same process will be repeated until an acceptable schedule is approved.

The site is not suspected to contain CWM; however, if suspect CWM is encountered during any phase of site activities the Contractor shall immediately halt operations and contact the COR for assistance and guidance.

All activities involving work in areas potentially containing MEC hazards shall be conducted in full compliance with Department of Army, state, and local requirements regarding personnel, equipment and procedures, and DoD Standard Operating Procedures and safety regulations. The Contractor must comply with USACE EM 385-1-1, part 01.D "Accident Reporting and Recordkeeping.

6.6 Quality Management

The Contractor must ensure that the quality of all work performed or produced under this contract meets Army approval. Quality control/assurance plans must be prepared and approved by the COR prior to performance of physical work.

Since the technical approach for this PBA will be developed by the Contractor, the Contractor will also develop a strategy for Army Quality Assurance (QA), to be submitted with the PMP. The QA strategy should highlight key quality control activities or events the COR will use to determine when Army (Contracting Officer (KO) or COR) inspections can be conducted to assess progress toward milestones. Activities identified in the QA strategy should be appropriately coded in the project schedule to allow for planning of QA inspections. These activities will be incorporated into the final Quality Assurance Surveillance Plan (QASP) that will be developed and implemented by the COR. The QASP will be made final within fifteen (15) calendar days of the final approved PMP.

The QASP will highlight key quality control activities or events that the COR will use to determine when Army (COR) inspections can be conducted to assess progress toward and/or completion of milestones. Activities identified in the QASP should be appropriately coded in the project schedule to allow for planning of QA inspections.

6.7 Quality Control

Quality Control shall be provided whenever sampling or analysis for chemical constituents is required in order to achieve milestones. Quality control for traditional soils or geotechnical testing shall also be included. Effective October 1, 2009, laboratory (ies) to be used by the Contractor to perform testing in support of the DoD environmental restoration programs and that do not hold an unexpired DoD Component (Army) approval. Need to be accredited in accordance with DoD Environmental Laboratory Accreditation Program (ELAP). Laboratories that have DoD Component approvals in place prior to this date will be subject to DoD ELAP requirements when those approvals expire or when additions or modifications to their scope of approval are required. The Contractor may establish an on-site testing laboratory at the project site if determined necessary by the Contractor. However, on-site testing shall meet the requirements of USEPA, specific state regulator requirements, and all requirements of the most recently approved DoD Quality Systems Manual (QSM).

Following task order award and during project implementation, the Contractor shall develop and submit documentation of project-specific quality assurance (QA) and QC activities prepared in accordance with the Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP). The Government will review and return the quality systems documentation, with comments, indicating acceptance or rejection. If necessary, the Contractor shall revise the documentation to address all comments and shall submit the revised documentation to the Government for acceptance. In addition, the Contractor shall develop and submit Quality Control Summary Reports to summarize the quality control details of the task order project. The problems and successes of the work done to control the quality of the chemical measuring activities and other chemically related cleanup activities shall be included in the summary reports.

6.8 Project Repository and Administrative Record

The Contractor shall update at least monthly a multimedia (i.e., both paper and electronic format) project repository of all project-related information to ensure that pertinent documentation and data are available for project reviews, and to provide a clear record of the PBA approach to support final decisions and remediation completion. This repository is the property of the Army and available to the Army upon request by the COR or KO. A project repository is currently maintained at: West Point Military Reservation, ATTN: IMNE-MIL-PWE-M, 667A Ruger Road, West Point, NY 10996-1592. "Project-related information" includes all previous environmental restoration documentation of a technical nature developed by the Army and previous Army contractors for the sites specified in this PWS, and all the documentation developed by the Contractor in order to achieve the performance objectives specified in this PWS. Documents generated prior to the PBA are not expected to be stored in electronic format; however, all documents generated by the Contractor shall be maintained in multi-media form.

The Contractor shall also update the repositories for the Administrative Record for CERCLA activities established at: West Point Military Reservation, ATTN: IMNE-MIL-PWE-M, 667A Ruger Road, West Point, NY 10996-1592, as needed. The project repository and Administrative Record shall be updated by the Contractor, and made available to the public, for the duration of the contract. Final electronic document files must be in text-searchable PDF format and be accompanied by defined metadata for upload into the Army Repository of Environmental Documents (READ). The Army, through the COR, will provide the metadata field requirements for READ to the Contractor.

6.9 Army Environmental Database and Environmental Restoration Information System

Once a site identified in this PWS has completed the remedial investigation (i.e., appropriate documentation is finalized), the Contractor shall be responsible for providing the COR with the data and documentation necessary for each site in the Army Environmental Database - Restoration Module (AEDB-R). In addition, the Contractor shall upload all generated analytical data into the Environmental Restoration Information System (ERIS) on a quarterly basis. The Army, through the COR, will provide data specifications for AEDB-R and ERIS to the Contractor. The Contractor shall comply with all applicable requirements for data validation and submission.

6.10 Additional Site Plans

Prior to beginning any field work, the Contractor shall prepare any additional plans or documents (e.g., sampling and analysis plans, quality assurance project plan, waste minimization plans [submitted with the PMP), health and safety plans] consistent with **Section C** of the basic contract, the applicable regulatory drivers listed in **Section 2.0** of this Task Order, and any other agreements, orders, or regulations that apply to the Installation and sites. These plans and documents shall be subject to Army review and approval, through the COR.

6.11 Waste Minimization Plans

The Contractor shall provide, and upon Army approval through the COR, implement a Waste Minimization Plan. A Draft and Final Waste Minimization Plan shall be submitted with the

PMP deliverables in accordance with **Table 1**. The plan shall identify waste streams and projected volumes to be generated to achieve the performance objectives identified in the PWS.

6.12 Installation Action Plan Meetings

Contractors currently do not participate in the Installation Action Planning Meetings (IAPs). If requested by the Installation, the contractor will provide site information to support the IAP process, participate in the IAP meetings, and provide input and comments on the draft IAP, as appropriate.

6.13 Protection of Property

If it is necessary to access property outside the control of the Army, the Contractor will submit a written request to the COR a minimum of 60 calendar days in advance of the proposed entry date stating that a Right of Entry will be needed. The Contractor will not enter any property not under the control of the Army without an approved Right of Entry and will be required to comply with all conditions specified in the Right of Entry. If the Government is unable to obtain the Right of Entry within 120 calendar days from the date of notification from the Contractor, the Contractor will make best efforts to complete the requirements of this PWS without entering such property.

The Contractor shall be responsible for any damage caused to property of the United States (Federal property) by the activities of the Contractor under this contract and shall exercise due diligence in the protection of all property located on the premises against fire or damage from any and all other causes. Any property of the United States damaged or destroyed by the Contractor incident to the exercise of the privileges herein granted shall be promptly repaired or replaced by the Contractor to a condition satisfactory to the COR or reimbursement is made by the Contractor sufficient to restore or replace the property to a condition satisfactory to the COR in accordance with FAR Clause 52.245-2.

6.14 Project Stakeholders

For the purposes of this PWS, project stakeholders will include but are not limited to:

- the Army;
- New York State Department of Environmental Conservation (NYSDEC);
- the U.S. Environmental Protection Agency (USEPA) Region II;
- the U.S. Mint;
- the Palisades Interstate Park;
- the Town of Phillipstown,
- the RAB (if one is established)

Specific Army stakeholders include the following: Installation staffs, Installation Management Command (IMCOM) as the Installation's parent organization, Department of Defense

Explosives Safety Board (DDESB), US Army Technical Center for Explosive Safety (USATCES), US Army Center for Health Promotion and Preventive Medicine, US Army Environmental Command, and US Army Corps of Engineers – Baltimore Districts.

The Contractor will be responsible for obtaining comments with appropriate approval on project deliverables consistent with applicable regulatory drivers and agreements for each site.

6.15 Regulatory Involvement

All regulatory contact and coordination shall be approved by the Army through the COR. The Contractor shall provide the necessary support to initiate, schedule, and address all regulatory aspects of the project (e.g., organizing discussions with regulators concerning site response objectives and completion requirements, obtaining regulator comments on site documents and appropriately addressing them, and obtaining written documentation of remediation completion from the regulators for all of the sites identified in this PWS). The COR, or designee, will attend and represent the Army at all meetings with the regulators. The Army will be the signature authority for all regulatory agreements and remediation documentation.

6.16 Public Involvement

All public participation coordination shall be approved by the Army through the COR. The Contractor shall provide the necessary support to initiate, schedule, and address all public participation aspects of the project (e.g., preparation of briefings, presentations, fact sheets, newsletters, articles/public notices to news media, and notifications to interested members of the public). The Contractor shall be responsible for requesting and addressing all public comments consistent with the applicable regulatory drivers listed in **Section 2.0** of this PWS. The COR, or designee, will attend and represent the Army at all meetings with the public.

Contractors should note that the Installation currently does not have a RAB. Should a RAB be established, the contractor will be required to provide the necessary support (e.g., preparation of briefings, presentations, fact sheets, newsletters, and notifications to RAB members) for the sites listed in this PWS. Activities required to support public meetings are included in this effort. The Contractor will be required to participate and provide presentations on sites listed in this PWS. The Installation will provide detailed information concerning the RAB's organization should one be established.

The Contractor is responsible for developing an approved MMRP Community Relations Plan (CRP) for the Installation that is consistent with the West Point Community Relations Plan.

6.17 *Communications*

The Contractor shall not make available or publicly disclose any data or report generated under this contract unless specifically authorized by the KO through the COR. If any person or entity requests information from the Contractor about the subject of this scope of work or work being conducted hereunder, the Contractor shall refer them to the COR. All reports and other information generated under this scope of work shall become the property of the Government, and distribution to any other source by the Contractor is prohibited unless authorized by the KO.

6.18 Deliverable Requirements

All documents must be produced in draft, draft-final, and final versions in both hard copy and electronic (PDF) format. The electronic format must have optical character recognition per the USAEC READ requirements. The Contractor will provide a sufficient number of copies of each submittal as requested by the various project stakeholders. The COR will provide consolidated Army comments on preliminary-draft documents to the Contractor within thirty (30) business days. Once initial comments are addressed, the Army will review draft-final documents before submission to appropriate regulatory agencies. The Contractor shall ensure that review periods are consistent with the applicable regulatory drivers noted in **Section 2** of this PWS. All documents shall be identified as draft-final until completion of stakeholder coordination, when they will be signed and finalized. One copy of the final document shall be placed in both the project repository and Administrative Record (for CERCLA documents). One copy of the final document shall be placed in both the project repository and Administrative Record (for CERCLA documents).

The Contractor will conform to US Army Corp of Engineers (USACE) requirements or a similar approach that addresses all subject matter areas prescribed in the USACE requirements, which can be found at: http://www.hnd.usace.army.mil/oew/CX_refdocs.aspx and http://140.194.76.129/publications/. The most recent version of these references at the time of task order award will apply.

The Munitions Response Site Prioritization Protocol (MRSPP) requirements in 32 CFR Section 179 require the DOD in consultation with representatives of the states and Indian tribes, to assign each MRS a relative priority for response actions. The initial MRSPP score for MRSs is developed during the SI phase. These MRSPP scores must be reviewed annually and must be revised whenever new data are obtained. Pursuant to this requirement, the Contractor shall annually review, revise MRSPP scores based on new information, and submit to the Army. In addition, the Contractor shall also include any information that may have influenced the MRS priority or MRS sequencing decision in the Administrative Record and the Information Repository. Furthermore, the FY02 Defense Authorization Act creating the MMRP requires DOD to develop and maintain an inventory of defense sites that are known or suspected to contain UXO, DMM or MC. Pursuant to this requirement, the Contractor shall submit annual updates to the Installation Munitions Response (MR) map that reflect changes to the location, boundaries and/or extent of the MMRP sites in .pdf format. ***Note that these two annual deliverables will not be accepted as interim payment milestones.***

The Contractor shall propose deliverables and payment milestones as part of its proposal, and if approved by the Army, included as part of the PMP. Final decisions regarding the adequacy of milestone and deliverable completion resides with the COR (see ***Section 5.2***, *Milestone Presentations*) and will be based on the appropriate acceptance and approval of required documentation by Regulatory Agencies, consistent with CERCLA and the NCP.

6.19 Geographic Information System

The Contractor shall adhere to all applicable federal, DoD, and Army geospatial data standards for tasks and deliverables in this PWS. Spatial data must be compliant with the Spatial Data Standards for Facilities, Infrastructure, and Environment v2.6. Spatial data must meet the requirements of the associated Quality Assurance Plan (QAP). If no QAP exists for the data layers developed, the Contractor shall meet the minimum requirements listed in Attachment D. Each geospatial data set shall be accompanied by metadata conforming to the Federal Geographic Data Committee (FGDC) Content Standard for Digital Geospatial Metadata (CSDGM) and the Army Installation Geospatial Information & Services (IGI&S) Metadata Standard, v1. The horizontal accuracy of any geospatial data created by the contractor shall be tested and reported in accordance with the National Standard for Spatial Data Accuracy (NSSDA) and the results shall be recorded in the metadata. All data must have a datum of WGS84 and a projection of Universal Transverse Mercator (UTM) Zone 18N. Army technical experts will independently review Contractor work to ensure compliance with all spatial data requirements. Installation subject matter experts will review Contractor work and validate geospatial data. Validated data will be submitted to the Army Mapper database.

All GIS data will be provided to the installation upon completion of the performance objectives as established in Table 1, or as requested by the installation.

7.0 Expertise and Necessary Personnel

The Contractor shall provide the necessary personnel and equipment to execute this PWS successfully. The Contractor is responsible for determining the requirements for licensed professionals and certifications.

The Contractor shall furnish all plant, labor, materials and equipment necessary to meet the performance objectives. The Contractor shall provide personnel trained as required by the Occupational Safety and Health Administration (OSHA) and all other applicable federal and state regulations. The Contractor shall provide all support activities necessary to ensure the safe and effective accomplishment of all work. For all work performed under this contract, the Contractor shall also develop and implement quality control measures consistent with all applicable federal and state regulatory requirements and standards.

The contractor shall ensure that at least one member of the project team has demonstrated expertise in the identification of ordinance items dating back to the Revolutionary War period.

7.1 Key Personnel

The Army requires that the following positions, at a minimum, be designated as “key personnel”, subject to the terms and conditions for such set forth in the basic contract. The Contractor will notify the COR of any changes in key personnel. The change of key personnel is subject to approval by the KO, although such approval will not be unreasonably withheld provided replacement personnel are of the same quality as originally proposed. Key personnel shall demonstrate compliance with the key personnel clause in the base contract and in the DDESB document titled “Minimum Qualifications for Unexploded Ordnance (UXO) Technicians and Personnel” with regard to minimum education and experiences requirements per key position. Key personnel should demonstrate compliance with regard to minimum education and experiences requirements per key positions.

POSITION PE	RSONNEL
Program Manager	[insert name]
Project Manager	[insert name]
Senior Geophysicist	[insert name]
Senior UXO Supervisor	[insert name]
UXO Safety Officer	[insert name]
UXO Quality Control Officer	[insert name]

8.0 Additional Requirements

8.1 Resources

8.1.1 Army Furnished Resources

The Army will provide the following resources to the Contractor:

- Access to Army-maintained records, reports, data, analyses, and information, in their current format (e.g., paper copy, electronic, tape, disks, CDs), as related to the MMRP Munitions Response Sites (MRSs).
- Access to DOD and Army policy and guidance documents.
- The cost for evacuations, compensation, and temporary housing for displaced residents during intrusive activities and MEC destruction will be the responsibility of the Government.
- All Army owned property used for Remedial Investigation purposes must be maintained by the Contractor in accordance with applicable maintenance requirements, and may not be replaced by the Army should new equipment be required.
- GIS database resources from the MMRP SI Reports will be provided by the COR following task order award.
- Access to personnel to conduct interviews on Installation operations and activities.
- All ROEs will be executed by a Government Real Property Officer.

8.1.2 Contractor Furnished Resources

The Contractor will be responsible for the following:

- Coordination with the Army and the Installation in order to get access to the Installation, as required for execution of this PWS and by doing so, will follow the procedures described during the Contractors' meeting at the Installation.
- Coordination with the Army and the Installation in order to gain access to available infrastructure (e.g., buildings, roadways, waste management units, other Installation facilities) and utilities (e.g., electric power and telephone lines, natural gas and water supply distribution pipelines, and wastewater discharge conveyances), as required for execution of this PWS.
- The contractor is responsible for disposal of all investigation derived waste generated under this contract including removal and disposal of munitions related debris, detonation and disposal of MEC.
- Site air monitoring for hazardous chemicals during intrusive activities.
- Any munitions debris or scrap found will be collected and managed for proper disposal following Installation requirements.
- Any other necessary resources needed to achieve the defined performance objectives of this PWS.

8.2 Contractor's Guarantee

For the purposes of this PWS, the following definitions apply. The "Project Price" for each site identified in this PWS will be equal to the approved proposed price for completion of performance objectives, the payment of which will be tied to one or more project milestones. The Contractor guarantees to complete and meet all of the performance objectives outlined in this PWS for all sites on the installation at the Project Price.

8.3 Certification and Approval of Project Milestones and Deliverables

The COR will perform contract management, inspection, oversight, review, and approval activities. Certification and approval of project milestones by the COR is necessary before distribution of financing payments. Certification by the Army is also contingent upon the Contractor performing in accordance with the terms and conditions of the contract for this work, this PWS, and all amendments.

Representatives of the Army and the Contractor will have a conference with the COR in a manner and at a time agreed to by all parties after receipt of each status report to:

- Formally review the quantity and quality of services;
- Inspect work for compliance with this PWS, the associated Contractor's final proposal, and project documentation;
- Accept or reject milestones and deliverables completed since the previous review; and

- Prepare, approve and submit DD Form 250 "Material Inspection and Receiving Report" for financing payments in accordance with milestone completions and approvals to the COR.

8.4 Government Rights

The Army has unlimited rights to all documents/material produced under this contract. All documents and materials, to include the source codes of any software, produced under this contract shall be Army owned and are the property of the Army with all rights and privileges of ownership/copyright belonging exclusively to the Army. These documents and materials cannot be used or sold by the Contractor without written permission from the KO. All materials supplied to the Army shall be the sole property of the Army and cannot be used for any other purpose. This right does not abrogate any other Army rights under the applicable Data Rights clause(s).

8.5 Stop Work

Government personnel have the authority and responsibility to stop work immediately if the work is considered to be a serious threat to the safety or health of workers, other personnel, or to the environment. Authorized Government personnel include, but are not limited to, Government OE Safety Specialists, Installation safety officers, Installation Environmental Division personnel, and command personnel with responsibility for overall Installation operations. When work is stopped due to a hazard/threat to worker safety, health, or the environment, the situation and resolution must be documented and submitted to the KO. Work must be stopped whenever chemical and biological warfare agents or radiological materials are discovered. In addition, the KO has the authority to temporarily stop work on a project following a 24-hour (one working day) written notification to the Contractor. Stop work notices may be related to nonconformance to project specifications, lack of performance by the Contractor, financial considerations, funding considerations, and other circumstances outlined in the contract. Stop work notices may also be related to security levels that could prevent access to the Installation during a time of national crisis.

8.6 Environmental Responsibility Considerations

The Army will retain responsibility for any assessed natural resource damages that are attributed to historic releases of hazardous substances (prior to contract with the Contractor) and any injuries that are necessary and incidental to the reasonable implementation of a selected response or remedial action. The Contractor shall be responsible for any/all additional natural resource injuries and associated Natural Resource Damages claims brought as a result of its actions (e.g. release of hazardous substance or unreasonable disturbance of natural resources as a result of construction activities).

The Army will retain all responsibility for third party liability for CWM or radiological material that are either targeted for or may be discovered during the course of remediation.

Response cost claims, property damage and personal injury claims brought due to contamination and hazardous substance releases that have occurred historically (prior to contract with the Contractor) and are not due to Contractor remediation activities are excluded from Contractor responsibility. The Contractor shall be responsible for and indemnify the Army for:

- Any response cost claims for any environmental remediation services which the Contractor has assumed responsibility for under this PWS;
- All costs associated with correction of a failure of any remedy implemented or operated and maintained by the Contractor to the extent such failure was caused by the willful or negligent acts or omissions of the Contractor in the course of performing the environmental services;
- All personal injury or property damage claims to the extent caused by the acts or omissions of the Contractor in the course of performing the environmental services;
- All natural resource damages pursuant to 42 U.S.C. Section 9607(a)(4)(C), to the extent that such damages were caused or contributed to by the actions of the Contractor or its successors in interest; and
- All costs associated with or arising from any negligent acts or omissions or willful misconduct of the Contractor in the course of performing the environmental services or implementing remedial actions.

8.7 Inspections

The Army technical experts will independently review Contractor work to ensure compliance with all applicable requirements.

Any service or submittal performed that does not meet Task Order requirements shall be corrected or re-performed by the Contractor and at no additional cost to the Government. Corrective action must be certified and approved by the COR. If the contractor performs any task unsatisfactorily and all defects are not corrected, the Government reserves the right to terminate the Task Order for default. In addition, the Government reserves the rights under FAR clause 52.246-4, Inspection of Services – Fixed Price, for further remedies concerning a Contractor’s failure to perform in conformance with contract requirements.

8.8 Organizational Conflicts of Interest

8.8.1 Disclosure.

The Contractor shall provide a disclosure statement with its proposal, which concisely describes all relevant facts concerning any past or present organizational conflicts of interest relating to the work in each PWS. In the same statement, the Contractor shall provide the information required in the following paragraph to assure the Government that the conflicts of interest have been mitigated and/or neutralized to the maximum extent possible. If a conflict of interest is discovered after contract award, the Contracting Officer will make a decision whether to terminate or rescind the PWS and/or contract at that time.

8.8.2 Potential Conflicts of Interest.

This request for proposals is open to any offeror to compete as a prime contractor, subcontractor or in any teaming arrangement. In order to avoid any organizational conflicts of interest, or even the appearance of any organizational conflicts of interest, any contractor performing environmental services work at the follow-on installation(s) under each contract will need to avoid, neutralize and/or mitigate - prior to contract award - significant potential conflicts of interest that may prejudice effective competition. The KO has determined that at a minimum contractors currently performing work on the identified installation(s) under each contract must ensure that all data pertaining to contamination at the sites compiled by or in the possession of such contractors shall be made available to all potential contractors in a timely fashion to the maximum extent possible by providing such data in to a data depository.

8.9 Access and Security

In order to ensure the security and orderly running of the Installation, any contractor personnel who wish to gain access to the Installation shall follow procedures established by the Installation. The Contractor should account for potential delays due to DOD security requirements in its pricing. The Contractor should also account for potential delays due to certain activities at USMA which will preclude work during that time. These may include, but are not limited to graduation week, reception day, and plebe march back day. The installation will provide these dates to the contractor as soon as they are announced.

Access will be issued by the installation staff to the contractor for period of performance.

8.10 Travel

Travel to/from the Installation and to other CONUS locations (locations within the continental United States) for such purposes as to attend meetings, briefings and/or presentations may be required incidental to this remedial action, the costs for which shall be included in the total price for the PWS.

8.11 Performance and Payment Bonds

In accordance with the base contract, the Contractor:

☒ is NOT required to furnish Performance and Payment Bonds on this PWS.

☐ is required to furnish Performance and Payment Bonds on this PWS in accordance with the following:

8.12 Warranty

In accordance with the base contract, the Contractor:

☒ is NOT required to provide a 5-year warranty for each site as specified in this PWS.

☐ is required to provide a 5-year warranty for each site as specified in this PWS.

9.0 Contracting Officer's Representative [to be inserted upon issuance of contract]

Name:
Orga nization:
Addre ss:
Addre ss:
City, State, Zip Code:
Tele phone:
Facs imile:
Em ail:

Attachment A: Reference Documents

The Army believes that documentation provided with the solicitation represents the most recent and appropriate documentation available for the Installation and sites identified in this contract. However, if there is a conflict between this information and other site documentation (the existing reports), the Contractor is solely responsible for reviewing all available information and forming their independent, professional conclusions/interpretation of site conditions and requirements to meet the objectives of this contract. This information is not intended as a substitute for complete analysis of technical data available, nor is it intended to be a guide on how the Contractor should address achievement of the performance objectives/standards.

Specific documents may be made available following a request to the Contracting Officer, if the documentation can be distributed in a timely manner. Electronic format is not guaranteed.

Table 2: Available Reference Documents.

Title Au	thor	Date
Final Site Inspection Report, United States Military Academy, West Point, NY	TLI Solutions	January 2007
Final Historical Records Review, United States Military Academy, West Point, NY	TechLaw, Inc.	March 2006
Final Army MMRP RI/FS Guidance Manual US	AEC/Malcolm-Pirnie	2009
MEC Hazard Assessment Guidance USE	PA	January 2007

Attachment B: List of Acronyms

AOC	Area of Concern
CAIS	Chemical Agent Identification Set
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COR	Contracting Officer's Representative
CTT	Closed, Transferred, and Transferring
CWM	Chemical Warfare Materiel
DDESB	Department of Defense Explosives Safety Board
DMM	Discarded Military Munitions
DOD	Department of Defense
DPW	Department of Public Works
DQO	Data Quality Objective
ERIS	Environmental Restoration Information System
ESP	Explosive Site Plans
ESS	Explosive Safety Submission
FAR	Federal Acquisition Regulation
GIS	Geographic Information System
HRR	Historical Records Review
IRA	Interim Removal Action
KO	Contracting Officer
MC	Munitions Constituents
MEC	Munitions and Explosives of Concern
MMRP	Military Munitions Response Program
MR	Munitions Response
NCP	National Oil and Hazardous Substances Contingency Plan
NELAP	National Environmental Laboratory Accreditation Program
NYSDEC	New York State Department of Environmental Conservation
OSHA	Occupational Safety and Health Administration
PBA	Performance-Based Acquisition
PMP	Project Management Plan
POC	Point of Contact
PPE	Personal Protective Equipment
PWS	Performance Work Statement
QA	Quality Assurance
QASP	Quality Assurance Surveillance Plan
QIPR	Quarterly In Progress Review
RAB	Restoration Advisory Board
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
SARA	Superfund Amendments and Reauthorization Act
SI	Site Inspection
SSHP	Site Safety and Health Plan
USACE	United States Army Corps of Engineers
USAEC	United States Army Environmental Center
USATCES	U.S. Army Technical Center for Explosives Safety
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
UXO	Unexploded Ordnance

Attachment C: Definitions

Activity-Based Schedule: Activities and milestones defined at the detail level and logically sequenced to support, and manage completion of the performance objectives.

Contractor's Project Costs: Costs incurred by the Contractor (including costs covered by insurance and the PMP) in executing the work required to achieve the performance objectives identified in the PWS for all sites identified in this contract/task order.

Chemical Warfare Materiel (CWM): An item configured as a munitions containing a chemical substance that is intended to kill, seriously injure, or incapacitate a person through its physiological effects. CWM also includes V- and G- services nerve agent, H-series blister agent, and lewisite in other than munitions configurations. Due to their hazards, prevalence, and military-unique application, Chemical Agent Identification Sets (CAIS) are also considered CWM. CWM does not include riot control agency, chemical herbicides, smoke and flame producing items, or soil, water, debris, or other media contaminated with chemical agent.

Deliverables: Documentation or data that support the completion of milestones or achievement of the performance objectives identified in this PWS.

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

Explosive Ordnance Disposal (EOD) – The detection, identification, on-site evaluation, rendering safe, recovery, and final disposal of unexploded explosive ordnance. It may also include explosive ordnance that has become hazardous by damage or deterioration.

Long-Term Management (LTM): The remedial phase including maintenance, monitoring, record keeping, remedy reviews, etc. initiated after response (removal or remedial) objectives have been met (i.e., after Response Complete). LTM includes development and implementation of an exit or ramp-down strategy for LTM activities at each site.

Milestones: Significant events or activities that occur in the course of the Contractor achieving the performance objectives identified in this PWS.

Military Munitions (MM) – All ammunition products and components produced or used by or for the DoD or the U.S. Armed Services for national defense and security, including MM under the control of the DoD, the U.S. Coast Guard, the U.S. Department of Energy, and National Guard personnel. The term military munitions includes: confined gaseous, liquid, and solid propellants, explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries used by DoD components, 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. MM do not include wholly inert items, improvised explosive devices, and nuclear weapons, nuclear devices, and nuclear components thereof. However, the term does include non-nuclear components of nuclear devices, managed under DOE's nuclear weapons program, after all required sanitization operations under the Atomic Energy Act of 1954, as amended, have been completed.

Munitions Constituents (MC): Any materials originating from unexploded ordnance, DMM, or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such 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 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 .SC 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 response – A response action, including investigation, removal actions, and remedial actions, to address the explosives safety, human health, and/or environmental risks presented by munitions and explosives of concern (MEC) and/or MC.

PMP Documents: The original PMP (including project schedule), revisions, and status reports.

Project Documents (CERCLA): Documentation and data required by CERCLA remediation and RA(O) and/or LTM activities. These documents include the additional site plans referenced in **Section 6.0** of this PWS.

Project Price: The approved proposed price for achieving completion of remediation services in accordance with the PWS, the payment of which will be tied to one or more project milestones. The Project Price does not include the cost of the PMP, insurance premiums or surplus line taxes, if applicable.

Project-related information: All previous environmental restoration documentation of a technical nature developed by the Army and previous Army contractors and subcontractors during their work at the sites specified in this PWS, and all the documentation developed by the Contractor in order to achieve the performance objectives specified in this PWS.

Remedial Action (Operations) (RA(O)): The remedial phase during which the remedy is in place and operating to achieve the cleanup objective identified in the Record of Decision (ROD) or other formal decision document. Any system operation (long-term operations) or monitoring (long-term monitoring) requirements during this time are considered RA(O). RA(O) includes development and implementation of an exit or ramp-down strategy for LTM activities at each site.

Remedy In Place (RIP): A final remedial action has been constructed and implemented and is operating as planned in the remedial design. An example of a remedy in place is a pump-and-treat system that is installed, is operating as designed, and will continue to operate until cleanup levels have been attained. Because operation of the remedy is ongoing, the site cannot be considered Response Complete.

Response Complete (RC): The remedy is in place and the required remedial action-operations (RA-O) have been completed. If there is no RA(O) phase and all response action objectives have been achieved and documented, then the remedial action-construction end date will also be the RC date.

Site Close-Out: Site Close-Out signifies when the Army has completed active management and monitoring at an environmental cleanup site, no additional environmental cleanup funds will be expended at the site and the Army has obtained regulator concurrence. For practical purposes, Site Close-Out occurs when cleanup goals have been achieved that allow unrestricted use of the property (i.e., no further LTM, including institutional controls, is required). Site Close-Out may include, but not be limited to, the dismantling, removal, recycling, reclamation and/or disposal of all remedial activity systems and ancillary equipment above and underground to return the site to its natural state.

Unforeseen environmental issues: include unknown and/or varied concentrations of contaminants at cleanup sites (off-installation areas included) identified in this PWS, but not unknown sites (e.g., sites not identified in this PWS). For sites addressed under the MMRP, unknown contaminants will be limited to MC and those chemicals reasonable associated with the identified munitions and munitions related activities.

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 such a manner as to constitute a hazard to operations, installations, personnel, or material; and remain unexploded either by malfunction, design, or any other cause.

Attachment D: Points of Contact

Jeffrey May
USACE Contracting Officer (KO)
Baltimore District Corps of Engineers
ATTN: CENAB-CT
10 South Howard Street
Baltimore, MD 21201-1715
410-962-5617
Jeffrey.B.May@usace.army.mil

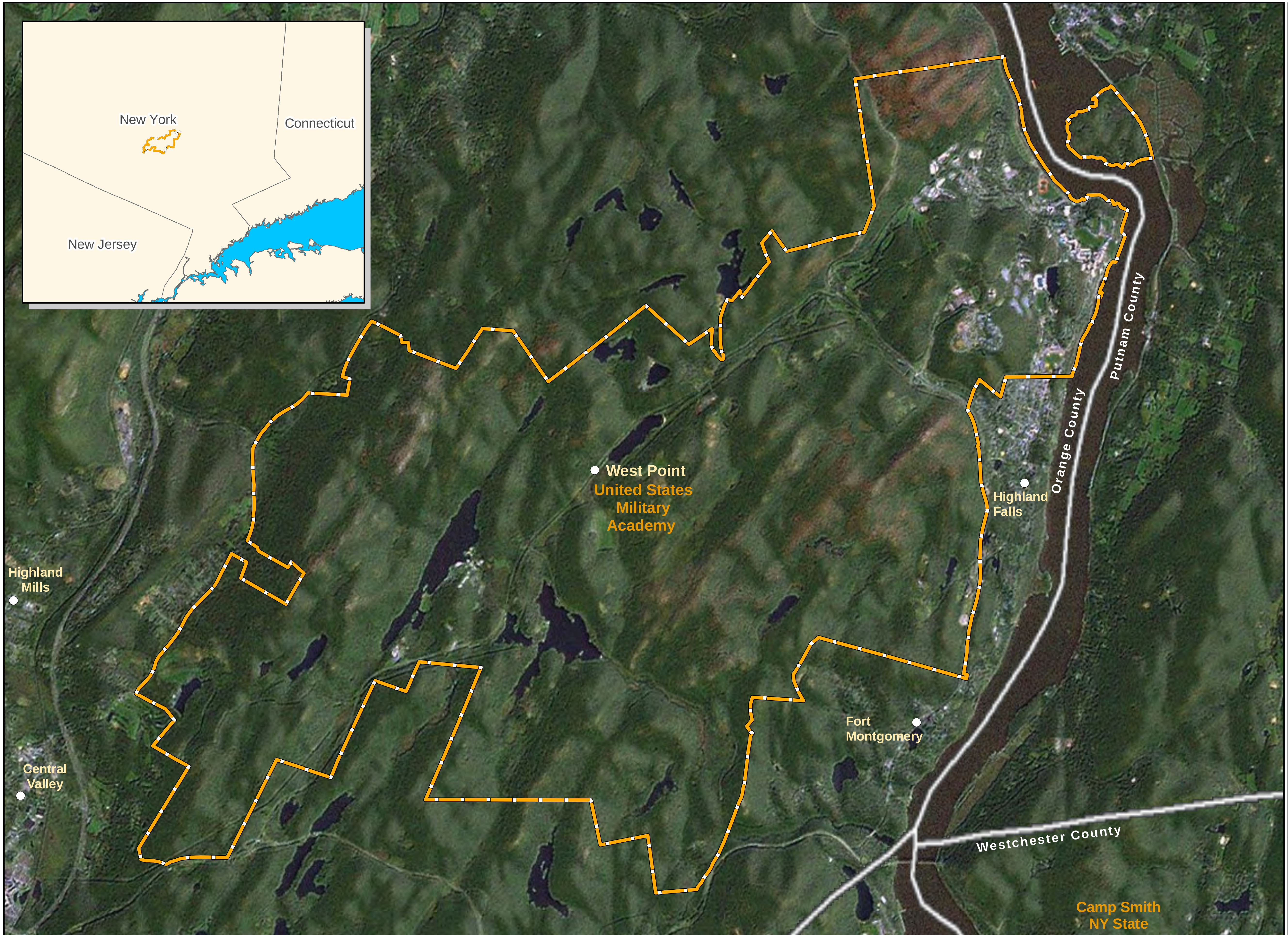
Christopher Evans
USACE Contracting Officer's Representative (COR)
ATTN: CENAB-EN-HM
10 South Howard Street
Baltimore, MD 21201-1715
410-962-2252
Christopher.L.Evans@usace.army.mil

Contracting Specialist:

Mary Tully
Contract Specialist
Baltimore District Corps of Engineers
ATTN: CENAB-CT
10 South Howard Street, Rm. 7000
Baltimore, MD 21201-1715
410-962-2281
Mary.K.Tully@usace.army.mil

Additional POCs will be provided after award.

APPENDIX B – SITE MAPS



Legend

Installation Boundary

Imagery Source: ESRI, Bing Mapping Service. 2009

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Figure B-1
Regional Location Map
U.S. Army Garrison - West Point

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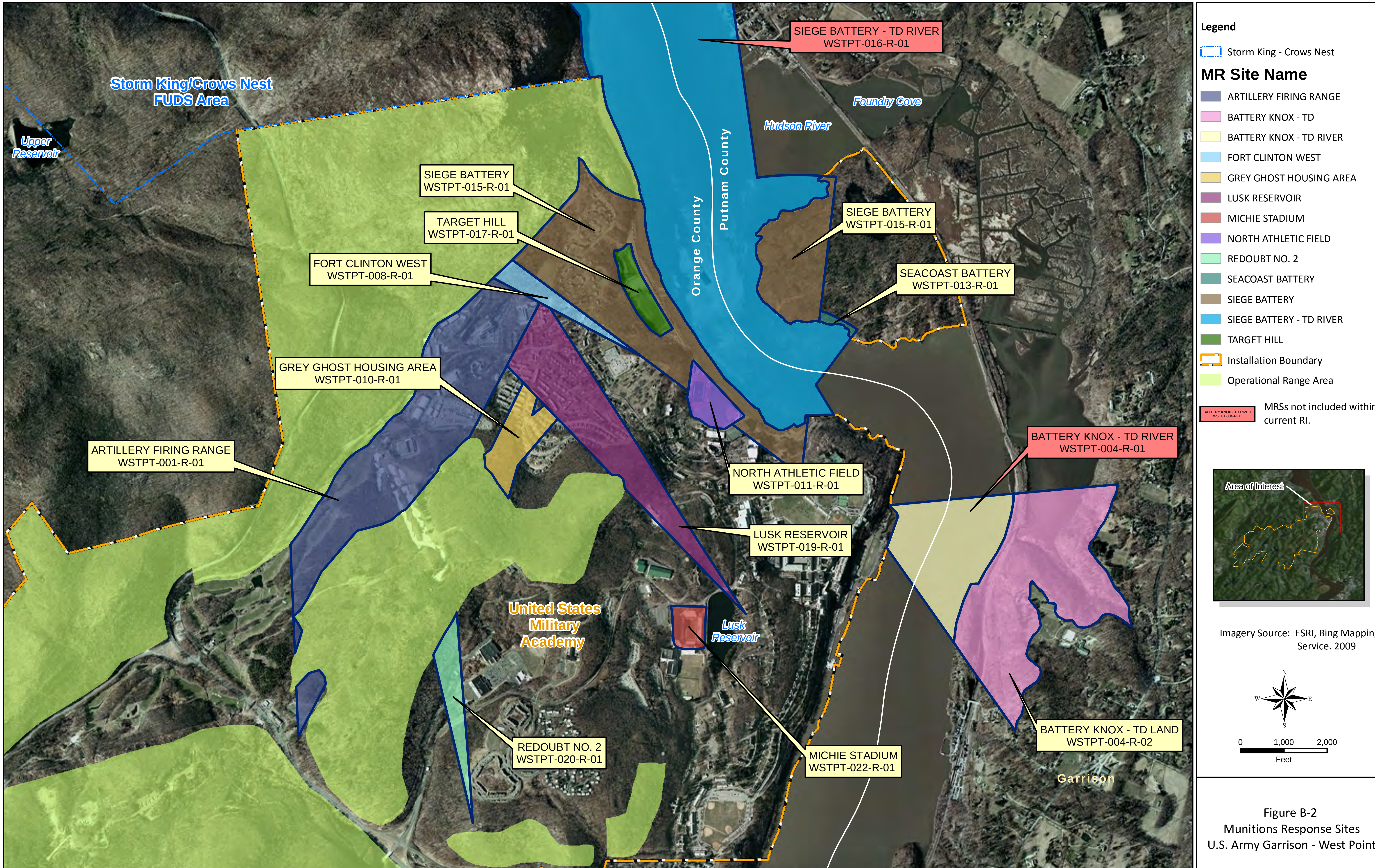

Figure B-2
Munitions Response Sites
U.S. Army Garrison - West Point

File: \\fsfed01\tiq\West_Point\mxd\PMP\Sites.mxd, 21-Dec-10 09:50, ricksc

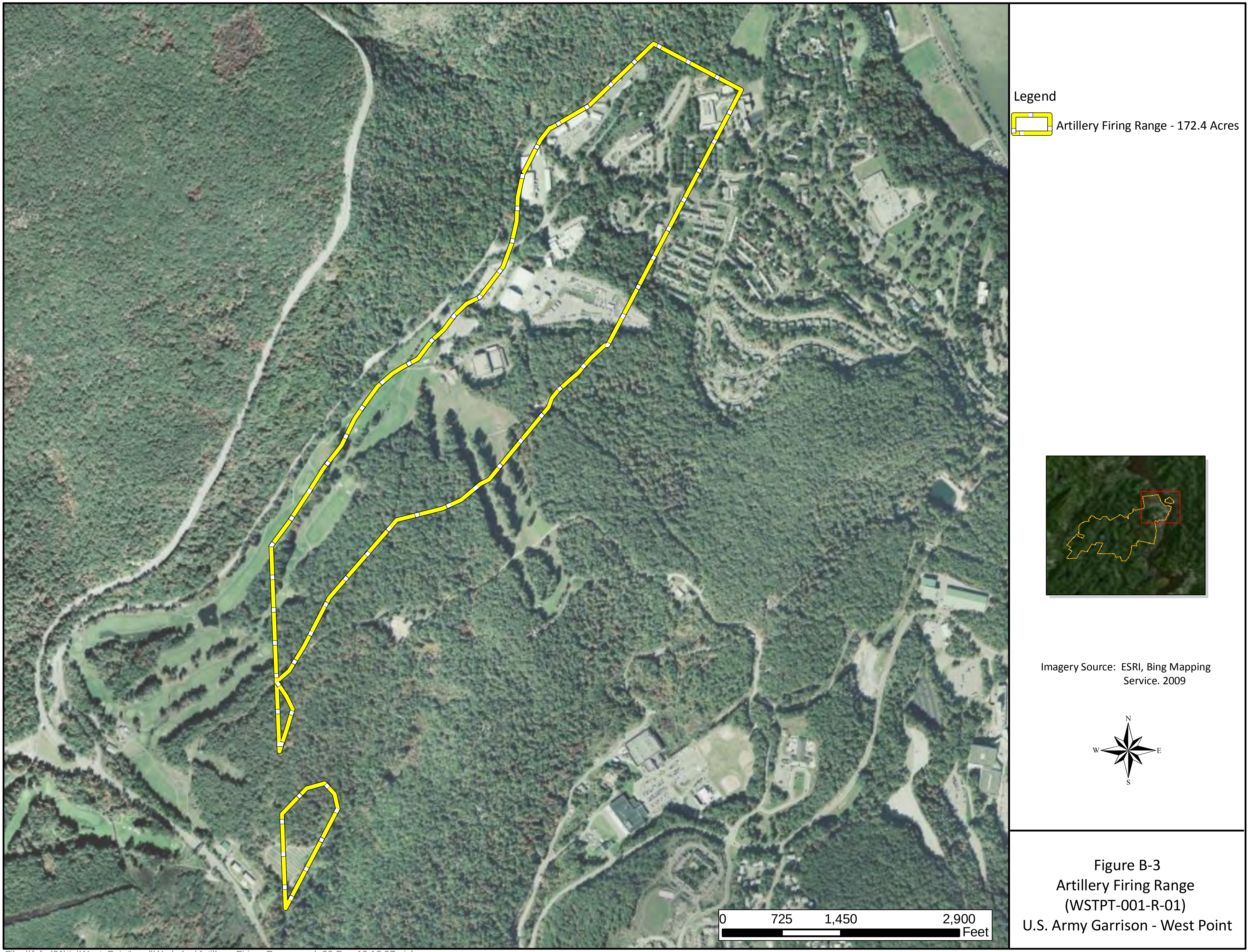

Figure B-3
Artillery Firing Range
(WSTPT-001-R-01)
U.S. Army Garrison - West Point

File: \\fsfed01\tig\West_Point\mxd\Workplan\Artillery_Firing_Range.mxd, 30-Dec-10 13:37, ricksc

Legend

Battery Knox TD - 141 Acres

Imagery Source: ESRI, Bing Mapping Service. 2009

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Figure B-4
Battery Knox-TD – Land
(WSTPT-004-R-02)
U.S. Army Garrison - West Point

File: \\fsfed01\tig\West_Point\mxd\Workplan\Battery_Knox_TD.mxd, 03-Jan-11 10:31, ricksc

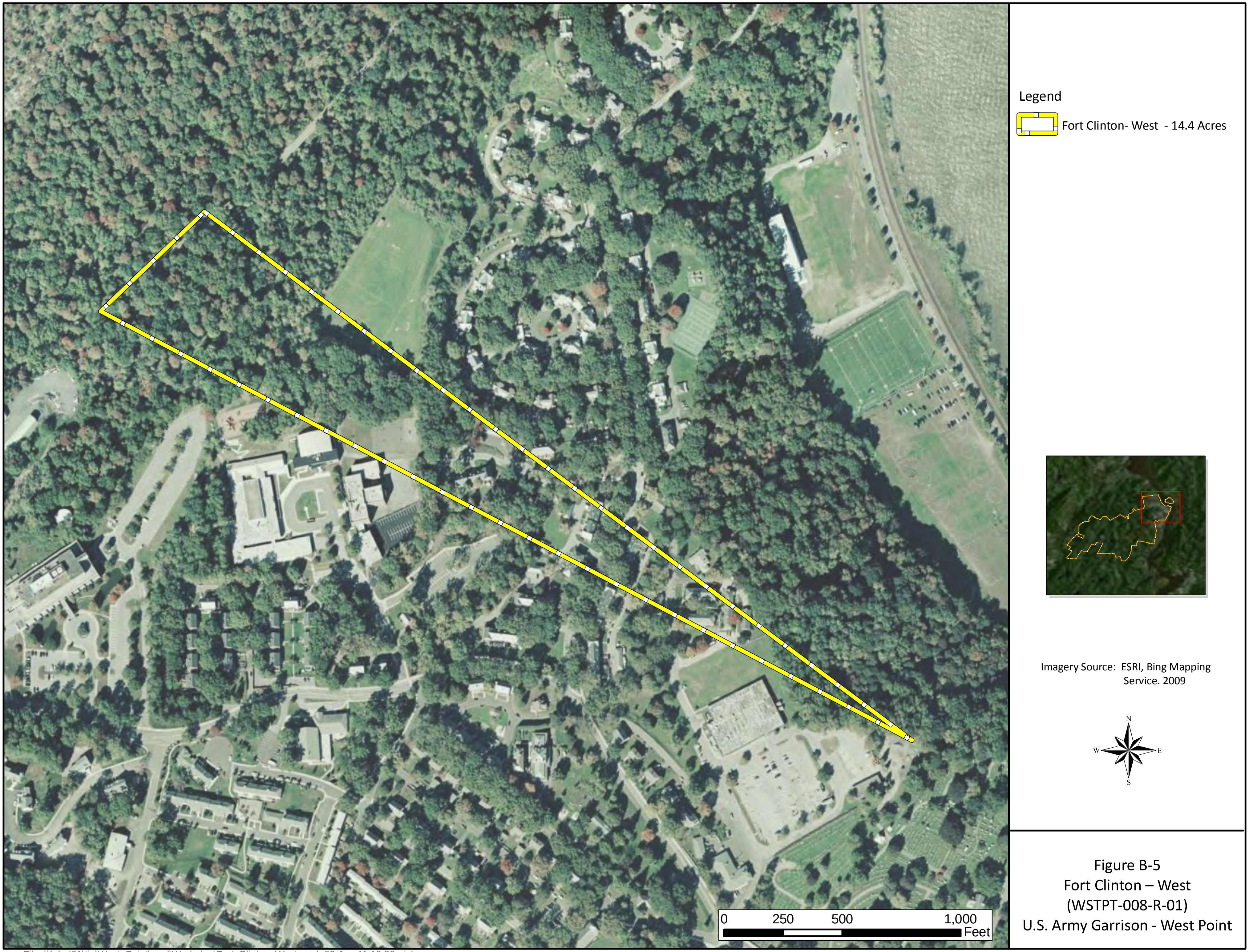
Legend
Fort Clinton- West - 14.4 Acres
Imagery Source: ESRI, Bing Mapping Service. 2009
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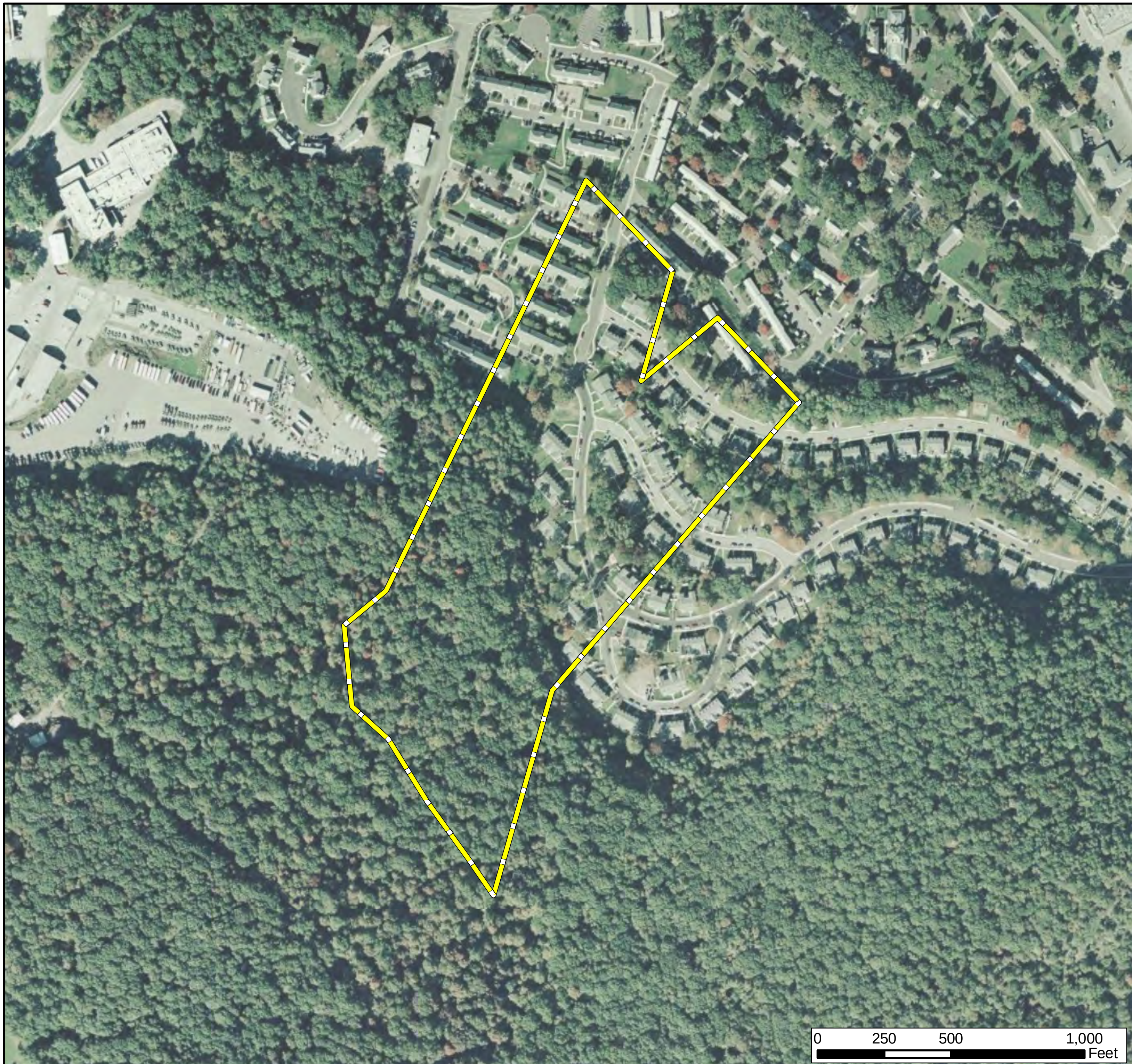
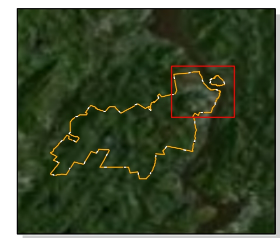
Figure B-5
Fort Clinton – West
(WSTPT-008-R-01)
U.S. Army Garrison - West Point



Legend

Grey Ghost Housing Area - 24 Acres



Imagery Source: ESRI, Bing Mapping Service. 2009

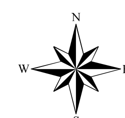
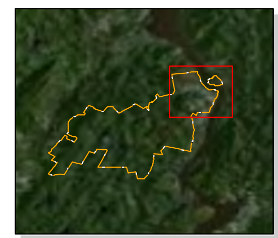


Figure B-6
Grey Ghost Housing Area
(WSTPT-010-R-01)
U.S. Army Garrison - West Point

File: \\fsfed01\tig\West_Point\mxd\Workplan\Grey_Ghost_Housing_Area.mxd, 03-Jan-11 10:43, ricksc

Legend

North Athletic Field - 14 Acres



Imagery Source: ESRI, Bing Mapping Service. 2009

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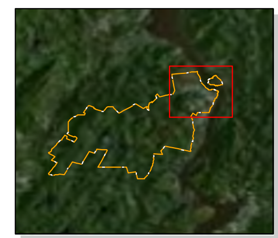
Figure B-7
North Athletic Field
(WSTPT-011-R-01)
U.S. Army Garrison - West Point

File: \\fsfed01\tig\West_Point\mxd\Workplan\North_Athletic_Field.mxd, 03-Jan-11 10:45, ricksc



Legend

Seacoast Battery - 2 Acres

Imagery Source: ESRI, Bing Mapping Service. 2009

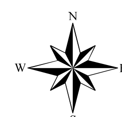


Figure B-8
Seacoast Battery
(WSTPT-013-R-01)
U.S. Army Garrison - West Point

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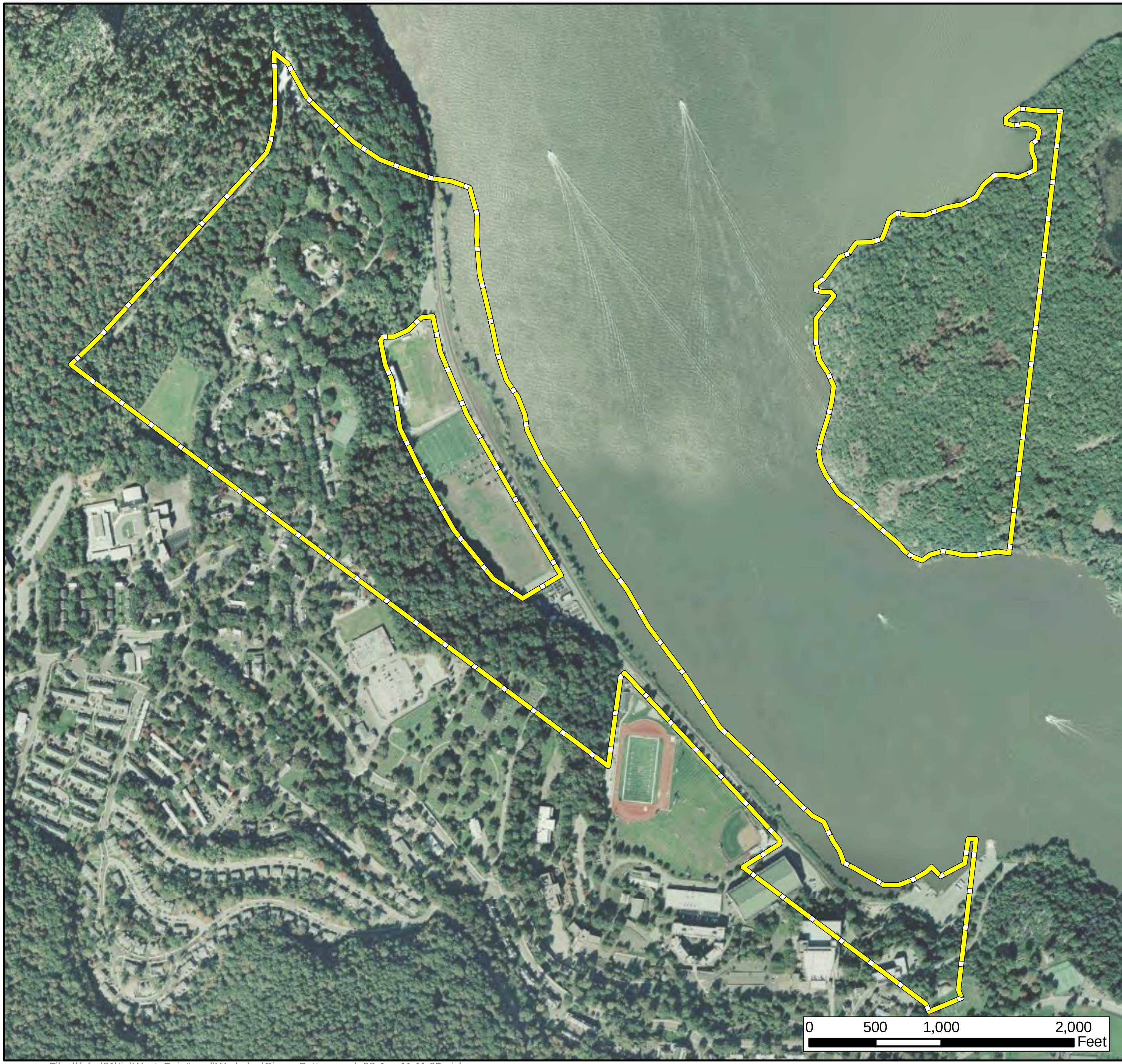


Legend

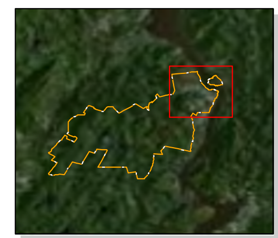
Siege Battery - 179.3 Acres

Imagery Source: ESRI, Bing Mapping Service. 2009

Figure B-9
Siege Battery
(WSTPT-015-R-01)
U.S. Army Garrison - West Point

Legend

Target Hill - 14 Acres



Imagery Source: ESRI, Bing Mapping Service. 2009

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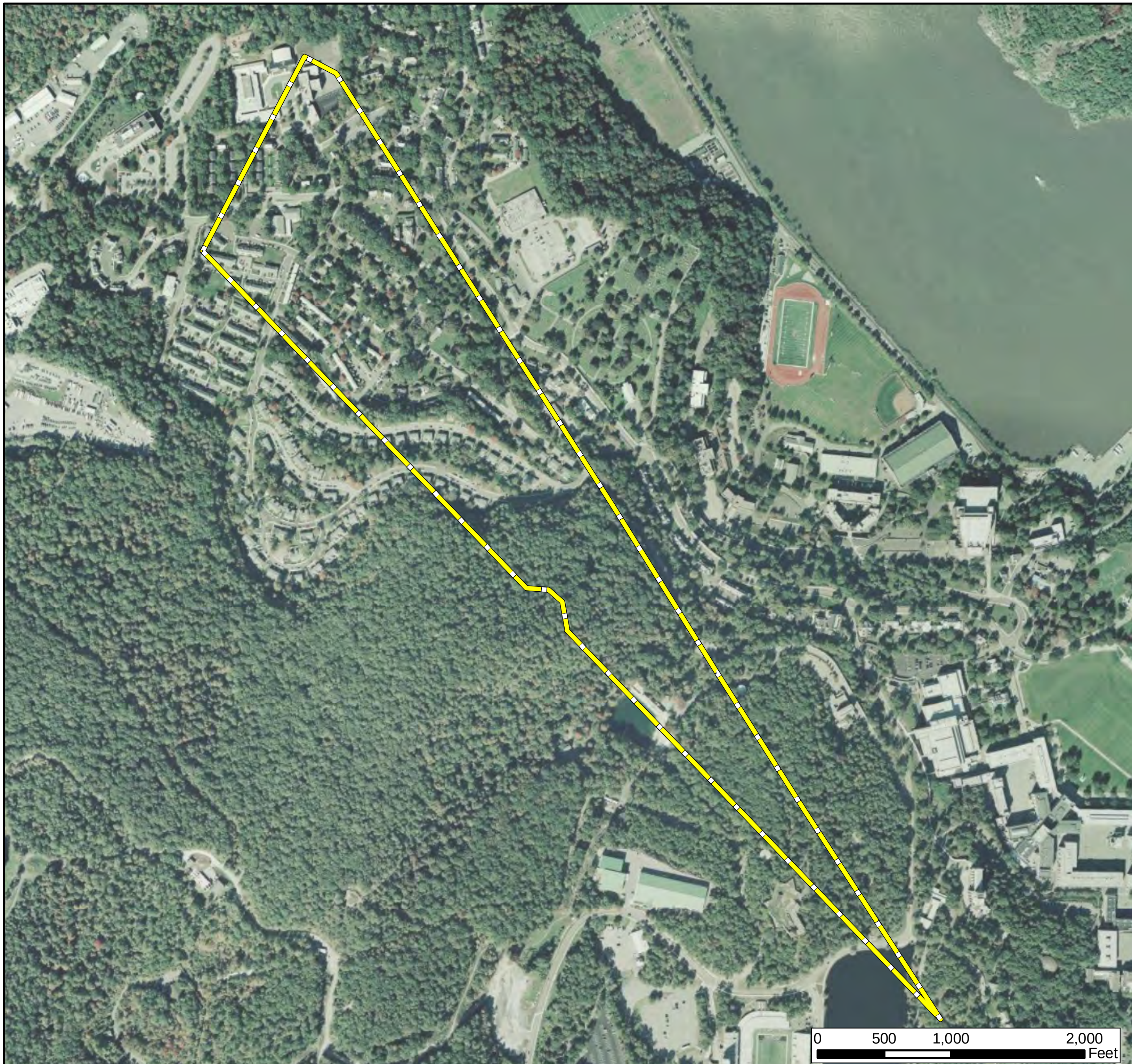
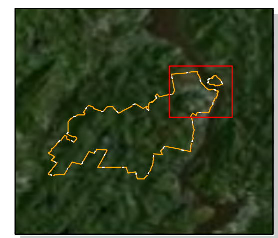
Figure B-10
Target Hill
(WSTPT-017-R-01)
U.S. Army Garrison - West Point

File: \\fsfed01\tig\West_Point\mxd\Workplan\Target_Hill.mxd, 03-Jan-11 11:04, ricksc



Legend

Lusk Reservoir - 83 Acres



Imagery Source: ESRI, Bing Mapping Service. 2009

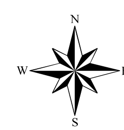
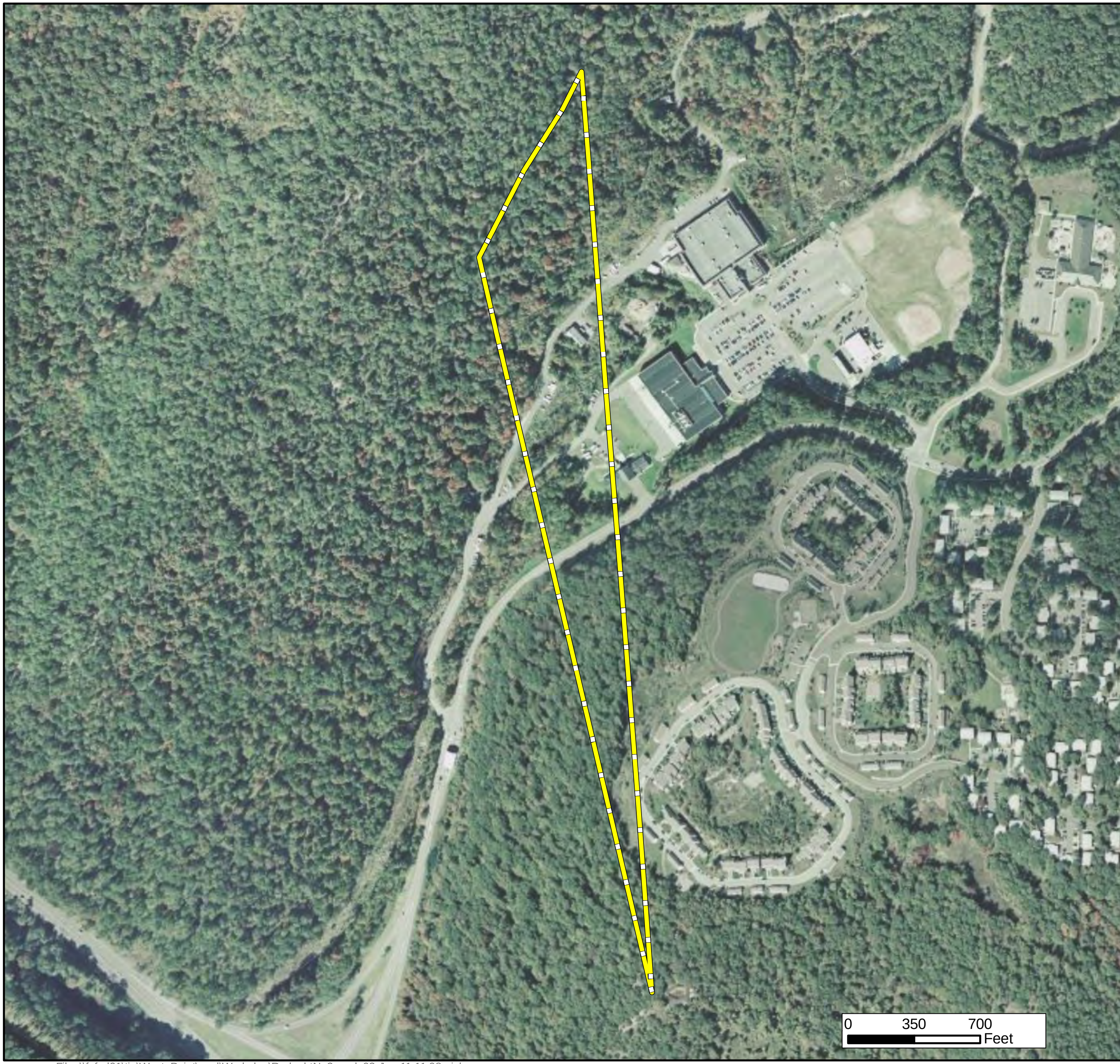


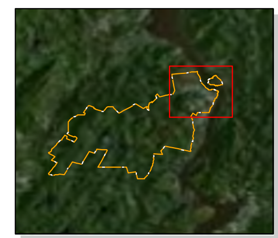
Figure B-11
Lusk Reservoir
(WSTPT-019-R-01)
U.S. Army Garrison - West Point

File: \\fsfed01\tig\West_Point\mxd\Workplan\Lusk_Reservoir.mxd, 03-Jan-11 11:07, ricksc



Legend

Redoubt No. 2 - 20 Acres



Imagery Source: ESRI, Bing Mapping Service. 2009

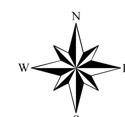
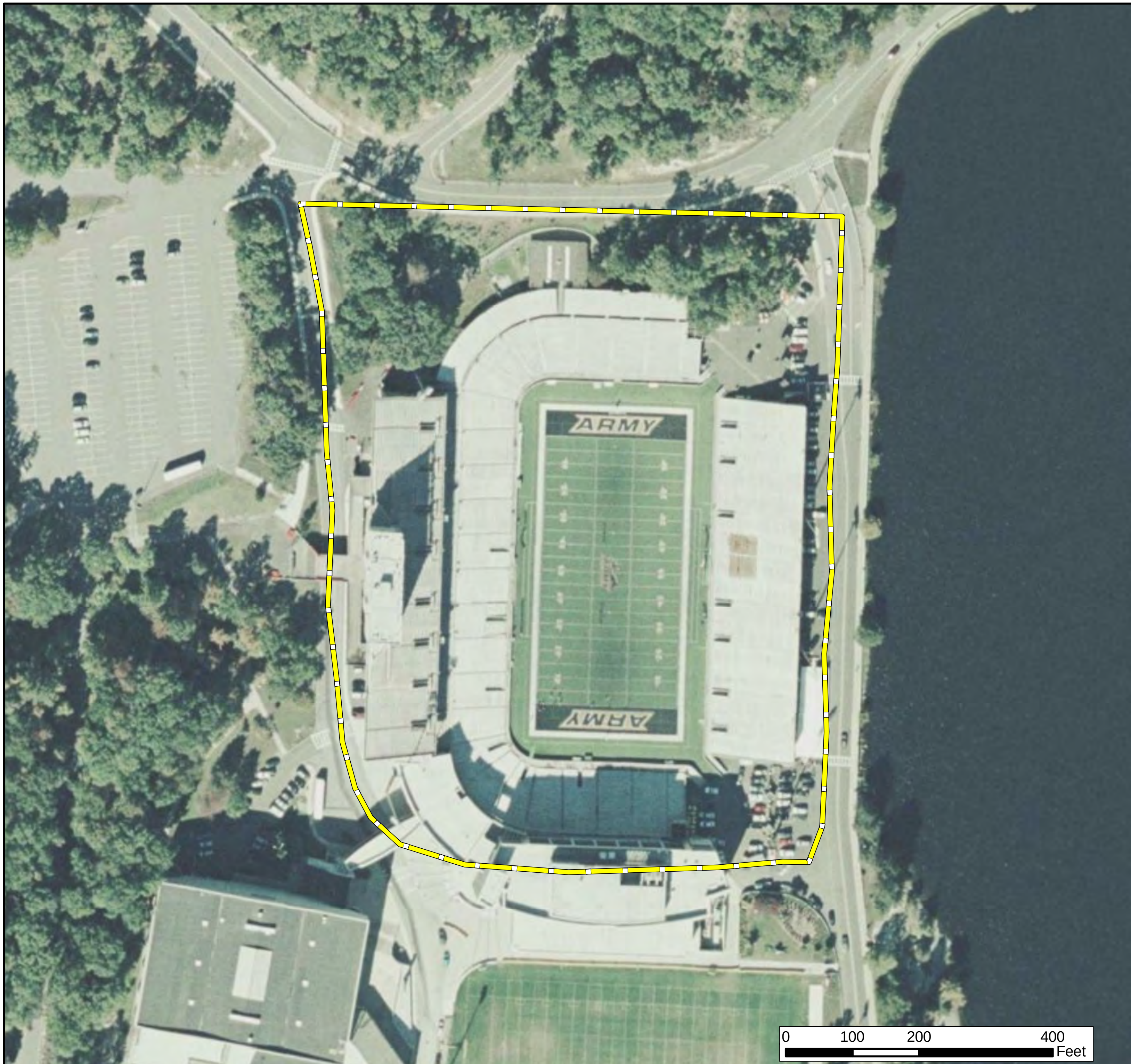


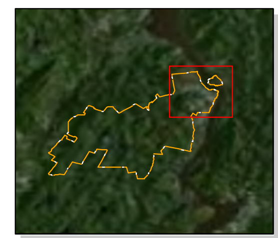
Figure B-12
Redoubt No. 2
(WSTPT-020-R-01)
U.S. Army Garrison - West Point

File: \\fsfed01\tig\West_Point\mxd\Workplan\RedoubtNo2.mxd, 03-Jan-11 11:08, ricksc



Legend

Michie Stadium - 9.4 Acres



Imagery Source: ESRI, Bing Mapping Service. 2009

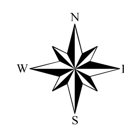


Figure B-13
Michie Stadium
(WSTPT-022-R-01)
U.S. Army Garrison - West Point

File: \\fsfed01\tig\West_Point\mxd\Workplan\Michie_Stadium.mxd, 03-Jan-11 11:10, ricksc

APPENDIX C – CONCEPTUAL SITE MODELS

Table C-1
Conceptual Site Model for West Point

Profile Type	Site Characterization
Facility Profile	**Security:** • Access to the installation is through one of several guarded gates. • Installation is enclosed within an 8-foot chain link fence topped with barbed wire.
Physical Profile	**Climate:** • Located within a cool, humid continental climate with relatively cool, short summers and long, cold winters • Average annual mean temperature is approximately 40 degrees Fahrenheit (^{o}F). • Extremes in temperature range from 96 ^{o}F to minus 31 ^{o}F. • Abundant snowfall from December through March with snow having been reported as early as October and as late as May
	Geology: • Located at the junction of two geological regions: Hudson Highlands and Great Valley • The Hudson Highlands are comprised of metamorphic rock as part of the Appalachian Mountains formed when the continents collided. • The Great Valley is comprised of Paleozoic sedimentary rock deposited when the glaciers retreated from the valley during the glacial period. • Rock outcrops of gneiss and schist (highly metamorphosed igneous and sedimentary rocks) are visible on hillsides and along the stream banks. • Rocks with highly oxidized iron content are prevalent.
	Topography: • Mountainous to flat, sloping to the northeast toward the Hudson River • Rugged hills to mountainous terrain • Low valleys of fertile soil
	Soil: • Well drained, medium-texture soils that overlie crystalline bedrock which is classified as the Hollis-Rock Outcrop. • Some of the soils in the valley areas contain gravel loams, with varying amounts of fine sand loam and sand loam. • Permeability in the soil is fairly high, with values ranging from 1.5 to 15.2 centimeters per hour and exhibits a low shrink-swell potential.
	Hydrogeology: • Two aquifers exist at West Point: an unconsolidated aquifer consisting of alluvial deposits and a consolidated bedrock aquifer. • Both aquifer systems are connected and have low well yields with limited extent making the area incapable of large municipal supply. • Stratified sand and gravel deposits are the most prolific sources of groundwater on the installation. • The deposits are relatively thin and are capable of domestic supply due to fairly small well yields averaging 151 liters per minute. • Recharge to this aquifer is primarily local precipitation, although some upward seepage from bedrock does occur in the lowland areas.

Table C-1
Conceptual Site Model for West Point (Continued)

Profile Type	Site Characterization
	Hydrology: • West Point is located on the west bank of the Hudson River. • Several smaller bodies of water are located on the installation: Stillwell Lake, Weyents Pond, Popolopen Pond, Long Pond, Dassoir Pond, Lusk Reservoir, and Delafield Pond. • Surface water typically drains to one of the above mentioned bodies of water.
	Vegetation: • Mature hardwood forest • Pockets of dense vegetation consisting of small saplings, mountain laurel, blueberry, briers, and vines • Some areas of heavy grass and low grasses
Land Use and Exposure Profile	**Potential Future Land Use:** • Main Post area will continue to be utilized as a school for cadets. • Garrison will continue to be used for administrative operations and family housing. • The majority of the MRSs have been redeveloped and are being used for other activities. • The Residential Communities Initiative (RCI) at West Point will result in the construction of new residential areas. Some of these developments may occur in undeveloped areas of the MRSs.
	Potential Future Human Receptors: • Future receptors are assumed to be similar to the current receptors, which are cadets, military personnel, and families including children. • Potential future human receptors may also include construction and maintenance workers.
	Zoning/Land Use Restrictions: • No known land use restrictions
	Beneficial Resources: • Area contains deposits of Iron Ore. • Geology formations in the region contain naturally formed cement.
	Demographics: • Orange County has a population of 372,893 persons with approximately 457 persons per square mile as of 2004. • Newburgh is located approximately 9 miles north and has a population of 28,412 (2003 census data). • Nearby communities include Highland Falls, Fort Montgomery, Cold Spring, Cornwall, and Woodbury. • Residents (cadets and families of military personnel) are also located on West Point property.
Ecological Profile	**Habitat Type:** • Fresh water in the Hudson River • Field grasses and hard wood trees typical of the Orange County area

Table C-1
Conceptual Site Model for West Point (Continued)

Profile Type	Site Characterization
	Ecological Receptors: • Mammals: Small-footed bat, Indiana bat, Allegheny wood rat • Birds: Cooper's hawk, Northern goshawk, Sharp-shinned hawk, Golden eagle, American bittern, Red-shouldered hawk, Whip-poor-will, Common nighthawk, Cerulean warbler, Peregrine falcon, Common loon, Bald eagle, Yellow-breasted chat, Least bittern, Red-headed woodpecker, Osprey, Pied-billed grebe, Vesper sparrow, Golden-winged warbler • Reptiles: Eastern wormsnake, Spotted turtle, Wood turtle, Timber rattlesnake, Eastern hognose, Eastern box turtle • Amphibians: Jefferson salamander, Blue-spotted salamander, Marbled salamander, Eastern spadefoot toad • Fish: Shortnose sturgeon, Atlantic sturgeon, Atlantic silverside • Insects, Dragonflies and Damselflies: Lateral bluet, Needham's skimmer S1 Plants: Virginia Snakeroot, Glomerate Sedge, Straw Sedge, Stripe-frutied Sedge or Lined Sedge, Water Pigmyweed, American waterwort, Carolina Cranesbill, Weak Rush, Gypsy-wort, Virginia Pine, Pondweed, Slender Marsh-pink, Georgia Bulrush, Michaux's Blue-eyed-grass • S2 Plants: Smooth Bur-marigold, Long's Bittercress, Thicket Sedge, Midland Sedget, Slender Crabgrass, Virginia Snakeroot, Featherfoil, Texas Wild Flax, , Riverweed, Carey's Smartweed, Pondweed, Small-Flowered Crowfoot, Spongy Arrowhead, Saltmarsh Aster, Small-Floating Bladderwort • S2S3 Plants: Pigmy Starwort, Cluster Sedge, Violet Wood-sorrel • S3 Plants: Purple Milkweed, River Birch, Emmon's Sedge, Bicknell's Sedge, Bush's Sedge, False Hop Sedge, Weak Stellate Sedge, Yellow Harlequin, Racemed Pinweed, Violet Bush Clover, Slender Knotweed, Gemmed Bladderwort, Netted Chainfern, Delisted Species, Schreber's Aster, Hay Sedge, Standley's Goosefoot, Dittany, Green-Fruited Clearweed, Two-Flowered Bladderwort, Rare in the Hudson Highlands, Bearberry, Mountain Paper Birch, Tall Bonesett, Upland Bonesett, Nuttall's Busch Cover, Miterwort, Naked Miterwort, Mountain Ash, Rare on the West Point Reservation, Bartonia, Dutchman's Breeches, Narrow-Leafed Sundew, Round-Leaf Sundew, Grand Manna Grass, Bluets, Torrey's Rush, Round-Leaved Ragwort, Massachusetts Fern, Small Cranberry, Large Cranberry
	Wetlands: • Approximately 1,085 acres of wetlands are contained within 310 known wetlands areas at West Point.
	Cultural, Archaeological, and Historical Resources: • Numerous cultural, archaeological, and historical sites throughout the installation. • West Point is one of the older training grounds in the United States that is still intact with numerous of historical references. • Several cemeteries that are considered historical resources exist throughout the installation.

Table C-2
MRS Conceptual Site Model
Artillery Firing Range (WSTPT-001-R-01)

Profile Type	Site Characterization
Facility Profile	**Area and Layout:** • 171 acres located along the western edge of the installation along Storm King Highway (State Highway 218) and the operational range areas • Includes portions of the West Point Golf Course and Victor Constant Ski Slope as well as the U.S. Mint • Three former artillery ranges were combined into the Artillery Firing Range MRS: Sacred Heart Cemetery Range, Silver Depository Range, and Adolphs Pond Range. • Firing points for the Sacred Heart Range and the Silver Depository Range are located within the MRS. • Firing point for the Adolphs Pond Range is located within operational range area. • Portions of the range fan are encompassed by the Crows Nest FUDS area, and Siege Battery, Siege Battery-TD, and Fort Clinton MRSs. • Site includes portions of range fans from both Lusk Reservoir and Redoubt No. 2 MRSs.
	Structures: • Approximately 51 structures are located within the artillery firing range including: Keller Army Hospital, laundry plant, residential housing, cemetery, Directorate of Logistics (DOL) storage warehouse and motor pool, maintenance shops, water tank, U.S. Mint, salt dome and structures associated with the Victor Constant Ski Slope.
	Boundaries: • Located to the east of State Highway 218 • Bordered along the east and west by operational range area • Southern boundary crosses the golf course • Northern boundary abuts Fort Clinton MRS
	Utilities: • Sewer lines are located in the eastern part the site and near the ski area. • Natural gas, wastewater, 11 transformer vaults, 21 transformers, and heating/cooling lines are located in the eastern part of the site. • Water lines are located near the structures to the east of the Artillery Firing Range, within the golf course, near the ski area and along the Goethals Road leading to Adolphs Pond.
	Security: • Once on base, access to this range area is open. • Area is accessible from the golf course.
Land Use and Exposure Profile	**Current Land Use:** • Recreational (ski area, golf course) • Residential housing (adult and child) • Industrial (U.S. Mint) • Four closed solid waste landfills including the Motor Pool, Ski Lot, Motor Pool East, and Organic Compost Landfill
	Current Human Receptors: • Residents (cadets, military personnel, families including children) • Installation personnel (instructors, soldiers, non-residents) • Recreational users (skiers and golfers) • Maintenance workers • Contractor personnel (e.g., construction workers, environmental) • Visitors

Table C-2
MRS Conceptual Site Model
Artillery Firing Range (WSTPT-001-R-01) (Continued)

Profile Type	Site Characterization
	Potential Future Land Use: • The West Point Prep School will possibly be relocating to the area of Directorate of Logistics (DOL) motor pool to the northwest of the Grey Ghost Housing Area within the Artillery Firing Range MRS. Construction of buildings and athletic fields may occur at this site in previously undisturbed areas.
	Potential Future Human Receptors: • In addition to the current human receptors, students attending the West Point Prep School
Ecological Profile	**Degree of Disturbance:** • Over 50% of the site has been disturbed through development of ski area, golf course, cemetery, and motor pool. • Potential ecological receptors are presented in Table C-1 CSM for West Point. A focused list of ecological receptors specific to this MRS will be developed with an ecological risk assessment if warranted following the RI.
	Wetlands: • None
	Cultural, Archaeological, and Historical Resources: • Sacred Heart Cemetery located within the southern parcel of the site • Historical rock walls cross the southern parcel of the site.
Munitions/Release Profile	**Munitions Types:** • Based on historical records, munitions may include 2.95-inch howitzer shells and 75mm artillery shells. • Munitions types observed during field activities include small arms, signal flare, grenade (fuze only), and smoke grenade (fuze only).
	Release Mechanisms: • Intentional munitions firing during training activities • Discarded or malfunctioned rounds
	Maximum Probable Penetration Depth (based on EM 1110-1-4009)**:** • 6.4 feet (ft) below ground surface (bgs) for 75mm shell (assumes loam soil type and worst-case scenario with perpendicular impact and no deforming of ordnance item upon impact)
	MEC Density: • No MEC was observed during the field activities; therefore, the MEC density is assumed to be low.
	Munitions Debris: • Items observed included fragments from artillery shells (north end of MRS only), small arms casings, snap flare, grenade fuze (expended), and smoke grenade fuze (expended).
	Associated Munitions Constituents (See Appendix G for details): • Metals: aluminum, copper, magnesium, zinc. • Explosives: nitroglycerin, pentaerythritol tetranitrate (PETN), hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), 2,4,6-trinitrotoluene (TNT), 2,4-dinitrotoluene (2,4-DNT), 2,6-dintrotoluene (2,6-DNT), 2-amino-4,6-dinitrotoluene (2-Am-DNT), 4-amino-2,6-dinitrotoluene (4-Am-DNT). • Other: ammonium nitrate, ammonium picrate, antimony sulfate, antimony sulfide, barium nitrate, diphenylamine, lead azide, lead styphnate, lead thiocyanate, mercury fulminate, picric acid, potassium chlorate, potassium nitrate, strontium nitrate, tetracene, nitrocellulose
	Transport Mechanisms/Migration Routes: • Primary transport mechanisms are soil disturbance and erosion. • Drainages throughout the site may potentially allow for the transport of contaminants through stormwater runoff and spring snow melt. • Vertical migration of groundwater is possible as no controls are in place to limit migration.

Table C-2
MRS Conceptual Site Model
Artillery Firing Range (WSTPT-001-R-01) (Continued)

Profile Type	Site Characterization
	Pathway Analysis: • **MEC** o No MEC was observed at this site during the field activities; however, subsurface anomalies and MD identified at the site indicate MEC may be present. Therefore, the pathway for MEC is complete. o If MEC was present at the site, the primary exposure to human and ecological receptors would be handle/treadle underfoot of surface MEC. o If MEC was present at the site, a subsurface pathway may occur because biota may nest or burrow at the site. • **MC** o MC identified above the EPA Region 9 PRG at this site included iron. Although no background data was available for this site, the area is known to have high levels of iron as a result of the highly oxidized iron content of the rocks. Therefore, it is assumed that the iron concentrations are the result of the naturally occurring geology and not the result of munitions. o Because no MC at levels above the EPA Region 9 PRGs resulting from the use of military munitions has been identified at the site, the pathway for human and ecological receptors to contact MC is considered incomplete.

Table C-3
MRS Conceptual Site Model
Battery Knox-TD Land (WSTPT-004-R-02)

Profile Type	Site Characterization
Facility Profile	**Area and Layout:** • Approximately 141 acres on the eastern river bank • Range fan for Battery Knox, which was located on the western bank of the Hudson River on the eastern side of the installation • Range fan extended from firing point (west) across the Hudson River to the river bank on the other side (east). • Firing from the battery occurred towards targets placed in the river. • The eastern portion of the site is located in Putnam County.
	Structures: • Structures associated with private residences • Railroad tracks
	Boundaries: • Battery Knox and West Point to the west • No natural or man-made boundaries on the east • Estimated eastern extent of the range fan was determined at the 44.1 meter contour line. • Hudson River borders the site to the north and south.
	Utilities: • No known utilities
	Security: • Located outside the West Point installation boundary • Access to the entire site is unrestricted.
Land Use and Exposure Profile	**Current Land Use:** • Recreational (boaters, fishermen, hikers, athletic fields) • Commercial (barges) • Railroad • Private residences • Private school
	Current Human Receptors: • Civilians (adults and children) • Railroad personnel • Residential and construction workers
	Potential Future Land Use: • No change to the Current Land Use is anticipated.
	Potential Future Human Receptors: • No change to the Current Human Receptors is anticipated.
Ecological Profile	**Degree of Disturbance:** • Build up of silt in the Hudson River • Construction and maintenance of railroad tracks • Majority of private property is undeveloped with scattered structures. • Potential ecological receptors are presented in Table C-1 CSM for West Point. A focused list of ecological receptors specific to this MRS will be developed with an ecological risk assessment if warranted following the RI.
	Wetlands: • Low lying wetlands are located along the eastern shore of the Hudson River.
Munitions/Release Profile	**Munitions Types:** • 100-lb and 300-lb Parrott guns • 8-inch Rodman guns • 10-inch muzzle-loaded Rodman guns

Table C-3
MRS Conceptual Site Model
Battery Knox-TD Land (WSTPT-004-R-02) (Continued)

Profile Type	Site Characterization
	Release Mechanisms: • Intentional munitions firing • Discarded or malfunctioned rounds
	Maximum Probable Penetration Depth: • It is not anticipated that munitions on the eastern bank of the Hudson River would be below the ground surface, because firing occurred at targets in the river and only overshot/misfired munitions would have impacted the bank.
	MEC Density: • No MEC was observed during the field activities; therefore, the MEC density is assumed to be low. • Potential for MEC on the floor of the Hudson River is high due to the depth and restricted access to the river bed.
	Munitions Debris: • No MD was observed at this site.
	Associated Munitions Constituents (See Appendix G for details): • Metals: Lead, mercury • Explosives: cyclotrimethylenetrinitramine (RDX), pentaerythritol tetranitrate (PETN), 1,3,5-trinitrobenzene, 1,3-dinitrobenzene, 3-nitrotoluene, nitroglycerin, 2,4,6-trinitrotoluene (TNT), 2,4-dinitrotoluene (2,4-DNT), 2,6-dintrotoluene (2,6-DNT), 2-amino-4,6-dinitrotoluene (2-Am-DNT), 4-amino-2,6-dinitrotoluene (4-Am-DNT) • Other: ammonium nitrate, diphenylamine, mercury fulminate, picric acid, potassium nitrate, nitrocellulose
	Transport Mechanisms/Migration Routes: • Primary transport mechanisms are soil disturbance and erosion. • Possible water currents could move items downstream. • Burial in sediment could cause sediment contamination. • Railroad maintenance could disturb the soils along the cliff.
	Pathway Analysis: • **MEC** o No MEC was observed on the land portion of this site during the field activities. Further investigation of MEC will be required at this site. Therefore, the pathway for MEC is complete. o If MEC was present at the site, the primary exposure to human and ecological receptors would be handle/treadle underfoot of surface MEC. o If MEC was present at the site, a subsurface pathway may occur because biota may nest or burrow at the site. • **MC** o MC identified above the EPA Region 9 PRG at this site included iron. Although no background data was available for this site, the area is known to have high levels of iron as a result of the highly oxidized iron content of the rocks. Therefore, it is assumed that the iron concentrations are the result of the naturally occurring geology and not the result of munitions. o Because no MC at levels above the EPA Region 9 PRGs resulting from the use of military munitions has been identified at the site, the pathway for human and ecological receptors to contact MC is considered incomplete.

Table C-4
MRS Conceptual Site Model
Fort Clinton – West (WSTPT-008-R-01)

Profile Type	Site Characterization
Facility Profile	**Area and Layout:** • Approximately 27 acres • The fort from which firing was conducted is the eastern terminus of the MRS. • Majority of range fan included in Siege Battery and Siege Battery-TD. • Portion of the range fan also encompassed by the Crows Nest FUDS area. • Range also overlaps with the following MRSs: Rifle Range, Target Hill, North Athletic Field, Lusk Reservoir, Artillery Firing Range, and Seacoast Battery. • Located in north area of installation close to Hudson River
	Structures: • Approximately 17 structures are located within Fort Clinton consisting primarily of residential housing. • Historical monuments are located within the eastern portion of the MRS.
	Boundaries: • MRS begins to the west of the cemetery and extends to the northwest to State Highway 218. • Western portion is bounded to the north by Siege Battery MRS, and to the south by Artillery Firing Range and Lusk Reservoir MRSs.
	Utilities: • Storm sewer, water, waste water lines, and 3 pad-mounted transformers are located in the residential area in the northern western portion. • One natural gas line is located on the eastern portion near Gees point.
	Security: • Once on base, access to both areas is open
Land Use and Exposure Profile	**Current Land Use:** • Residential • Recreational/visitors • One Solid Waste Landfill (Post School Landfill) intersects along the eastern boundary on the western portion of the site.
	Current Human Receptors: • Residential (adult and child) • Installation personnel (permanent and temporary) • School aged children and cadets • Maintenance workers • Contractor personnel (e.g., construction workers, environmental) • Visitors/Recreational users
	Potential Future Land Use: • No change to the Current Land Use is anticipated.
	Potential Future Human Receptors: • No change to the Current Human Receptors is anticipated.
Ecological Profile	**Degree of Disturbance:** • Extensively disturbed with development of housing area including landscaping; however, a portion of the area also remains heavily forested. • Potential ecological receptors are presented in Table C-1 CSM for West Point. A focused list of ecological receptors specific to this MRS will be developed with an ecological risk assessment if warranted following the RI.
	Wetlands: • None

Table C-4
MRS Conceptual Site Model
Fort Clinton – West (WSTPT-008-R-01) (Continued)

Profile Type	Site Characterization
	Cultural, Archaeological, and Historical Resources: • Eastern portion contains historical sites associated with Fort Clinton and the Chain Battery. • Historical items were found in the eastern portion, including old glass bottles.
Munitions/Release Profile	**Munitions Types:** • Brass 4-pounder • Brass mortars • Iron 12-pounder or 18-pounder • 75mm guns
	Release Mechanisms: • Intentional munitions firing • Discarded or malfunctioned rounds
	Maximum Probable Penetration Depth (based on EM 1110-1-4009)**:** • Penetration depth data is not available for the types of munitions fired from Fort Clinton; however, the impacts are assumed to be similar to those for 75mm shells. Therefore, the maximum penetration depth would be 6.4 ft bgs (assumes loam soil type and worst-case scenario with perpendicular impact and no deforming of ordnance item upon impact).
	MEC Density: • No MEC was observed during field activities; therefore, the MEC density is assumed to be low.
	Munitions Debris: • No MD was observed in the eastern portion of the MRS. • Fragments of artillery shells were found scattered throughout the western portion of the MRS.
	Associated Munitions Constituents (See Appendix G for details): • <u>Metals</u>: lead, mercury • <u>Explosives</u>: nitroglycerin, 2,4,6-trinitrotoluene (TNT), 2,4-dinitrotoluene (2,4-DNT), 2,6-dintrotoluene (2,6-DNT), 2-amino-4,6-dinitrotoluene (2-Am-DNT), 4-amino-2,6-dinitrotoluene (4-Am-DNT) • <u>Other</u>: ammonium nitrate, diphenylamine, mercury fulminate, picric acid, potassium nitrate, nitrocellulose
	Transport Mechanisms/Migration Routes: • Primary transport mechanisms are soil disturbance and erosion. • Drainages throughout the site may potentially allow transport of contaminants through stormwater runoff and spring snow melt. • Vertical migration to groundwater is possible as no controls are in place to limit migration.

Table C-4
MRS Conceptual Site Model
Fort Clinton – West (WSTPT-008-R-01) (Continued)

Profile Type	Site Characterization
	Pathway Analysis: • **MEC** o No MEC was observed in the western portion of this site during the field activities; however, MD identified in this area indicates MEC may be present. Therefore, the pathway for MEC is complete. o If MEC was present at the site, the primary exposure to human and ecological receptors would be handle/treadle underfoot of surface MEC. o If MEC was present at the site, a subsurface pathway may occur because biota may nest or burrow at the site. • **MC** o MC identified above the EPA Region 9 PRG at this site included iron. Although no background data was available for this site, the area is known to have high levels of iron as a result of the highly oxidized iron content of the rocks. Therefore, it is assumed that the iron concentrations are the result of the naturally occurring geology and not the result of munitions. o Because no MC at levels above the EPA Region 9 PRGs resulting from the use of military munitions has been identified at the site, the pathway for human and ecological receptors to contact MC is considered incomplete.

Table C-5
MRS Conceptual Site Model
Grey Ghost Housing Area (WSTPT-010-R-01)

Profile Type	Site Characterization
Facility Profile	**Area and Layout:** • Approximately 26.84 acres • Located in the central campus area, south of Washington Road • Part of the range intersects with the Lusk Reservoir Range to the north and the operational range to the south.
	Structures: • 48 structures, which include mostly residential housing units
	Boundaries: • South of Washington Road • Southeast of the Artillery Firing Range and Crows Nest • North of the operational ranges in the center of the installation
	Utilities: • Natural gas, storm sewer, water, and waste water lines • 5 electrical transformers
	Security: • Once on base, access to this area is open.
Land Use and Exposure Profile	**Current Land Use:** • Residential use as a multi-family complex since 1950 • Undeveloped forested area
	Current Human Receptors: • Residential (adult and child) • Maintenance workers • Contractor personnel (e.g., construction workers, environmental) • Installation personnel (permanent and temporary)
	Potential Future Land Use: • No change to the Current Land Use is anticipated.
	Potential Future Human Receptors: • No change to the Current Human Receptors is anticipated.
Ecological Profile	**Degree of Disturbance:** • Over 50% of the site has been disturbed through the development of the Grey Ghost Housing Area. • Portions of the site are undeveloped and covered with dense vegetation. • Potential ecological receptors are presented in Table C-1 CSM for West Point. A focused list of ecological receptors specific to this MRS will be developed with an ecological risk assessment if warranted following the RI.
	Wetlands: • None
	Cultural, Archaeological, and Historical Resources: • None
Munitions/Release Profile	**Munitions Types:** • Based on historical records, munitions may include .22 caliber machine guns, .30 caliber machine guns, and .22 caliber rifles. • Munitions types observed during field activities included 3-inch Stokes mortar rounds and 37mm projectile
	Release Mechanisms: • Intentional munitions firing • Discarded or malfunctioned rounds

Table C-5
MRS Conceptual Site Model
Grey Ghost Housing Area (WSTPT-010-R-01) (Continued)

Profile Type	Site Characterization
	Maximum Probable Penetration Depth (based on EM 1110-1-4009)**:** • 5.2 ft bgs for 37mm, M63 (assumes loam soil type and worst-case scenario with perpendicular impact and no deformation of the ordnance item upon impact)
	MEC Density: • No MEC was observed during the field activities; therefore, the MEC density is assumed to be low.
	Munitions Debris: • Items observed include a sand-filled Stokes mortar round, and fragments from Stokes mortar round and 37mm projectile. These items were all located in close proximity to each other within the wooded area at center of the site.
	Associated Munitions Constituents (See Appendix G for details): • Metals: aluminum, antimony, bismuth, cadmium, chromium, cobalt, copper, lead, magnesium, manganese, nickel, phosphorus, tin, titanium, vanadium, zinc • Explosives: nitroglycerin, hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), 2,4,6-trinitrotoluene (TNT), 2,4-dinitrotoluene (2,4-DNT), 2,6-dintrotoluene (2,6-DNT), 2-amino-4,6-dinitrotoluene (2-Am-DNT), 4-amino-2,6-dinitrotoluene (4-Am-DNT), methyl-2,4,6-trinitrophenyl nitramine (tetryl) • Other: 2-nitrodiphenyl amine, antimony sulfide, barium stearate, calcium resinate, calcium stearate, diethylphthalate, diphenylamine, ethyl centralite, lead thiocyanate, lead azide, lead styphnate, potassium chlorate, potassium sulfide, potassium nitrate, sodium sulfate, strontium peroxide, zinc stearate, nitrocellulose •
	Transport Mechanisms/Migration Routes: • Primary transport mechanisms are soil disturbance and erosion. • Drainages throughout the site may potentially allow transport of contaminants through stormwater runoff and spring snow melt. • Vertical migration to groundwater is possible as no controls are in place to limit migration.
	Pathway Analysis: • **MEC** o No MEC was observed at this site during the field activities; however, MD identified at the site indicates MEC may be present. Therefore, the pathway for MEC is complete. o If MEC was present at the site, the primary exposure to human and ecological receptors would be handle/treadle underfoot of surface MEC. o If MEC was present at the site, a subsurface pathway may occur because biota may nest or burrow at the site. • **MC** o No MC at levels above the EPA Region 9 PRGs has been identified at the site; therefore, the pathway for human or ecological receptors to contact MC is considered incomplete.

Table C-6
MRS Conceptual Site Model
North Athletic Field (WSTPT-011-R-01)

Profile Type	Site Characterization
Facility Profile	**Area and Layout:** • Approximately 14 acres • Along the shore of the Hudson River, within the central campus area • Possibility of munitions related debris from several sites including: Siege Battery, Target Hill, and Fort Clinton
	Structures: • Two structures are located within the North Athletic Field site
	Boundaries: • Townsly Road to the west • Tower Road to the south/southeast • Upton Road, railroad tracks and the Hudson River to the north/northeast
	Utilities: • Storm sewer, water, and waste water lines • 2 electrical transformers
	Security: • Once on base, access to this site is open.
Land Use and Exposure Profile	**Current Land Use:** • Athletic fields
	Current Human Receptors: • Recreational (adult and child) • Visitors (adult and child) • Installation personnel (temporary and permanent) • Maintenance workers • Contractor personnel (e.g., construction workers, environmental)
	Potential Future Land Use: • No change to the Current Land Use is anticipated.
	Potential Future Human Receptors: • No change to the Current Human Receptors is anticipated.
Ecological Profile	**Degree of Disturbance:** • 100% of site has been disturbed through development of athletic fields. • During the construction of the North Athletic Field in 1944, fill was removed from the Target Hill area and used to level the North Athletic Field. • Potential ecological receptors are presented in Table C-1 CSM for West Point. A focused list of ecological receptors specific to this MRS will be developed with an ecological risk assessment if warranted following the RI.
	Wetlands: • None
	Cultural, Archaeological, and Historical Resources: • None
Munitions/Release Profile	**Munitions Types:** • Large caliber HE and practice rounds • Small arms - .22 caliber rifles
	Release Mechanisms: • Intentional munitions firing • Discarded or malfunctioned rounds
	Maximum Probable Penetration Depth: • Discarded rounds would be buried beneath the fill dirt that has been added to the site.

Table C-6
MRS Conceptual Site Model
North Athletic Field (WSTPT-011-R-01) (Continued)

Profile Type	Site Characterization
	MEC Density: • No MEC was observed at the site during field activities; therefore, the MEC density is assumed to be low.
	Munitions Debris: • No debris was observed at the site.
	Associated Munitions Constituents (See Appendix G for details): • Metals: lead, mercury • Explosives: nitroglycerin, 2,4,6-trinitrotoluene (TNT), 2,4-dinitrotoluene (2,4-DNT), 2,6-dintrotoluene (2,6-DNT), 2-amino-4,6-dinitrotoluene (2-Am-DNT), 4-amino-2,6-dinitrotoluene (4-Am-DNT) • Other: ammonium nitrate, diphenylamine, mercury fulminate, picric acid, potassium nitrate, nitrocellulose •
	Transport Mechanisms/Migration Routes: • Primary transport mechanisms are soil disturbance and erosion. • Vertical migration to groundwater is possible as no controls are in place to limit migration.
	Pathway Analysis: • **MEC** o No MEC was observed at this site during the field activities; however, the identification of subsurface anomalies indicates MEC may be present. Therefore, the pathway for MEC is complete. o If MEC was present at the site, the primary exposure to human and ecological receptors would be handle/treadle underfoot of surface MEC. o If MEC was present at the site, a subsurface pathway may occur because biota may nest or burrow at the site. • **MC** o No MC at levels above the EPA Region 9 PRGs has been identified at the site; therefore, the pathway for human and ecological receptors to contact MC is considered incomplete.

Table C-7
MRS Conceptual Site Model
Seacoast Battery (WSTPT-013-R-01)

Profile Type	Site Characterization
Facility Profile	**Area and Layout:** • Approximately 2 acres of land located on Constitution Island • The site is comprised of portion of the range fan for the Seacoast Battery that is not overlapped by other range fans. • Targets for the Seacoast Battery were assumed to have been placed in the Hudson River; however, the site on Constitution Island may have been impacted by firing. • Most of the range fan is covered by the Siege Battery-TD with the firing point being across the river within the Siege Battery MRS. • Site could include munitions debris from the Siege Battery range fan.
	Structures: • None
	Boundaries: • Southern shoreline of Constitutional Island that faces West Point • South bounded by Hudson River
	Utilities: • None
	Security: • Access to the island by road is restricted with locked gate that must be accessed by contacting the caretaker. • Area is accessible by boat from West Point.
Land Use and Exposure Profile	**Current Land Use:** • Recreational
	Current Human Receptors: • Visitors (adult and child) • Installation personnel • Contractor personnel (e.g., construction workers, environmental)
	Potential Future Land Use: • No change to the Current Land Use is anticipated.
	Potential Future Human Receptors: • No change to the Current Human Receptors is anticipated.
Ecological Profile	**Degree of Disturbance:** • No known disturbance on the island • Potential ecological receptors are presented in Table C-1 CSM for West Point. A focused list of ecological receptors specific to this MRS will be developed with an ecological risk assessment if warranted following the RI.
	Wetlands: • None
	Cultural, Archaeological, and Historical Resources: • Several Revolutionary War sites are present along the shoreline of Constitution Island.
Munitions/Release Profile	**Munitions Types:** • 8-inch, 10-inch and 15-inch Rodman rifle • 100-lb, 200-lb and 300-lb Parrott gun • 8-inch muzzle loading rifle • 15-inch smooth bore Rodman guns • 13-inch smooth bore mortar • 12-inch breech-loading rifle mortar

Table C-7
MRS Conceptual Site Model
Seacoast Battery (WSTPT-013-R-01) (Continued)

Profile Type	Site Characterization
	Release Mechanisms: • Intentional munitions firing • Discarded or malfunctioned rounds
	Maximum Probable Penetration Depth (based on EM 1110-1-4009)**:** • Penetration depth data is not available for the types of munitions fired from the Seacoast Battery; however, the impacts are assumed to be similar to those for 75mm shells. Therefore, the maximum penetration depth would be 6.4 ft bgs (assumes loam soil type and worst-case scenario with perpendicular impact and no deforming of ordnance item upon impact).
	MEC Density: • No MEC was observed during the field activities; therefore, the MEC density is assumed to be low.
	Munitions Debris: • No MD was observed during the field activities.
	Associated Munitions Constituents (See Appendix G for details): • Metals: lead, mercury • Explosives: nitroglycerin, 2,4,6-trinitrotoluene (TNT), 2,4-dinitrotoluene (2,4-DNT), 2,6-dintrotoluene (2,6-DNT), 2-amino-4,6-dinitrotoluene (2-Am-DNT), 4-amino-2,6-dinitrotoluene (4-Am-DNT) • Other: ammonium nitrate, diphenylamine, mercury fulminate, picric acid, potassium nitrate, nitrocellulose •
	Transport Mechanisms/Migration Routes: • Primary transport mechanisms are soil disturbance and erosion. • Vertical migration to groundwater is possible as no controls are in place to limit migration.
	Pathway Analysis: • **MEC** o No MEC was observed at this site during the field activities; however, the presence of MEC and MD in the Siege Battery MRS adjacent to this site indicates MEC may be present. Therefore, the pathway for MEC is complete. o If MEC was present at the site, the primary exposure to human and ecological receptors would be handle/treadle underfoot of surface MEC. o If MEC was present at the site, a subsurface pathway may occur because biota may nest or burrow at the site. • **MC** o No MC at levels above the EPA Region 9 PRGs has been identified at the site; therefore, the pathway for human and ecological receptors to contact MC is considered incomplete.

Table C-8
MRS Conceptual Site Model
Siege Battery (WSTPT-015-R-01)

Profile Type	Site Characterization
Facility Profile	**Area and Layout:** • Approximately 179 acres of land located on western shore of Hudson River and Constitution Island • Firing point located south of Gees Point and the Hudson River in northeast corner of installation. • Portion of the range fan extends onto Constitution Island and is included as part of the range. • Portion of MRS located on Constitution Island was a possible target area for the Siege and Seacoast Batteries. • Firing point for Seacoast Battery is included in the Siege Battery MRS. • Range overlaps with the North Athletic Field, Fort Clinton, Target Hill, Rifle Range, Artillery Firing Range, Lusk Reservoir, and Seacoast Battery. • Remainder of the range fan is contained in the Siege Battery-TD. • Portion of the range fan also extends into the Crows Nest FUDS area.
	Structures: • Approximately 86 structures are located within the Siege Battery including residential housing, sewage treatment facility, field house, Eisenhower Hall, and an amphitheater on the western shore of the Hudson River • No structures are located with the site on Constitution Island.
	Boundaries: • Portion of the range fan extends onto Constitution Island • The cemetery is located to the south of the Siege Battery • The Hudson River borders the entire site to the east/northeast
	Utilities: • Storm sewer, water, waste water, natural gas and heating/cooling lines are located within the Siege Battery site. • Seventeen transformers and 2 transformer vaults are located within the site along the western shore of the Hudson River. • No known utilities on Constitution Island
	Security: • Once on base, access to the area is open • Access to Constitution Island is restricted by road with locked gate that must be accessed by contacting the caretaker. • Constitution Island is accessible by boat from West Point.
Land Use and Exposure Profile	**Current Land Use:** • One Solid Waste Landfill Area (Post School Landfill) is located within the western area • Residential • Military Academy housing, classrooms (Academic) • Recreational (visitors to Constitutional Island)
	Current Human Receptors: • Installation personnel (cadets, instructors, military personnel) • Maintenance workers • Contractor personnel (e.g., construction workers, environmental) • Residential (adult and child) • Visitors (adult and child)
	Potential Future Land Use: • No change to the Current Land Use is anticipated.

Table C-8
MRS Conceptual Site Model
Siege Battery (WSTPT-015-R-01) (Continued)

Profile Type	Site Characterization
	Potential Future Human Receptors: • No change to the Current Human Receptors is anticipated.
Ecological Profile	**Degree of Disturbance:** • The majority of the site located on the western shore of the Hudson River has been disturbed by the development of the Academy and residential housing; however, there are pockets of heavily-forested, undisturbed land. • The area on Constitution Island is undisturbed. • Potential ecological receptors are presented in Table C-1 CSM for West Point. A focused list of ecological receptors specific to this MRS will be developed with an ecological risk assessment if warranted following the RI.
	Wetlands • Four wetland areas are located on Constitution Island totaling 2.24 acres
	Cultural, Archaeological, and Historical Resources: • Several areas containing historical debris, such as bottles and broken dishes, were found within the western portion of the site. • Several historical sites from the Revolutionary War are located on Constitution Island.
Munitions/Release Profile	**Munitions Types:** • During field activities, a 3-inch Stokes mortar round was observed during field activities on Constitution Island. • Based on historical records, the following items may be present: o 4½-inch rifled gun o 30-lb. Parrott gun o 8-inch and 10-inch smooth bore siege mortars o 3.2-inch field guns o 5-inch steel breech-loading gun o 7-inch steel breech-loading howitzers o 7-inch howitzers o 7-inch breech-loading mortars o 7-inch breech-loading rifle howitzers o 6-inch disappearing coastal defense gun o 8-inch, 10-inch and 15-inch Rodman rifle (Seacoast Battery) o 100-lb, 200-lb and 300-lb Parrott gun (Seacoast Battery) o 8-inch muzzle loading rifle (Seacoast Battery) o 15-inch smooth bore Rodman guns (Seacoast Battery) o 13-inch smooth bore mortar (Seacoast Battery) o 12-inch breech-loading rifle mortar (Seacoast Battery)
	Release Mechanisms: • Intentional munitions firing • Discarded or malfunctioned rounds
	Maximum Probable Penetration Depth (based on EM 1110-1-4009)**:** • Penetration depth data is not available for the types of munitions fired from the Siege Battery; however, the impacts are assumed to be similar to those for 75mm shells. Therefore, the maximum penetration depth would be 6.4 ft bgs (assumes loam soil type and worst-case scenario with perpendicular impact and no deforming of ordnance item upon impact).
	MEC Density: • One MEC item (3-inch Stokes mortar round) was observed during the field activities on Constitution Island. The MEC density is assumed to be low.

Table C-8
MRS Conceptual Site Model
Siege Battery (WSTPT-015-R-01) (Continued)

Profile Type	Site Characterization
	Munitions Debris: • A portion of a Mark IV fuze from a Stokes mortar round and fragments of cannonballs were observed on Constitution Island. • Over 50 fragments were observed in the area around Lee Housing Area.
	Associated Munitions Constituents (See Appendix G for details): • Metals: lead, mercury • Explosives: nitroglycerin, pentaerythritol tetranitrate (PETN), 2,4,6-trinitrotoluene (TNT), 2,4-dinitrotoluene (2,4-DNT), 2,6-dintrotoluene (2,6-DNT), 2-amino-4,6-dinitrotoluene (2-Am-DNT), 4-amino-2,6-dinitrotoluene (4-Am-DNT) • Other: ammonium nitrate, antimony sulfate, antimony sulfide, diphenylamine, lead azide, lead styphnate, lead thiocyanate, mercury fulminate, picric acid, potassium chlorate, potassium nitrate, nitrocellulose
	Transport Mechanisms/Migration Routes: • Primary transport mechanisms are soil disturbance and erosion. • Drainages throughout the site may potentially allow transport of contaminants through stormwater runoff and spring snow melt. • Vertical migration to groundwater is possible as no controls are in place to limit migration.
	Pathway Analysis: • **MEC** o One MEC item was observed at this site during the field activities on Constitution Island. In addition, an extensive amount of MD was observed in the western portion of the site; therefore, the pathway for MEC is complete. o The primary exposure to human and ecological receptors would be handle/treadle underfoot of surface MEC. o A subsurface pathway may occur because biota may nest or burrow at the site. • **MC** o MC identified above the EPA Region 9 PRG at this site included iron. One of the samples collected from the site where a cannonball fragment was found on Constitution Island indicated an exceedance that is probably the result of iron leaching from the MD. The other sample which showed an exceedance of the iron PRG was collected from a drainage to the east of the Lee Housing and is probably naturally occurring iron. o Because one exceedance of the EPA Region 9 PRGs resulted from the use of military munitions, the pathway for human and ecological receptors to contact MC is considered complete.

Table C-9
MRS Conceptual Site Model
Target Hill (WSTPT-017-R-01)

Profile Type	Site Characterization
Facility Profile	**Area and Layout:** • Comprised of approximately 14 acres of land within West Point • Located north of the athletic field and just west of the Hudson River • Siege Battery and Fort Clinton range fans overlap the site.
	Structures: • The wastewater treatment plant is located south of the site boundary. • Construction of a Rugby Center is occurring on the northern half of site.
	Boundaries: • North of the athletic field • West of the Hudson River and Railroad Tracks/River Road • At the base of the hillside on the east of Lee Housing Area
	Utilities: • Storm sewer, water and waste water lines are located on the site.
	Security: • Once on base, access to the area is open.
Land Use and Exposure Profile	**Current Land Use:** • Athletic fields
	Current Human Receptors: • Installation personnel • Maintenance workers • Contractor personnel (e.g., construction workers, environmental) • Visitors
	Potential Future Land Use: • No change to the Current Land Use is anticipated.
	Potential Future Human Receptors: • No change to the Current Human Receptors is anticipated.
Ecological Profile	**Degree of Disturbance:** • 100% of the site has been disturbed through the development of athletic fields and the construction of the Rugby Center. • Potential ecological receptors are presented in Table C-1 CSM for West Point. A focused list of ecological receptors specific to this MRS will be developed with an ecological risk assessment if warranted following the RI.
	Wetlands: • None
	Cultural, Archaeological, and Historical Resources: • None
Munitions/Release Profile	**Munitions Types:** • Large caliber HE and practice rounds
	Release Mechanisms: • Intentional munitions firing • Discarded or malfunctioned rounds
	Maximum Probable Penetration Depth (based on EM 1110-1-4009)**:** • Penetration depth data is not available for the types of munitions fired from the Siege Battery; however, the impacts are assumed to be similar to those for 75mm shells. Therefore, the maximum penetration depth would be 6.4 ft bgs (assumes loam soil type and worst-case scenario with perpendicular impact and no deforming of ordnance item upon impact).

Table C-9
MRS Conceptual Site Model
Target Hill (WSTPT-017-R-01) (Continued)

Profile Type	Site Characterization
	MEC Density: • No MEC was observed during the field activities; therefore, the MEC density is assumed to be low.
	Munitions Debris: • Several fragments were observed along the western and northern boundary of the site near the Siege Battery MRS.
	Associated Munitions Constituents (See Appendix G for details): • Metals: lead, mercury • Explosives: nitroglycerin, 2,4,6-trinitrotoluene (TNT), 2,4-dinitrotoluene (2,4-DNT), 2,6-dintrotoluene (2,6-DNT), 2-amino-4,6-dinitrotoluene (2-Am-DNT), 4-amino-2,6-dinitrotoluene (4-Am-DNT) • Other: ammonium nitrate, diphenylamine, mercury fulminate, picric acid, potassium nitrate, nitrocellulose •
	Transport Mechanisms/Migration Routes: • Primary transport mechanisms are soil disturbance and erosion. • Vertical migration to groundwater is possible as no controls are in place to limit migration.
	Pathway Analysis: • **MEC** o No MEC was observed at this site during the field activities; however, the identification of subsurface anomalies indicates MEC may be present. Therefore, the pathway for MEC is complete. o If MEC was present at the site, the primary exposure to human and ecological receptors would be handle/treadle underfoot of surface MEC. o If MEC was present at the site, a subsurface pathway may occur because biota may nest or burrow at the site. • **MC** o No MC at levels above the EPA Region 9 PRGs has been identified at the site; therefore, the pathway for human and ecological receptors to contact MC is considered incomplete.

Table C-10
MRS Conceptual Site Model
Lusk Reservoir (WSTPT-019-R-01)

Profile Type	Site Characterization
Facility Profile	**Area and Layout:** • The firing point for the range is located east of the Lusk Reservoir near Stewart Road. • Range area includes 83.19 acres. • Range area potentially includes munitions from the Grey Ghost Housing Area range firing points. • Range fan intersects and is encompassed by Fort Clinton, Siege Battery, and the Artillery Firing Range. • Portion of the range fan also extends into the Crows Nest FUDS area.
	Structures: • Approximately 150 structures are located within the boundaries of the site including a residential housing area, elementary school, youth center, water pump station, post chapel, gas regulator station, transformer vault and Substation C.
	Boundaries: • No distinct boundaries • Extends northwest from firing point located to the east of Lusk Reservoir and crosses through the central portion of West Point
	Utilities: • Storm sewer, water, waste water and natural gas lines are located on the site. • An electrical substation C is located on the site along with 17 transformers and 8 transformer vaults.
	Security: • Once on base, access to the former range area is open.
Land Use and Exposure Profile	**Current Land Use:** • Schools and other residential buildings including homes. • Delafield Pond is used for swimming.
	Current Human Receptors: • Residents (adult and child) • Recreational • Installation personnel • Contractor personnel (e.g., construction workers, environmental) • School children
	Potential Future Land Use: • No change to the Current Land Use is anticipated.
	Potential Future Human Receptors: • No change to the Current Human Receptors is anticipated.
Ecological Profile	**Degree of Disturbance:** • About 50% of the site has been disturbed with the development of the Grey Ghost Housing Area in the northern portion of the site. • Middle portion of the site is undisturbed and consists of heavily-forested, steep terrain. • Potential ecological receptors are presented in Table C-1 CSM for West Point. A focused list of ecological receptors specific to this MRS will be developed with an ecological risk assessment if warranted following the RI.
	Wetlands: • None
	Cultural, Archaeological, and Historical Resources: • Several Revolutionary War sites are located near the firing point. • Fort Putnam, a Revolutionary War fort, is located along the south side of the site.

Table C-10
MRS Conceptual Site Model
Lusk Reservoir (WSTPT-019-R-01) (Continued)

Profile Type	Site Characterization
Munitions/Release Profile	**Munitions Types:** • 2.95-inch Mountain Howitzers • 75mm gun M1897 and M1907 • 6-inch high capacity gun • 15-inch and 16-inch mortars
	Release Mechanisms: • Intentional munitions firing • Discarded or malfunctioned rounds
	Maximum Probable Penetration Depth (based on EM 1110-1-4009)**:** • Penetration depth data is not available for the types of munitions fired from the Siege Battery; however, the impacts are assumed to be similar to those for 75mm shells. Therefore, the maximum penetration depth would be 6.4 ft bgs (assumes loam soil type and worst-case scenario with perpendicular impact and no deforming of ordnance item upon impact).
	MEC Density: • No MEC was observed during the field activities, therefore, the MEC density is assumed to be low.
	Munitions Debris: • Geophysical investigation during construction at the Elementary school revealed a 6.5-inch projectile (rifled), portion of an 8-inch Parrott round and fragment of 8-inch round • One fragment was observed during the field activities.
	Associated Munitions Constituents (See Appendix G for details): • <u>Metals</u>: aluminum, copper, magnesium, zinc • <u>Explosives</u>: nitroglycerin, pentaerythritol tetranitrate (PETN), hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), 2,4,6-trinitrotoluene (TNT), 2,4-dinitrotoluene (2,4-DNT), 2,6-dintrotoluene (2,6-DNT), 2-amino-4,6-dinitrotoluene (2-Am-DNT), 4-amino-2,6-dinitrotoluene (4-Am-DNT) • <u>Other</u>: ammonium nitrate, ammonium picrate, antimony sulfate, antimony sulfide, barium nitrate, diphenylamine, lead azide, lead styphnate, lead thiocyanate, mercury fulminate, picric acid, potassium chlorate, potassium nitrate, strontium nitrate, tetracene, nitrocellulose •
	Transport Mechanisms/Migration Routes: • Primary transport mechanisms are soil disturbance and erosion. • Drainages throughout the site may potentially allow for the transport of contaminants through stormwater runoff or spring snow melt. • Vertical migration to groundwater is possible as no controls are in place to limit migration.

	Pathway Analysis:
	• **MEC**
	  o No MEC was observed at this site during the field activities; however, MD identified during a previous investigation indicates MEC may be present. Therefore, the pathway for MEC is complete.
	  o If MEC was present at the site, the primary exposure to human and ecological receptors would be handle/treadle underfoot of surface MEC.
	  o If MEC was present at the site, a subsurface pathway may occur because biota may nest or burrow at the site.
	• **MC**
	  o No MC at levels above the EPA Region 9 PRGs has been identified at the site; therefore, the pathway for human and ecological receptors to contact MC is considered incomplete.

Table C-11
MRS Conceptual Site Model
Redoubt No. 2 (WSTPT-020-R-01)

Profile Type	Site Characterization
Facility Profile	**Area and Layout:** • Approximately 19.6 acres located in the southern portion of the installation • Located northeast of Highway 9W and west of Dassori Pond • Range fan extends directly north into the Crows Nest FUDS area • Range fan intersects with an Operational Range Area and the Artillery Firing Range Fan
	Structures: • Several structures including a Fire House are located within site area.
	Boundaries: • No distinct boundaries • Site extends northward from the firing point located in proximity to Redoubt No. 2. • Stony Lonesome Housing Area borders the site to the east. • Crosses Stony Lonesome Road and passes to the west of the Commissary • Northern boundary intersects with the Operational Range Area
	Utilities: • Storm sewer line is located in the southern area.
	Security: • Once on base, access to the range is open.
Land Use and Exposure Profile	**Current Land Use:** • Recreational • Open land
	Current Human Receptors: • Residents (adult and child) • Installation personnel • Contractor personnel (e.g., construction workers, environmental) • Visitors
	Potential Future Land Use: • No change to the Current Land Use is anticipated.
	Potential Future Human Receptors: • No change to the Current Human Receptors is anticipated.
Ecological Profile	**Degree of Disturbance:** • There is limited disturbance in the northern portion of the site through the construction of buildings and roads. • Potential ecological receptors are presented in Table C-1 CSM for West Point. A focused list of ecological receptors specific to this MRS will be developed with an ecological risk assessment if warranted following the RI.
	Wetlands: • Wetland area classified as a Palustrine Emergent totaling 0.44 acres • Wetland area classified as a Palustrine Forested totaling 0.17 acres • An additional wetland area of unspecified size
	Cultural, Archaeological, and Historic Resources: • Redoubt No. 2, a Revolutionary War site, is located in proximity to the firing point.
Munitions/Release Profile	**Munitions Types:** • 2.95-inch Mountain Howitzers • 75mm gun M1897 and M1907 • 6-inch high capacity gun • 15-inch and 16-inch mortars

Table C-11
MRS Conceptual Site Model
Redoubt No. 2 (WSTPT-020-R-01) (Continued)

Profile Type	Site Characterization
	Release Mechanisms: • Intentional munitions firing • Discarded or malfunctioned rounds
	Maximum Probable Penetration Depth (based on EM 1110-1-4009)**:** • Penetration depth data is not available for the types of munitions fired from the Siege Battery; however, the impacts are assumed to be similar to those for 75mm shells. Therefore, the maximum penetration depth would be 6.4 ft bgs (assumes loam soil type and worst-case scenario with perpendicular impact and no deforming of ordnance item upon impact).
	MEC Density: • No MEC was observed during the field activities, therefore, the MEC density is assumed to be low.
	Munitions Debris: • No MD was observed during the field activities. • In April 1996, eight 105mm artillery casings were found near Building 1245, which is located within Redoubt No. 2.
	Associated Munitions Constituents (See Appendix G for details): • Metals: aluminum, copper, magnesium, zinc • Explosives: nitroglycerin, pentaerythritol tetranitrate (PETN), hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), 2,4,6-trinitrotoluene (TNT), 2,4-dinitrotoluene (2,4-DNT), 2,6-dintrotoluene (2,6-DNT), 2-amino-4,6-dinitrotoluene (2-Am-DNT), 4-amino-2,6-dinitrotoluene (4-Am-DNT) • Other: ammonium nitrate, ammonium picrate, antimony sulfate, antimony sulfide, barium nitrate, diphenylamine, lead azide, lead styphnate, lead thiocyanate, mercury fulminate, picric acid, potassium chlorate, potassium nitrate, strontium nitrate, tetracene, nitrocellulose •
	Transport Mechanisms/Migration Routes: • Primary transport mechanisms are soil disturbance and erosion. • Drainages throughout the site may potentially allow for the transport of contaminants through stormwater runoff or spring snow melt. • Vertical migration to groundwater is possible as no controls are in place to limit migration.
	Pathway Analysis: • **MEC** o No MEC was observed at this site during the field activities; however, the identification of subsurface anomalies indicates MEC may be present. Therefore, the pathway for MEC is complete. o If MEC was present at the site, the primary exposure to human and ecological receptors would be handle/treadle underfoot of surface MEC. o If MEC was present at the site, a subsurface pathway may occur because biota may nest or burrow at the site. • **MC** o No MC at levels above the EPA Region 9 PRGs has been identified at the site; therefore, the pathway for human and ecological receptors to contact MC is considered incomplete.

Table C-12
MRS Conceptual Site Model
Michie Stadium (WSTPT-022-R-01)

Profile Type	Site Characterization
Facility Profile	**Area and Layout:** • Approximately 9.4 acres located west of Lusk Reservoir • Several athletic complexes including the Holleder Center, Howze Field, the Kimsey Athletic Center, and Randall Hall are located in or adjacent to the site.
	Structures: • Structures associated with Michie Stadium
	Boundaries: • Howze Field located to the south of the stadium • Holleder Sports Center to the southwest • Lusk Reservoir to the east • Terraced parking lots to the west • Stony Lonesome Road to the north
	Utilities: • Storm sewer, water, waste water and natural gas lines are located around Michie Stadium. • Five transformers located within the site.
	Security: • Once on base, access to the site is open.
Land Use and Exposure Profile	**Current Land Use:** • Sports complex area
	Current Human Receptors: • Visitors (adult and child) • Installation personnel and residents • Recreational personnel (athletes) • Maintenance workers • Contractor personnel (e.g., construction workers, environmental)
	Potential Future Land Use: • No change to the Current Land Use is anticipated.
	Potential Future Human Receptors: • No change to the Current Human Receptors is anticipated.
Ecological Profile	**Degree of Disturbance:** • Almost 100% of the site has been disturbed by the development of the athletic complex. • Potential ecological receptors are presented in Table C-1 CSM for West Point. A focused list of ecological receptors specific to this MRS will be developed with an ecological risk assessment if warranted following the RI.
	Wetlands: • None
	Cultural, Archaeological, and Historical Resources: • Michie Stadium is a cultural resource
Munitions/Release Profile	**Munitions Types:** • 3-inch and 4-inch Stokes mortars
	Release Mechanisms: • Discarded munitions
	Maximum Probable Penetration Depth: • Buried and not visible on the surface

Table C-12
MRS Conceptual Site Model
Michie Stadium (WSTPT-022-R-01) (Continued)

Profile Type	Site Characterization
	MEC Density: • No MEC was observed during the field activities; therefore, the MEC density is assumed to be low. • Fourteen Stokes mortar rounds have been found in the subsurface during construction activities at the site.
	Munitions Debris: • No MD was observed during the field activities.
	Associated Munitions Constituents: • <u>Metals</u>: lead • <u>Explosives</u>: nitroglycerin, 2,4,6-trinitrotoluene (TNT), 2,4-dinitrotoluene (2,4-DNT), 2,6-dintrotoluene (2,6-DNT), 2-amino-4,6-dinitrotoluene (2-Am-DNT), 4-amino-2,6-dinitrotoluene (4-Am-DNT) • <u>Other</u>: antimony sulfide, diethylphthalate, ethyl centralite, lead thiocyanate, potassium chlorate, nitrocellulose
	Transport Mechanisms/Migration Routes: • Primary transport mechanisms are soil disturbance and erosion. • Drainages throughout the site may potentially allow for the transport of contaminants through stormwater runoff or spring snow melt. • Vertical migration to groundwater is possible as no controls are in place to limit migration.
	Pathway Analysis: • **MEC** o No MEC was observed at this site during the field activities; however, MEC has been identified at this site during previous construction projects. Therefore, the pathway for MEC is complete. o If MEC was present at the site, the primary exposure to human and ecological receptors would be handle/treadle underfoot of surface MEC. o If MEC was present at the site, a subsurface pathway may occur because biota may nest or burrow at the site. • **MC** o No MC at levels above the EPA Region 9 PRGs has been identified at the site; therefore, the pathway for human and ecological receptors to contact MC is considered incomplete.

APPENDIX D – PROJECT POINTS OF CONTACT

Appendix D - Points of Contact Information

Name	Title/Project Function	Address	Contact Information
WEST POINT			
Jeff Sanborn	Environmental Engineer	United States Military Academy, Environmental Engineering Branch ATTN: IMNE-MIL-PWE-M 667A Ruger Road West Point, NY 10996-1952	845-938-5041 (office) 845-938-4588 (fax) 518-963-4106 (mobile) Jeff.Sanborn@usma.edu
USAEC			
Douglas Scarborough	Environmental Restoration Manager (ERM)	5179 Hoadley Road Bldg. E4480 Aberdeen Proving Ground, MD 21010	410-436-3152 (office) Douglas.Scarborough@us.army.mil
USACE			
Jeffrey May	USACE Contracting Officer (KO)	U.S. Army Corps of Engineers, Baltimore District 10 South Howard Street Baltimore, MD 21201-1715	410-962-5617 (office) Jeffrey.B.May@usace.army.mil
Christopher Evans	USACE Contracting Officer's Representative (COR)	U.S. Army Corps of Engineers, Baltimore District 10 South Howard Street Baltimore, MD 21201-1715	410-962-2252 (office) Christopher.L.Evans@usace.army.mil
Travis McCoun	Military Munitions Design Center (MMDC) Program Manager	U. S. Army Corps of Engineers, Baltimore District 10 South Howard Street Baltimore, MD 21201-1715	410-962-6728 (office) 443-844-8192 (mobile) Travis.Mccoun@usace.army.mil
Tom Meyer	USACE Project Manager	U. S. Army Corps of Engineers, Baltimore District 10 South Howard Street Baltimore, MD 21201-1715	410-962-0032 (office) Tom.Meyer@usace.army.mil
Brooke Conway	USACE Design Team Leader (DTL)	U. S. Army Corps of Engineers, Baltimore District 10 South Howard Street Baltimore, MD 21201-1715	410-962-6805 (office) 410-336-7115 (mobile) Brooke.E.Conway@usace.army.mil
Mary Tully	Contract Specialist	U. S. Army Corps of Engineers, Baltimore District 10 South Howard Street Baltimore, MD 21201-1715	410-962-2281 (office) Mary.K.Tully@usace.army.mil
NYSDEC			
Paul Patel	Environmental Engineer	NYSDEC Division of Solid and Hazardous Materials 625 Broadway Albany, NY 12233-7258	518-402-8602 (office) appatel@gw.dec.state.ny.us
EPA			
Bill Roach	Remedial Project Manager (RPM)	U.S. EPA, Region 2 290 Broadway New York, NY 10017	212-637-4335 (office) roach.bill@epa.gov

Appendix D Points of Contact Information (Continued)

Name	Title/Project Function	Address	Contact Information
WESTON			
Greg Daloisio	Program Manager	Weston Solutions, Inc. 1400 Weston Way P.O. Box 2653, Bldg 4-2 West Chester, PA 19380	610-701-3786 (office) 610-306-7351 (mobile) 610-701-3187 (fax) G.Daloisio@westonsolutions.com
John Gerhard	Project Manager	Weston Solutions, Inc. 1400 Weston Way P.O. Box 2653, Bldg 4-2 West Chester, PA 19380	610-701-3793 (office) 610-513-6897 (mobile) 610-701-3187 (fax) J.Gerhard@westonsolutions.com
Ryan Steigerwalt	MMRP Technical Manager/Project Geophysicist	Weston Solutions, Inc. 1371 Brass Mill Road, Suite N Riverside Corporate Center Belcamp, MD 21017	410-612-5940 (office) 267-258-2672 (mobile) 410-612-5901(fax) Ryan.Steigerwalt@westonsolutions.com
Dave Carlin	Senior UXO Supervisor/Site Manager	Weston Solutions, Inc. 1400 Weston Way P.O. Box 2653, Bldg 4-2 West Chester, PA 19380	484-753-1778 (mobile) 610-701-3187 (fax) Dave.Carlin@westonsolutions.com
John Day	UXO Quality Control Specialist/UXO Safety Officer	Weston Solutions, Inc. 1400 Weston Way P.O. Box 2653, Bldg 4-2 West Chester, PA 19380	716-673-6580 (mobile) 610-701-3187 (fax) John.Day@westonsolutions.com

APPENDIX E – RESUMES

GREGORY S. DALOISIO

Qualifications Summary

- More than 24 years of experience in hazardous, radioactive, and mixed waste management including SIs, RI/FSs, RAs, RDs, PPs, and RODs.
- Program Manager for $25-million indefinite delivery-type, firm fixed price, and cost reimbursement contract to perform HTRW studies, investigations, and designs for the USACE, Baltimore District.
- Project Manager for $22 million award-winning program at LEAD, recipient of the Army's 2002 National Award for Environmental Restoration.
- Deputy Program Manager for $30 million environmental services support contract to the Army, including project management responsibilities for projects exceeding $20 million for RI, remediation, and Base Realignment and Closure (BRAC) support at Letterkenny Army Depot.
- Management of cost plus fixed fee, cost plus award fee, and firm fixed-price contracts for federal clients, including the U.S. Army Corps of Engineers (USACE), U.S. Army Environmental Center (USAEC), Atlantic Division (LANTDIV) Naval Facilities Engineering Command, U.S. Department of Energy (DOE), and U.S. Nuclear Regulatory Commission (NRC).
- Development and implementation of pollution prevention programs as well as assessment of waste management programs relative to regulatory requirements and industry experience.

Fields of Competence

Project management of Superfund site remedial investigations (RIs), site investigations (SIs), RI/feasibility studies (RI/FSs), risk assessments (RAs), design, and construction; hazardous, radioactive, and mixed waste management; design and implementation of pollution prevention programs; underground storage tank (UST) site characterizations/assessments; regulatory compliance; and radioactive waste program evaluations and performance assessments.

Education

B.S., Mechanical Engineering—The Pennsylvania State University (1982)

Credentials

40-Hour Hazardous Waste Site Training Course, OSHA 29 CFR 1910.120(e)(3), (1991)
8-Hour Hazardous Waste Refresher Course, OSHA 29 CFR 1910.120(e)(8), (2006)
Bloodborne Pathogens Refresher Training, OSHA 29 CFR 1910.1030, (2006)
American Society of Mechanical Engineers (ASME)
Lecturer: ASME Radioactive Waste Management Course; "Waste Sources and Characteristics" (1988); "Computer Applications in Radwaste Management" (1990)

Employment History

1990-Present	WESTON
1985-1990	Analytical Resources, Inc.
1982-1985	Gilbert Associates, Inc.

Key Projects

Hazardous, Toxic, and Radioactive Waste (HTRW) Contracts, Various Locations, U.S. Army Corps of Engineers (USACE), Baltimore District, Program Manager. Program Manager for $25-million and $15-million indefinite delivery-type, firm fixed price (FFP) and cost reimbursement contracts to

Key Projects (Continued)

perform HTRW studies, investigations, and designs for the USACE, Baltimore District.

Remediation of Groundwater, Soils, and Sediments, Letterkenny Army Depot (LEAD), Chambersburg, PA, USACE, Baltimore District, Project Manager. Since 1997, has been responsible for managing numerous cleanup actions at LEAD including:

- Full-scale in situ treatment (enhanced bioremediation using sodium lactate amendments) of Southeastern (SE) Area Operable Unit (OU) 10 groundwater for past 7 years, including post-injection monitoring.
- Vacuum dredging and disposal of sediments contaminated with volatile organic compounds (VOCs), metals, and petroleum hydrocarbons from approximately 4,000 ft of stormwater drainageways (Rowe Run and SE drainageways).
- Delineation, removal, and off-site disposal of approximately 6,500 cubic yards (yd^3) of VOC-contaminated soils (including listed hazardous waste) from three separate source areas associated with leaking industrial wastewater sewer (IWWS) lines.
- In situ treatment (chemical oxidation using hydrogen peroxide [H_2O_2]) of 2,200 yd^3 of F-listed vadose zone soils contaminated with VOCs at the Property Disposal Office (PDO) Area Oil Burn Pit (OBP).
- Closure of 15,000-gal. septic tank contaminated with polychlorinated biphenyls (PCBs) and metals, including absorption of excess fluids with corncob product and off-site disposal of septage.
- Characterized and shredded 43,000 yd^3 of wood pallets at the transfer burning revetments and transported wood off-site to a local farmer for composting in lieu of land disposal (per agreement negotiated with Pennsylvania Department of Environmental Protection [PADEP]).
- Conducted two focused soil removals at Pad 5 landfill for a localized 1,1,1-TCA source area as well as a localized trichloroethylene (TCE) source area.
- Closure of three sinkholes contributing to groundwater contamination.

RI/RAs of 60+ Base Realignment and Closure (BRAC) Parcels, LEAD, Chambersburg, PA, USACE, Baltimore District, Project Manager. Responsible for managing simultaneous investigations at up to 20 parcels to determine if the property is suitable for industrial reuse by the Local Redevelopment Authority (LRA). Accomplishments include successful development, negotiation (with U.S. Environmental Protection Agency [EPA] Region 3 and PADEP), and implementation of a screening-level risk assessment process to "clear" non-impacted parcels; demonstrated ability to adjust schedules and reprioritize RIs and reporting based on Army and LRA needs; extensive use of geophysics and field screening techniques to limit sampling requirements; preparation of baseline human health and ecological risk assessments for sites that do not pass the screening-level process; and closure of radiological buildings in accordance with both Nuclear Regulatory Commission (NRC) and BRAC requirements for unrestricted reuse.

Pilot Studies for Evaluating Innovative In Situ Groundwater and Surface-Water Remediation Techniques, LEAD, Chambersburg, PA, USACE, Baltimore District, Project

Key Projects (Continued)

Manager. Responsible for managing preparation of plans and specifications, field testing, and evaluation of the following innovative in situ remediation technologies relative to site-specific conditions at LEAD:

- In situ chemical oxidation (ISCO) (using hydrogen peroxide [H_2O_2]) of dense nonaqueous phase liquid (DNAPL) in the shale bedrock aquifer.
- In situ chemical oxidation (using H_2O_2) of DNAPL in the limestone (karst) bedrock aquifer.
- Treatment of VOCs in surface water via a patented microporous ozone sparging technology.
- Removal of PCB-contaminated suspended sediment from surface waters via sedimentation and filtration with coagulant/polymer additives.

FFS, Proposed Plan, and ROD for Two Groundwater OUs with DNAPL Sources in Karst, LEAD, Chambersburg, PA, USACE, Baltimore District, Project Manager. Responsible for managing preparation of Focused Feasibility Study (FFS), Proposed Plan (PP), and Record of Decision (ROD) for two groundwater OUs at LEAD. Evaluation of alternatives included innovative solutions to source removal of DNAPL in a limestone (karst) bedrock aquifer, including several in situ chemical oxidation (ISCO) approaches to destroy DNAPLs mixed with petroleum, oil, and lubricants (POLs).

Emergency Removal of Soils and Sediments, LEAD, Chambersburg, PA, USACE, Baltimore District, Project Manager. Responsible for managing a 5- to 12-person crew to conduct emergency removal (vacuum dredging) and disposal of sediments contaminated with VOCs, metals, and total petroleum hydrocarbons (TPH) from approximately 4,000 ft of stormwater drainageways; emergency delineation, removal, and disposal of approximately 6,500 cubic yards (yd^3) of VOC-contaminated (i.e., 1,1,1-trichloroethane [TCA], TCE, and by-products) soils from three separate source areas; and closure of two sinkholes contributing to groundwater contamination at this Superfund site. Effort for this $4.2-million remediation effort included preparation of project plans; design and installation of sheeting and shoring systems; construction of waste staging, dewatering, and handling area; emergency removal of soils and sediments; waste characterization (including Form U testing parameters); and transport and disposal of both residual and hazardous wastestreams.

BRAC Program, LEAD, Chambersburg, PA, USACE, Baltimore District, Project Manager. Responsible for managing detailed background investigation, assessment of site conditions, and review of ongoing operations at LEAD and preparation of Environmental Baseline Survey (EBS), BRAC Cleanup Plan (BCP), Community Environmental Response Facilitation Act (CERFA) Report, and Finding of Suitability to Lease (FOSL), and Finding of Suitability to Transfer (FOST) to facilitate property transfer of the LEAD BRAC 95 parcel. The program was conducted in accordance with the U.S. Department of Defense's (DOD) Fast Track Cleanup Program for Closing Installations.

Key Projects (Continued)

RI/FS for PCBs in the Rocky Spring System, LEAD, Chambersburg, PA, USACE, Baltimore District, Project Manager. Responsible for managing RI/FS to investigate the extent of PCB contamination at several potential source areas, determine specific migration pathways and mechanisms of transport of PCBs to the Rocky Spring system, and assess the potential human health and ecological risks associated with the PCB contamination. Effort includes coordination of a comprehensive field program over a 2.5-year period involving the installation of monitor wells, soil borings, test pits, and sediment collection systems; flow studies; coordination with regulatory agencies and Restoration Advisory Board (RAB), as well as the collection and analysis of water, soil, sediment, fish, and milk samples for PCBs.

Site Characterization, Alternatives Evaluation and Design for Removal Action, Harvey Point Defense Testing Activity (HPDTA), Hertford, NC, Atlantic Division (LANTDIV), Project Manager. Responsible for managing delineation of PCB contamination at three active range areas (Ranges A, B, and D); preparation of an engineering evaluation/cost analysis (EE/CA) to evaluate remedial alternatives; and preparation of design plans, specifications, and cost estimate for removal actions. Delineation activities included both field screening and laboratory confirmation for PCBs and required extensive coordination with LANTDIV and HPDTA to prevent shutdown of active range areas. Plans and specifications were written for fast-track cleanup (excavation, sampling, backfill, and restoration activities had to be completed within a 3-week period) to accommodate range schedules.

Waste Minimization/Pollution Prevention (Wmin/P2) Support to the Office of Energy Research (ER-8), Germantown, MD, U.S. Department of Energy (DOE), Technical Consultant. Provided technical support to DOE Headquarters to develop and implement ER Program strategies to reduce waste generation (hazardous, radioactive, mixed, and sanitary wastes) and minimize emissions. Support included review of regulations, DOE and current DOE programs; evaluation of incorporating Wmin/P2 requirements into the National Environmental Policy Act (NEPA) process; and developing plans, guidance, and performance measures for incorporating Wmin/P2 into existing environmental, safety, and health (ES&H) programs.

SI at Naval Supply Center, Cheatham Annex, Williamsburg, VA, LANTDIV, Project Manager. Responsible for managing a comprehensive SI to determine the presence and extent of contamination at three sites: a landfill adjacent to a former incinerator (site 1); a decontamination agent disposal area (site 10); and an abandoned scrap storage yard (site 11). Contaminants of concern included VOCs, base/neutral/acids (BNAs), PCBs, metals, dioxin/furans, and total petroleum hydrocarbons (TPH). Investigations included installation and sampling of soil borings and monitor wells as well as surface soil, surface-water, sediment, and marsh sediment sampling.

Remedial Design (RD) and Title II Support for the Austin Avenue Radiation Site, Lansdowne, PA, USACE, Baltimore District, Project Manager. Responsible for the development of plans and specifications for the delineation, dismantlement, decontamination, and renovation/reconstruction of 21 properties contaminated with radium-226 at this Superfund site. The project involved extensive coordination with property owners, USACE, EPA, and PADEP. The design considers handling of radioactive, hazardous, and mixed waste as well as

Key Projects (Continued)

asbestos-containing material (ACM). Responsible for construction oversight activities for 12 homes being rebuilt as part of the program. Prepared more than 290 drawings and unique architectural plans for restoring existing homes. Provided public affairs support to optimize positive public opinion. Held more than 100 individual homeowner meetings to address house design issues and keep owners informed of project status.

Confirmation Sampling and Sitewide Soil Surveillance Program, Morgantown Energy Technology Center, Morgantown, WV, USACE, Baltimore District, Project Manager. Responsible for confirmation sampling following removal of concrete pads (Gasifier Pad and Stretford Pad) used for coal gasification and gas cleanup research. Confirmation sampling was conducted for VOCs, BNAs, coal tar pitch volatiles, metals, and cyanide. Managed sitewide soil sampling program to determine and confirm the nature, areal extent, and vertical extent of contamination at nine source areas identified on-site. The sampling program involved the installation of 33 soil borings and collection and analysis of 66 subsurface soil samples and 83 surface soil samples for benzene, toluene, ethylbenzene, and xylene (BTEX), BNAs, metals, and cyanide.

Mixed Waste Management Plan and Miscellaneous Sampling, Watertown, MA, U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) Installation Restoration Program (IRP), U.S. Army Materials Technology Laboratory (AMTL), Project Manager. Responsible for managing various tasks conducted in support of site remediation and base closure activities at AMTL. Activities include health and safety plan (HASP) development for conducting field sampling of hazardous and radioactive materials; preparation of a management plan for handling, treating, and disposing of mixed waste (both radioactive and hazardous) in accordance with requirements of NRC and EPA; sample collection, analysis, and characterization of potential mixed wastestreams; review of Resource Conservation and Recovery Act (RCRA) storage and compliance issues; radiation surveys; preparation of a radiation monitoring procedures manual; and review/evaluation of the facilities decommissioning schedule.

Enhanced Preliminary Assessment (PA), Fort Devens, MA, USATHAMA, Project Manager. Managed an extensive background investigation and assessment of site conditions, history, and operations of an operating Army base. Project activities included interviews with site and agency personnel, regulations reviews, data compilation, assessment of solid and hazardous waste management areas and practices, records searches and reviews, and preparation of a report that included recommendations for characterization and sampling.

Site Characterization, Various Locations, LANTDIV, U.S. Navy Comprehensive Long-Term Environmental Actions Navy (CLEAN) Program, Project Manager. Managed 14 UST site characterization/site assessment projects in Virginia and North Carolina to define the horizontal and vertical extent of contamination (typically petroleum-related compounds) as a result of a known or suspected release from a UST or underground pipeline. Recommend remedial alternatives (if applicable) that will meet state and federal cleanup standards. Each of these assignments involves UST field investigations, work plan and HASP development, installation of soil borings and monitor wells for sample collection, chemical analyses, risk

Key Projects (Continued)

assessment, and evaluation/recommendation of remedial alternatives. For each of the task orders managed under the CLEAN Program, responsible for cost and schedule control, client interface, technical coordination, resource planning, subcontractor procurement and management, and product deliverables.

Integrated Mixed Waste Management Program, Palo Alto, CA, Electric Power Research Institute (EPRI), Project Manager. Worked with a committee of utility experts from the nuclear power industry to develop several comprehensive guidance documents on mixed waste management and mixed waste characterization. Responsible for collecting and assembling data pertaining to mixed waste characterization programs at nuclear power stations throughout the country and assessing mixed waste management practices. The management guidelines developed as part of this program considered cradle-to-grave management of mixed waste, including requirements for obtaining a RCRA Part B permit.

Environmental Impact Statement/Environmental Impact Report (EIS/EIR), Lawrence Livermore National Laboratory (LLNL), Livermore, CA, DOE, Project Engineer. Provided technical support in preparing the hazardous/radioactive waste management sections of the first sitewide EIS/EIR for DOE. The report satisfied the requirements of National Environmental Policy Act (NEPA) as well as the California Environmental Quality Act (CEQA). Evaluated waste management practices at LLNL, Sandia National Laboratory (SNL), and Site 300 as part of these investigations. Conducted on-site investigations of laboratory operations and evaluated practices (including waste handling, packaging, storage, transport, and effluent releases to the environment) for compliance with applicable laws, regulations, DOE orders, and various state and local requirements.

Permitting of Waste Generators, Carriers, and Brokers, Harrisburg, PA, PADEP, Project Manager. Responsible for developing permitting regulations for access (by generators, carriers, and brokers) to the Pennsylvania Low-Level Radioactive Waste Disposal Facility being sited for the Appalachian Compact Region.

Office of Civilian Radioactive Waste Management (OCRWM), Washington, DC, DOE, Systems Engineer. Provided systems integration support in developing the technical requirements of the waste management system for DOE's high-level waste program. The waste management system consists of the high-level waste repository (Yucca Mountain), the monitored retrievable storage (MRS) facility, and the waste transport system. Provided technical review (i.e., requirements research) of numerous laws, regulations, DOE orders, and program guidance documents to identify requirements for the waste management system as they related to individual functional requirements within the program. Supported the physical system functional analysis effort through application of a Computer-Aided Systems Engineering (CASE tool) program.

Student Training Manuals, Chattanooga, TN, NRC Technical Training Center, Project Engineer. Authored sections of NRC student training manuals on radioactive waste management and the nuclear fuel cycle. Responsibilities included the development of training modules on

Key Projects (Continued)

solid waste management processing and practices as well as nuclear fuel fabrication and enriched scrap recovery operations.

Nuclear Utility Low-Level Waste Database, Palo Alto, CA, Electric Power Research Institute (EPRI), Project Manager/Project Engineer. Developed and managed the most comprehensive database available of utility low-level radioactive waste information, including wastestream volumes, physical and radiological characteristics, packaging methods and performance, successful source minimization techniques, and waste generation trends from 1978 through 1989.

Industry Impacts of NRC/U.S. Department of Transportation (DOT) Adoption of International Atomic Energy Agency (IAEA) Regulations, Washington, DC, Nuclear Management and Resource Council (NUMARC), Project Engineer. Evaluated the impact to the nuclear power industry of NRC/DOT adoption (with proposed changes) of IAEA regulations for the safe transport of radioactive material, per Safety Series No. 6, 1985 edition. Assessed the use of an A1 multiple (2 x A1) as the upper limit for low specific activity (LSA) and the impacts relative to the total number of Type A versus Type B shipments, as well as the overall economic impact to the industry.

Waste Management Decision Analysis Program, Palo Alto, CA, EPRI, Project Manager/Project Engineer. Designed and developed a decision analysis methodology using a programmable relational database application to evaluate potential impacts of future regulatory and operational events as they relate to radioactive waste operations and processing/disposal costs.

Replacement Plastic Program, Palo Alto, CA, EPRI, Project Engineer. Evaluated potential applications for the use of dissolvable plastics as a replacement for products used for radiological control in contaminated environments, including the analysis of physical and chemical properties of various plastic materials found in contaminated wastestreams, as well as the evaluation of processing and disposal options for replacement plastics.

Radwaste Minimization Program, Juno Beach, FL, Florida Power & Light Company, Project Manager/Project Engineer. Assisted in the development and implementation of a comprehensive radwaste minimization and control program at the St. Lucie and Turkey Point stations. Identified site-specific source terms using root cause analysis for solid radwaste generation and developed a program aimed at minimizing waste generation at the source. Evaluated the economic and operational impacts of volume minimization and volume reduction techniques to develop a plan based on both short-term and long-term waste generation goals. Developed computer applications for tracking and managing radwaste generation at the sites.

Radiation Exposure Characterization, Palo Alto, CA, EPRI, Project Manager/Project Engineer. Conducted a detailed site-specific assessment of radiation exposure received by operations and maintenance (O&M) personnel at Public Service Electric and Gas's (PSE&G's) Salem and Hope Creek plants, including review of radiological conditions relative to specific

Key Projects (Continued)

worker and job functions and evaluation of radiation work permits and associated radiological surveys.

Radwaste Disposal Drum Centrifuge, Waltham, MA, Foster-Miller, Inc., Project Engineer. Provided technical support and radioactive waste management expertise for the design, licensing, and commercialization of a novel centrifuge design to dewater spent ion exchange resins to levels below newly purchased media, while substantially reducing the total disposal volume by dewatering the material inside the disposal container. **Radwaste Minimization Program, Pilgrim, MA, Boston Electric Company, Radwaste Engineer.** Assisted in the development of a comprehensive radwaste minimization and control program at the Pilgrim station. Identified site-specific source terms using root cause analysis for solid radwaste generation and assisted in the development of a program aimed at minimizing waste generation at the source. Evaluated the economic and operational impacts of volume minimization and volume reduction techniques to develop a plan based on both short- and long-term waste generation goals.

Below Regulatory Concern (BRC) Candidate Wastestream Evaluation, Palo Alto, CA, EPRI, Project Engineer. Conducted an evaluation of low-level radioactive wastestreams for inclusion in a program to develop generic exemption criteria for wastes with radiological characteristics BRC. Waste characteristics evaluated included typical activity, isotopic content, volume generated, potential for recycle, and physical and chemical characteristics.

Perry Nuclear Project, Perry, OH, Cleveland Electric Illuminating Company, Mechanical Engineer. Provided mechanical systems design support for sizing tanks, pumps, heat exchangers, and piping systems for various balance of plant systems. Coordinated effort for development of system operating modes for more than 20 mechanical systems.

Identification of Radwaste Sources and Reduction Techniques, Palo Alto, CA, EPRI, Radwaste Engineer. Served as principal investigator for a comprehensive evaluation of reactor plant radwaste sources and successful minimization techniques. Conducted detailed evaluations to correlate waste generation rates with nuclear plant operational parameters. Developed a unique waste comparative methodology using operational parameters for plant radwaste management evaluations.

High-Integrity Container (HIC) Assessment, Middlesex, England, Wimpey-Gilbert, Radwaste Engineer. Conducted a detailed assessment of designs, materials of construction, licensing criteria, and limitations of radwaste disposal HICs as part of technology transfer from the United States to international radwaste generators.

Decommissioning of a Three-Loop Power Water Reactor (PWR), Japan, Mitsubishi Heavy Industries, Engineer Trainee. Performed economic evaluations of equipment and piping decontamination prior to dismantlement to reduce personnel exposure. Developed preliminary work packages for sequential equipment dismantling to ensure efficient packaging procedures during decommissioning.

Publications and Presentations

Key Projects (Continued)

Daloisio, G.S., R.E. Hahn, and P.J. Robinson. 1989. “The Industrywide Effects of New Transportation Regulations on the Shipment of LSA Material from Nuclear Utilities.” PATRAM ‘89, Arlington, VA.

Daloisio, G.S. and P.J. Robinson. 1988. “Atypical Radwaste Generation from Nuclear Power Reactors.” ASME/EPRI Radwaste Workshop, Hartford, CT.

Daloisio, G.S. 1988. “Waste Sources and Characteristics.” ASME Short Course Program Radioactive Waste Management for Nuclear Power Reactors and Other Facilities, Alexandria, VA.

Daloisio, G.S., C.P. Deltete, and P.J. Robinson. 1988. “Evaluation of Candidate Wastestreams for Inclusion in the EPRI BRC Program.” Waste Management ‘88, Tucson, AZ.

Daloisio, G.S. and C.P. Deltete. 1988. “Dry Waste Minimization Programs and Techniques.” ASME Short Course Program Radioactive Waste Management for Nuclear Power Reactors and Other Facilities, Alexandria, VA.

Daloisio, G.S. and P.J. Stoner. 1987. “Development and Implementation of a Radwaste Minimization Program at FPL.” ASME/EPRI Radwaste Management Seminar, Boulder, CO.

Daloisio, G.S. and C.P. Deltete. 1984. “Dry Active Waste Composition: The Potential for Volume Reduction.” ANS Summer Meeting, New Orleans, LA.

Daloisio, G.S. and C.P. Deltete. 1983. “Trends in BWR Condensate Polisher Operation.” Waste Management ‘83, Tucson, AZ.

JOHN P. GERHARD

Registration

Construction Quality Management for Contractors Certification, USACE (2003)

Fields of Competence

Project management of munitions and explosives of concern (MEC) investigations and removals; project scheduling; cost estimating; progress reporting; data management; historical record searches; report and plan preparation; engineering evaluation/cost analysis; action memorandums; remedial investigations (RIs); decision documents; bioremediation/ biodegradation studies; soil vapor extraction (SVE) systems, installation, operation and maintenance (O&M); in situ respiration tests; groundwater and soils remediation; air, soils, and groundwater sampling; flow and automated sampling equipment.

Education

B.S., Environmental Resource Management—The Pennsylvania State University (1997)

Credentials

UXO Project Manager/Engineer Training, WESTON (2006)
Munitions Response Site Prioritization Protocol Training Modules and Reference Material, USACE (2007)
40-Hour Hazardous Waste Site Training Course, OSHA 29 CFR 1910.120(e)(3), ERM (1997)
8-Hour Hazardous Waste Refresher Course, OSHA 29 CFR 1910.120(e)(8), WESTON (2009)
Confined Space Training for Non-Entry Rescuers, OSHA 29 CFR 1910.146, WESTON (1998)
Dangerous Goods Shipping Course, DOT and ICAO Regulations, WESTON (1998)
CPR/First Aid Training, Medic First Aid (2006)
8-Hour Site Health and Safety Coordinators (SHSC) Course, OSHA 29 CFR 1910.120(e)(4), WESTON (1999)

Qualifications Summary

- More than 11 years of professional experience.
- Five years of project management, including the supervision, coordination, and motivation of multidisciplinary teams consisting of scientists, engineers, construction personnel, cost estimators, and financial analysts. Responsibilities include resource management and forecasting, project budget control, team safety, regulatory compliance, and client satisfaction.
- Point of contact and facilitator for communications with clients, project team, and regulators.
- Experience with the planning, design, installation, and operation and maintenance (O&M) of soil and groundwater remediation systems, including sampling and analysis of various media.
- Experience with project scheduling, and preparing documents and cost estimates for remediation projects under RCRA, CERCLA, and SARA regulations.
- Experience with NPDES permitting, sampling, and reporting.
- Experience with flow monitoring equipment, automated sampling equipment, and in-line TOC meters.
- Experience managing HTRW field efforts including WESTON and subcontractor personnel.
- Experience managing MEC investigations and clearance/removal projects.

Credentials (Continued)

10-Hour Construction Safety Training, OSHA Construction Outreach Training Program, OSHA 29 CFR 1926, WESTON (2004)
Attended "A Client Workshop" for Pennsylvania's Act 2 Regulations and Land Recycling Program's Technical Manual, PA Dept. of Environmental Protection (1998)
Introduction to ArcView GIS Course, ESRI (1999)
Training Course for Site Managers on the Management of Ordnance and Explosives at Closed, Transferred, and Transferring (CTT) Ranges and Other Sites, EPA (2003)
Project Management Training, WESTON (2002)
Site Investigation and Remediation for Munitions Response Projects, ITRC (2005)

Employment History

1997-Present WESTON

Key Projects

Munitions and Explosives of Concern (MEC) Non-Time-Critical-Removal Action (NTCRA), Surf City and Ship Bottom, Long Beach Island, NJ, U.S. Army Corps of Engineers (USACE), New England District (CENAE) Remedial Action Contract (RAC) -9, Philadelphia District, Project Manager. WESTON worked as an integrator with USACE (Philadelphia District and Baltimore District Military Munitions Design Center) personnel to develop a plan of attack to conduct a rapid removal action to not delay the opening of the beach for the summer season (2009). This was a fast-track project in a 4-month window to excavate and mechanically screen approximately 390,000 cubic yards of hydraulically placed beachfill to remove discarded military munitions (DMM) from a 1.5-mile section of beach in Surf City and Ship Bottom, NJ. Project required mobilization of several subcontractors and over 40 pieces of heavy equipment modified with protective armaments to ensure safety of operators and site personnel, over 60 personnel including unexploded ordnance (UXO) technicians, construction supervisors, equipment operators, laborers, and surveyors. Maintained four separate munitions sifting operations to facilitate schedule and ensure project was completed ahead of schedule. Project included the restoration of beach, pedestrian crossovers (21), vehicular crossovers (3), handicap crossovers, and private crossovers (57). WESTON utilized UXOFast℠ technology to help manage the field data. Near-real-time data documentation and mapping was provided to the project delivery team through TeamLink® so that decisionmakers could adjust approaches and manage change appropriately. Participated in public and community outreach effort through attendance at public meetings and installation of land-use control (LUC) signage at beach access points. This allowed USACE to maintain the overall project schedule to release the beaches for public use.

35% Design for Landfill Constructability/Landfill Closure Design, 250,000-Gallon Aboveground Water Storage Tank, Industrial Wastewater Treatment Plant and Water Supply for U.S. Military Academy Preparatory School (USMAPS) and Directorate of Logistics (DOL) Relocation to U.S. Military Academy (USMA), West Point, NY, Ewing

Key Projects (Continued)

Cole, Project Manager. Was responsible for execution of landfill constructability study and landfill closure design, 250,000-gallon aboveground water storage tank, Industrial Wastewater Treatment Plant (IWTP), and water supply for future USMAPS and DOL facilities at West Point, NY. Work entailed evaluation of existing data, and design requests. Landfill investigation included time-sensitive historical information review, rapid mobilization and planning for expedited field characterization (soil and waste, landfill gas, and leachate), and reporting to maintain overall project schedule. Constructability study evaluated building location for USMAPS project and buildings relative to existing municipal solid waste (MSW) landfills. Worked closely with Ewing Cole and subcontracted design team (USACE- New York District, USMA – Department of Public Works [DPW] and Environmental staff, New York State Department of Environmental Conservation [NYSDEC]) to ensure project timeline for landfill closure and other designs were not going to prevent delays in overall MILCON building.

Munitions and Explosives of Concern (MEC) Construction Support, Fort Dix/McGuire Air Force Base (AFB), NJ, United Communities (RCI Contractor), Project Manager. Responsible for assisting RCI contractor with MEC construction support during construction activities associated with the McGuire AFB and Fort Dix Housing Privatization Project Parcel G in Burlington County, NJ. MEC construction support sweeps were necessary in certain locations (Holly Crest and Grove Park Housing Areas) due to historical ordnance range and training operations. Locations in these areas designated for subsurface excavation, digging, trenching, drilling, or any type of earth disturbance were inspected and investigated by qualified UXO personnel prior to intrusive activities. Over 20 items were safely identified and removed during construction activities.

MEC Construction Support for Drainage Repair Project, Bolling AFB/Naval Station Anacostia, Washington, DC, John C. Grimberg Company, Project Manager. Responsible for assisting prime contractor and subcontractors (earthwork and sheeting and shoring) with MEC construction support during construction activities associated with the drainage repair project, Washington, DC. Included Work Plan and geophysical prove-out (GPO) of appropriate instrumentation. MEC construction support sweeps were necessary due to historical cannon ball activities. Locations in these areas designated for subsurface excavation, digging, trenching, drilling, or any type of earth disturbance were inspected and investigated by qualified UXO personnel prior to intrusive activities. Items were safely identified and removed during construction activities.

Munitions and Explosives of Concern (MEC) Time-Critical-Removal Action (TCRA), Surf City and Ship Bottom, Long Beach Island, NJ, CENAE Remedial Action Contract (RAC) - 9, Philadelphia District and Schnabel Engineering, Project Manager. In early March 2007, after a beach nourishment project (800,000 cubic yards of sand placed on beach) was completed, potentially explosive munitions were discovered on the beach in Surf City and Ship Bottom, NJ. WESTON worked as an integrator with USACE (Philadelphia District and Baltimore District Military Munitions Design Center) personnel to develop a plan of attack to rapidly characterize the beach (approximately 70 acres) to not delay the opening of the beach for the summer season (2007). Managed generation of expedited USACE-approved Work Plans and Safety Plans prior

Key Projects (Continued)

to conducting field work. Executed a GPO to differentiate which digital geophysical mapping (DGM) equipment was appropriate based on beach conditions and expected munitions. Supervised a team of geophysicists collecting DGM data with a towed array configuration of accessible areas of the beach (berm and dune top). Supervised a team of up to 15 UXO specialists with heavy equipment operators reacquiring anomalies. Dig teams utilized WESTON's UXOFast^SM technology to help manage the field data. Additionally, the surf zone from water's edge to a distance of 150 ft and dune slopes were investigated with a mag and dig approach. UXO construction support and avoidance was provided for the dredging contractor as they completed necessary pedestrian, vehicular, and handicap crossovers. WESTON was able to rapidly characterize the beach with the towed array configuration and reacquire over 1,000 MEC items, which were recovered and disposed of accordingly. Near-real-time data documentation and mapping was provided to the project delivery team through TeamLink® so decisionmakers could adjust approaches and manage change appropriately. Participated in public and community outreach effort through attendance at public meetings and installation of LUC signage at beach access points. This allowed USACE to maintain the overall project schedule to release the beaches for public use. WESTON was able to conduct all phases (self-performance and subcontractors) of this work, allowing the client to have "one stop shopping," allowing for cost savings.

Munitions Response Action at Fort Miles Military Reservation Formerly Used Defense Site (FUDS), Lewes, DE, USACE, Baltimore District, Project Manager. Responsible for the execution of this MEC fixed price remediation with insurance (FPRI) project at Fort Miles from remedial investigation (RI) addendum through implementation of a long-term management plan after Response Complete. Successfully completed expedited RI addendum, feasibility study, proposed plan, implementation of removal action, and establishment of Administrative Record and public involvement plan. Project ahead of schedule to complete work prior to required milestones. Successfully negotiated with regulators to implement No DOD Action Indicated (NDAI) on several munitions response sites. Removal work consisted of supervision of multidiscipline geophysical and UXO technician team removing munitions remaining at the three munitions response sites to instrument detection depth. This work was conducted in sensitive ecological habitat areas (dune and beach systems). Coordination with regulators for accelerated reviews of key Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) documents helped to accelerate project schedule for completion 12 months ahead of requirements.

Redevelopment Support Services/MEC Education and Awareness Video for Fort Ritchie, Corporate Office Properties Trust (COPT), Cascade, MD, Project Manager. Reviewed existing redevelopment plans prepared by COPT and other site documentation prepared by the U.S. Army for Fort Ritchie. Developed and assembled an education and safety awareness video to be used to inform construction personnel of potential hazards associated with MEC. Supervised the production of professionally produced and narrated DVD in both English and Spanish versions. Attended kickoff meeting and status update meeting to successfully keep project on schedule and under budget.

Key Projects (Continued)

Southeastern Area (SE) Operable Unit (OU) 3A, Additional Characterization and Cleanup Alternative Analysis, Letterkenny Army Depot (LEAD), U.S. Army Corps of Engineers (USACE) Baltimore District (CENAB), Hazardous, Toxic, Radioactive Waste (HTRW) 2000/2005 Contracts, Task Manager/Project Engineer. WESTON was contracted to assess existing data for SE OU 3A and to develop exit strategies and cleanup alternatives for this dense nonaqueous phase liquid (DNAPL)-impacted groundwater plume. Evaluated existing studies and conceptual site models for potential data gaps to further refine flow patterns and contamination. Managed field work to fill in these data gaps. This work consisted of installation of multiple well groupings at various groundwater depths. Additional groundwater sampling rounds were conducted to capture an accurate picture of the current groundwater plumes. Once these data were assembled cleanup alternatives were evaluated to rapidly clean up the site. Alternatives then were evaluated based on regulator approval.

SE OU 11, Additional Characterization and Cleanup Alternative Analysis, LEAD, USACE, Baltimore District, CENAB HTRW 2000, Task Manager/Project Engineer. WESTON was contracted to assess existing data for SE OU 11 and to develop exit strategies and cleanup alternatives for this DNAPL-impacted groundwater plume. Evaluated existing studies, treatment system, and conceptual site models for potential data gaps to further refine flow patterns and contamination. Worked with WESTON technical staff on further defining the conceptual model by filling in these data gaps. This work consisted of installation of multiple well groupings at various groundwater depths. Additional groundwater sampling rounds were conducted to capture an accurate picture of the current groundwater plumes. Once these data were assembled, cleanup alternatives were evaluated to rapidly clean up the site. Assembled all of the data into an evaluation report with recommendations. Alternatives then were evaluated based on regulator approval.

Community Outreach Support for the Spring Valley FUDS, Washington, DC, USACE, Baltimore District HTRW 2005 Contract, Project Manager. Directing this high-profile FUDS project for the USACE Baltimore District. Project requires dedicated on-site community outreach Project Manager and support staff integrated within USACE project delivery team. Services include Restoration Advisory Board (RAB) support (planning, execution of meetings, and documentation of meetings), partnering meeting support, generation of monthly update letters and documentation for Administrative Record and information repository, coordination with residential and commercial property owners during negotiations for Rights-of-Entry (ROEs) with contractors conducting military munitions response program (MMRP) and HTRW removal activities. In addition, is generating public outreach documentation in support of these high profile removal activities.

Earthwork and Impacted Soil Removal at Fort McNair – National Defense University Marshall Hall Expansion, Turner Construction Company (TCCO) Working for USACE, Baltimore District (CENAB), Project Manager. Developed work plans, performed site characterization, and removed approximately 27,000 tons of impacted soil in support of the renovation of Marshall Hall at the National Defense University in Washington, DC. This soil consisted of material generated during the removal of the existing parking lot and mass

Key Projects (Continued)

excavation cut to subgrade. Managed field crew consisting of up to seven construction personnel. Removed approximately 2,200 tons of concrete encountered during the mass excavation cut to subgrade and grout generated during caisson installation with no demobilization or downtime. This material was stockpiled, broken up, consolidated, and shipped to a local concrete recycling firm. Provided discharge support for TCCO so that they could discharge treated surface water and groundwater encountered during the excavation activities into the sanitary sewer system to meet the client demands for flow requirements and minimize cost impacts to the project. Consulted directly with the District of Columbia (DC) Water and Sewer Authority (WASA) for TCCO. Also provided sampling of other suspect environmental contaminants encountered at the site including asbestos-containing material (ACM). Performed all this work with an integrated team of WESTON transportation and disposal (T&D) subcontractor and on-site construction personnel.

Earthwork at Worldgate Monument III Project, Herndon, VA, James G. Davis Construction Corporation, Project Manager. Excavated and removed over 17,000 cubic yards of soil and rock in support of the mass and structural excavation activities at the site for a 191,000-square-foot, 7-story building expected to be completed by the end of 2006. Provided excavation and backfill (interior and exterior) services as well as related items such as erosion and sediment control, stormwater management, transportation and disposal of soil and rock, sub-grade preparation, and rough and finish grading. Subcontracted drilling and blasting services for approximately 3,500 cubic yards of shale rock within the building footprint. Provided one-stop shopping for earthwork excavation activities including rock blasting. Other contractors did not want this project due to the presence of rock and difficult foundation design. WESTON stepped in and provided value-added service in rock excavation through the use of both Hoe Ram, and drilling and blasting methods. WESTON kept the project on schedule by shifting focus to help the client meet needs through change order work. Provided a fully trained earthwork team to complete the specified scope of work and other assigned tasks. No lost time accidents occurred on this project.

Remedial Investigation (RI), Pad 5 Area, LEAD, USACE, Baltimore District, HTRW 2005 Contract, Project Manager. WESTON was contracted to conduct an RI to assess the nature and extent of contamination in the groundwater, surface soils, and subsurface soils. Pad 5 is a former construction debris landfill located within the Base Realignment and Closure (BRAC) parcel at LEAD.

The project consisted of conducting an RI of the Pad 5 site. A technical work plan and a site safety plan were developed for this project in accordance with USACE requirements. This field work consisted of installation of Geoprobe® soil borings, surface soil sampling locations, groundwater sampling, delineation sampling, and disposal of identified impacted material encountered during investigative activities. Approximately 400 tons of residual material was removed during the first phase of investigation. Managed the technical execution of the project, which included manpower, equipment, excavation, and subcontracted the appropriate transportation and disposal of this material. The material was sent to a residual waste facility in accordance with all federal and state requirements. Additional areas of delineation have

Key Projects (Continued)

been conducted to fully delineate the extent of this historical landfill. An additional 1,235 tons of hazardous waste material was removed and sent to the appropriately permitted facility in accordance with all federal and state requirements. Restoration activities at these areas included post-excavation sampling and backfilling and site grading work. An RI report and associated baseline human health risk assessment (BHHRA) were developed based on the site information. Proactively managed reporting phase to the advantage of the client.

Underground Storage Tank (UST) and Aboveground Storage Tank (AST) Compliance for LEAD, Chambersburg, PA, USACE, Baltimore District, HTRW 2000/2005 Contracts, Project Manager. Managed the inspection, reporting, and repair of tanks for LEAD. The compliance tasks involved inspection and reporting of over 40 Veeder Root monitoring systems on a quarterly basis. Managed subcontracted personnel for the inspection and reporting pieces. Performed closure sampling and prepared documentation of existing UST and AST in accordance with PADEP regulations. Conducted geotechnical evaluations regarding stability of surrounding soil and foundations for UST removal or in-place closure, and any necessary engineering controls. Installed new ASTs in compliance with all applicable fuel oil regulations.

EP 1110-1-18 Guidance Document Rewrite, Zapata Engineering and U.S. Army Engineering Center Huntsville Center, Project Manager. WESTON, under contract to Zapata Engineering to the U.S. Army Engineering Huntsville Center, has provided consulting services to revise EP 1110-1-18 formerly titled “Ordnance and Explosives Response.” The revised guidance document will be titled "Military Munitions Response Process.” Managed the technical execution of integrating the CERCLA process into the document in accordance with the FUDS program and the new military munitions response program (MMRP). This document provides the context, scope, goals, objectives, governing policies, procedures, and processes for the USACE MMRP, along with recommended formats for CERCLA guidance (preliminary assessment [PA], site investigation [SI], RI/FS, decision documents, etc.). Response actions at USACE military munitions projects can include all forms of response, i.e., identification; detection; investigation; and removal actions; remedial actions, or a combination of removal and remedial actions to address munitions and explosives of concern (MEC) or munitions constituents (MC). This document specifically addresses military munitions (MM) response actions conducted under the USACE FUDS program. Key changes include the addition of the CERCLA process and addition of MC sampling. Worked closely with USACE personnel at the MM Center of Expertise (CX) at the Huntsville Center and Zapata Engineering to meet the required accelerated schedule for implementation into this document. Numerous onboard review meetings and real-time response to comments have streamlined the finalization of this document.

Site Inspection Addendum for Geophysical Mapping and Intrusive Investigation at Public Housing Areas, Fort Dix, NJ, USACE, Baltimore District (CENAB), HTRW 2000 Contract, Project Manager. Led this geophysical survey looking for suspected munitions and explosives of concern (MEC) at two housing areas on Fort Dix, NJ. Techniques used were required to be state-of-the art, and included electromagnetic (EM-61, MK2) and magnetometry (G-858 and G-856) surveys. Properties were reported to be locations for potential former firing ranges, and were scheduled for subsequent transfer. Approximately 24 acres were mapped geophysically and

Key Projects (Continued)

investigated intrusively to further refine the site conceptual model. Data and reports were thoroughly reviewed by the USACE Baltimore and Huntsville Districts in addition to Fort Dix. A decision document recommending no further action with awareness training was the end result of this investigation.

Geophysical Mapping for the Spring Valley FUDS, Washington, DC, USACE, Baltimore District, HTRW 2000/2005 Contracts, Project Manager. Directing this high-profile FUDS project for the USACE Baltimore District. Project required state-of-the-art geophysical techniques for mapping anomalies, looking for evidence of MEC and chemical warfare materials (MEC/CWM) at over 70 properties. Responsiveness to USACE's aggressive schedule is critical because the data support subsequent removal actions at these high-profile residential and American University properties. Electromagnetic (EM-61, MK 2) and magnetometry (G-858 and G-856) surveying methods are used. Data and reports are thoroughly reviewed by the USACE Baltimore and USACE Huntsville clients, in addition to the U.S. Environmental Protection Agency (EPA), DC Public Health, and the property owners.

Lead Paint Sampling, Fort Drum, NY, USACE, Baltimore District, HTRW 2000 Contract, Project Manager. Managed the sampling of barracks and buildings slated for demolition and disposal. Project included an innovative lead paint sampling program, which included composite sampling of building materials on a proportional-weight basis. Project team consisted of seven WESTON technical personnel. Sampled over 339 buildings, including occupied structures, and roofs. Managed subcontracted analytical laboratory. Utilized EnviroData for managing analytical data packages. Provided data to client within 2 weeks of field work. This program saved Fort Drum considerable costs in disposal of the building materials after demolition.

Building Deconstruction Waste Management Study, Fort Drum, NY, USACE, Baltimore District, HTRW 2000 Contract, Project Manager. Managed the building deconstruction waste management study to evaluate whether materials of construction from buildings under consideration for demolition can be disposed of in an alternative manner rather than through typical demolition and disposal practices. Data collection phase consisted of contacting local contractors, recyclers, vendors, and disposal facilities. A site visit was conducted with Fort Drum personnel to thoroughly understand current practices and future goals for the installation. Alternatives evaluated were based on cost, local market demand for material, and effectiveness. Study identified an alternative, which would allow Fort Drum to stay in compliance with specified Army directives regarding diversion rates from solid waste disposal facilities. Implemented pilot study to verify desktop study results, which included the selective deconstruction of two buildings, and the phased segregation and appropriate disposal by recycling, reuse, or disposal of building materials.

Needs Assessment, Tobyhanna Army Depot (TYAD), PA, Buchart Horn, Inc. and USACE, Baltimore District, Project Manager. Managed the needs assessment (NA) portion of real property master planning documentation, primarily focusing on environmental issues at Tobyhanna Army Depot. A week of roundtable discussion with stakeholders and management level personnel identified future needs and requirements for the facility. A Needs Assessment report was developed based on current needs and long-term component items identified in

Key Projects (Continued)

planning process. Worked with two other contractors in the development of this document.

Unexploded Ordnance (UXO) Sweep of Proposed Waterline, Aberdeen Proving Ground (APG), MD, USACE, Baltimore District, HTRW 2000 Contract, Project Manager. WESTON was contracted to clear the proposed waterline area to a depth of 2 feet. The history of the facility required that clearance of UXO be undertaken to protect the worker installing the waterline. Prepared work plan (WP), including field sampling/analysis plan (FSAP), and health and safety plan (HASP) in accordance with all regulatory requirements. Responsible for managing work plan production, UXO field effort, reporting, budget, and project schedule. Prepared monthly progress reports. Project was completed on-time.

HAZWOPER Training of USACE Personnel, USACE, Baltimore District, HTRW 2000 Contract, Project Manager. Managed five refresher training classes on Hazardous Waste Operations and Emergency Response (HAZWOPER), per Occupational Safety and Health Administration (OSHA) requirements. Directed two WESTON safety professionals (Certified Industrial Hygienists [CIHs]) in the appropriate agenda, topics, and activities toward training approximately 150 total USACE personnel.

Confined Space Training of USACE Personnel, USACE, Baltimore District, HTRW 2000 Contract, Project Manager. Managed one training class on confined space training, per OSHA requirements and USACE requirements. Directed two WESTON safety professionals (CIHs) in the appropriate agenda, topics, and activities toward training approximately 25 total USACE personnel.

Remedial Investigation, New Jersey, Confidential Client, USACE, HTRW 2000 Contract, Project Engineer. WESTON was contracted to conduct an RI to assess the nature and extent of contamination in the groundwater, surface soils, sediments, and subsurface soils for two different operable units (OUs). This work was performed under the Formerly Utilized Sites Remedial Action Program (FUSRAP). This site was used by the Manhattan Engineering District (MED) program and contracts to develop a process to convert uranium oxide to produce uranium tetrafluoride and small quantities of uranium metal. The site has an extensive history of chemical manufacturing varying from explosives, dye manufacturing, fluorochemicals, motor fuels, petroleum chemicals, polymer products, and aromatics. All of these manufacturing processes have led to contamination of the surrounding media. Prepared work plan (WP), including field sampling and analysis plan (FSAP), and site safety and health plan (SSHP), in accordance with all regulatory requirements. Responsible for presentation material dealing with the project. Responsible for subcontractors and coordinating field efforts. A significant amount of field effort was conducted in Level B personal protective equipment (PPE) requiring extensive health and safety requirements. A project website was developed for the collaboration of the WESTON and USACE technical and management teams. Developed data management tools for the extensive field and laboratory data acquisition and evaluation.

NPDES Stormwater Compliance, City of Philadelphia, Division of Aviation (DOA), Philadelphia International Airport and the Northeast Philadelphia Airport, Project Engineer. WESTON assisted DOA regarding compliance with the National Pollutant Discharge

Key Projects (Continued)

Elimination System (NPDES) requirements. Activities included support during the permit application, negotiation of the NPDES permit, preparing discharge monitoring reports, and developing alternatives and cost estimates for reducing aircraft deicing discharges to the Delaware River. Assisted with the implementation of a Preparedness, Prevention, and Contingency Plan (PPCP); and Contingency Plan for Hazardous Material and Hazardous Waste Management as the primary author. As part of the deicing program, characterized flow (chemical and physical analysis) off the deicing pad facility, and reported discharge concentrations. Study of flow off the deicing pad was used to determine discharge setpoint. Assisted DOA with managing captured stormwater deicing flow runoff for discharge to the sanitary sewer via two 600,000-gallon tanks. Assisted with sampling and reporting of discharges to the Philadelphia Water Department (PWD).

Tobyhanna Army Depot (TYAD) Monitor/Residential Well Sampling Program, Tobyhanna, PA, USACE Baltimore District, HTRW 1996 Contract, Project Engineer. This ongoing Superfund remediation project involves groundwater sampling and analysis for monitor and residential wells in the vicinity of TYAD. Contaminants of concern include tetrachloroethylene (PCE), dichloroethylene (DCE), trichloroethylene (TCE), and vinyl chloride. Responsibilities included project coordination and planning, sampling, data management, and report preparation.

Tobyhanna Army Depot (TYAD) Landfill Well Sampling Program, Tobyhanna, PA, USACE Baltimore District, HTRW 1996 Contract, Project Engineer. This ongoing Superfund remediation project involves groundwater sampling and analysis for monitor and residential wells in the vicinity of TYAD. Contaminants of concern include tetrachloroethylene (PCE), dichloroethylene (DCE), trichloroethylene (TCE), vinyl chloride, and inorganics. Responsibilities included project coordination and planning, sampling, data management, and report preparation.

Havertown PCP Superfund Site Oil/Water Separator Investigation, Haverford Township, PA, USACE, Baltimore District, HTRW 1992 Contract, Project Engineer. Project involved sampling and maintenance of an oil/water separator in a residential setting. Contaminants of concern included pentachlorophenol (PCP), dioxins and furans, tetrachloroethylene (PCE), dichloroethylene (DCE), trichloroethylene (TCE), and vinyl chloride. Responsibilities included coordinating sampling through the U.S. Environmental Protection Agency (EPA) Contract Laboratory Program (CLP), scheduling maintenance visits to clean and remove solid waste and oil from the separator, scheduling periodic waste pick-ups with a hazardous waste hauler, and preparing quarterly reports for EPA.

Soil Vapor Extraction (SVE)/Free Product Recovery (FPR), Soil and Groundwater Remediation, Gibbsboro, NJ, Confidential Client, Project Engineer. System includes two-phase approach to remediation of free product and the vadose zone soils. First phase is free product recovery using controllerless skimmer pumps to recover floating product on the groundwater surface. The second phase uses SVE to remove volatile organic compounds (VOCs) from vadose zone soils and to assist in product recovery. The project involved initial installation

Key Projects (Continued)

of equipment and startup. Responsible for bimonthly O&M of automated free product recovery system, 12 vertical SVE extraction vents, and 4 horizontal SVE extraction vents. Responsible for troubleshooting problems and taking corrective actions. Performed monthly sampling of the air stream associated with the off-gas treatment. Responsible for scheduling a hazardous waste hauler to perform periodic pick-ups of recovered product. Prepared O&M manual for treatment system. Responsible for the monthly modeling of groundwater and product elevation modeling. Prepared progress report for New Jersey Department of Environmental Protection (NJDEP). Responsible for tracking costs incurred through system operation of this ongoing project.

Canal Creek Hazardous Material Facilities Characterization, Aberdeen Proving Ground (Edgewood Area), MD, Directorate of Safety, Health, and Environment (DSHE), Base Environmental Support Team (BEST)-1 Contract, Project Engineer. The project involved tasks required to remove/abandon underground tanks (non-petroleum), also called Hazardous Materials Facilities (HMFs), potentially impacting the groundwater in the Canal Creek aquifer. Prepared an engineering evaluation/cost analysis (EE/CA) in which specific removal action alternatives were evaluated. Performed records search to verify existing information concerning the HMFs. Prepared a field sampling/analysis plan, and a site-specific safety and health plan for sampling the HMFs. Duties also included sampling the HMFs, supervising a two-man sampling team, interpreting results, and making recommendations to minimize future impacts to the Canal Creek aquifer.

Site Characterization/Remediation of an Underground Storage Tank (UST) at Building 509, TYAD, Tobyhanna, PA, USACE Baltimore District, HTRW 1992 Contract, Assistant Engineer. WESTON was contracted to perform a site characterization study to investigate soils surrounding a non-regulated home heating oil UST. Project activities included investigating the site geology and hydrogeology, determining the extent and severity of potential subsurface petroleum migration, recommending abatement and cleanup activities, and executing remedial activities. Specific tasks consisted of installing monitoring wells, quarterly groundwater monitoring, soils sampling, data management, and report preparation.

Remedial Investigation (RI), Former Nansemond Ordnance Depot (FNOD), VA, USACE Baltimore District, HTRW 1996 Contract, Project Engineer. WESTON was contracted to conduct an RI to assess the nature and extent of contamination in the groundwater, surface soils, sediments, and subsurface soils. The RI also assessed the associated health and environmental risks at two sites while conducting background sampling for comparison. This work was performed under the Defense Environmental Restoration Program (DERP) for Formerly Used Defense Sites (FUDS). The history of the facility required that clearance of unexploded ordnance (UXO) be undertaken. Prepared work plan (WP), including field sampling/analysis plan (FSAP), health and safety plan (HASP), and quality assurance project plan (QAPP), in accordance with all regulatory requirements. Responsible for subcontractors and coordinating sampling events in the field. Dealt with data management, and was primary author for the reports.

EE/CA, FNOD, VA, USACE Baltimore District, HTRW 1996 Contract, Project Engineer. WESTON was contracted to conduct an EE/CA to recommend and justify preferred removal

Key Projects (Continued)

alternatives of potential hazardous and toxic wastes, ordnance-related items, and solid waste at the James River beachfront. This project was on the fast-track program. This work was performed under the DERP for FUDS. The history of the facility required that clearance of UXO be undertaken. Prepared WP, including FSAP, HASP, and QAPP, in accordance with all regulatory requirements. Responsible for oversight of subcontractors, coordination of sampling events in the field, and preparation of the EE/CA document recommending preferred removal options. Dealt with data management, and was primary author for the reports.

SVE/Air Sparging (AS), Installation of Vents, and Soil and Groundwater Remediation, Calvert City, KY, The GEON Company, Field Engineer. WESTON was contracted to design, build, and operate an SVE/AS system at an active chemical manufacturing facility. The main contaminants of concern included ethylene dichloride (EDC) and vinyl chloride. Responsible for the installation of deep extraction vent, shallow extraction vent, and AS vent within the same boring to extract VOCs at varying depths, while also treating the groundwater by sparging below the groundwater table. WESTON’s patented SVE vent design was used at this facility. More than 50 extraction and sparging points were installed in multiple locations at the facility. Supervised multiple drilling crews at the site during installation of vents, logged lithologic data, performed sampling, and also managed well construction logs and data.

In Situ Groundwater Vacuum Vaporizer Well Remediation Technology (UVB), Fort Drum, NY, USACE Baltimore District, HTRW 1996 Contract, Field Engineer. This project required cleanup of groundwater contaminated with wastes from a former UST and fueling location within an active military facility. The main contaminants of concern were benzene, toluene, ethylbenzene, and xylene (BTEX). The UVB technology uses a system of chemical, physical, and biological processes to treat VOC-contaminated groundwater and subsurface soils. Responsibilities included weekly groundwater sampling of surrounding wells and O&M of UVB system; periodic air sampling of system to check for destruction efficiency; and adjustments of system to maximize capture of contaminated groundwater.

Site Characterization, Pennsylvania, Southeastern Pennsylvania Transit Authority (SEPTA), Assistant Engineer. This project involved the characterization of an active rail yard facility where electric rail cars are serviced. Polychlorinated biphenyl (PCB) contamination was documented at the site during historical investigations. This project was completed in accordance with the Pennsylvania Act 2 provisions for land recycling. Duties consisted of management of field investigations, including coordination with sampling personnel, surveyors, and a drilling subcontractor; in addition, coordinated with the rail yard dispatcher to ensure safety of the sampling personnel. Report preparation consisted of data compilation and management for the final recommendations to the client.

Bioremediation Inoculation, SVE, and AS, Soil and Groundwater Remediation, Hampstead, MD, Confidential Client, Project Engineer. An SVE and AS system was installed to remediate trichloroethene (TCE) and tetrachloroethene (PCE) contamination in the source area. The SVE system was started in October 1997 and has run consistently since that time. Pulse pumping in part of the system, which has both SVE and AS systems, has led to increased

Key Projects (Continued)

contaminant recovery, and a respiration test demonstrated enhanced aerobic biodegradation. Intermixed with the TCE and PCE is petroleum hydrocarbon (PHC) contamination in the soil. WESTON excavated and installed an inoculation trench with three injection points adjacent to the current SVE system and source area. A commercially available adapted microbial culture was added to the vadose zone, along with suitable nutrients to enhance PHC degradation. Supervised two-man crew for installation of system. Coordinated with analytical laboratory for sampling, data interpretation, and management, in addition to compiling periodic progress reports.

Publications and Presentations

Gerhard, J, L. Pastor, and G. Follett. 2009. “Performance Based Munitions Response.” *The Military Engineer.* Vol. 101, No. 657. pp. 49-50.

Gerhard, J., G. Follett, and K. Watson. 2007. “MEC Time Critical Removal Action Public Beach Boroughs of Surf City and Ship Bottom, New Jersey.” UXO Forum. August 2007.

Gerhard, J., K. Taylor-Haynes, and A. Wood. 2005. “Recycling Deconstruction Material at Fort Drum.” *Public Works Digest.* Vol. XVII, No. 3. pp. 14-15.

RYAN S. STEIGERWALT, P.G.

Qualifications Summary

- More than 8 years of diverse professional experience performing task, site, quality, and safety management for construction-related projects and environmental and military munitions response investigations and removal actions. Develops statistically defensible investigation strategies and approaches to characterize nature and extent of munitions and explosives of concern contamination, densities, and remaining risk.
- Experienced Project Geophysicist, conducts geophysical surveys to detect munitions and explosives of concern including unexploded ordnance and discarded military munitions and chemical warfare materiel at a wide range of facilities across the United States and in Canada.
- Proficient in various GIS, geophysical, and statistical applications for digital data processing and analysis, i.e., Geosoft OASIS montaj contouring software, Visual Sample Plan, and UXO Estimator.

Registration

Licensed Professional Geologist in the Commonwealth of Pennsylvania (No. PG004779; 2007)
Blaster's License in the Commonwealth of Pennsylvania (No. BL-7590; 2007)

Fields of Competence

Task/site management and on-site project coordination; quality control (QC); digital geophysical mapping (DGM) survey design and digital data processing and analysis; Military Munitions Response Program (MMRP) implementation (SI level through remedial action including preparation of Proposed Plans and Decision Documents); preparation of work, safety, and quality plans for munitions response projects; Explosive Safety Submittals (ESSs); munitions disposal; munitions constituent (MC) investigations; tracking and progress reporting; and multiple client integration. Directly involved with a variety of munitions response investigations and program phases including site inspections, engineering evaluations and cost analyses (EE/CAs), remedial investigations and feasibility studies (RI/FSs), time-critical-removal actions (TCRAs), Proposed Plans, and removal actions.

Education

M.Sc., Geology/Geophysics—The University of Akron (2002)
B.Sc., Geology—Bloomsburg University of Pennsylvania (2000)

Credentials

National Association of OEW Contractors (NAOC), Technology Committee Member
Environmental and Engineering Geophysical Society, Member
American Geophysical Union, Member
Radiological Worker II Training, Stoller Navarro Joint Venture (2005); Refresher (2009)
30-Hour Construction Safety Training, OSHA 29 CFR 1926, WESTON (2004); Refresher (2007)
40-Hour Hazardous Waste Site Training Course, OSHA 29 CFR 1910.120(e)(3), DASET (2002)
8-Hour Hazardous Waste Refresher Course, OSHA 29 CFR 1910.120(e)(8), WESTON (2003); Refresher (2010)

Credentials (Continued)

First Aid/CPR Training, Refresher (2009)
Bloodborne Pathogens Training, OSHA 29 CFR 1910.1030, WESTON (2003); Refresher (2010)
Classification Methods for Military Munitions Response Projects, SERDP/ESTCP Short Course (2008)
Visual Sample Plan Unexploded Ordnance Module, SERDP/ESTCP Short Course (2008)
Geosoft DoD UXO QC System Training (2003)

Employment History

2008-Present	WESTON
2007-2008	Shaw Environmental, Inc.
2002-2007	WESTON
2000-2002	The University of Akron (Teaching Assistant)
2001	The University of Akron (Research Assistant)
1998-2000	Pennsylvania Geological Survey (Summers)

Key Projects

Munitions and Explosives of Concern (MEC) Data Gap Investigation and Removal Action, Aerojet Chino Hills Facility, California, Aerojet-General Corporation, Deputy Project Manager/Site Manager. Conducted a **s**ubsurface MEC removal action over approximately 40 acres of rolling and steep topography to detect 20mm, 25mm, 30mm, and 40mm projectiles. Managed geophysical survey, geographic information system (GIS), and unexploded ordnance (UXO) teams performing anomaly reacquisition and intrusive investigation and mag and dig surveys. Used a multisensory electromagnetic sensor array for digital geophysical mapping (DGM) in accessible areas. Developed a robust sitewide seeding program as part of the geophysical system verification (GSV) process for all removal activities. The rigorous quality control (QC) approach was accepted by California state regulators and the final report was approved with minimal comments. Worked with local officials to maintain explosives storage magazine licensing. Maintained a tracking database of all munitions potentially presenting an explosive hazard (MPPEH) until items were transferred and explosively treated. Case study of the GSV process was presented at the American UXO Range and Countermine Forum 2009.

Remedial Actions at G-Street Salvage Yard Military Munitions Response Program (MMRP)/Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Site, Aberdeen Proving Ground (APG), MD, Directorate of Safety, Health, and Environment (DSHE), Project Geophysicist. Designed and implemented a DGM survey plan to delineate boundaries of a potential munitions and explosives of concern/chemical warfare material (MEC/CWM) waste burial site and to determine, based on geophysical response characteristics, initial locations to position the negative-pressure vapor containment structure (VCS). A DGM survey robust enough to detect individual MEC items was conducted using an EM-61 MK2 and land-based positioning methodology across the Burn Residue Disposal Area (BRDA) and vicinity. Electromagnetic data were processed and interpreted using Geosoft to select targets along the boundaries of the burial site for mark-out by the intrusive remediation team. Following excavation of the buried wastes, a post-investigation DGM survey was

Key Projects (Continued)

conducted to ensure all metallic debris was removed from the walls and floor of the excavation site. Remaining targets were selected, reacquired, and sources investigated to confirm remediation was complete. The final report was quickly approved by stakeholders and regulators without comment.

Interim Removal Action (IRA), New Boston Air Force Station (AFS), New Boston, NH, U.S. Army Corps of Engineers (USACE) Omaha District, Task Manager. This was an approximately $4.5 million IRA project involving a 1,100-acre surface MEC clearance and 80-acre subsurface MEC investigation in munitions response sites (MRSs) anticipated to be carried into the remedial investigation (RI) phase. The project site is characterized as remote with rough and variable terrain and thick vegetation. Developed planning documents to minimize impact to station operations and to avoid disrupting off-station activities. The project munition with the greatest fragmentation distance (MGFD) was the 100-lb general-purpose bomb (high explosive). Used maximum fragment distance and hazardous fragment distance arcs to segment the project area to direct project teams and minimize impact. This was the first IRA that was being performed under the Air Force MMRP. Required engineering evaluation/cost analysis (EE/CA) development and Action Memorandum signature prior to implementation.

Air Force MMRP Comprehensive Site Evaluation (CSE) Phase II Projects, USACE Omaha District, Technical Lead/ Geophysicist. Implemented all aspects of the Air Force MMRP CSE Phase II program on more than 10 installations across the United States. Performed quality oversight on field teams performing transect surveys, munitions constituents (MC) sampling using X-ray fluorescence (XRF) and fixed-based laboratory samples and DGM. Developed work planning and safety documents. Assisted in frequent and open team meetings with USACE, AF Major Command, and installation personnel. Project sites included Arnold Air Force Base (AFB), Barksdale AFB, Buckley AFB, Clear AFS, Davis-Monthan AFB, Hill AFB, Langley AFB, McChord AFB, Nellis AFB, New Boston AFS, and Vandenberg AFB.

MEC Removal Action, Former Grenade and Rocket Ranges, Fort Sill, OK, USACE Tulsa District, Project Technical Advisor. Served as Technical Advisor for the $1.2 million MEC removal action at the former grenade and rocket ranges munitions response site located in the Southwest Cantonment Area of Fort Sill, OK. Provided oversight on all aspects of the project, including work and safety plan development, explosive siting issues, DGM, mag and dig implementation, and interim and final reporting. Replaced a previous contractor to complete project prior to critical Base Realignment and Closure (BRAC) construction activities.

Munitions Response Action, Former Fort Miles Military Reservation Formerly Used Defense Site (FUDS), USACE Huntsville Center (HNC) and Baltimore District, Project Geophysicist. Served as Project Geophysicist for munitions response actions at nine Munitions Response Sites (MRSs) at the Former Fort Miles Reservation (FMMR) FUDS located in Cape Henlopen State Park, Delaware. Was responsible for the project Proposed Plan, geophysical prove-out (GPO) work plan, GPO implementation, and GPO letter report.

Repair/Rehabilitation Project, Confidential and Secure Location, Air Force Center for Engineering and the Environment (AFCEE), Site Manager. Was Site Safety Manager for installation of a modular structure at a secure facility. Conducted oversight for a project team

Key Projects (Continued)

consisting of multiple subcontractors. Managed site earthwork, construction, and finishing phases of the project.

Area of Concern-1 MEC TCRA, USACE Baltimore District (CENAB), Hazardous, Toxic, Radioactive Waste (HTRW) 2000 Contract, Project Engineer/Geophysicist. Project Engineer/Geophysicist for the 278-acre MEC TCRA at the Tobyhanna Artillery Ranges (TOAR) FUDS, Tobyhanna, PA. Responsibilities included technical direction to dig, survey, and geographic information system (GIS) teams; progress tracking; and daily and weekly reporting. Prepared planning documents including work and safety plans, explosives safety submittal (ESS), and site-specific final report. Performed tracking and quality control (QC) of project metrics including production rates, costs, and progress milestones. Re-mobilized to perform a 74-acre TCRA expansion and adaptive clearance work funded by the Pennsylvania Department of Environmental Protection (PADEP) with USACE oversight. Performed munitions removal activities within neighboring residential developments. Began to prepare munitions response site prioritization protocol, project designation, and revised inventory project report for the FUDS property.

Geophysical Investigation, Spring Valley FUDS, Washington, DC, USACE CENAB, HNC, HTRW Contract, Project Geophysicist. Project Geophysicist for the Spring Valley FUDS DGM investigations. Conducted more than 50 DGM surveys in a residential/urban environment. Implemented both electromagnetic and magnetic methods to locate pit and trench-like features in addition to individual discrete anomalies indicative of buried military munitions and/or chemical warfare materials (CWM). Aided in the design of advanced geophysical data processing procedures for anomaly/clutter discrimination. Conducted frequent Anomaly Review Board presentations to the Spring Valley Partners (CENAB, HNC, U.S. Environmental Protection Agency [EPA], and other regulators).

Repair/Rehabilitation Project, Confidential and Secure Location, AFCEE, Worldwide Environmental Restoration and Construction (WERC) Contract, Site Manager. Functioned as the Site Manager and provided safety oversight for a subcontractor team of six personnel performing repair/rehabilitation design and implementation work. Conducted QC activities throughout the project to ensure structural stability and safety for the team and surrounding infrastructure. Coordinated with facility personnel daily to update on project progression.

Historic Outfall 4S MEC TCRA, Former Mare Island Naval Shipyard, U.S. Department of Navy BRAC Program Management Office West and Naval Facilities Engineering Command Southwest, Geophysicist. Conducted DGM to locate MEC. Prepared planning documents. Implemented a GPO. Located and reacquired geophysical anomalies. Prepared geophysical site-specific final report.

Demolition and Transportation of an Indirectly Heated High Temperature Thermal Desorption System, West Chester, PA, WESTON, Site Coordinator. Aided in the coordination and dismantling of an indirectly heated high temperature thermal desorption system. Inventoried and tracked the shipping of all equipment and machinery related to the system. Managed and provided oversight of transportation and crane operations during final equipment staging.

Key Projects (Continued)

Well Abandonment Activities, Defense Distribution Depot Susquehanna, Pennsylvania (DDSP), USACE CENAB, HTRW 2000 Contract, Site Manager. Conducted a geophysical investigation to locate buried supply wells in a residential neighborhood. Managed a team of subcontractors to excavate and abandon identified wells. Performed quality oversight and coordinated directly with the client on quality and technical issues.

Geophysical Anomaly Reacquisition, Luke AFB, AFCEE, WERC Contract, Geophysicist. Reacquired geophysical anomalies over approximately 60 miles of roadway through Barry Goldwater Former Bombing Range. Used real-time kinematic global positioning system (RTK-GPS) for reacquisition.

Nevada Test Site – Areas 7 and 18, U.S. Department of Energy (DOE)/Stoller Navarro Joint Venture, Geophysicist. Responsible for DGM activities using a multi-sensor towed array system, and data collection using MAGLOG with Trimble RTK navigation. Performed surveying and reacquisition using RTK.

Ordnance and Explosives (OE) Site Inspection Addendum (SIA), Fort Dix, Ocean, and Burlington Counties, NJ, USACE, HTRW 2000 Contract, Geophysicist/Site Manager. Managed geophysical teams, MEC dig operations, and subcontractors. Directed site operations while processing and performing QC activities on geophysical data. Developed a target prioritization scheme for magnetic anomalies by extracting anomaly information such as size, response, and fit properties. This process reduced digs by approximately 30%. Approval was granted by CENAB and HNC reviewers.

Tobyhanna Artillery Ranges Remedial Investigation/Feasibility Study (RI/FS), EE/CA, PADEP/CENAB, HTRW 2000 Contract, Processing/Site Geophysicist. Processed and interpreted magnetic data collected using a variety of positioning systems including GPS and USRADS. Performed QC checks and discussed daily operations with the project geophysicist and site manager. EE/CA involved the evaluation of approximately 27,000 acres of rough and wooded terrain located in Tobyhanna State Park and Pennsylvania Game Lands #127. Transitioned through EE/CA to RI/FS.

Geophysical Prove-out (GPO), Fort Worth, TX, Carswell AFB, AFCEE WERC Contract, Project Geophysicist. Designed and implemented GPO. Created sled for EM-61 MK2 to enable detection of 20mm rounds. Used Trimble RTK for navigation and surveying. Provided QC on towed-array system data.

TCRA, Buckroe Beach, Hampton, VA, USACE, Baltimore and Norfolk Districts, HTRW 2000 Contract, Project Geophysicist. Performed electromagnetic geophysical surveying to identify 40, 75, and 76mm projectiles of World War I and World War II era. Items were mistakenly emplaced during beach replenishment activities in the 1990s. Approximately 13 acres were surveyed extending from and including the dry beach to 18 inches of water. The EM-61 MK2 system was water-proofed and modified to withstand the high-energy surf zone environment. The single coil system was integrated with an RTK GPS using NMEA output to eliminate the need for time synchronization.

Key Projects (Continued)

OE Removal Action, Open Detonation Grounds, Romulus, NY, Seneca Army Depot, USACE, Remedial Action Contract (RAC), QC Geophysicist. Implemented newly prepared QC procedures to ensure geophysical data and positional quality during towed-array electromagnetic geophysical surveys. The primary objective of this investigation was to accurately identify MEC over an area encompassing approximately 230 acres. The use of these QC procedures identified problem areas quickly and efficiently, and needed less client oversight and supervision.

Quality Assurance (QA) Geophysical Surveys, Open Burning Grounds, Romulus, NY, Seneca Army Depot, USACE, RAC, Geophysicist. Electromagnetic (EM-61) and magnetometry (G-858 and G-856) surveys were conducted for QA purposes on 4 acres of the Seneca Army Depot. The objective was to detect anomalies that had the potential to be unexploded ordnance (UXO) at depths of up to 2 ft below ground surface (bgs). Anomaly maps and dig sheets were submitted and investigated on-site to evaluate previous geophysical investigations.

UXO Geophysical Survey, Fort Dix, Ocean, and Burlington Counties, NJ, USACE, Baltimore District, HTRW 2000 Contract, Geophysicist. Performed meandering magnetic surveys over approximately 90 acres using GPS navigation in accordance with a visual sample plan developed through VSP software. Aided in identifying six high-priority areas that required further investigation. These six 1-acre sites were geophysically scanned using both EM-61 MK2 and G-858 instrumentation utilizing fiducial navigation along relative grids.

OE/Debris Pile Delineation, Former Nansemond Ordnance Depot, Suffolk, VA, USACE, Norfolk District, HTRW 2000 Contract, Geophysicist. Utilized a combination of magnetics, electromagnetics, and ground-penetrating radar (GPR) to delineate and three-dimensionally image debris piles having the potential of containing OE materials. This technique provided approximate debris volumes needed for cost estimation and future removal actions, and focused sampling. Devised flotation devices for both G-858 and EM-31 instrumentation to scan a horseshoe-shaped pond directly inland from the Nansemond River.

Nonintrusive Geophysical Investigation, Howard County, MD, Department of Public Works, Geophysicist. Geophysically scanned high-priority areas for buried foundations, tanks, drums, and other debris that posed potential risks for future land development plans.

Suspect Drum Search, Removal Support Team (RST), Saratoga Springs, NY, EPA, Region 2 Superfund Technical Assessment and Response Team (START), Geophysicist. Performed metal detection and GPR surveys to identify anomalies indicative of buried drums. Produced anomalies table with position information to perform intrusive activities.

Leach Field Delineation and Well Placement, Newtown, CT, Confidential Client, Geophysicist. The objectives of this geophysical investigation were to provide subsurface information to locate and identify former and current septic leach fields and geologic/ hydrogeologic conditions. The geophysical results were used to determine the placement of subsequent groundwater monitoring wells. Subsurface imaging of the site was conducted utilizing a complement of terrain conductivity electromagnetic (EM) and earth resistivity (ER) methods.

Key Projects (Continued)

Underground Storage Tank (UST) and Utility Investigation, West Virginia, City of Wheeling, Economic and Community Development Department, Geophysicist. Performed electromagnetic and GPR surveys to provide subsurface information needed for Phase II investigations and future land development.

Buried Drum Investigation, Lock Haven, PA, Confidential Client, Geophysicist. Performed both EM-61 high-sensitivity metal detection and EM-31 terrain conductivity surveys to scan the subsurface in search of alleged drums buried at a former chemical plant. Anomalies were geographically referenced, navigated to, and flagged for follow-up GPR imaging. The results were used as reference for potential property purchasers.

Geophysical Investigation, Philadelphia, PA, Philadelphia Gas Works, Passyunk and Richmond Plants, Geophysicist. The primary objective was to locate and map potential USTs, utilities, and former building foundations that may affect soil boring and test pit placement. Reconnaissance surveying using electromagnetic (EM-61) methods was used to determine areas that may need further investigation. Investigated these areas using GPR to provide information necessary to enhance the resolution and depth of specific major anomalies previously imaged by the EM-61.

Formerly Utilized Sites Remedial Action Program (FUSRAP) Project, Deepwater, NJ, Confidential Client, Level B Support. Supported Level B operations during FUSRAP investigations. Aided in decontamination procedures, and worked closely with drill crews and sampling teams.

Site and Location Map Development, Strasburg Landfill, Chester County, PA, PADEP. Developed a site and location map using GPS positions collected on-site.

Publications and Presentations

Steigerwalt, R.S., J. Austreng, and C.S. Goulart. 2009. "Commercial Application of the Physics-Based Test Strip and Seeding Approach." UXO Countermine and Range Forum 2009, Orlando, FL. August 2009.

Ervine, M.J., R.S. Steigerwalt, and N. Fatherly. 2007. "Lines of Evidence Support New Investigation of Lake Target Outside of TOAR FUDS." UXO Countermine and Range Forum 2007, Orlando, FL. 30 August 2007.

Steigerwalt, R.S., J.A. Williams, and C.L. Evans. 2006. "Digital Geophysical Mapping Program at the Spring Valley FUDS, Washington, D.C." SERDP/ESTCP Partners in Environmental Technology Technical Symposium, Washington, DC.

Steigerwalt, R.S. 2005. "Prioritization Routine for Digital and Visual Magnetic Anomaly Evaluation." EEGS *FastTimes*.

Pasapane, B.P., J. Brzezenski, R.S. Steigerwalt, and D. Pohl. 2003. "Real-Time and 3D Delineation of Possible OE-Related Buried Materials." Mid-Atlantic SAME Conference 2003 Proceedings.

Publications and Presentations (Continued)

Steigerwalt, R.S. and D.N. Steer. 2002. “New Evidence for Shallow Lateral Movement Within the Grenville Province: Implications for Basin Development.” *GSA Bulletin.*

Steigerwalt, R.S. and D.N. Steer. 2002. “New Constraints on Transport Direction During the Grenville Orogeny: Evidence for a Basement Lateral Ramp in the Eastern Mid-Continent, North-Central Section and South-Central Section.” GSA joint meeting.

Steigerwalt, R.S. and D.N. Steer. 2001. “Constraints on Transport Direction Along a Shallow Detachment in the Upper Precambrian of the Eastern Midcontinent.” *EOS*, Trans., AGU 82(47): F1236, Fall Meeting Supplement.

JOHN A. WILLIAMS, JR., P.G.

Qualifications Summary

- More than 34 years of professional experience.
- More than 24 years of experience in geological and geophysical investigations, including subsurface profiling with GPR, electrical resistivity (ER) and EM conductivity, TDEM, magnetics, VLF, SP, shallow seismic refraction, magnetotelluric, and GPS techniques for numerous private industry, municipal, and state and federal facilities.
- Over 23 years of experience in analysis, interpretation, integration, and reporting of geological and geophysical data; and 6 years of experience in bathymetric, hydrographic, and aquatic biological studies.

Registration

Registered Professional Geologist in the State of Tennessee (#1127; 1987)

Certified Ground Penetrating Radar (GPR) Operator, Geophysical Surveys Systems, Inc. (GSSI) (1987)

OASIS UX-Detect Data Processing, Geosoft, Inc. (2001)

Fields of Competence

Geological and geophysical investigations; geological and groundwater sampling techniques, and instrumentation technology; design, operation, and evaluation of geophysical survey equipment; testing and analysis of aquifers and groundwater pollution; and remedial investigations/feasibility studies (RI/FSs).

Experienced in several computer software programs for processing geophysical data, including GSSI-RADAN3, EM-DAT31/34/61, MagMap, Geosoft (OASIS/UX-Detect), and Trimble Pathfinder.

Education

B.S., Earth Science (Geology)—West Chester University (1983)

A.S., Marine Technology—Cape Fear Technical Institute (1975)

Graduate Studies, Geophysics—West Chester University (1988-1989)

Credentials

40-Hour Hazardous Waste Site Training Course, OSHA 29 CFR 1910.120(e)(3), WESTON (1985)

8-Hour Hazardous Waste Refresher Course, OSHA 29 CFR 1910.120(e)(8), WESTON (2009)

10-Hour Construction Safety Training, OSHA 29 CFR 1926, WESTON (2004)

Bloodborne Pathogens Training, OSHA 29 CFR 1910.1030, WESTON (2007)

First Aid/CPR Training (2009)

Project Management Training, WESTON (1993)

Short Course in Theory and Field Application of Magnetotellurics Methods in Hydrogeological Investigations, University of Berkley Field Campus (1996)

Credentials (Continued)

Theory and Practice of Applying Subsurface Interface Radar Technology in Engineering and Geological Investigations, GSSI Facility (1987)
Short Course, OASIS montaj UX-Detect Software for UXO Data Analyses, Geosoft, Inc., UXO Countermine Conference (2001)
Environmental and Engineering Geophysical Society

Employment History

1982-Present	WESTON
1980-1982	Environmental Resources Management, Inc.
1977-1980	WESTON
1976-1977	Highway Service Marineland
1975-1976	Lawler, Matusky, Skelly Engineers

Key Projects

Resource Conservation and Recovery Act (RCRA) Investigation at the Inactive McGregor Range Open Detonation Site – Fort Bliss, Otero County, NM, Project Geophysicist. Conducted Electromagnetic (EM-31)/Global Positioning System (GPS) surveys to investigate materials potentially buried at a Solid Waste Management Unit (SWMU) former trench area. Using field interpretation of the geophysical data and complimentary historical information, confirmation test trenches were conducted to manually investigate and physically characterize subsurface materials associated with elevated geophysical responses. While it was evident that the EM-31 digital geophysical mapping was capable of mapping the subtle differences in natural soil properties, there are no well-defined anomalies providing clear evidence of the suspected trench. $37K.

PM-MEC Investigation of the Dona Ana Range Digital Multi-Purpose Training Facility Project, Fort Bliss, Otero County, NM, Project Geophysicist. Managed geophysical investigations to locate ordnance and explosives (OE) including unexploded ordnance (UXO) in a 93-mile network of roads in support of investigation/clearance for acceptance by the Corp Fort Worth District. Utilized multi-sensor towed array to acquire high density data and expedite field activities on roads. Conducted geophysical prove-out (GPO), geophysical survey, data analyses management and tracking for investigation of identified anomalies, and removal/disposal of OE/UXO. $284K.

Tobyhanna Artillery Ranges Engineering Evaluation/Cost Analysis (EE/CA), Pennsylvania Department of Environmental Protection (PADEP)/U.S. Army Corps of Engineers (USACE) Baltimore District (CENAB), Site Geophysicist. Provided on-site project tracking and mapping support to aid in the management of geotechnical data. Coordinated quality control (QC) checks and discussed daily operations with the project site manager and USACE OE Safety Specialist. Provided daily QC and activity reports and bi-weekly technical summaries with updated maps of data collected through GPS. EE/CA involved the evaluation of approximately

Key Projects (Continued)

27,000 acres of State Park and Game Lands. Transitioned from EE/CA to the Military Munitions Response Program (MMRP) Remedial Investigation/Feasibility Study (RI/FS).

Geophysical Investigation, Laughlin Air Force Base (AFB), TX, Air Education and Training Command (AETC), Geophysicist. Led preparation of work plan and design of geophysical investigation at U.S. Air Force Marina, Release Site, Lake Amistad National Recreation Area, Del Rio, TX. Supervised very low frequency (VLF) profiling and earth resistivity electrical imaging methods to map structure (conductive/resistive zones) in the shallow bedrock. The objective of this survey was to provide information necessary to locate and map structural trends in the shallow bedrock, specifically major vertical fractures and voids. It is suspected that these features in proximity to a hydrocarbon release point may have acted as possible conduits for migration of hydrocarbons. The results and information yielded from the geophysical investigation provided focus and guidance for follow-up intrusive activities (i.e., optimizing locations for exploratory excavations to confirm the movement and extent of contamination).

Pilot Study, Area A, Barry M. Goldwater Range (BMGR), Luke AFB, AZ, AETC, Geophysicist. Led geophysical investigations to locate OE (especially UXO) in a 60-mile network of roads within Area A in support of investigation/eventual clearance of OE and cleanup of munitions constituents (MC) for formal acceptance of Area A by the Bureau of Land Management (BLM). Utilized multi-sensor towed array to acquire high density data and expedite field activities on roads and trails. Field activities included GPO, geophysical survey, investigation of identified anomalies, and removal/disposal of OE/UXO. WESTON also had the challenge of meeting AETC/BLM's aggressive performance standard for clearance of munitions and explosives of concern (MEC) within former Area A and coordinating with state, local, and other federal stakeholders in order to complete the field work in a National Monument. In addition, there were several logistical issues related to working in the remote area of the Sonoran Desert under extremely hot weather conditions. These projects were located in a remote section of the Sonoran Desert National Monument area. WESTON coordinated with the Air Force, BLM, U.S. Fish and Wildlife Service, and Arizona Game and Fish Department in order to accommodate sensitive habitat of protected flora and fauna including saguaro cactus and pygmy owl. Provided Basis for Conveyance Strategy Plan to develop operations and maintenance (O&M) costs, and enabled the site's lessee to accelerate remedial activities and optimize formal acceptance of the area.

Remedial Investigation (RI), Former Carswell AFB, TX, Air Force Center for Engineering and the Environment (AFCEE) 4P Architect-Engineering (A-E) Contract, Geophysicist. Directed geophysical investigations that were part of this RI to remove identified UXO and related materials, based on site-specific conditions. Project resulted in the site receiving a U.S. Department of Defense Explosive Safety Board (DDESB) Residential Land Certification.

UXO Site Investigation (SI), Thule AB, Greenland, AFCEE Environmental Remedial Action Contract (ENRAC), Geophysicist. Assisted in preparation of work scope. Provided technical oversight in the preliminary UXO site investigations, including digital geophysical

Key Projects (Continued)

mapping. Work consisted of visual sweeps of off-base areas where UXO had previously been found, delineation of other UXO source areas, and mapping of located UXO in other areas of environmental concern with electromagnetic instrumentation. Work was performed at remote locations in rigorous terrain. The work schedule was expedited taking into consideration a 3- to 5-month window surrounding seasonal weather conditions.

Geophysical Investigations, Seneca Army Depot, NY, U.S. Army Corps of Engineers (USACE), New England District, Rapid Response, Lead Geoscientist. Worked closely with CENAB and CEHNC geophysicists on developing Type II Work Plan relative to CEHNC Data Item Descriptions (DID). Responsible for quality assurance (QA) of geophysical subcontractor data acquisition and reporting relative to all aspects of CEHNC DID requirements.

Geophysical Investigations, Fort Dix, NJ, USACE, Baltimore District (CENAB), Hazardous, Toxic, Radioactive Waste (HTRW) 2000 Contract, Lead Geoscientist. Participated in TTP session to design geophysical investigations using time-domain electromagnetic (TDEM), and magnetometry (MAG) techniques at Fort Dix to identify potential buried ordnance and ordnance related items. Worked closely with CENAB and CEHNC geophysicists on developing Type I Work Plan and project geophysical QC requirements relative to CEHNC DIDs.

Geophysical Investigations at Various Sites, Spring Valley, DC, USACE, Baltimore District, HTRW 2000 and HTRW 2005 Contracts, Lead Geoscientist. Conducted and provided technical oversight for digital geophysical mapping of 56 property parcels under this high profile project for USACE, Baltimore District, over a 4-year period from 2002 through 2006. Required close coordination with USACE based on limited time-frames for rights-of-entry (ROE). The project required state-of-the-art geophysical techniques for mapping anomalies looking for evidence of MEC and chemical warfare material (CWM). Electromagnetic (EM-61, MK 2) and magnetometry (G-858 and G-856) surveying methods were used to investigate the parcels. Stringent data collection and QC requirements, as described in the USACE-approved work plan, are required. Data and reports are thoroughly reviewed by the USACE Baltimore and Huntsville clients, in addition to the U.S. Environmental Protection Agency (EPA), DC Public Health, and the property owners. Aggressive schedules are required by USACE to expedite removal actions at these high-profile residential and American University properties. Expert support and presentation of data at Anomaly Review Board meetings is required for consensus approval from regulators and Army clients. WESTON has effectively identified numerous high priority anomalies on this project. WESTON has provided high quality digital geophysical mapping with a dedicated team of professionals. Integration of a target prioritization protocol through data modeling and analysis has minimized unnecessary anomaly reacquisition, and allowed WESTON to streamline the collection and data processing on this project, giving the client a cost-effective option for identifying anomalies. WESTON has also utilized the TeamLink^{SM} website for the transfer of files and collaborative workspace with the clients. Since initiating the Spring Valley, MD, formerly used defense site (FUDS) support in 2002, WESTON has used DrChecks, a specific application of the USACE PROJect extraNet (ProjNet) web service. This web service allows the secure exchange of design and construction information

Key Projects (Continued)

among authorized business partners in the context of specific business processes, and has been used extensively on this project to reduce meeting time and cost, eliminate collating of comments submitted in a variety of formats, promote participation by facility managers and owners, and speed reviews. On the Spring Valley project, it has been clearly demonstrated that the use of the program has saved USACE and the project shareholders time and effort, and has resulted in a higher quality product. WESTON has used DrChecks in the review of over 50 documents, resulting in an estimated savings of over $25,000. Work performed at Spring Valley has been performed consistent with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 104, and in substantial compliance with National Contingency Plan (NCP) Sections 300.120(c) and 300.295(e), and applicable provisions of 29 Code of Federal Regulations (CFR) 1910.120.

"New Techniques for Precisely Locating Buried Infrastructure" Project, Various Locations, American Water Works Association Research Foundation (AwwaRF), Lead Scientist. The project required the use of electromagnetic (EM) and sonic and acoustic (S&A) instruments and ground penetrating radar (GPR). Responsibilities included coordination of field evaluation, workshop presentations, data analyses, interpretation, and reporting.

Geophysical Investigation, Shenandoah Road Groundwater Contamination Site, East Fishkill, NY, U.S. Environmental Protection Agency (EPA), Region 2 Superfund Technical Assessment and Response Team (START), Lead Geoscientist. Conducted geophysical surveys to better characterize general structure (conductive/resistive zones) in the shallow bedrock along the Shenandoah Ridge using very low frequency (VLF) profiling and electrical imaging using earth resistivity (ER) methods. The objectives were to provide structural information about the bedrock and overburden on the northern portion of the ridge, and better locate and delineate fault and joint surfaces, which facilitate the transport toward the main valley. (These fracture zones represent high-yield zones that the drillers were likely seeking when they were installing the residential wells.) The information obtained from this investigation was used to: (1) further develop the site conceptual model; (2) provide focus for the RI activities and optimize the placement of proposed monitoring wells; (3) better understand the migration pathways of tetrachloroethylene (PCE) to the various locations where it was detected; and (4) provide structural information to better determine if the easternmost fault acts a hydraulic barrier, keeping contaminated water from migrating beyond the Precambrian block.

Geophysical Investigation at Lajes Airfield, Azores, Portugal, U.S. Air Force (USAF), Lead Geoscientist. Designed and implemented magnetotelluric (MT) surveys to image hydrogeologic characteristics adjacent to the airfield's water supply wells. All of the supply wells drew their water from a deep basal aquifer system under the island. Over-pumping and saltwater intrusion were identified as potential contributors to elevated drinking water quality standards. The objectives of the MT surveys were to image the suspended and basal aquifers in regard to variations in the thickness and location of the freshwater/saltwater (transitional) zones. Additional structures, such as fractures and faults, were identified. Responsible for analyses, interpretation, and reporting of data. Results were used to map well field stratigraphy, identify seawater intrusion zones, and freshwater recharge zones to locate future production wells.

Key Projects (Continued)

Geophysical Investigations at Various Sites, USACE, Baltimore District, HTRW Contract, Geophysicist. Conducted geophysical investigations using GPR, EM, and MAG techniques at five facilities. At Aberdeen Proving Ground (APG), MD, conducted GPR and EM investigations to identify buried ordnance waste pits, buried process lines, and buried septic systems at several sites. At Morgantown Energy Technology Center (METC) in Morgantown, WV, conducted GPR and EM investigations to identify a potential buried chemical waste pit, and a buried process line at two sites. At Lower Saddle River, NJ, conducted GPR, EM, and MAG investigations to characterize a buried waste area for a flood control project.

Geophysical Investigation for UXO, APG, Edgewood Area, MD, N-Field Site, Geophysicist. The objective of the investigation was to locate and map MAG and EM anomalies (indicative of potential ordnance and/or related anomalies) at depths of approximately 2 to 8 feet below ground surface (bgs). WESTON conducted both electromagnetic (EM-61) and magnetic (G-858) surveys. Surveys were conducted using a dense sampling interval to obtain the high resolution necessary to detect significant anomalies. A total of 109 anomalies requiring further analysis and visualization were selected from these plots. Data were used to construct the geophysical anomaly summary tables. Potential “discrete” ordnance locations were derived in state planar coordinates for the 109 selected anomalies. Reacquisition activities were conducted in March 2000. Results were used to identify and remove significant munitions-related items that could potentially impact site construction activities proposed at the site.

Subsurface Imaging, Washington Navy Yard, Washington, DC, Geophysicist. Used GPR and EM to locate underground storage tanks (USTs), associated piping, and other potential utilities/assets. A geographic information system (GIS) database was developed, which included asset codes, characteristics, and ID confidence ratings for mapping the features. Assets were color-coded and plotted on GIS site facility maps.

Geophysical Investigation, Fullco Wood Treatment Facility, Alabama, EPA Region 4, Emergency Response Team (ERT), Project Coordinator/Field Team Leader. Coordinated and supervised field crews conducting seismic refraction, EM terrain conductivity (EM-31 and EM-34), VLF, and spontaneous potential (SP) to determine bedrock configuration and the presence of weathered or fractured zones in the shallow subsurface. Additional responsibilities included data analysis and interpretation, and report preparation.

Geophysical Investigation, Riverbank Army Ammunition Plant (RBAAP), Riverbank, CA, USACE, HTRW Contract, Lead Project Scientist. Conducted a preliminary geophysical investigation using GPR and MAG to characterize the disposition of waste materials as part of a site assessment. Data from the study located the boundaries of a former landfill.

Base Realignment and Closure (BRAC) Soils Investigation, 15 Military Facilities in the States of Connecticut, New York, and New Jersey, and Commonwealths of Massachusetts and Virginia, Argonne National Laboratory (ANL), USACE, Under Contract to U.S. Army Toxic and Hazardous Materials Agency (USATHAMA), Field Team Leader. Coordinated and supervised a three-person field crew conducting soil boring, surface soil, and sediment sampling for geological, hydrogeological, and contaminant characterizations at 15 sites,

Key Projects (Continued)

including housing and commissary areas and Nike sites. Responsible for data management, interpretation, and report preparation.

Enhanced Preliminary Assessment (PA), Massachusetts, Fort Devens, USACE, Under Contract to USATHAMA, Project Geologist. Performed property characterizations to identify and characterize "areas requiring further environmental evaluation" associated with historical and current uses, with emphasis on physiography, geology, hydrogeology, and sensitive environments, and the effects related to human and environmental receptors. In addition, served as project geologist for enhanced PAs conducted at Fort McClellan, AL, and the Kansas Army Ammunition Plant, KS.

Groundwater Assessment, Newark, OH, Owens Corning Landfill, Project Geologist/Field Team Leader. Conducted field investigations for hydrogeological SIs pertaining to a permit-to-install application. Provided interpretation of geological conditions and hydrogeological regime in the underlying aquifer.

Geophysical Investigation, Virginia, Fort Myer, USACE, Baltimore District, Lead Project Scientist. Conducted a preliminary geophysical investigation using GPR to characterize the disposition of waste materials as part of a site assessment pertaining to a proposed construction project. Data from the GPR study located a lobe of the former sanitary landfill under the proposed construction area.

SI and RI/FS, Naval Weapons Station (NWS) Earle, Colts Neck, NJ, Northern Division (NORTHDIV), Naval Facilities Engineering Command (NAVFAC), Lead Project Geologist. Coordinated and supervised a field crew conducting soil borings, monitor well installations, Hydropunch sampling, and groundwater, surface water, and sediment sampling for geological, hydrogeological, and contaminant characterizations at 25 waste disposal sites. Conducted and supervised aquifer slug testing. Member of project Technical Review Committee (TRC) responsible for reporting to NORTHDIV, EPA Region 2, and the New Jersey Department of Environmental Protection (NJDEP). Additional responsibilities included data management, data interpretation, and preparation of work plans and reports.

RI/FS, NWS Yorktown, Yorktown, VA, Atlantic Division (LANTDIV), NAVFAC, Lead Project Geologist. Conducted preliminary geophysical investigations, including the use of GPR and EM to characterize the disposition of waste materials at eight sites. Coordinated follow-up activities and supervised a field crew conducting soil borings, monitor well installations, Hydropunch sampling, aquifer slug testing, tidal and groundwater monitoring, and groundwater, surface water, and sediment sampling for geological, hydrogeological, and contaminant characterizations at 16 waste disposal sites. Conducted and supervised aquifer slug testing. Member of project TRC responsible for reporting to NORTHDIV, EPA Region 2, and NJDEP. Additional responsibilities included data management, data interpretation, and preparation of work plans and reports.

Publications and Presentations

Williams, J., M. Saunders, and C. Evans. 2007. "Feasibility of Modeling EM Data To Enhance Anomaly Evaluation and Target Selection." UXO Countermine Range Forum 2007, 30 August 2007.

Steigerwalt, R.S., J.A. Williams, and C.L. Evans. 2006. "Digital Geophysical Mapping Program at the Spring Valley FUDS, Washington, DC." SERDP/ESTCP Partners in Environmental Technology Technical Symposium, Washington, DC, December 2006.

Williams, Jr., J.A., et al. 2001. "New Techniques for Precisely Locating Buried Infrastructure." American Water Works Research Foundation, September 2001.

Qualifications Summary

- More than 10 years of professional experience as an EOD/UXO Specialist and Supervisor.
- Supervision of personnel conducting UXO/EOD removal and disposal operations.
- Recovery of UXO and firing range residue, including detection, excavation, transport, storage, and disposition.
- Responsible for QC and safety of UXO operations; compliance with site safety and health plans; and conducting daily site safety briefings.

DAVID CARLIN

Registration

Delaware Blasters License (2009)

Fields of Competence

Hazardous explosive devices; explosive ordnance disposal tools; explosive safety and handling; demolition procedures; hazardous waste handling; remote robotics operation; U.S. and foreign ordnance identification.

Education

Graduate of Naval EOD School, Indian Head, MD (1991)

Credentials

Emergency Medical Technician Course, Mountain Home AFB, Idaho (1994)
Hazardous Waste Generator Training Course, Mountain Home AFB, Idaho (1993)
Remote Robotics School, Oak Ridge, TN (1992)

Employment History

2004-Present	WESTON
1999-2004	Self-Employed
1998-1999	Cutlery Shoppe
1998	Western Aircraft
1995-1997	Intermountain Outdoor Sports
1990-1995	U.S. Air Force, Active Duty

Key Projects

Non-Time-Critical-Removal Action (NTCRA), Surf City, NJ, U.S. Army Corps of Engineers (USACE), Philadelphia/ Baltimore Districts, Quality Control (QC) Specialist. Supported Project Manager (PM)/field staff in planning/ enforcing USACE QC methods. Developed QC plans, and reviewed and supervised work to ensure compliance. Trained staff and ensured compliance with the munitions and explosives of concern (MEC)-specific sections of the Quality Control Plan (QCP). Provided leadership and direction of MEC clearance and recovery teams. Ensured compliance with equipment checkouts and maintenance issues.

Key Projects (Continued)

Ordnance Removal Action, Tobyhanna Army Depot, USACE, Baltimore District Oversight, QC Specialist/Site Safety Officer. Supports PM/field staff in planning/enforcing USACE QC methods. Develops QC plans, and reviews and oversees work to ensure compliance. Trains staff and ensures compliance with the MEC-specific sections of the QCP and site-specific Health and Safety Plan (HASP). Conducts daily safety briefings, and is responsible for overall site safety. Conducts checks on explosives magazines, all equipment, and vehicles. Has direct oversight on all explosives operations.

Ordnance Removal Action, Pennsylvania Department of Environmental Protection (PADEP), Tobyhanna State Park, USACE, Baltimore District, QC Specialist/Site Safety Officer. Supports PM/field staff in planning/enforcing USACE QC methods. Develops QCPs, and reviews and oversees work to ensure compliance. Trains staff and ensures compliance with the MEC-specific sections of the QCP and the site-specific HASP. Conducts daily safety briefings, and is responsible for overall site safety. Conducts daily checks on explosives magazines, all equipment, and vehicles. Has direct oversight on all explosives operations.

Ordnance Removal Action, Ft. Miles Military Reservation, USACE, Baltimore District, Unexploded Ordnance (UXO) Supervisor. Supervises personnel conducting MEC detection, investigation, excavation, and removal. Conducts surface and subsurface detection, investigations, excavation, and removal. Performs demilitarization operations on discarded military munitions (DMM).

Time-Critical-Removal Action (TCRA), Tobyhanna State Park, USACE, Baltimore District, UXO Supervisor. Supervised MEC detection, investigation, excavation, transportation, and storage operations. Conducted explosive demilitarization of UXO.

Ordnance Removal Action, Former Nansemond Ordnance Depot (FNOD), Norfolk, VA, USACE, Baltimore District, UXO Supervisor. Supervised MEC detection, investigation, excavation, transportation, and storage operations.

366th Composite Wing, Mountain Home Air Force Base (AFB), ID, Explosive Ordnance Disposal (EOD) Specialist/Supervisor. Provided support to Mountain Home AFB. Support included bombing range maintenance, EOD emergency response, and training of federal, state, and local law enforcement agencies. Accountable for four equipment cells totaling in excess of $9 million. Responsible for unit’s extensive non-combat explosive allowance account. Supported combat efforts of Operation Desert Storm, Saudi Arabia.

JOHN L. DAY

Qualifications Summary

- More than 19 years of professional experience.
- More than 8 years of professional experience as EOD/UXO Specialist.
- Recovery of UXO and firing range residue, including detection, excavation, transport, storage, and disposition.
- Responsible for QC and safety of UXO operations; compliance with site safety and health plans; and site safety briefings.
- Responsible for sampling, packaging, and shipping of possibly contaminated soils.
- Compliance with federal, state, and local regulations.

Registration

UXO Certification, USACE Huntsville Center (No. 1229)

Fields of Competence

All tasks for any level unexploded ordnance (UXO) technician, including: reconnaissance, identification, and classification of UXO; handling, certification, and disposition of scrap material; excavation and recovery of subsurface UXO; transportation and storage of commercial explosives and UXO, ensuring compliance with federal, state, and local laws; disposal of UXO by detonation or burning operations; UXO quality oversight and inspections; soil sampling, packaging, and shipping. Safety Officer and Quality Control (QC) Officer.

Education

Undergraduate Studies, Information Systems—University of Phoenix (2003-2004)

Credentials

Explosive Ordnance Disposal School, Indian Head, MD, U.S. Navy (1998)
40-Hour Hazardous Waste Site Training Course, OSHA 29 CFR 1910.120(e)(3), Green Tree (1999)
8-Hour Hazardous Waste Refresher Course, OSHA 29 CFR 1910.120(e)(8), WESTON (2007)
30-Hour Construction Safety and Health Training Course, OSHA 29 CFR 1926 Subparts C, E, M, P, and X, WESTON (2007)
8-Hour Managers and Supervisors Course (SHSC), OSHA 29 CFR 1910.120(e)(4), WESTON (2008)
First Aid/CPR Training, American Red Cross (2007)

Employment History

2004-Present WESTON
2002-Present Various MEC Removal Companies
1989-2001 U.S. Army

Key Projects

Ordnance Removal Action, Former Nansemond Ordnance Depot, Suffolk, VA, U.S. Army Corps of Engineers (USACE) Baltimore District, USACE New England District (CENAE) Remedial Action Contract (RAC) 9, Unexploded Ordnance (UXO) Technician 3/UXO Quality Control (QC)/Safety Officer. Supervised munitions and explosives of concern (MEC) clearance, and recovery of surface and subsurface MEC items. Performed daily safety briefings, and ensured compliance with USACE standards for MEC removal operations.

Ordnance Removal Action, Tobyhanna State Park, PA, USACE Baltimore District, UXO Technician 3/UXO QC/Safety Officer. Supervised MEC clearance, and recovery of surface and subsurface MEC items. Performed daily safety briefings, and ensured compliance with USACE standards for MEC removal operations.

Hurricane Katrina Recovery Action Team Leader, New Orleans, LA, U.S. Environmental Protection Agency (EPA) Region 6, Superfund Technical Assessment and Response Team (START-2), UXO Technician 3. Supervised firearms, ammunition, and explosives recovery team. Recorded abandoned firearms, ammunition, and explosives.

Ordnance Removal Action, Fort McClellan, AL, Joint Powers Authority, UXO Technician 2. Conducted MEC clearance, and recovery of surface and subsurface MEC items.

Ordnance Removal Action, Former Fort Devens, MA, Mass Development, UXO Technician 2. Conducted MEC clearance, and recovery of surface and subsurface MEC items.

Ordnance Removal Action, Tonopah Test Range, NV, U.S. Department of Energy (DOE), UXO Technician 2. Conducted MEC clearance, and recovery of surface and subsurface MEC items.

Ordnance Removal Action, Former Fort Ritchie, MD, USACE Baltimore District, UXO Technician 2. Conducted MEC clearance, and recovery of surface and subsurface MEC items.

Ordnance Removal Action, Seneca Army Depot, NY, USACE, New York District, UXO Technician 2. Conducted MEC clearance, and recovery of surface and subsurface MEC items. Certified demilitarized munitions debris.

Ordnance Removal Action, Luke AFB, Phoenix, AZ, Barry G. Goldwater Bombing Range Site, U.S. Air Force, UXO Technician 2. Assisted geophysical teams in mapping and reacquiring surface and subsurface anomalies using the EM-61 and Trimble RTK global positioning system (GPS).

Engineering Evaluation/Cost Analysis (EE/CA), Tobyhanna Army Depot, PA, USACE, UXO Technician 2. Conducted detection, investigations, and excavations of possible MEC items. Aided in the transportation and storage of explosives. Conducted explosive demilitarization of UXO. Assisted the geophysical teams in mapping and reacquiring anomalies in chosen areas using the G-858 and the USRADS positioning system.

Ordnance Avoidance Action, Fort Hood, TX, USACE, UXO Technician 2. Conducted MEC clearance, and recovery of surface and subsurface MEC items.

Ordnance Removal Action, Fort Campbell, KY, USACE, Huntsville District, UXO Specialist. Conducted surface and subsurface detection, investigation, excavation, transport, and

Key Projects (Continued)

disposal operations of ordnance items found. Provided ordnance avoidance for non-UXO personnel.

Ordnance Removal Action, Atlantic City, NJ, USACE New Jersey, UXO Technician 2. Conducted MEC clearance, and recovery of surface and subsurface MEC items.

M. BRIAN JUNCK

Qualifications Summary

- More than 8 years of related experience in geophysical surveying.
- Primary experience in electromagnetic, magnetic, GPR, and electrical imaging/resistivity fields.
- Served as lead geophysicist on numerous projects.
- Performed magnetics and electromagnetics to search for potential UXO.
- Experienced with several navigation systems (RTK, RTS, USRADS) for location and survey control.
- Performed seismic reflection and refraction surveys to locate bedrock and overburden stratigraphy.
- Skilled in many computer software programs and applications: OASIS Montaj, ArcView, AutoCAD, Adobe graphic design applications, and numerous other geophysical data processing programs.

Fields of Competence

Geophysics; data processing; environmental geophysics including electromagnetics, magnetics, seismic refraction, and REMI; micro-gravity; resistivity; ground penetrating radar (GPR).

Education

M.Sc., Fluvial Geomorphology/Geophysics—University of Calgary (2009)
B.Sc., Cartography—University of Wisconsin – Eau Claire (2000)

Credentials

40-Hour Hazardous Waste Site Training Course, OSHA 29 CFR 1910.120(e)(3), Compliance Solutions (2003)
8-Hour Hazardous Waste Refresher Course, OSHA 29 CFR 1910.120(e)(8), WESTON (2009)
First Aid/CPR Training, Zee Medical (2007)
Bloodborne Pathogens Training, OSHA 29 CFR 1910.1030, Zee Medical (2009)
10-Hour Construction Safety Training, OSHA 29 CFR 1926, WESTON (2004)
30-Hour Construction Safety and Health Training Course, OSHA 29 CFR 1926, WESTON (2007)

Employment History

2006-Present	WESTON
2005-2006	Enviroscan, Inc.
2003-2005	WESTON
2000-2002	University of Calgary (Research Assistant)
1997-2000	University of Eau Claire (Research Assistant)

Key Projects

Geophysical Investigation, Spring Valley Formerly Used Defense Site (FUDS), Washington, DC, U.S. Army Corps of Engineers (USACE), Project Geophysicist. Performed electromagnetic (EM-61 MK2) and magnetic (G-858) geophysical surveys to map subsurface conditions at multiple properties indicative of suspected ordnance and

Key Projects (Continued)

explosives/chemical warfare material (OE/CWM). Responsible for all processing and quality control (QC) of daily data, as well as generation of site-specific final reports.

Munitions Response Action at Fort Miles Military Reservation FUDS, Lewes, DE, USACE, Baltimore District, Project Geophysicist. Responsible for all processing and QC of daily data collected by field teams. Processed data and selected targets potentially representing munitions and explosives of concern (MEC) for reacquisition by unexploded ordnance (UXO) technicians over approximately 70 acres of beach. Managed all aspects of daily geophysical activities and planning.

Time-Critical-Removal Action (TCRA), Full-Scale Digital Geophysical Mapping for MEC, Surf City and Ship Bottom, Ocean County, NJ, USACE, Project Geophysicist. Responsible for all processing and QC of daily data collected by field teams. Processed data and selected targets potentially representing MEC for reacquisition by UXO technicians over 1.5 miles of beach. Managed all aspects of daily geophysical activities and planning.

Full-Scale Digital Geophysical Mapping for MEC, Nevada Test Site (NTS), Nye County, NV, Stoller-Navarro, Site Geophysicist. Responsible for all processing and QC of daily data collected by field teams. Processed data and selected targets potentially representing MEC for reacquisition by UXO technicians over an approximately 60-acre site. Managed all aspects of daily geophysical activities and planning.

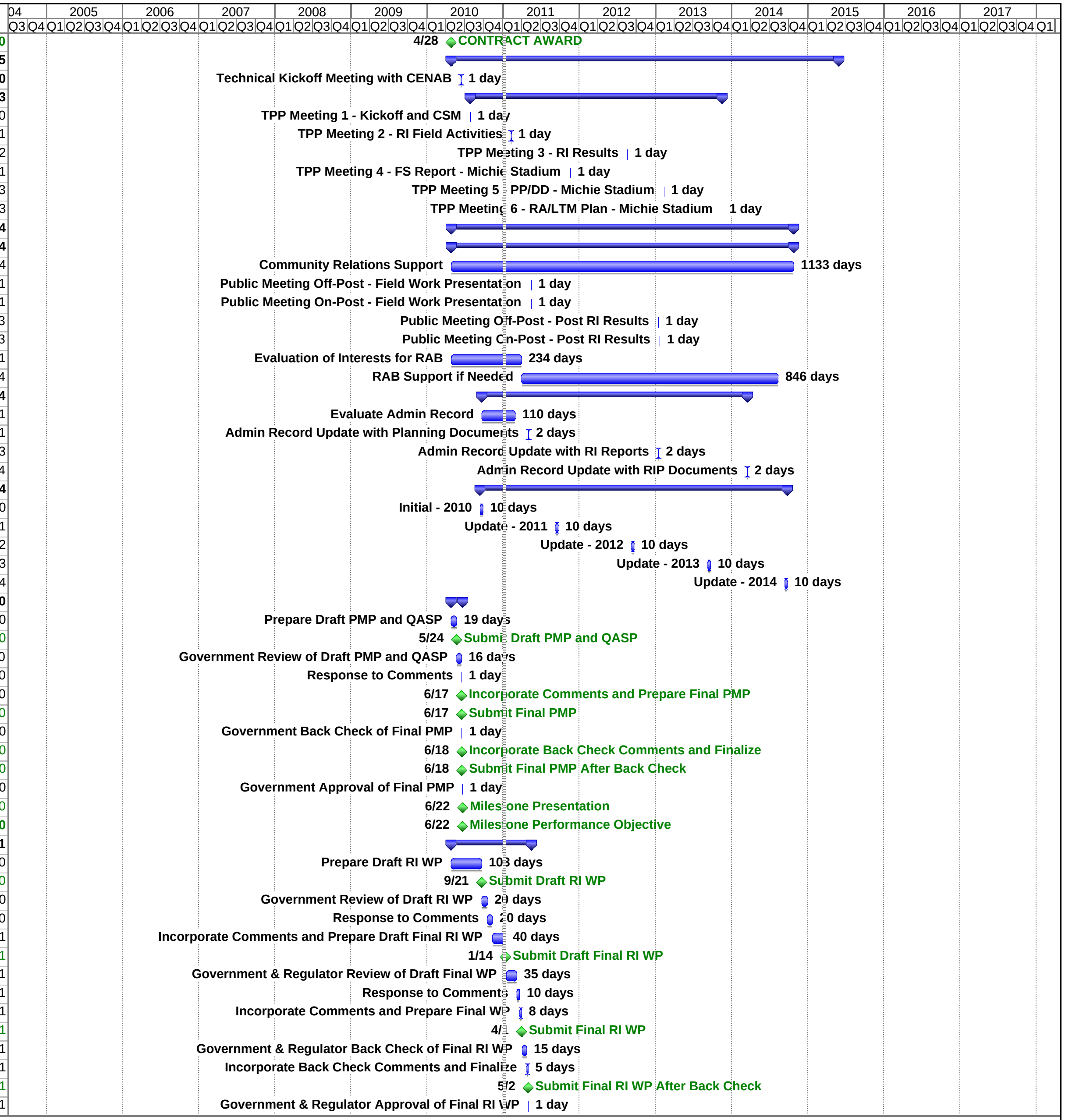
Full-Scale Digital Geophysical Mapping for MEC, Former Tobyhanna Artillery Range (TOAR), Tobyhanna, PA, USACE, Geophysicist. Responsible for data collection and target reacquisition throughout Tobyhanna State Park and adjacent State Game Lands.

QC Geophysical Surveys, Seneca Army Depot, Romulus, NY, USACE, Geophysicist. The objective was to ensure high quality data and accurate target picks for the reacquisition of potential UXO. QC was performed on geophysical data (EM-61 MK2) collected by the site subcontractor. Examined data and checked to ensure all USACE standards were met for the project.

OE Materials Rapid Response, Quonset Point Former Naval Yard, Quonset, RI, Geophysicist. Performed an electromagnetic (EM-31) geophysical survey to map the subsurface of the Former Quonset Point Naval Air Station. The survey was performed to provide confirmatory data associated with the removal of bulk OE materials present before excavation.

APPENDIX F – PROJECT SCHEDULE

ID	Task Name	Duration	Start	Finish
1	CONTRACT AWARD	0 days	Wed 4/28/10	Wed 4/28/10
2	**REMEDIAL INVESTIGATION**	**1279 days**	**Wed 4/28/10**	**Sun 5/31/15**
3	**Technical Kickoff Meeting with CENAB**	**1 day**	**Tue 6/15/10**	**Tue 6/15/10**
4	**TPP Meetings**	**834 days**	**Thu 7/29/10**	**Mon 11/18/13**
5	TPP Meeting 1 - Kickoff and CSM	1 day	Thu 7/29/10	Thu 7/29/10
6	TPP Meeting 2 - RI Field Activities	1 day	Thu 2/10/11	Thu 2/10/11
7	TPP Meeting 3 - RI Results	1 day	Mon 8/20/12	Mon 8/20/12
8	TPP Meeting 4 - FS Report - Michie Stadium	1 day	Mon 11/21/11	Mon 11/21/11
9	TPP Meeting 5 - PP/DD - Michie Stadium	1 day	Tue 2/12/13	Tue 2/12/13
10	TPP Meeting 6 - RA/LTM Plan - Michie Stadium	1 day	Mon 11/18/13	Mon 11/18/13
11	**Programmatic Support for EMS, GIS, IAP, & Cultural Resources**	**1133 days**	**Thu 4/29/10**	**Mon 10/27/14**
12	**Community Relations**	**1133 days**	**Thu 4/29/10**	**Mon 10/27/14**
13	Community Relations Support	1133 days	Thu 4/29/10	Mon 10/27/14
14	Public Meeting Off-Post - Field Work Presentation	1 day	Tue 5/17/11	Tue 5/17/11
15	Public Meeting On-Post - Field Work Presentation	1 day	Tue 5/17/11	Tue 5/17/11
16	Public Meeting Off-Post - Post RI Results	1 day	Wed 1/16/13	Wed 1/16/13
17	Public Meeting On-Post - Post RI Results	1 day	Wed 1/23/13	Wed 1/23/13
18	Evaluation of Interests for RAB	234 days	Thu 4/29/10	Thu 3/31/11
19	RAB Support if Needed	846 days	Fri 4/1/11	Wed 8/13/14
20	**Administration Record & Project Repository**	**874 days**	**Wed 9/22/10**	**Wed 3/19/14**
21	Evaluate Admin Record	110 days	Wed 9/22/10	Tue 3/1/11
22	Admin Record Update with Planning Documents	2 days	Wed 5/4/11	Thu 5/5/11
23	Admin Record Update with RI Reports	2 days	Wed 1/16/13	Thu 1/17/13
24	Admin Record Update with RIP Documents	2 days	Tue 3/18/14	Wed 3/19/14
25	**Annual MRSPP/Installation Munitions Response Map**	**1016 days**	**Tue 9/14/10**	**Fri 9/26/14**
26	Initial - 2010	10 days	Tue 9/14/10	Mon 9/27/10
27	Update - 2011	10 days	Mon 9/12/11	Fri 9/23/11
28	Update - 2012	10 days	Mon 9/10/12	Fri 9/21/12
29	Update - 2013	10 days	Tue 9/10/13	Mon 9/23/13
30	Update - 2014	10 days	Mon 9/15/14	Fri 9/26/14
31	**Project Management Plan and QASP**	**39 days**	**Wed 4/28/10**	**Tue 6/22/10**
32	Prepare Draft PMP and QASP	19 days	Wed 4/28/10	Mon 5/24/10
33	Submit Draft PMP and QASP	1 day	Mon 5/24/10	Mon 5/24/10
34	Government Review of Draft PMP and QASP	16 days	Tue 5/25/10	Wed 6/16/10
35	Response to Comments	1 day	Thu 6/17/10	Thu 6/17/10
36	Incorporate Comments and Prepare Final PMP	0 days	Thu 6/17/10	Thu 6/17/10
37	Submit Final PMP	1 day	Thu 6/17/10	Thu 6/17/10
38	Government Back Check of Final PMP	1 day	Fri 6/18/10	Fri 6/18/10
39	Incorporate Back Check Comments and Finalize	0 days	Fri 6/18/10	Fri 6/18/10
40	Submit Final PMP After Back Check	1 day	Fri 6/18/10	Fri 6/18/10
41	Government Approval of Final PMP	1 day	Mon 6/21/10	Mon 6/21/10
42	Milestone Presentation	1 day	Tue 6/22/10	Tue 6/22/10
43	**Milestone Performance Objective**	**0 days**	**Tue 6/22/10**	**Tue 6/22/10**
44	**Project RI Work Plan (FSP and QAPP)**	**268 days**	**Wed 4/28/10**	**Wed 5/18/11**
45	Prepare Draft RI WP	103 days	Wed 4/28/10	Tue 9/21/10
46	Submit Draft RI WP	1 day	Tue 9/21/10	Tue 9/21/10
47	Government Review of Draft RI WP	20 days	Wed 9/22/10	Mon 10/18/10
48	Response to Comments	20 days	Tue 10/19/10	Thu 11/11/10
49	Incorporate Comments and Prepare Draft Final RI WP	40 days	Fri 11/12/10	Fri 1/14/11
50	Submit Draft Final RI WP	1 day	Fri 1/14/11	Fri 1/14/11
51	Government & Regulator Review of Draft Final WP	35 days	Tue 1/18/11	Tue 3/8/11
52	Response to Comments	10 days	Wed 3/9/11	Tue 3/22/11
53	Incorporate Comments and Prepare Final WP	8 days	Wed 3/23/11	Fri 4/1/11
54	Submit Final RI WP	1 day	Fri 4/1/11	Fri 4/1/11
55	Government & Regulator Back Check of Final RI WP	15 days	Mon 4/4/11	Mon 4/25/11
56	Incorporate Back Check Comments and Finalize	5 days	Tue 4/26/11	Mon 5/2/11
57	Submit Final RI WP After Back Check	1 day	Mon 5/2/11	Mon 5/2/11
58	Government & Regulator Approval of Final RI WP	1 day	Tue 5/3/11	Tue 5/3/11



Calendar is in Business Days | Task | Critical Path | Milestone | Summary

WESTON SOLUTIONS

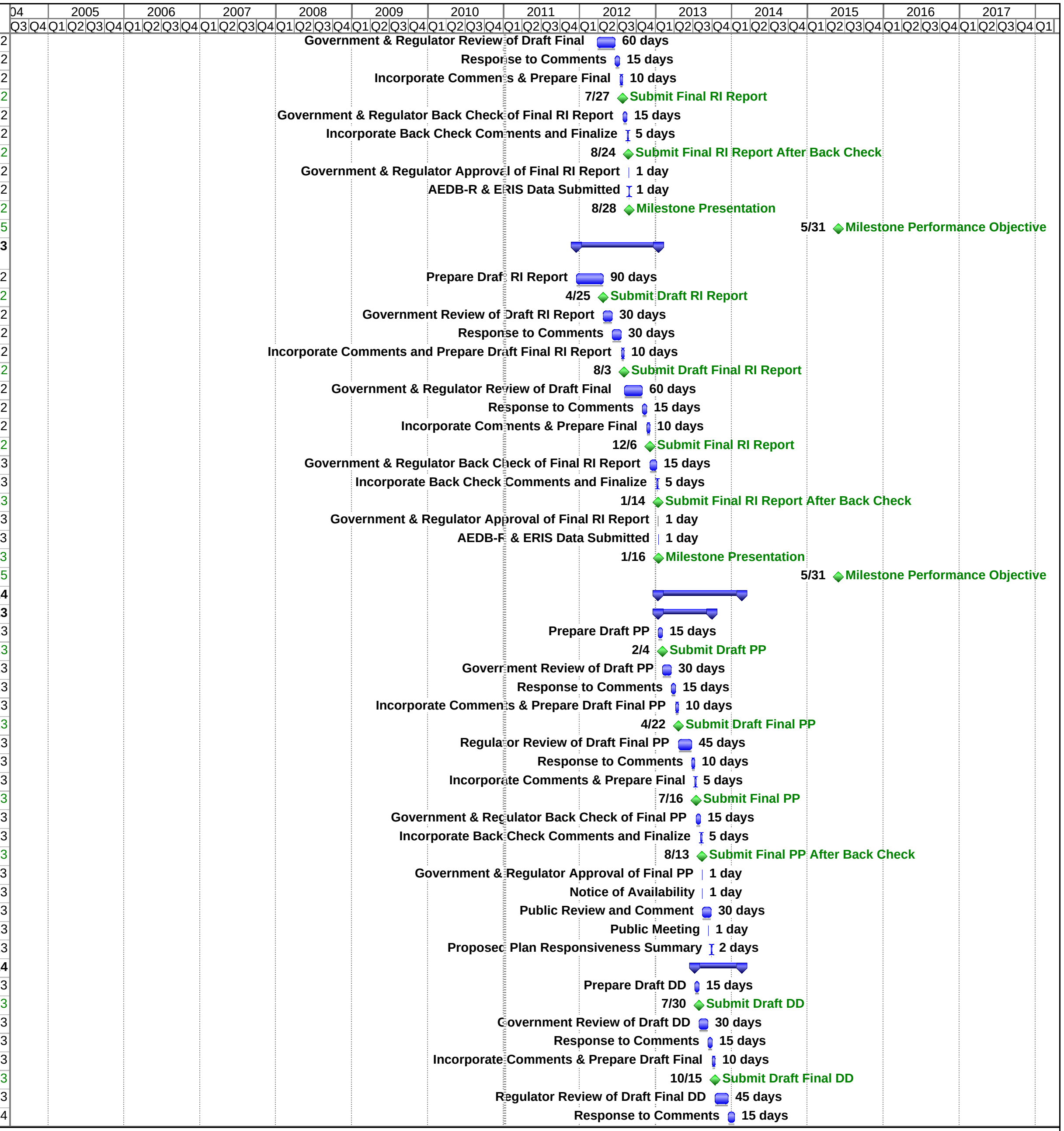
MMRP Remedial Investigations, Munitions Responses Services for U.S. Army Garrison - West Point, West Point, NY

ID	Task Name	Duration	Start	Finish
59	Milestone Presentation	1 day	Wed 5/4/11	Wed 5/4/11
60	Right of Entry Initiation for Battery Knox - TD Land	75 days	Tue 2/1/11	Wed 5/18/11
61	**MMRP Community Relations Plan**	**211 days**	**Wed 4/28/10**	**Fri 2/25/11**
62	Prepare Draft MMRP Community Relations Plan	45 days	Wed 4/28/10	Wed 6/30/10
63	Submit Draft MMRP Community Relations Plan	1 day	Wed 6/30/10	Wed 6/30/10
64	Government Review of Draft MMRP Community Relations Plan	21 days	Thu 7/1/10	Thu 7/29/10
65	Revised Draft MMRP Community Relations Plan	14 days	Fri 7/30/10	Wed 8/18/10
66	Government Review of Revised Draft	25 days	Thu 8/19/10	Thu 9/23/10
67	USACE Forwarded CRP	18 days	Thu 9/16/10	Fri 10/8/10
68	Response to Comments	12 days	Mon 10/11/10	Tue 10/26/10
69	Incorporate Comments & Prepare DF MMRP Community Relations Plan	1 day	Wed 10/27/10	Wed 10/27/10
70	Submit Draft Final MMRP Community Relations Plan	1 day	Wed 10/27/10	Wed 10/27/10
71	Government & Regulator Review of Draft Final	35 days	Thu 10/28/10	Mon 12/13/10
72	Response to Comments	15 days	Tue 12/14/10	Tue 1/11/11
73	Incorporate Comments & Prepare Final	10 days	Wed 1/12/11	Wed 1/26/11
74	Submit Final MMRP Community Relations Plan	1 day	Wed 1/26/11	Wed 1/26/11
75	Government & Regulator Back Check of Final MMRP Community Relat. Plan	15 days	Thu 1/27/11	Wed 2/16/11
76	Incorporate Back Check Comments and Finalize	5 days	Thu 2/17/11	Thu 2/24/11
77	Submit Final MMRP Community Relations Plan After Back Check	1 day	Thu 2/24/11	Thu 2/24/11
78	Government & Regulator Approval of Final MMRP Community Relations Plan	1 day	Fri 2/25/11	Fri 2/25/11
79	**RI Field Work - DGM Activities: Michie Stadium, North Athletic Field, Target Hill, Battery Knox - TD Land, Redoubt No. 2, Artillery Firing Range, Lusk Reservoir, Fort Clinton-West, Seige Battery & Grey Ghost Housing Area**	**45 days**	**Tue 3/22/11**	**Tue 5/24/11**
80	**First Mobilization**	**45 days**	**Tue 3/22/11**	**Tue 5/24/11**
81	Set up Facilities	5 days	Tue 3/22/11	Mon 3/28/11
82	Survey Control	12 days	Tue 3/22/11	Wed 4/6/11
83	GSV Process	39 days	Tue 3/22/11	Mon 5/16/11
84	Dig Safe Permitting Process	39 days	Tue 3/22/11	Mon 5/16/11
85	Site Layout for Collection	15 days	Mon 4/4/11	Mon 4/25/11
86	DGM Transects	1 day	Mon 4/11/11	Mon 4/11/11
87	DGM Grids	25 days	Mon 4/11/11	Mon 5/16/11
88	Data Analysis/Government Review of Data	30 days	Tue 4/12/11	Tue 5/24/11
89	**First Demobilization**	2 days	Tue 5/17/11	Wed 5/18/11
90	**RI Field Work - Intrusive Activities: Michie Stadium, North Athletic Field, Target Hill, Battery Knox - TD Land, Redoubt No.2, Artillery Firing Range, Lusk Reservoir, Fort Clinton - West, Siege Battery, Grey Ghost Housing Area, & Seacoast Battery**	**79 days**	**Wed 6/8/11**	**Wed 9/28/11**
91	**Second Mobilization**	**79 days**	**Wed 6/8/11**	**Wed 9/28/11**
92	Re-establish Facilities	2 days	Wed 6/8/11	Thu 6/9/11
93	GSV Process	42 days	Fri 6/10/11	Tue 8/9/11
94	Dig Safe Permitting Process	42 days	Fri 6/10/11	Tue 8/9/11
95	Reacquisition and Excavation	27 days	Fri 6/10/11	Tue 7/19/11
96	Mag and Dig Transects	15 days	Wed 7/20/11	Tue 8/9/11
97	MC Sampling	42 days	Fri 6/10/11	Tue 8/9/11
98	Lab Analysis	20 days	Wed 8/10/11	Wed 9/7/11
99	Data Validation	15 days	Thu 9/8/11	Wed 9/28/11
100	**Final Demobilization**	2 days	Wed 8/10/11	Thu 8/11/11
101	**RI Report - North Athletic Field, Target Hill, Battery Knox - TD Land, & Redoubt No. 2**	**267 days**	**Wed 8/10/11**	**Tue 8/28/12**
102	Prepare Draft RI Report	90 days	Wed 8/10/11	Fri 12/16/11
103	Submit Draft RI Report	1 day	Fri 12/16/11	Fri 12/16/11
104	Government Review of Draft RI Report	30 days	Mon 12/19/11	Mon 1/30/12
105	Response to Comments	30 days	Tue 1/31/12	Tue 3/13/12
106	Incorporate Comments and Prepare Draft Final RI Report	10 days	Wed 3/14/12	Tue 3/27/12
107	Submit Draft Final RI Report	1 day	Tue 3/27/12	Tue 3/27/12

Calendar is in Business Days

Task | Critical Path | Milestone | Summary

ID	Task Name	Duration	Start	Finish
108	Government & Regulator Review of Draft Final	60 days	Wed 3/28/12	Thu 6/21/12
109	Response to Comments	15 days	Fri 6/22/12	Fri 7/13/12
110	Incorporate Comments & Prepare Final	10 days	Mon 7/16/12	Fri 7/27/12
111	Submit Final RI Report	1 day	Fri 7/27/12	Fri 7/27/12
112	Government & Regulator Back Check of Final RI Report	15 days	Mon 7/30/12	Fri 8/17/12
113	Incorporate Back Check Comments and Finalize	5 days	Mon 8/20/12	Fri 8/24/12
114	Submit Final RI Report After Back Check	1 day	Fri 8/24/12	Fri 8/24/12
115	Government & Regulator Approval of Final RI Report	1 day	Mon 8/27/12	Mon 8/27/12
116	AEDB-R & ERIS Data Submitted	1 day	Tue 8/28/12	Tue 8/28/12
117	Milestone Presentation	1 day	Tue 8/28/12	Tue 8/28/12
118	**Milestone Performance Objective**	0 days	Sun 5/31/15	Sun 5/31/15
119	**RI Report - Artillery Range, Lusk Reservoir, Ft. Clinton-West, Siege Battery, Seacoast Battery & Grey Ghost Housing**	**267 days**	**Mon 12/19/11**	**Wed 1/16/13**
120	Prepare Draft RI Report	90 days	Mon 12/19/11	Wed 4/25/12
121	Submit Draft RI Report	1 day	Wed 4/25/12	Wed 4/25/12
122	Government Review of Draft RI Report	30 days	Thu 4/26/12	Thu 6/7/12
123	Response to Comments	30 days	Fri 6/8/12	Fri 7/20/12
124	Incorporate Comments and Prepare Draft Final RI Report	10 days	Mon 7/23/12	Fri 8/3/12
125	Submit Draft Final RI Report	1 day	Fri 8/3/12	Fri 8/3/12
126	Government & Regulator Review of Draft Final	60 days	Mon 8/6/12	Tue 10/30/12
127	Response to Comments	15 days	Wed 10/31/12	Tue 11/20/12
128	Incorporate Comments & Prepare Final	10 days	Wed 11/21/12	Thu 12/6/12
129	Submit Final RI Report	1 day	Thu 12/6/12	Thu 12/6/12
130	Government & Regulator Back Check of Final RI Report	15 days	Fri 12/7/12	Mon 1/7/13
131	Incorporate Back Check Comments and Finalize	5 days	Tue 1/8/13	Mon 1/14/13
132	Submit Final RI Report After Back Check	1 day	Mon 1/14/13	Mon 1/14/13
133	Government & Regulator Approval of Final RI Report	1 day	Tue 1/15/13	Tue 1/15/13
134	AEDB-R & ERIS Data Submitted	1 day	Wed 1/16/13	Wed 1/16/13
135	Milestone Presentation	1 day	Wed 1/16/13	Wed 1/16/13
136	**Milestone Performance Objective**	0 days	Sun 5/31/15	Sun 5/31/15
137	**Site Closeout for NFA Site**	**279 days**	**Tue 1/15/13**	**Fri 2/21/14**
138	**Proposed Plan**	**184 days**	**Tue 1/15/13**	**Mon 9/30/13**
139	Prepare Draft PP	15 days	Tue 1/15/13	Mon 2/4/13
140	Submit Draft PP	1 day	Mon 2/4/13	Mon 2/4/13
141	Government Review of Draft PP	30 days	Tue 2/5/13	Mon 3/18/13
142	Response to Comments	15 days	Tue 3/19/13	Mon 4/8/13
143	Incorporate Comments & Prepare Draft Final PP	10 days	Tue 4/9/13	Mon 4/22/13
144	Submit Draft Final PP	1 day	Mon 4/22/13	Mon 4/22/13
145	Regulator Review of Draft Final PP	45 days	Tue 4/23/13	Mon 6/24/13
146	Response to Comments	10 days	Tue 6/25/13	Tue 7/9/13
147	Incorporate Comments & Prepare Final	5 days	Wed 7/10/13	Tue 7/16/13
148	Submit Final PP	1 day	Tue 7/16/13	Tue 7/16/13
149	Government & Regulator Back Check of Final PP	15 days	Wed 7/17/13	Tue 8/6/13
150	Incorporate Back Check Comments and Finalize	5 days	Wed 8/7/13	Tue 8/13/13
151	Submit Final PP After Back Check	1 day	Tue 8/13/13	Tue 8/13/13
152	Government & Regulator Approval of Final PP	1 day	Wed 8/14/13	Wed 8/14/13
153	Notice of Availability	1 day	Thu 8/15/13	Thu 8/15/13
154	Public Review and Comment	30 days	Fri 8/16/13	Thu 9/26/13
155	Public Meeting	1 day	Fri 9/13/13	Fri 9/13/13
156	Proposed Plan Responsiveness Summary	2 days	Fri 9/27/13	Mon 9/30/13
157	**Decision Document**	**154 days**	**Wed 7/10/13**	**Fri 2/21/14**
158	Prepare Draft DD	15 days	Wed 7/10/13	Tue 7/30/13
159	Submit Draft DD	1 day	Tue 7/30/13	Tue 7/30/13
160	Government Review of Draft DD	30 days	Wed 7/31/13	Tue 9/10/13
161	Response to Comments	15 days	Wed 9/11/13	Tue 10/1/13
162	Incorporate Comments & Prepare Draft Final	10 days	Wed 10/2/13	Tue 10/15/13
163	Submit Draft Final DD	1 day	Tue 10/15/13	Tue 10/15/13
164	Regulator Review of Draft Final DD	45 days	Wed 10/16/13	Tue 12/17/13
165	Response to Comments	15 days	Wed 12/18/13	Thu 1/16/14



Calendar is in Business Days | Task | Critical Path | Milestone | Summary

ID	Task Name	Duration	Start	Finish
166	Incorporate Comments & Prepare Final	5 days	Fri 1/17/14	Thu 1/23/14
167	Submit Final DD	1 day	Thu 1/23/14	Thu 1/23/14
168	Government & Regulator Back Check of Final DD	15 days	Fri 1/24/14	Thu 2/13/14
169	Incorporate Back Check Comments and Finalize	5 days	Fri 2/14/14	Thu 2/20/14
170	Submit Final PP After Back Check	1 day	Thu 2/20/14	Thu 2/20/14
171	Government & Regulator Approval of Final DD	1 day	Fri 2/21/14	Fri 2/21/14
172	**RI Report - Michie Stadium**	**182 days**	**Wed 4/27/11**	**Thu 1/12/12**
173	Prepare Draft RI Report	40 days	Wed 4/27/11	Wed 6/22/11
174	Submit Draft RI Report	1 day	Wed 6/22/11	Wed 6/22/11
175	Government Review of Draft RI Report	30 days	Thu 6/23/11	Thu 8/4/11
176	Response to Comments	10 days	Fri 8/5/11	Thu 8/18/11
177	Incorporate Comments and Prepare Draft Final RI Report	10 days	Fri 8/19/11	Thu 9/1/11
178	Submit Draft Final RI Report	1 day	Thu 9/1/11	Thu 9/1/11
179	Government & Regulator Review of Draft Final	45 days	Fri 9/2/11	Fri 11/4/11
180	Response to Comments	10 days	Mon 11/7/11	Fri 11/18/11
181	Incorporate Comments & Prepare Final	10 days	Mon 11/21/11	Tue 12/6/11
182	Submit Final RI Report	1 day	Tue 12/6/11	Tue 12/6/11
183	Government & Regulator Back Check of Final RI Report	15 days	Wed 12/7/11	Tue 12/27/11
184	Incorporate Back Check Comments and Finalize	10 days	Wed 12/28/11	Tue 1/10/12
185	Submit Final RI Report After Back Check	1 day	Tue 1/10/12	Tue 1/10/12
186	Government & Regulator Approval of Final RI Report	1 day	Wed 1/11/12	Wed 1/11/12
187	AEDB-R & ERIS Data Submitted	1 day	Thu 1/12/12	Thu 1/12/12
188	Milestone Presentation	1 day	Thu 1/12/12	Thu 1/12/12
189	**Milestone Performance Objective**	0 days	Thu 5/31/12	Thu 5/31/12
190	**Option: Remedy-In-Place at Michie Stadium**	**590 days**	**Mon 11/7/11**	**Wed 3/19/14**
191	**Feasibility Study**	**158 days**	**Mon 11/7/11**	**Thu 6/21/12**
192	Prepare Draft FS	30 days	Mon 11/7/11	Tue 12/20/11
193	Submit Draft FS	1 day	Tue 12/20/11	Tue 12/20/11
194	Government Review of Draft FS	30 days	Wed 12/21/11	Tue 1/31/12
195	Response to Comments	10 days	Wed 2/1/12	Tue 2/14/12
196	Incorporate Comments & Prepare Draft Final	10 days	Wed 2/15/12	Wed 2/29/12
197	Submit Draft Final FS	1 day	Wed 2/29/12	Wed 2/29/12
198	Regulator Review of Draft Final FS	45 days	Thu 3/1/12	Wed 5/2/12
199	Response to Comments	10 days	Thu 5/3/12	Wed 5/16/12
200	Incorporate Comments & Prepare Final	5 days	Thu 5/17/12	Wed 5/23/12
201	Submit Final FS	1 day	Wed 5/23/12	Wed 5/23/12
202	Government & Regulator Back Check of Final FS	15 days	Thu 5/24/12	Wed 6/13/12
203	Incorporate Back Check Comments and Finalize	5 days	Thu 6/14/12	Wed 6/20/12
204	Submit Final FS After Back Check	1 day	Wed 6/20/12	Wed 6/20/12
205	Government & Regulator Approval of Final FS	1 day	Thu 6/21/12	Thu 6/21/12
206	**Proposed Plan**	**169 days**	**Fri 6/22/12**	**Fri 3/1/13**
207	Prepare Draft PP	15 days	Fri 6/22/12	Fri 7/13/12
208	Submit Draft PP	1 day	Fri 7/13/12	Fri 7/13/12
209	Government Review of Draft PP	30 days	Mon 7/16/12	Fri 8/24/12
210	Response to Comments	10 days	Mon 8/27/12	Mon 9/10/12
211	Incorporate Comments & Prepare Draft Final	10 days	Tue 9/11/12	Mon 9/24/12
212	Submit Draft Final PP	1 day	Mon 9/24/12	Mon 9/24/12
213	Regulator Review of Draft Final PP	45 days	Tue 9/25/12	Mon 11/26/12
214	Response to Comments	10 days	Tue 11/27/12	Mon 12/10/12
215	Incorporate Comments & Prepare Final	5 days	Tue 12/11/12	Mon 12/17/12
216	Submit Final PP	1 day	Mon 12/17/12	Mon 12/17/12
217	Government & Regulator Back Check of Final PP	15 days	Tue 12/18/12	Mon 1/7/13
218	Incorporate Back Check Comments and Finalize	5 days	Tue 1/8/13	Mon 1/14/13
219	Submit Final PP After Back Check	1 day	Mon 1/14/13	Mon 1/14/13
220	Government & Regulator Approval of Final PP	1 day	Tue 1/15/13	Tue 1/15/13
221	Notice of Availability	1 day	Wed 1/16/13	Wed 1/16/13
222	Public Review and Comment	30 days	Thu 1/17/13	Wed 2/27/13
223	Public Meeting	1 day	Thu 2/14/13	Thu 2/14/13

Calendar is in Business Days

Task | Critical Path | Milestone | Summary

MMRP Remedial Investigations, Munitions Responses Services for U.S. Army Garrison - West Point, West Point, NY

ID	Task Name	Duration	Start	Finish
224	Proposed Plan Responsiveness Summary	2 days	Thu 2/28/13	Fri 3/1/13
225	**Decision Document**	**150 days**	**Tue 12/11/12**	**Thu 7/18/13**
226	Prepare Draft DD	15 days	Tue 12/11/12	Wed 1/9/13
227	Submit Draft DD	1 day	Wed 1/9/13	Wed 1/9/13
228	Government Review of Draft DD	30 days	Thu 1/10/13	Wed 2/20/13
229	Response to Comments	10 days	Thu 2/21/13	Wed 3/6/13
230	Incorporate Comments & Prepare Draft Final	10 days	Thu 3/7/13	Wed 3/20/13
231	Submit Draft Final DD	1 day	Wed 3/20/13	Wed 3/20/13
232	Regulator Review of Draft Final DD	45 days	Thu 3/21/13	Wed 5/22/13
233	Response to Comments	15 days	Thu 5/23/13	Wed 6/12/13
234	Incorporate Comments & Prepare Final	5 days	Thu 6/13/13	Wed 6/19/13
235	Submit Final DD	1 day	Wed 6/19/13	Wed 6/19/13
236	Government & Regulator Back Check of Final DD	15 days	Thu 6/20/13	Wed 7/10/13
237	Incorporate Back Check Comments and Finalize	5 days	Thu 7/11/13	Wed 7/17/13
238	Submit Final DD After Back Check	1 day	Wed 7/17/13	Wed 7/17/13
239	Government & Regulator Approval of Final DD	1 day	Thu 7/18/13	Thu 7/18/13
240	**Remedial Design / LTM Plan**	**121 days**	**Thu 6/20/13**	**Tue 12/10/13**
241	Draft Document / Includes Video Storyboards	15 days	Thu 6/20/13	Thu 7/11/13
242	Submit Draft Document	1 day	Thu 7/11/13	Thu 7/11/13
243	Government Review	30 days	Fri 7/12/13	Thu 8/22/13
244	Response To Comments	1 day	Fri 8/23/13	Fri 8/23/13
245	Incorporate Comments and Draft Final Document / Includes Video Storyboards	15 days	Mon 8/26/13	Fri 9/13/13
246	Submit Draft Final Document	1 day	Fri 9/13/13	Fri 9/13/13
247	Regulatory Agency Review	45 days	Mon 9/16/13	Fri 11/15/13
248	Final Document / Includes Video Storyboards	10 days	Mon 11/18/13	Tue 12/3/13
249	Submit Final Document	1 day	Tue 12/3/13	Tue 12/3/13
250	Backcheck and Approval	5 days	Wed 12/4/13	Tue 12/10/13
251	**Remedial Action**	**79 days**	**Mon 11/18/13**	**Wed 3/19/14**
252	Procure & Produce Brochures	15 days	Mon 11/18/13	Tue 12/10/13
253	Awareness Training Video Production	15 days	Wed 12/11/13	Thu 1/9/14
254	Provide Brochures and Video	5 days	Fri 1/10/14	Thu 1/16/14
255	Draft Letter Report	5 days	Fri 1/17/14	Thu 1/23/14
256	Submit Draft Letter Report	1 day	Thu 1/23/14	Thu 1/23/14
257	Government & Regulator Review	30 days	Fri 1/24/14	Thu 3/6/14
258	Response to Comments	2 days	Fri 3/7/14	Mon 3/10/14
259	Incorporate Comments & Prepare Final Letter Report	5 days	Tue 3/11/14	Mon 3/17/14
260	Submit Final Letter Report	1 day	Mon 3/17/14	Mon 3/17/14
261	Government & Regulator Approval of Final Letter Report	1 day	Tue 3/18/14	Tue 3/18/14
262	Milestone Presentation	1 day	Wed 3/19/14	Wed 3/19/14
263	**Milestone Performance Objective**	0 days	Mon 3/31/14	Mon 3/31/14

Calendar is in Business Days

Task | Critical Path | Milestone | Summary

MMRP Remedial Investigations, Munitions Responses Services for U.S. Army Garrison - West Point, West Point, NY

Figure F-1
Mobilization 1: Digital Mapping Survey Activities from 3/22/2011 to 5/24/2011
U.S. Army Garrison - West Point

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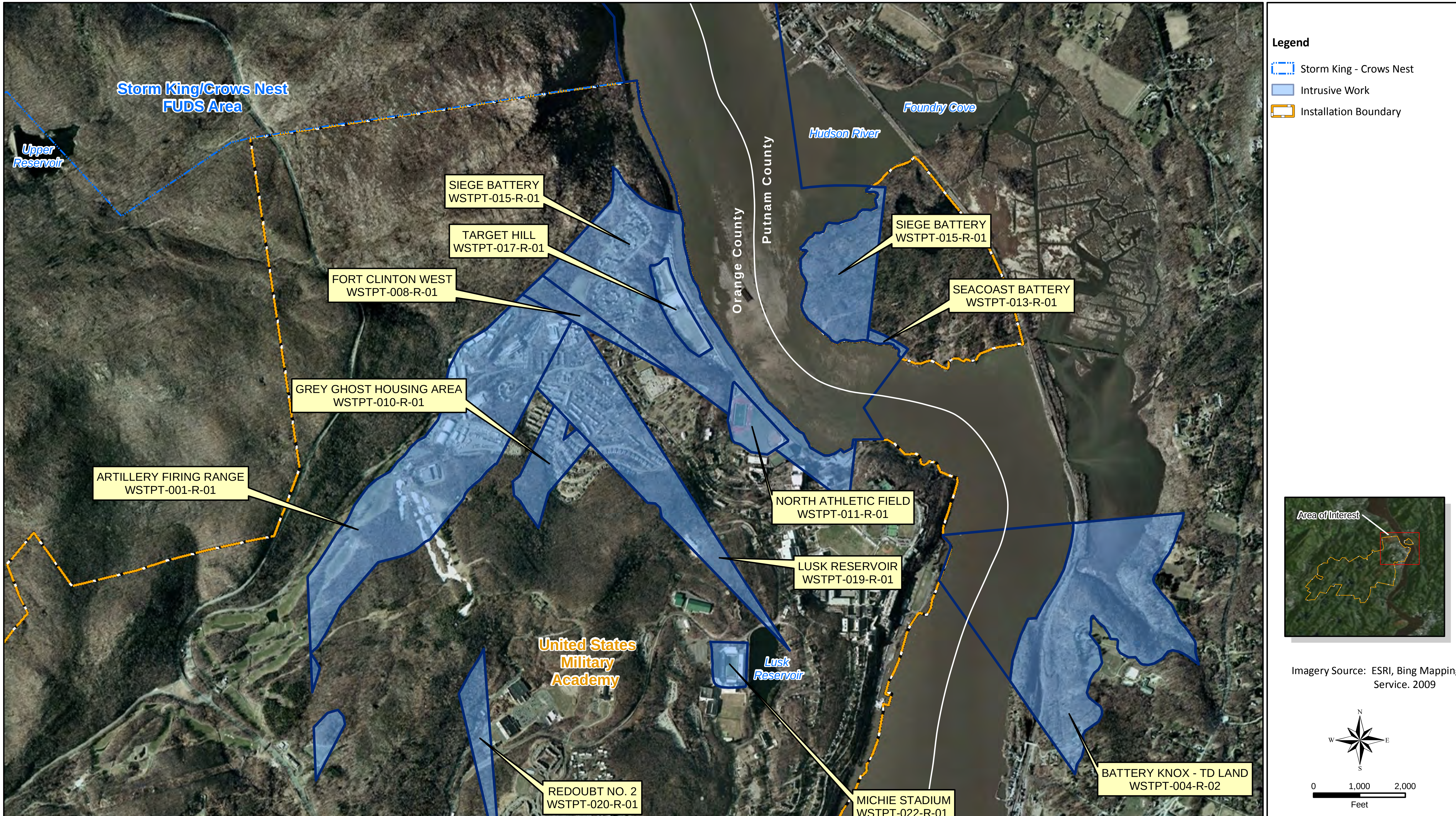

Figure F-2
Mobilization 2: Intrusive Activities from 6/8/2011 to 9/28/2011
U.S. Army Garrison - West Point

APPENDIX G – MC SAMPLING MEMORANDUM

APPENDIX G – MC SAMPLING RATIONALE

MILITARY MUNITIONS RESPONSE PROGRAM
REMEDIAL INVESTIGATIONS
U.S. ARMY GARRISON WEST POINT

1.0 INTRODUCTION

Munitions constituents (MC) concentrations in soil will be characterized at 11 munitions response sites (MRSs) as part of the U.S. Army Garrison – West Point (West Point) Military Munitions Response Program (MMRP) Remedial Investigation (RI). MC may be present at these MRSs due to military munitions use at these former ranges. The results of the MC characterization will be used to perform a baseline risk assessment and support Munitions Response Site Prioritization Protocol scoring. This memorandum documents the decision logic for the MC sampling process during the West Point RI for the following MRSs:

- Artillery Firing Range (WSTPT-001-R-01)
- Battery Knox – TD Land (WSTPT-004-R-02)
- Fort Clinton – West (WSTPT-008-R-01)
- Grey Ghost Housing Area (WSTPT-010-R-01)
- North Athletic Field (WSTPT-011-R-01)
- Seacoast Battery (WSTPT-013-R-01)
- Siege Battery (WSTPT-015-R-01)
- Target Hill (WSTPT-017-R-01)
- Lusk Reservoir (WSTPT-019-R-01)
- Redoubt No. 2 (WSTPT-020-R-01)
- Michie Stadium (WSTPT-022-R-01)

Section 2 of this memorandum describes the various munitions and explosives of concern (MEC) and MC release scenarios that may be encountered at West Point during the RI. Section 3 details specific MC that may be present at each West Point MRS based on former munitions and weapons systems used during training exercises. The locations of each MRS are presented in Figure 1-1.

A thorough review of numerous documents was completed to develop the information presented here. A list of these resources is contained in Attachment 1 to this appendix. Unless otherwise noted, all statements of fact presented in this appendix are based on the review of these documents and the *West Point Final Site Inspection Report*, January 2007 by TLI Solutions, Inc. (Final SI Report).

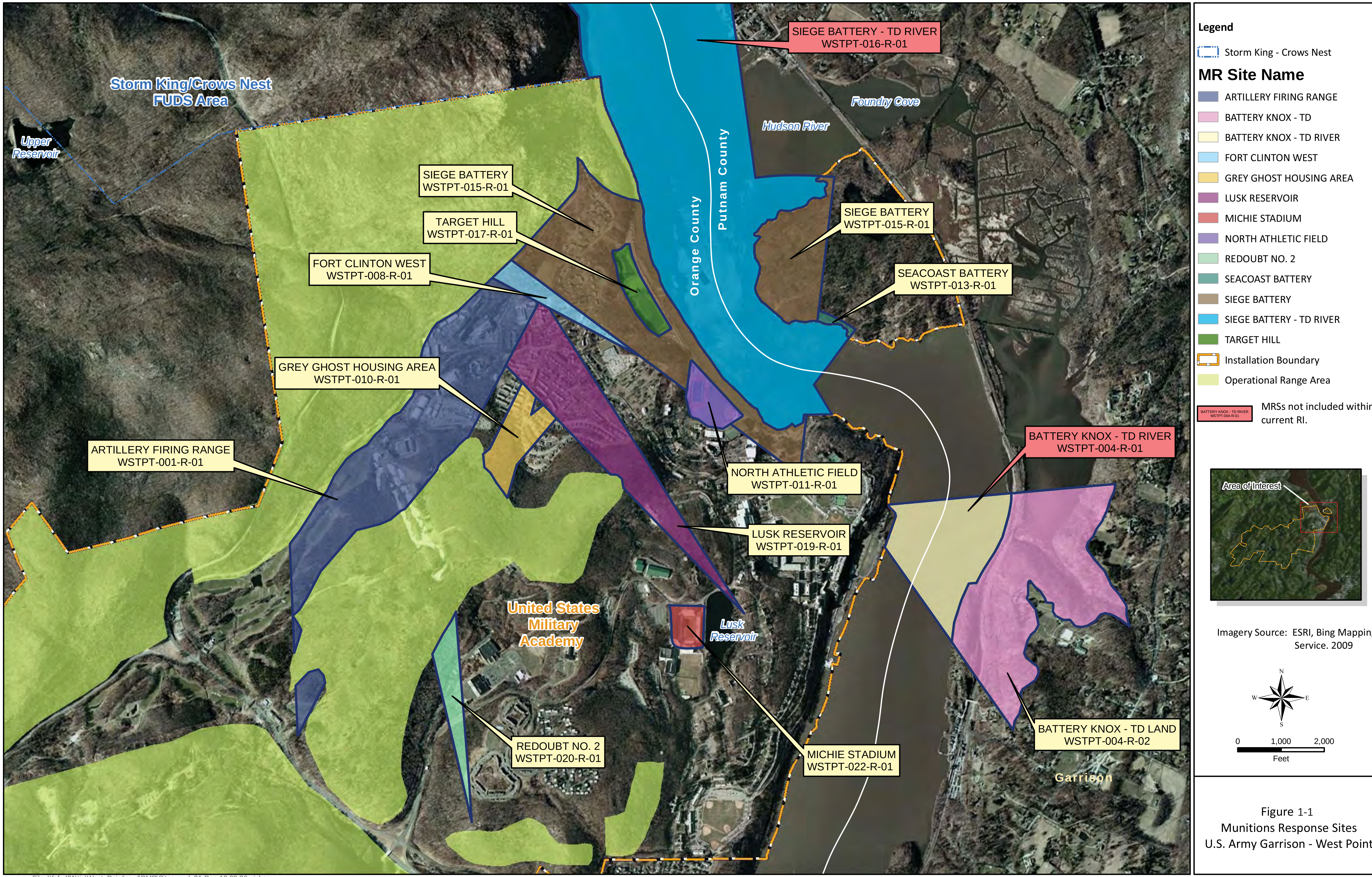

Figure 1-1
Munitions Response Sites
U.S. Army Garrison - West Point

2.0 DECISION LOGIC AND SAMPLING CRITERIA

MRSs at West Point are associated with former artillery and small arms training, which occurred from as early as the Revolutionary War up to World War II. Many of the MRSs are portions of former artillery range fans that are bisected by operational range areas or areas being addressed through other programs (e.g. the Formerly Used Defense Sites [FUDS] MMRP) that fall outside of the objectives of the RI. Based on the Site Inspection (SI) (TLI, 2007), no known artillery impact areas exist within the MRSs. However, historical records reviews indicate that several former firing point positions may be present. In addition, although a small arms target area was historically located within the Grey Ghost Housing Area MRS, no evidence of the target area was observed during the SI.

As part of the RI, geophysical surveys will be performed to investigate the potential presence of MEC on the ground surface and in the subsurface. If the geophysical surveys identify areas of high anomaly densities, these areas will be investigated to determine if MEC or munitions debris (MD) is present. The presence of significant amounts of MEC or MD may indicate the potential presence of MC. In addition, the identification of a single MEC item that appears to be a low order detonation, cracked, or leaking may also indicate a release of MC has occurred. During the RI, MC investigations will be initiated when encountering the following criteria:

- Further investigate MC based on SI recommendations for Battery Knox-TD Land (WSPT-004-R-02) and Siege Battery (WSPT-015-R-01) MRSs.
- Perform MC investigations at currently unknown but potential MEC releases identified during geophysical surveys that will be conducted as part of the West Point RI.
- Investigate for MC at known former artillery range firing points that potentially contain MC without indicators of a MEC release: Artillery Firing Range (WSTPT-001-R-01), Siege Battery (WSTPT-015-R-01), Lusk Reservoir (WSTPT-019-R-01), and Redoubt No. 2 (WSTP-020-R-01).
- Sample at individual MEC item locations where soil staining or visible evidence of a potential MC release is observed.

Potential MEC releases identified during the RI will be reported to the project team stakeholders. A memorandum will be prepared describing the potential MEC release and proposed MC sampling methodology and design. MRSs that were recommended in the Final SI Report to require further investigation of MC, such as Battery Knox-TD Land (WSPT-004-R-02), will have sampling designs prepared and presented in the RI work plan. Details of the sampling methods that may be utilized for the RI are presented in the RI work plan.

3.0 MC ANALYSIS

This section presents the specific MC that can be anticipated at each MRS based on the munitions and weapons systems used at West Point. This allows for laboratory analysis of soil samples collected during the RI to focus on those specific MC that are expected to be present and indicative of potential contamination. Generally, MC at the West Point MRSs can be classified into two groups: metals and explosives.

The media to be analyzed during the RI consists of soil only. Sampling of groundwater is not proposed for the RI. Based on a review of soil and geological data for the area, the two most common soil types surrounding West Point are Hollis Soils and the Rock Outcrop Hollis Complex. Bedrock associated with these soil types ranges in depth from approximately 10 inches to more than 5 feet below ground surface. There is usually no perched water table above the bedrock[1]. [Note: A perched water table is an aquifer that occurs above the regional water table. This occurs when there is an impermeable layer of rock or sediment or relatively impermeable layer above the main water table/aquifer but below the surface of the land.] In addition, according to the chemical soil properties for Orange County, the cation exchange capacity for soils at West Point is relatively high, which indicates the soils have a high capacity to retain cations such as iron[2]. Therefore, due to the shallowness and impermeability of the bedrock, the lack of a perched water table and the soils ability to retain cations, there is little potential for contamination to reach the groundwater.

The first step in determining the MC associated with the West Point MRSs is to identify the munitions used at each MRS. Munitions use at the West Point MRSs began in the late 1700s and continued until the early 1900s. Although historical records identify the types of munitions used at various ranges, the specific nomenclature of the munitions is not available. In addition, prior to World War II, there was little effort made to ensure the consistency of munitions and their constituents. For example, based on a review of documents regarding Civil War munitions (see Attachment 1), it is evident that during the Civil War, each weapons manufacturer produced ammunition unique for their weapons and many weapons and ammunition were acquired by the Union and Confederate Armies from foreign sources. Therefore, only general information is available regarding the MC associated with these munitions.

[1] United States Department of Agriculture, Soil Conservation Service in cooperation with Cornell University Agricultural Experiment Station, Soil Survey of Orange County New York (National Cooperative Soil Survey, 1981)
[2] *Chemical Soil Properties*. (2010, February 5). Retrieved August 30, 2010, from U.S. Department of Agriculture, Natural Resources Conservation Service: http://soildatamart.nrcs.usda.gov/

Attachment 1 contains a narrative description of the MC associated with the various munitions used at West Point as presented in the *Final Historical Records Review* (Final HRR), March 2006 by TLI Solutions, Inc. and/or the Final SI Report. Both the Final HRR and Final SI were reviewed and approved by New York State Department of Environmental Conservation (NYSDEC) and United States Environmental Protection Agency (USEPA) Region II. In addition, Attachment 1 includes a table that identifies the MC potentially associated with the firing points, if applicable, and impact areas of each MRS.

Based on the information contained in Attachment 1, the compounds potentially associated with each MRS are evaluated for MC sampling and those evaluations are presented in the following sections. Because of the time period of munitions used at West Point, specific nomenclature for the munitions was not available in the historical records; therefore, generic MC information was compiled for these items.

It should be noted that iron is associated with munitions used at the majority of the MRSs associated with West Point. However, iron will not be included in the MC analysis for the MRSs, because iron is known to occur naturally in the soils throughout the West Point area. According to the *Geologic Map of New York*, 1970 compiled by the New York State Museum and Science Services, the soils in the vicinity of West Point are primarily derived from biotite-hornblende granite, granite gneiss, and rusty and gray biotite-quartz-feldspar gneisses[3]. These bedrocks are known to be high in iron content; therefore, soils derived from these rocks would also be high in iron.

4.0 MC SAMPLING AT WEST POINT MRSs

4.1 Battery Knox-TL Land MRS

The Battery Knox-TD Land MRS (WSPT-004-R-02) is the potential overshoot area for the impact area associated with the historical Battery Knox artillery firing range. The firing point was located on the western shore of the Hudson River and the impact area or targets were placed in the Hudson River. The firing point and water portions of this range are not included in this MRS. The battery was used from approximately 1936 to the World War II era when it was demolished. During the SI, composite (spoke and hub) samples were collected from the Battery Knox-TD Land MRS and analyzed for metals and explosives. No MC were detected above the USEPA Region 9 Preliminary Remediation Goals (PRGs) at the MRS. However, trace amounts of explosives were

[3] New York State Museum and Science Serves in cooperation with the U.S. Geological Survey and the University of the State of New York, Geologic Map of New York (New York State Museum, 1970 and reprinted 1995)

identified in the samples. The stakeholders requested that these compounds be further evaluated during the RI.

The potential MC at this MRS as documented in Attachment 1 Table A-1 were evaluated to determine those MC to be analyzed for in soil samples collected during the RI. This evaluation is presented in Table 4-1 below.

Table 4-1: Battery Knox-TD Land MRS Analyte Evaluation

Analyte	Analysis Available?	Analysis Required?	Notes
Metals USEPA Method SW-846 3010A/3050B/ 6010B			
Iron	Yes	No	Note #1
Lead	Yes	Yes	Known MC associated with munitions; evaluation will be conducted if MEC sources are identified during geophysical survey
Metals USEPA Method SW-846 3050B/7471B			
Mercury	Yes	Yes	Known MC associated with munitions; evaluation will be conducted if MEC sources are identified during geophysical survey
Explosives USEPA Method SW-846 3535A/8330B or 8330A			
Cyclotrimethylenetrinitramine (RDX)	Yes	Yes	Note #2
Pentaerythritol tetranitrate (PETN)			
1,3,5-Trinitrobenzene			
1,3-Dinitrobenzene			
3-Nitrotoluene			
Nitroglycerin	Yes	Yes	Known MC associated with munitions
2,4,6-Trinitrotoluene (TNT)	Yes	Yes	Known MC associated with munitions
2,4-Dinitrotoluene (2,4-DNT)	Yes	Yes	Breakdown product of TNT
2,6-Dintrotoluene (2,6-DNT)	Yes	Yes	Breakdown product of TNT
2-Amino-4,6-dinitrotoluene (2-Am-DNT)	Yes	Yes	Breakdown product of TNT
4-Amino-2,6-dinitrotoluene (4-Am-DNT)	Yes	Yes	Breakdown product of TNT
Other Compounds/Constituents			
Ammonium nitrate	Not available	No	Note #3
Diphenylamine	Yes (SW-846 8270C)	No	Note #4
Mercury fulminate	Not available	No	Note #3
Picric acid	Yes (SW-846 8330B)	No	Note #5
Potassium nitrate	Not available	No	Note #3
Nitrocellulose Method SW-846 9056/CRREL-ECB ERDC SOP			
Nitrocellulose	Note #6	No	Note #6

Table 4-1: Battery Knox-TD Land MRS Analyte Evaluation (Continued)

Notes:

Note #1 – Iron was associated with the munitions used at the Battery Knox-TD Land MRS. Based on a review of soil and geological data for the area, it has been determined that it occurs naturally in the soils[3]. It is not anticipated that iron from munitions would result in levels higher than those that occur naturally. Therefore, analysis for iron will not be conducted.

Note #2 – These explosives are not associated with the munitions used at Battery Knox-TD Land MRS. In fact based on a review of the historical references identified in Attachment 1, these explosives were not in use by the Army during the time period in which the MRS was in use. However, trace amounts of these explosives were detected during the SI in soil samples collected within the MRS; therefore, they will be further evaluated during the RI.

Note #3 – These explosives compounds do not have developed laboratory methods, but methods may exist for the individual components of these compounds. However, because the mass of the individual components is small, it is not anticipated that the components would be detected in the soil samples. Furthermore, the explosives used in the greatest quantity at the Battery Knox-TD Land MRS were TNT and nitroglycerin, which are insoluble in water and do not hydrolyze, volatilize, or bioconcentrate under normal environmental conditions. They also have average adsorption coefficients suggesting that they will reasonably adsorb to soil and sediments and maintain low soil mobility. Also, the volatilization rate from soil is extremely low[4]. Therefore, TNT, its breakdown products, and nitroglycerin are anticipated to remain in the environment and are good indicators for explosives at the Battery Knox-TD Land MRS. Analysis for TNT, its breakdown products, and nitroglycerin will be sufficient indicators of explosives contamination at the site and analysis will not be performed for other explosives compounds or their individual components.

Note #4 – Based on the review of the Munitions Items Disposition Action System **(**MIDAS**)** database for munitions similar to those used at this site, it has been determined that this semi-volatile organic compound (SVOC) would be present only in trace amounts within munitions used at the MRS. The compound is not anticipated to be present at detectable concentrations in MRS soils. Therefore, sampling is not planned for the RI. This decision is based on a determination that, for this SVOC, the total mass present at the Battery Knox-TD Land MRS would be very small.

Note #5 – Based on the review of the MIDAS database for munitions similar to those used at this site, it has been determined this explosive compound would be present in only trace amounts within munitions used at the MRS and is not anticipated to be present at detectable concentrations in MRS soils. Therefore, sampling is not planned for the RI. This decision is based on a determination that for this explosive, the total mass present at the Battery Knox-TD Land MRS would be very small.

Note #6 – Further analysis for nitrocellulose, which was present in the artillery shells used at the Battery Knox-TD Land MRS, is not planned for the RI. This decision is based on the lack of a reliable analytical method for this analyte and because available data on human health affects and mammalian toxicity suggest nitrocellulose is virtually nontoxic[5].

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[4] Ware, G. W. (2007). *Reviews of Environmental Contamination and Toxicology, Volume 191.* New York: Springer Science + Business Media, LLC
[5] Oak Ridge National Laboratory. (1986). *Water Quality Criteria for Nitrocellulose.* Oak Ridge: Oak Ridge National Laboratory.

The predominant pathway for introducing MC to the environment at the Battery Knox-TD Land MRS is from a MEC source area. The MRS only encompasses the portion of the historical range fan that may have been impacted from overshoots of the target area, which was located in the Hudson River. Source areas within the MRS include potential areas where MEC may be distributed on the surface and in the subsurface. Therefore, the sampling of surface and subsurface (to the depth of observed MEC) soils is recommended.

MC sampling will be conducted at this site during the RI to further evaluate the presence of trace amounts of explosives identified during the SI. Additional sampling may be conducted based on geophysical survey results and identification of MEC source areas. Samples collected from MEC source areas will be analyzed for metals and explosives. Based on the information provided in Table A-1 and the evaluation in Table 4-1, the following MC analyses and analytes are proposed for samples collected during the RI at the Battery Knox-TD Land MRS:

- Explosives, Method USEPA SW-846 8330B or 8330A: RDX, PETN, Nitroglycerin, and TNT along with its breakdown products (2,4-DNT, 2,6-DNT, 2-Am-DNT, and 4-Am-DNT)
- Metals, Method USEPA SW-846 6010B: Lead (only if a MEC source area is identified)
- Metals, Method USEPA SW-846 3050B/7471B: Mercury (only if a MEC source area is identified)

4.2 Siege Battery MRS

The Siege Battery MRS (WSPT-015-R-01) was used for artillery training from the latter part of the 19th century to approximately 1939 when the battery was replaced with an amphitheatre. The MRS encompasses the firing point and a portion of the range fans associated with the historical battery. In addition, portions of the range fans associated with the Artillery Firing Range, Seacoast Battery, Lusk Reservoir, and Redoubt No. 2 MRSs are encompassed within the Siege Battery MRS. During the SI, composite (spoke and hub) samples were collected from the Siege Battery MRS and analyzed for metals and explosives. The only MC identified above the USEPA Region 9 PRGs at this MRS was iron. Although no background data were available for this MRS, the conclusions in the SI stated that the level of iron detected indicated that it may be the result of leaching from MD observed during the SI.

The potential MC at this MRS as documented in Attachment 1 Table A-1 were evaluated to determine constituents and analysis to be performed during the RI and are presented in Table 4-2.

Table 4-2: Siege Battery MRS Analyte Evaluation

Analyte	Analysis Available?	Analysis Required?	Notes
Metals USEPA Method SW-846 3010A/3050B/ 6010B			
Iron	Yes	No	Note #1
Lead	Yes	Yes	Known MC associated with munitions
Metals USEPA Method SW-846 3050B/7471B			
Mercury	Yes	Yes	Known MC associated with munitions
Explosives USEPA Method SW-846 3535A/8330B or 8330A			
Nitroglycerin	Yes	Yes	Known MC associated with munitions
Pentaerythritol tetranitrate (PETN)	Yes	Yes	Note #2
2,4,6-Trinitrotoluene (TNT)	Yes	Yes	Known MC associated with munitions
2,4-Dinitrotoluene (2,4-DNT)	Yes	Yes	Breakdown product of TNT
2,6-Dintrotoluene (2,6-DNT)	Yes	Yes	Breakdown product of TNT
2-Amino-4,6-dinitrotoluene (2-Am-DNT)	Yes	Yes	Breakdown product of TNT
4-Amino-2,6-dinitrotoluene (4-Am-DNT)	Yes	Yes	Breakdown product of TNT
Other Compounds/Constituents			
Ammonium nitrate Antimony sulfate Antimony sulfide	Not available	No	Note #3
Diphenylamine	Yes (SW-846 8270C)	No	Note #4
Lead azide Lead styphnate Lead thiocyanate Mercury fulminate	Not available	No	Note #3
Picric acid	Yes (SW-846 8330B)	No	Note #5
Potassium chlorate Potassium nitrate	Not available	No	Note #3
Nitrocellulose Method SW-846 9056/CRREL-ECB ERDC SOP			
Nitrocellulose	Note #6	No	Note #6

Table 4-2: Siege Battery MRS Analyte Evaluation (Continued)

Notes:

Note #1 – Iron was associated with the munitions used at the Siege Battery MRS and the concentration of iron in one soil sample collected during the SI was higher than project screening level. The sample was a biased sampled collected in proximity to a cast iron fragment. Based on a review of soil and geological data for the area, it has been determined that iron occurs naturally in the soils[3]. It is not anticipated that iron from munitions would result in levels higher or pose any greater risk than those that occur naturally. Therefore, analysis for iron will not be conducted.

Note #2 – This explosive is not associated with the munitions used at Siege Battery MRS. However, trace amounts of this explosive were detected during the SI in soil samples collected within the MRS; therefore, it will be further evaluated during the RI.

Note #3 – These explosives compounds do not have developed laboratory methods, but methods may exist for the individual components of these compounds. However, because the mass of the individual components is small, it is not anticipated that the components would be detected in the soil samples. Furthermore, the explosives used in the greatest quantity at the MRS were TNT and nitroglycerin, which are insoluble in water and do not hydrolyze, volatilize, or bioconcentrate under normal environmental conditions. They also have average adsorption coefficients suggesting that they will reasonably adsorb to soil and sediments and maintain low soil mobility. Also, the volatilization rate from soil is extremely low[4]. Therefore, TNT, its breakdown products, and nitroglycerin are anticipated to remain in the environment and are good indicators for explosives at the Siege Battery MRS. Analysis for TNT, its breakdown products, and nitroglycerin will be sufficient indicators of explosives contamination at the site and analysis will not be performed for other explosives compounds or their individual components.

Note #4 – Based on the review of the MIDAS database for munitions similar to those used at this site, it has been determined that this SVOC is present only in trace amounts within munitions used at the MRS and is not anticipated to be present at detectable concentrations in MRS soils. Therefore, sampling is not planned for the RI. This decision is based on a determination that for this SVOC, the total mass present at the Siege Battery MRS would be very small.

Note #5 – Based on the review of the MIDAS database for munitions similar to those used at this site, it has been determined this explosive compound would be present in only trace amounts within munitions used at the MRS and is not anticipated to be present at detectable concentrations in MRS soils. Therefore, sampling is not planned for the RI. This decision is based on a determination that for this explosive, the total mass of present at the MRS would be very small.

Note #6 – Further analysis for nitrocellulose, which was present in the artillery shells used at the Siege Battery MRS, is not planned for the RI. This decision is based the lack of a reliable analytical method for this analyte and because available data on human health affects and mammalian toxicity suggest nitrocellulose is virtually nontoxic[5].

The predominant pathway for introducing MC to the environment at the Siege Battery MRS is from a MEC source area. Source areas within the MRS include potential areas where MEC may be distributed on the surface and in the subsurface from artillery training activities. Potential MC may also be located at the firing point even if a MEC source area is not identified. Therefore, the sampling of surface and subsurface (to the depth of observed MEC) soils is recommended.

MC sampling will be conducted at this site during the RI based on geophysical survey results and identification of MEC source areas. The Siege Battery firing point will also be sampled for MC. The method for collecting samples will be determined based on the criteria outlined in Section 3.0, above. Samples collected from MEC source areas will be analyzed for metals and explosives. Based on the information provided in Table A-1 and the evaluation in Table 4-2, the following MC analyses and analytes are proposed for samples collected during the RI at the Siege Battery MRS:

- Explosives, Method USEPA SW-846 8330B or 8330A: Nitroglycerin, PETN, TNT and its breakdown products (2,4-DNT, 2,6-DNT, 2-Am-DNT, and 4-Am-DNT)
- Metals, Method USEPA SW-846 6010B: Lead (only if a MEC source area is identified)
- Metals, Method USEPA SW-846 3050B/7471B: Mercury (only if a MEC source area is identified)

4.3 Artillery Firing Range MRS, Lusk Reservoir MRS, and Redoubt No. 2 MRS

The Artillery Firing Range MRS (WSPT-001-R-01), Lusk Reservoir MRS (WSPT-019-R-01), and the Redoubt No. 2 MRS (WSPT-020-R-01) were all used within the same time period (1906 through the late 1930s) for artillery firing during training. The firing points of the Grey Ghost Housing Area small arms ranges were also located within the Lusk Reservoir MRS. MC associated with the small arms firing point would be the same as the MC associated with the artillery firing. During the SI, composite (spoke and hub) samples were collected from the Artillery Firing Range, Lusk Reservoir, and Redoubt No. 2 MRSs and analyzed for metals and explosives. Iron was identified above the USEPA Region 9 PRGs within the Artillery Firing Range MRS. Although no background data were available for this MRS, the area is known to have high levels of iron as a result of the highly oxidized iron content of the rocks. According to the *Geologic Map of New York*, 1970 compiled by the New York State Museum and Science Services, the soils in the vicinity of West Point are primarily derived from biotite-hornblende granite, granite gneiss, and rusty and gray biotite-quartz-feldspar gneisses[3]. These bedrocks are known to be high in iron content;

therefore, soils derived from these rocks would also be high in iron. Therefore, it is assumed that the iron identified in the SI soil samples was naturally occurring.

The potential MC at this MRS as documented in Attachment 1 Table A-1 were evaluated to determine constituents and analysis to be performed during the SI and are presented in Table 4-3.

Table 4-3: Artillery Firing Range MRS, Lusk Reservoir MRS, and Redoubt No. 2 MRS Analyte Evaluation

Analyte	Analysis Available?	Analysis Required?	Notes
Metals USEPA Method SW-846 3010A/3050B/ 6010B			
Aluminum	Yes	No	Known MC associated with munitions; however, it is not anticipated to be present at levels that would be potentially harmful
Copper	Yes	No	Known MC associated with munitions; however, it is not anticipated to be present at levels that would be potentially harmful
Iron	Yes	No	Note #1
Magnesium	Yes	No	Known MC associated with munitions; however, screening criteria not available
Zinc	Yes	No	Known MC associated with munitions; however, it is not anticipated to be present at levels that would be potentially harmful
Explosives USEPA Method SW-846 3535A/8330B or 8330A			
Nitroglycerin	Yes	Yes	Known MC associated with munitions
Pentaerythritol tetranitrate (PETN)	Yes	Yes	Known MC associated with munitions
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	Yes	Yes	Known MC associated with munitions
2,4,6-Trinitrotoluene (TNT)	Yes	Yes	Known MC associated with munitions
2,4-Dinitrotoluene (2,4-DNT)	Yes	Yes	Breakdown product of TNT
2,6-Dintrotoluene (2,6-DNT)	Yes	Yes	Breakdown product of TNT
2-Amino-4,6-dinitrotoluene (2-Am-DNT)	Yes	Yes	Breakdown product of TNT
4-Amino-2,6-dinitrotoluene (4-Am-DNT)	Yes	Yes	Breakdown product of TNT
Other Components			
Ammonium nitrate	Not available	No	Note #2
Ammonium picrate			
Antimony sulfate			
Antimony sulfide			

Table 4-3: Artillery Firing Range MRS, Lusk Reservoir MRS, and Redoubt No. 2 MRS Analyte Evaluation (Continued)

<table>
<tr><th>Analyte</th><th>Analysis Available?</th><th>Analysis Required?</th><th>Notes</th></tr>
<tr><td>Barium nitrate</td><td></td><td></td><td></td></tr>
<tr><td>Diphenylamine</td><td>Yes (SW-846 8270C)</td><td>No</td><td>Note #3</td></tr>
<tr><td>Lead azide</td><td rowspan="4">Not available</td><td rowspan="4">No</td><td rowspan="4">Note #2</td></tr>
<tr><td>Lead styphnate</td></tr>
<tr><td>Lead thiocyanate</td></tr>
<tr><td>Mercury fulminate</td></tr>
<tr><td>Picric acid</td><td>Yes (SW-846 8330B)</td><td>No</td><td>Note #4</td></tr>
<tr><td>Potassium chlorate</td><td rowspan="4">Not available</td><td rowspan="4">No</td><td rowspan="4">Note #2</td></tr>
<tr><td>Potassium nitrate</td></tr>
<tr><td>Strontium nitrate</td></tr>
<tr><td>Tetracene</td></tr>
<tr><td colspan="4">Nitrocellulose Method SW-846 9056/CRREL-ECB ERDC SOP</td></tr>
<tr><td>Nitrocellulose</td><td>Note #5</td><td>No</td><td>Note #5</td></tr>
</table>

Notes:

Note #1 – Iron was associated with the munitions used at these MRSs. Based on a review of soil and geological data for the area, it has been determined that iron occurs naturally in the soils[3]. It is not anticipated that iron from munitions would result in levels higher than those that occur naturally. Therefore, analysis for iron will not be conducted

Note #2 – These explosives compounds do not have developed laboratory methods, but methods may exist for the individual components of these compounds. However, because the mass of the individual components is small, it is not anticipated that the components would be detected in the soil samples. Furthermore, the explosives used in the greatest quantity at these MRSs were TNT and nitroglycerin, which are insoluble in water and do not hydrolyze, volatilize, or bioconcentrate under normal environmental conditions. They also have average adsorption coefficients suggesting that they will reasonably adsorb to soil and sediments and maintain low soil mobility. Also, the volatilization rate from soil is extremely low[4]. Therefore, TNT, its breakdown products, and nitroglycerin are anticipated to remain in the environment and are good indicators for explosives at these MRSs. Analysis for TNT, its breakdown products, and nitroglycerin will be sufficient indicators of explosives contamination at the sites and analysis will not be performed for other explosives compounds or their individual components.

Note #3 – Based on the review of the Munitions Items Disposition Action System **(**MIDAS**)** database for munitions similar to those used at these sites, it has been determined that this SVOC would be present only in trace amounts within munitions used at the MRS. The compound is not anticipated to be present at detectable concentrations in MRS soils. Therefore, sampling is not planned for the RI. This decision is based on a determination that, for this SVOC, the total mass present at the MRSs would be very small.

Note #4 – Based on the review of the MIDAS database for munitions similar to those used at these sites, it has been determined this explosive compound would be present in only trace amounts within munitions used at the MRSs and is not anticipated to be present at detectable concentrations in MRS soils. Therefore, sampling is not planned for the RI. This decision is based on a determination that for this explosive, the total mass present at the these MRSs would be very small.

Note #5 – Further analysis for nitrocellulose, which was present in the artillery shells used at these MRSs, is not planned for the RI. This decision is based on the lack of a reliable analytical method for this analyte and because available data on human health affects and mammalian toxicity suggest nitrocellulose is virtually nontoxic[5].

The predominant pathway for introducing MC to the environment at these MRSs is from a MEC source area. Source areas within the MRS include potential areas where MEC may be distributed on the surface and in the subsurface from artillery training activities. Potential MC may also be located at the firing point even if a MEC source area is not identified. Therefore, the sampling of surface and subsurface (to the depth of observed MEC) soils is recommended.

MC sampling will be conducted at this site during the RI based on geophysical survey results and identification of MEC source areas. The firing points at these MRSs will also be sampled for MC. Based on the information provided in Table A-1 and the evaluation in Table 4-3, the following MC analyses and analytes are proposed for samples collected during the RI at these MRSs:

- Explosives, Method USEPA SW-846 8330B or 8330A: Nitroglycerin, PETN, RDX, TNT, and its breakdown products (2,4-DNT, 2,6-DNT, 2-Am-DNT, and 4-Am-DNT)

4.4 Fort Clinton West MRS, North Athletic Field MRS, Seacoast Battery MRS, and Target Hill MRS

The Fort Clinton West MRS (WSPT-008-R-01), Seacoast Battery MRS (WSPT-013-R-01), and Target Hill MRS (WSPT-017-R-01) were used for artillery training from as early as 1778 at Fort Clinton to approximately the WW II era. These MRSs encompass the range fans associated with several historical and overlapping firing ranges. The majority of the range fans associated with these historical ranges are encompassed within the Siege Battery MRS. In addition, the North Athletic Field MRS (WSPT-011-R-01) was created by the use of fill dirt that may contain artillery shells from the Target Hill area. During the SI, composite (spoke and hub) samples were collected from these MRSs and analyzed for metals and explosives. Iron was identified above the USEPA Region 9 PRGs within the Fort Clinton West MRS. Although no background data were available for this MRS, the area is known to have high levels of iron as a result of the highly oxidized iron content of the rocks. According to the *Geologic Map of New York,* 1970 compiled by the New York State Museum and Science Services, the soils in the vicinity of West Point are primarily derived from biotite-hornblende granite, granite gneiss, and rusty and gray biotite-quartz-feldspar gneisses[3]. These bedrocks are known to be high in iron content; therefore, soils derived from these rocks would also be high in iron. Therefore, it is assumed that the iron identified in the SI soil samples was naturally occurring.

The potential MC at this MRS as documented in Attachment 1 Table A-1 were evaluated to determine constituents and analysis to be performed during the SI and are presented in Table 4-4.

Table 4-4: Fort Clinton MRS, North Athletic Field MRS, Seacoast Battery MRS, and Target Hill MRS Analyte Evaluation

Analyte	Analysis Available?	Analysis Required?	Notes
Metals USEPA Method SW-846 3010A/3050B/ 6010B			
Iron	Yes	No	Note #1
Lead	Yes	Yes	Known MC associated with munitions
Metals USEPA Method SW-846 3050B/7471B			
Mercury	Yes	Yes	Known MC associated with munitions
Explosives USEPA Method SW-846 3535A/8330B or 8330A			
Nitroglycerin	Yes	Yes	Known MC associated with munitions
2,4,6-Trinitrotoluene (TNT)	Yes	Yes	Known MC associated with munitions
2,4-Dinitrotoluene (2,4-DNT)	Yes	Yes	Breakdown product of TNT
2,6-Dintrotoluene (2,6-DNT)	Yes	Yes	Breakdown product of TNT
2-Amino-4,6-dinitrotoluene (2-Am-DNT)	Yes	Yes	Breakdown product of TNT
4-Amino-2,6-dinitrotoluene (4-Am-DNT)	Yes	Yes	Breakdown product of TNT
Other Components			
Ammonium nitrate	Not available	No	Note #2
Diphenylamine	Yes (SW-846 8270C)	No	Note #3
Mercury fulminate	Not available	No	Note #2
Picric acid	Yes (SW-846 8330B)	No	Note #4
Potassium nitrate	Not available	No	Note #2
Nitrocellulose Method SW-846 9056/CRREL-ECB ERDC SOP			
Nitrocellulose	Note #5	No	Note #5

Notes:

Note #1 – Iron was associated with the munitions used at these MRSs. Based on a review of soil and geological data for the area, it has been determined that it occurs naturally in the soils[3]. It is not anticipated that iron from munitions would result in levels higher than those that occur naturally. Therefore, analysis for iron will not be conducted.

Note #2 – These explosives compounds do not have developed laboratory methods, but methods may exist for the individual components of these compounds. However, because the mass of the individual components is small, it is not anticipated that the components would be detected in the soil samples. Furthermore, the explosives used in the greatest quantity at these MRSs were TNT and nitroglycerin, which are insoluble in water and do not hydrolyze, volatilize, or bioconcentrate under normal environmental conditions. They also have average adsorption coefficients suggesting that they will reasonably adsorb to soil and sediments and maintain low soil mobility. Also, the volatilization rate from soil is extremely low[4]. Therefore, TNT, its breakdown products, and nitroglycerin are anticipated to remain in the environment and are good indicators for explosives at these MRSs. Analysis for TNT, its breakdown products, and nitroglycerin will be sufficient indicators of explosives contamination at the site and analysis will not be performed for other explosives compounds or their individual components.

Table 4-4: Fort Clinton MRS, North Athletic Field MRS, Seacoast Battery MRS, and Target Hill MRS Analyte Evaluation (Continued)

Note #3 – Based on the review of the MIDAS database for munitions similar to those used at these sites, it has been determined that this SVOC would be present only in trace amounts within munitions used at these MRSs. The compound is not anticipated to be present at detectable concentrations in MRS soils. Therefore, sampling is not planned for the RI. This decision is based on a determination that, for this SVOC, the total mass present at these MRSs would be very small.

Note #4 – Based on the review of the MIDAS database for munitions similar to those used at these sites, it has been determined this explosive compound would be present in only trace amounts within munitions used at these MRSs and is not anticipated to be present at detectable concentrations in MRS soils. Therefore, sampling is not planned for the RI. This decision is based on a determination that for this explosive, the total mass present at these MRSs would be very small.

Note #5 – Further analysis for nitrocellulose, which was present in the artillery shells used at these MRSs, is not planned for the RI. This decision is based on the lack of a reliable analytical method for this analyte and because available data on human health affects and mammalian toxicity suggest nitrocellulose is virtually nontoxic[5].

The predominant pathway for introducing MC to the environment at these MRSs is from a MEC source area. Source areas within the MRS include potential areas where MEC may be distributed on the surface and in the subsurface from artillery training activities. Therefore, the sampling of surface and subsurface (to the depth of observed MEC) soils is recommended.

MC sampling will be conducted at this site during the RI based on geophysical survey results and identification of potential MEC source areas. Samples collected from MEC source areas will be analyzed for metals and explosives. Based on the information provided in Table A-1 and the evaluation in Table 4-4, the following MC analyses and analytes are proposed for samples collected during the RI at these MRSs:

- Explosives, Method USEPA SW-846 8330B or 8330A: Nitroglycerin, TNT, and its breakdown products (2,4-DNT, 2,6-DNT, 2-Am-DNT, and 4-Am-DNT)
- Metals, Method USEPA SW-846 6010B: Lead (only if a MEC source area is identified)
- Metals, Method USEPA SW-846 3050B/7471B: Mercury (only if a MEC source area is identified)

4.5 Grey Ghost Housing Area MRS

The Grey Ghost Housing Area MRS (WSPT-010-R-01) was used for small arms training from approximately 1920 to sometime in the 1940s. In addition, MD associated with 3-inch Stokes mortars and 37mm rounds was identified during the SI. The MRS encompasses the range fans associated with the two historical firing ranges used for rifle and machine gun training. The actual location of the firing lines has been extensively developed within the Grey Ghost Housing Area and is encompassed with the Lusk

Reservoir MRS. During the SI, composite (spoke and hub) samples were collected from the Grey Ghost Housing Area MRS and analyzed for metals and explosives. No MC was identified above the USEPA Region 9 PRGs at this site.

The potential MC at this MRS as documented in Attachment 1 Table A-1 were evaluated to determine constituents and analysis to be performed during the SI and are presented in Table 4-5.

Table 4-5: Grey Ghost Housing Area Analyte Evaluation

Analyte	Analysis Available?	Analysis Required?	Notes
Metals USEPA Method SW-846 3010A/3050B/ 6010B			
Aluminum	Yes	No	Known MC associated with munitions; however it is not anticipated to be present at levels that would be potentially harmful.
Antimony	Yes	Yes	Known MC associated with munitions
Bismuth	Not available	No	Known MC associated with munitions; however, no established analytical method exists
Cadmium	Yes	Yes	Known MC associated with munitions
Chromium	Yes	Yes	Known MC associated with munitions
Cobalt	Yes	Yes	Known MC associated with munitions
Copper	Yes	Yes	Known MC associated with munitions
Iron	Yes	No	Note #1
Lead	Yes	Yes	Known MC associated with munitions
Magnesium	Yes	No	Known MC associated with munitions; however, screening criteria not available
Manganese	Yes	Yes	Known MC associated with munitions
Nickel	Yes	Yes	Known MC associated with munitions
Phosphorus	Yes	No	Known MC associated with munitions; however , it is not anticipated to be present at detectable concentrations in MRS soils
Tin	Yes	Yes	Known MC associated with munitions; however it is not anticipated to be present at levels that would be potentially harmful.
Titanium	Yes	Yes	Known MC associated with munitions
Vanadium	Yes	Yes	Known MC associated with munitions
Zinc	Yes	Yes	Known MC associated with munitions
Explosives USEPA Method SW-846 3535A/8330B or 8330A			
Nitroglycerin	Yes	Yes	Known MC associated with munitions
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	Yes	Yes	Known MC associated with munitions
2,4,6-Trinitrotoluene (TNT)	Yes	Yes	Known MC associated with munitions
2,4-Dinitrotoluene (2,4-DNT)	Yes	Yes	Breakdown product of TNT
2,6-Dintrotoluene (2,6-DNT)	Yes	Yes	Breakdown product of TNT
2-Amino-4,6-	Yes	Yes	Breakdown product of TNT

Table 4-5: Grey Ghost Housing Area Analyte Evaluation (Continued)

<table>
<tr><th>Analyte</th><th>Analysis Available?</th><th>Analysis Required?</th><th>Notes</th></tr>
<tr><td>dinitrotoluene (2-Am-DNT)</td><td></td><td></td><td></td></tr>
<tr><td>4-Amino-2,6-dinitrotoluene (4-Am-DNT)</td><td>Yes</td><td>Yes</td><td>Breakdown product of TNT</td></tr>
<tr><td>Methyl-2,4,6-trinitrophenyl nitramine (Tetryl)</td><td>Yes</td><td>Yes</td><td>Known MC associated with munitions</td></tr>
<tr><td colspan="4">Other Components</td></tr>
<tr><td>2-Nitrodiphenyl amine</td><td>Yes (SW-846 8270C)</td><td>No</td><td>Note #2</td></tr>
<tr><td>Antimony sulfide</td><td rowspan="4">Not available</td><td rowspan="4">No</td><td rowspan="4">Note #3</td></tr>
<tr><td>Barium stearate</td></tr>
<tr><td>Calcium resinate</td></tr>
<tr><td>Calcium stearate</td></tr>
<tr><td>Diethylphthalate</td><td rowspan="2">Yes (SW-846 8270C)</td><td rowspan="2">No</td><td rowspan="2">Note #2</td></tr>
<tr><td>Diphenylamine</td></tr>
<tr><td>Ethyl centralite</td><td rowspan="10">Not available</td><td rowspan="10">No</td><td rowspan="10">Note #3</td></tr>
<tr><td>Lead thiocyanate</td></tr>
<tr><td>Lead azide</td></tr>
<tr><td>Lead styphnate</td></tr>
<tr><td>Potassium chlorate</td></tr>
<tr><td>Potassium sulfide</td></tr>
<tr><td>Potassium nitrate</td></tr>
<tr><td>Sodium sulfate</td></tr>
<tr><td>Strontium peroxide</td></tr>
<tr><td>Zinc stearate</td></tr>
<tr><td colspan="4">Nitrocellulose Method SW-846 9056/CRREL-ECB ERDC SOP</td></tr>
<tr><td>Nitrocellulose</td><td>Note #4</td><td>No</td><td>Note #4</td></tr>
</table>

Notes:

Note #1 – Iron was associated with the munitions used at the Grey Ghost Housing Area MRS. Based on a review of soil and geological data for the area, it has been determined that it occurs naturally in the soils[3]. It is not anticipated that iron from munitions would result in levels higher than those that occur naturally. Therefore, analysis for iron will not be conducted.

Note #2 – Based on the review of the MIDAS database for munitions similar to those used at this site, it has been determined that these SVOCs would be present only in trace amounts within munitions used at the MRS. These compounds are not anticipated to be present at detectable concentrations in MRS soils. Therefore, sampling is not planned for the RI. This decision is based on a determination that, for this SVOC, the total mass present at the Grey Ghost Housing Area MRS would be very small.

Note #3 – These explosives compounds do not have developed laboratory methods, but methods may exist for the individual components of these compounds. However, because the mass of the individual components is small, it is not anticipated that the components would be detected in the soil samples. Furthermore, the explosives used in the greatest quantity at the Grey Ghost Housing Area MRS were TNT and nitroglycerin, which are insoluble in water and do not hydrolyze, volatilize, or bioconcentrate under normal environmental conditions. They also have average adsorption coefficients suggesting that they will reasonably adsorb to soil and sediments and maintain low soil mobility. Also, the volatilization rate from soil is extremely low[4]. Therefore, TNT, its breakdown products, and nitroglycerin are anticipated to remain in the environment and are good indicators for explosives at the

Table 4-5: Grey Ghost Housing Area Analyte Evaluation (Continued)

Grey Ghost Housing Area MRS. Analysis for TNT, its breakdown products, and nitroglycerin will be sufficient indicators of explosives contamination at the site and analysis will not be performed for other explosives compounds or their individual components.

Note #4 – Further analysis for nitrocellulose, which was present in the munitions at the Grey Ghost Housing Area MRS, is not planned for the RI. This decision is based on the lack of a reliable analytical method for this analyte and because available data on human health affects and mammalian toxicity suggest nitrocellulose is virtually nontoxic[5].

The predominant pathway for introducing MC to the environment at the Grey Ghost Housing Area MRS is from a MEC source area. Source areas within the MRS include potential areas where MEC may be distributed on the surface and in the subsurface from artillery training activities. Therefore, the sampling of surface and subsurface (to the depth of observed MEC) soils is recommended.

MC sampling will be conducted at this site during the RI based on geophysical survey results and identification of potential MEC source areas. Samples collected from MEC source areas will be analyzed for metals and explosives. Based on the information provided in Table A-1 and the evaluation in Table 4-5, the following MC analyses and analytes are proposed for samples collected during the RI at the Grey Ghost Housing Area MRS:

- Explosives, Method USEPA SW-846 8330B or 8330A: Nitroglycerin, RDX, Tetryl, TNT, and its breakdown products (2,4-DNT, 2,6-DNT, 2-Am-DNT, and 4-Am-DNT)
- Metals, Method USEPA SW-846 6010B: Antimony, cadmium, chromium, cobalt, copper, lead, manganese, nickel, titanium, vanadium, and zinc

4.6 Michie Stadium MRS

The Michie Stadium MRS (WSPT-022-R-01) encompasses an area in which Stokes mortars were indentified during construction projects. There is no historical information indicating that this area was part of a range used for military training. During the SI, composite (spoke and hub) samples were collected from the Michie Stadium MRS and analyzed for metals and explosives. No MC were identified above the USEPA Region 9 PRGs at this MRS.

The potential MC at this MRS as documented in Attachment 1 Table A-1 were evaluated to determine constituents and analysis to be performed during the SI and are presented in Table 4-6.

Table 4-6: Michie Stadium Analyte Evaluation

Analyte	Analysis Available?	Analysis Required?	Notes
Metals USEPA Method SW-846 3010A/3050B/ 6010B			
Iron	Yes	No	Note #1
Lead	Yes	Yes	Known MC associated with munitions
Explosives USEPA Method SW-846 3535A/8330B or 8330A			
Nitroglycerin	Yes	Yes	Known MC associated with munitions
2,4,6-Trinitrotoluene (TNT)	Yes	Yes	Known MC associated with munitions
2,4-Dinitrotoluene (2,4-DNT)	Yes	Yes	Breakdown product of TNT
2,6-Dintrotoluene (2,6-DNT)	Yes	Yes	Breakdown product of TNT
2-Amino-4,6-dinitrotoluene (2-Am-DNT)	Yes	Yes	Breakdown product of TNT
4-Amino-2,6-dinitrotoluene (4-Am-DNT)	Yes	Yes	Breakdown product of TNT
Other Components			
Antimony sulfide	Not available	No	Note #2
Diethylphthalate	Yes (SW-846 8270C)	No	Note #3
Ethyl centralite	Not available	No	Note #2
Lead thiocyanate			
Potassium chlorate			
Nitrocellulose Method SW-846 9056/CRREL-ECB ERDC SOP			
Nitrocellulose	Note #4	No	Note #4

Notes:

Note #1 – Iron was associated with the munitions identified at the Michie Stadium MRS. Based on a review of soil and geological data for the area, it has been determined that it occurs naturally in the soils[3]. It is not anticipated that iron from munitions would result in levels higher than those that occur naturally. Therefore, analysis for iron will not be conducted.

Note #2 – These explosives compounds do not have developed laboratory methods, but methods may exist for the individual components of these compounds. However, because the mass of the individual components is small, it is not anticipated that the components would be detected in the soil samples. Furthermore, the greatest quantity of explosives associated with munitions identified at the Michie Stadium MRS were TNT and nitroglycerin, which are insoluble in water and do not hydrolyze, volatilize, or bioconcentrate under normal environmental conditions. They also have average adsorption coefficients suggesting that they will reasonably adsorb to soil and sediments and maintain low soil mobility. Also, the volatilization rate from soil is extremely low[4]. Therefore, TNT, its breakdown products, and nitroglycerin are anticipated to remain in the environment and are good indicators for explosives at the Michie Stadium MRS. Analysis for TNT, its breakdown products, and nitroglycerin will be sufficient indicators of explosives contamination at the site and analysis will not be performed for other explosives compounds or their individual components.

Note #3 – Based on the review of the MIDAS database for munitions similar to those used at this site, it has been determined that this SVOC would be present only in trace amounts within munitions identified at the MRS. The compound is not anticipated to be present at detectable concentrations in

Table 4-6: Michie Stadium Analyte Evaluation (Continued)

MRS soils. Therefore, sampling is not planned for the RI. This decision is based on a determination that, for this SVOC, the total mass present at the Michie Stadium MRS would be very small.

Note #4 – Further analysis for nitrocellulose, which was present in the stokes mortars found at the Michie Stadium MRS, is not planned for the RI. This decision is based on the lack of a reliable analytical method for this analyte and because available data on human health affects and mammalian toxicity suggest nitrocellulose is virtually nontoxic[5].

The predominant pathway for introducing MC to the environment the Michie Stadium MRS is from a MEC source area. Source areas within the MRS include potential areas where MEC may be distributed on the surface and in the subsurface. Therefore, the sampling of surface and subsurface (to the depth of observed MEC) soils is recommended.

MC sampling will be conducted at this site during the RI based on geophysical survey results and identification of potential MEC source areas. The method for collecting samples will be determined based on the criteria outlined in Section 3.0, above. Samples collected from MEC source areas will be analyzed for metals and explosives. Based on the information provided in Table A-1 and the evaluation in Table 4-6, the following MC analyses and analytes are proposed for samples collected during the RI at the Michie Stadium MRS:

- Explosives, Method USEPA SW-846 8330B or 8330A: Nitroglycerin, TNT, and its breakdown products (2,4-DNT, 2,6-DNT, 2-Am-DNT, and 4-Am-DNT)
- Metals, Method USEPA SW-846 6010B: Lead

ATTACHMENT 1: POTENTIAL MEC AND MC

The following section provides a summary of the potential MEC and MC at West Point as identified during the SI completed in 2007. Because of the time period of munitions used at West Point, specific nomenclature for the munitions was not available in the historical records; therefore, generic MC information was compiled for these items. In addition to the Munitions Items Disposition Action System (MIDAS) database, which provides MC data for munitions, the following sources were used to compile this information:

Army Documents

- Office of the Chief of Ordnance, Technical Division, Catalogue of Standard Ordnance Items, Volume III, 1944
- Office of the Chief of Ordnance, Handbook Number 1939, History of Artillery Projectiles, 1921
- Notes on Ammunition, U.S. Army Coast Artillery School, Fort Monroe, VA, 1918
- TM 4-205, Coast Artillery Ammunition, 1940
- TM 43-0001-27, Army Ammunition Data Sheets, Small Caliber Ammunition
- TM 43-0001-28, Army Ammunition Data Sheets, Artillery Ammunition, Guns, Howitzers, Mortars, Recoilless Rifles, Grenade Launchers, and Artillery Fuzes
- TM 9-1300-200, Ammunition General
- TM 9-1300-203, Ammunition for Antiaircraft, Tank, Antitank, and Field Artillery Weapons
- TM 9-1300-214, Military Explosives
- TM 9-1900, Ammunition General
- TM 9-1901, Artillery Ammunition
- TM 9-1910, Military Explosives
- TM 9-1990, Small Arms Ammunition

Navy Documents

- OP 1664, U.S. Explosive Ordnance, 1947
- Civil War Explosive Ordnance, U.S. Naval School, Explosive Ordnance Disposal, Indianhead, MD, (undated)

Other Sources

- Notes on Ammunition of the American Civil War, Colonel Berkley R. Lewis, U.S Army Ordnance Corps
- Civil War Ordnance, Volume II, American Ordnance Association

- Civil War Projectiles II, W. Reid McKee and M. E. Mason, Jr.
- Arms and Equipment of the Civil War, Jack Coggins
- American Civil War Artillery, 1861-1865, Philip Katcher
- Artillery and Ammunition of the American Civil War, Warren Ripley

All statements of fact presented below were compiled from the sources listed above. The information is presented for various munitions types that were used at West Point and then summarized for each MRS in Table A-1, located at the end of this attachment.

Small Arms Ammunition

Small arms were used at the Grey Ghost Housing Area MRS and the North Athletic Field MRS. In addition, the firing point of the Grey Ghost Housing Area MRS was located within the area encompassed by the Lusk Reservoir MRS. Weapons fired at these ranges included .22 caliber rifles, .30 caliber machine guns, and .22 caliber machine guns. Complete small arms rounds are not considered MEC; therefore, MEC associated with small arms is not anticipated at these sites. In addition, munitions debris (MD) associated with small arms was not identified during the SI completed in January 2007.

Based on a review of the sources listed at the beginning of this attachment, the potential MC for machine gun ammunition at the firing point may include black powder (comprised of potassium nitrate, sulfur and charcoal), nitrocellulose (NC), dinitrotoluene (DNT), trinitrotoluene (TNT), and nitroglycerin (NG). The potential MC downrange for machine guns includes TNT and lead; however, black powder is non-toxic and is not considered a hazardous MC.

In addition to the MC associated with machine gun ammunition, there also is potential for MC to be associated with other small arms at the firing points on small arms ranges. Although MC such as lead, NC, NG, picric acid, TNT, DNT, and mercury fulminate may be present at the firing points, the probability is low for these MC to be present. The lead would only be associated with the dust created by the friction of firing a projectile and the explosives would primarily be consumed during firing of the munitions. Therefore, a very insignificant amount of these MC may remain at the firing point. The potential MC from these small arms that can be found down range in target berms is primarily lead with much smaller amounts of antimony and copper from the bullets.

Artillery

Historical documentation indicates that artillery was used at the ranges associated with the following MRSs: Artillery Firing Range, Battery Knox-TD Land, Fort Clinton West, Seacoast Battery, Siege Battery, Target Hill, Lusk Reservoir, and Redoubt No. 2. In addition, the North Athletic Field MRS may contain fill dirt containing artillery shells from the Target Hill impact area. The weapons systems and artillery used at these ranges, based on historical documentation and munitions found at the ranges, include:

2.95-inch howitzers
7-inch steel-breech-loading howitzers
7-inch howitzers
7-inch breech-loading rifle howitzers
75mm howitzers
105mm howitzers
15mm howitzers
75mm guns
6-inch high capacity guns
Brass 4-pounders
Iron 6-pounders
Iron 12-pounders
Iron 18-pounders
30-pound Parrott guns
100-pound Parrott guns
20-pound Parrott guns
300-pound Parrott guns
Brass mortars
60mm mortars
81mm mortars
4.2-inch mortars
7-inch breech-loading mortars
8-inch smooth bore siege mortars
12-inch breech-loading rifle mortars
13-inch smooth bore mortars
15-inch mortars
16-inch mortars
2.36-inch rocket launchers
3.5-inch rocket launchers
3.2-inch field guns
4½-inch rifled guns
8-inch muzzle-loading rifles
5-inch steel breech-loading guns
6-inch disappearing coastal defense guns
8-inch Rodman guns
10-inch muzzle-loading Rodman guns
5-inch smooth bore Rodman guns

Although historical records identify the types of munitions used at various ranges, the specific nomenclature of the munitions used is not typically available from the historical record. In addition, it is evident based on a review of the sources listed at the beginning of this attachment that prior to World War II, there was little effort made to ensure the consistency of munitions and their constituents. Therefore, only general information is available regarding the MC associated with artillery munitions from this period. Following is a summary of the MC associated with the artillery used at West Point.

Based on the time frame of use, all the artillery shells casings would have been either cast iron or steel. Therefore, iron may be a MC associated with discarded munitions at firing points and associated with projectiles down range.

Based on a review of the sources listed at the beginning of this attachment, it was determined that nitrocellulose powder was adopted by the Army in 1899 as an explosive in artillery shells; thus, NC is considered potential MC for artillery used starting in 1899. Diphenylamine was introduced as a stabilizer in 1909, making this a potential MC for artillery used starting in 1909.

Projectile Fillers and Bursting Charges for Projectiles

In 1912, the U.S. Army adopted TNT as a projectile filler as a replacement for picric acid. Prior to the use of picric acid, black powder was used for the bursting charges in projectiles. During the time frame of 1912 to 1940, 50-50 Amatol, a mixture of 50 percent ammonium nitrate and 50 percent TNT was often used as a substitution for pure TNT. Therefore potential MC for artillery used prior to 1912 includes, but is not limited to, picric acid and black powder (comprised of a non-toxic blend of potassium nitrate, sulfur and charcoal) and could be found at the firing point associated with discarded munitions or resulting from detonation of explosives during firing and down range. Potential MC for artillery used between 1912 and 1940 includes, but is not limited to TNT and ammonium nitrate and could be found at the firing point and down range.

Fuzes

Prior to 1905, any number of standard or non-standard fuzes could have been used in artillery shells. The primary energetic components of fuzes used after 1905 were mercury fulminate and black powder. Mercury fulminate is considered an MC; however, black powder (comprised of potassium nitrate, sulfur, and charcoal) is non-toxic and is not considered a hazardous MC. These constituents may be found at the firing point could be found at the firing point associated with discarded munitions or resulting from detonation of explosives during firing and down range. The fuzes themselves are considered potential MEC and may be found at the firing point as discarded munitions and down range.

Primers and Propellants

Primers could be found abandoned at all artillery firing ranges and are potential MEC. Potential MC from primers include sulfur, potassium chlorate, antimony sulfate, black powder (non-toxic), and mercury fulminate, and would only be found at the firing points. In addition, post Civil War priming mixes may also include lead styphnate, lead azide, lead thiocyanate, antimony sulfide, potassium chlorate, aluminum powder, tetracene, TNT, and pentaerythritol tetranitrate (PETN) in various mixes. Battery Knox, Fort Clinton, Seacoast Battery, Siege Battery, and Target Hill ranges were constructed in an era when primer material for artillery fuses contained lead and mercury; therefore, these constituents are also listed as potential MC for the respective ranges and for the North Athletic Field MRS.

The propellants used with artillery at West Point varied over time. Prior to 1906, black powder (non-toxic) or NC was used as propellants. After 1906, NC or a mixture of NC/NG was used. These constituents would be potential MC for the artillery firing points.

Rodman Guns, Parrott Rifles and Guns, Muzzle Loaders, and Breech Loaders

All muzzle loaders and breech loaders that did not have cartridges (such as Rodman Guns, Parrott Rifles, and 8-inch converted rifles) were loaded with bagged propellant, and thus would not have expended cartridges and/or discarded cartridges. The bagged charges were loaded with black powder (non-toxic); therefore, black powder may be present at the firing points for these weapons. Guns with cartridges would have left these expended and discarded cartridges at the firing point. The potential MC associated with these cartridges are NC, diphenylamine, and black powder (non-toxic).

Weapons such as 20- and 30-pound Parrott Rifles could have had primers, black powder propelling charges, and unfired black powder loaded projectiles abandoned at the firing points. The black powder-loaded projectiles and related solid shot could be found down range. The 100-, 200-, and 300-pound Parrott guns could have abandoned primers, fuzes, black powder propelling charges, and unfired black powder-filled shells at their firing points. Only the fuzes, black powder-filled shells, and related solid-shot would be found down range.

Virtually all of the Parrott Rifles and Rodman guns could fire black powder-loaded shells, solid iron shot, grapeshot, and canisters. Grapeshot is a grouping of large iron balls that are solid and inert. The canister (also known as case shot) is similar to grapeshot, except the balls were smaller and made of cast iron, lead, or brass. The metallic balls were packaged in a tin casing. The 8-inch and 10-inch Rodman Guns could have abandoned primers, fuzes, black powder propelling charges, and black powder-filled shells at the firing point. Only the fuzes, black powder-filled shells, and related solid shot would be found down range. This is also true for 8-inch converted rifles. It should be noted that the solid shot, grape shot, canisters, and iron ball are not considered to have an explosive issue associated with them, and, therefore, are not considered MEC.

Shrapnel Projectiles and Sub-Caliber Devices

Shrapnel projectiles are munitions with a powder-train timed fuze that are loaded with lead balls in a resin matrix, with a black powder ejection charge. The fuzes and projectiles could be found at both the firing point and down range.

Weapons firing sub-caliber devices could have the sub-caliber cartridge containing either a sand filled or solid steel projectile abandoned at the firing point. The potential MC associated with these weapons includes NC and NG. The fired projectiles could also be found down range.

Time-Dependent Artillery

Both Battery Knox and Siege Battery were used over an extended period of time. Based on their use over this large span of time, the potential MC are time-dependent and have evolved.

Between 1869 and 1891, the weapons listed as being used at these ranges may have abandoned primers, fuzes, black powder propelling charges, and black powder-filled projectiles at the firing points. Only the fuzes, black powder-filled projectiles, and related shot would be found down range.

From 1892 to 1899, all of the weapons listed except for the 10-inch smooth bore mortars and 3.2-inch field guns could have primers, fuzes, NC propelling charges and high explosive (picric acid, not TNT), and shrapnel projectiles found down range. The 10-inch smooth bore mortar could have primers, fuzes, black powder propelling charges, and black powder projectiles abandoned at the firing point, and fuzes and black powder projectiles down range. The 2.5-inch siege rifles and the 3.2-inch field guns could have cartridges containing either black powder or NC propelling charges, or black powder shrapnel propelling charges abandoned at the firing point. Only the black powder shrapnel projectiles would be found down range for the 2.5-inch siege rifles and the 3.2-inch field guns.

From 1906 through 1918, all listed weapons could have primers, fuzes, NC or NC/NG based propelling charges and high explosive (picric acid or TNT) loaded projectiles abandoned at the firing site. With the exception of the mortars, all weapons could also have black powder shrapnel projectiles down range. In addition, with the exception of the mortars, all of the listed weapons could have sub-caliber devices installed on the weapon instead of the service ammunition to practice firing. When this was done, the sub-caliber cartridge (NC or NC/NG propellant) containing a sand filled or solid steel projectile could have been abandoned at the firing point and the fired projectiles could be found down range.

Mortars

Stokes mortars have been identified at the Siege Battery, Grey Ghost Housing Area, and Michie Stadium MRSs. Mark I stokes mortars, like those identified at West Point, were in use by the Army during WWI and until just prior to WWII. The Mark I weighed approximately 12 pounds and contained approximately 2.75 pounds of nitrostarch explosive compound. The filler for the mortar was sand, nitrostarch, or TNT. The ignition cartridges contained NC, NG, diethylphthalate, ethyl centralite, potassium chlorate, lead thiocyanate, antimony sulfide, and TNT. The nose plugs were present on the stokes mortars that were found at Michie Stadium; therefore, no fuzes were present and it is assumed that these items are discarded military munitions (DMM). The stokes mortars found at Grey Ghost Housing Area and the Siege Battery MRSs did not contain fuzes.

Anti-Tank Rounds

Munitions debris associated with 37mm anti-tank rounds have been identified at the Grey Ghost Housing Area MRS. It is not anticipated that the firing point for these munitions was located with this MRS. MEC associated with the impact area for 37mm rounds would include projectiles and high explosive fuzes. The canisters would be comprised of copper, zinc, lead, and iron and would be filled with a mixture of manganese, sulfur, phosphorus, magnesium, cobalt, chromium, cadmium, aluminum, tin, bismuth, vanadium, potassium nitrate, antimony sulfide, titanium, potassium sulfide, 2-nitrodiphenyl amine, calcium resinate, calcium stearate, nickel, calcium carbonate, zinc stearate, TNT, tetryl, barium stearate, strontium peroxide, RDX, lead styphnate, lead thiocyanate, potassium chlorate, lead azide, diphenylamine, sodium sulfate, antimony sulfide. Therefore, these are considered to be MC.

Table A-1: Summary of Potential MEC and MC

Note: Several MRSs encompass multiple historical ranges. The information noted below includes the information for all historical ranges associated with the MRS.

Munitions Response Area	Potential Munitions	Potential Primary Release Mechanism	Potential MEC at Firing Point*	Potential MC at Firing Point	Potential MEC Down Range*	Potential MC Down Range
Artillery Firing Range	Artillery	2.95-inch Mountain Howitzers, 75mm gun M1897, 75mm gun M1907, 6-inch high capacity gun, 15-inch mortar, 16-inch mortar	75mm munitions; 6-inch MK 34 projectiles; Powder Train Time Fuze 1907-M fuzes; 75mm HE and ejection rounds, 15-inch and 16-inch mortar rounds; fuzes associated with discarded full rounds, friction primers, and percussion primers	Mercury fulminate, potassium nitrate, sulfur, NC, NG, picric acid, diphenylamine, TNT, ammonium nitrate, lead styphnate, lead azide, lead thiocyanate, antimony sulfate, antimony sulfide, potassium chlorate, aluminum powder, tetracene, PETN, iron	Powder Train Time Fuze 1907-M fuzes, 75mm HE and ejection rounds and fuzes	NC, diphenylamine, picric acid, potassium nitrate, sulfur, TNT, ammonium nitrate, mercury fulminate, NG, iron
		Lusk Reservoir: 2.95-inch Mountain Howitzers, 75mm gun M1897, 75mm gun M1907, 6-inch high capacity gun, 15-inch mortar, 16-inch mortar	Lusk Reservoir: Not applicable (firing point is not located within this MRS)		Lusk Reservoir: Powder Train Time Fuze 1907-M fuzes, 75mm HE and ejection rounds and fuzes	
		Redoubt No. 2: 2.95-inch Mountain Howitzers, 75mm gun M1897, 75mm gun M1907, 6-inch high capacity gun, 15-inch mortar, 16-inch mortar	Redoubt No. 2: Not applicable (firing point is not located within this MRS)		Redoubt No. 2: Powder Train Time Fuze 1907-M fuzes, 75mm HE and ejection rounds, fuzes	

Table A-1: Summary of Potential MEC and MC (continued)

Munitions Response Area	Potential Munitions	Potential Primary Release Mechanism	Potential MEC at Firing Point*	Potential MC at Firing Point	Potential MEC Down Range*	Potential MC Down Range
		Additional items observed during previous investigations: MK1A1 Training Hand Grenade, M21 Practice Hand Grenade, .30-06 small arms blanks, Projectile, 8-inch Naval Munitions, 35mm silver tail signal flare,		Black powder, smokeless propellant, copper, aluminum		Aluminum alloy, zinc alloy, ammonium nitrate (amatol), ammonium picrate (explosive D), tetryl, RDX (Comp A3), copper, aluminum, TNT, black powder, barium nitrate, strontium nitrate, magnesium
Battery Knox-TD Land	Artillery	100-lb Parrott guns, 200-lb Parrott guns, 8-inch Rodman guns, 10-inch muzzle-loaded Rodman guns	Not applicable (no firing point is located within this MRS)	Not applicable (no firing point is located within this MRS)	Fuzes, black powder-filled shells	NC, diphenylamine, picric acid, potassium nitrate, sulfur, TNT, ammonium nitrate, mercury fulminate, NG, iron, lead, mercury
Fort Clinton West	Artillery	Brass 4-pounder, brass mortars, iron 12-pounder, iron 18-pounder, 75mm guns Artillery Firing Range: 2.95-inch Mountain Howitzers, 75mm gun M1897, 75mm gun M1907, 6-inch high capacity gun, 15-inch mortar, 16-inch mortar Lusk Reservoir: 2.95-inch Mountain Howitzers, 75mm gun M1897, 75mm gun M1907, 6-inch high capacity gun, 15-inch mortar, 16-inch mortar	Not applicable (firing points are not located within the MRS)	N/A (firing points are not located within the MRS)	black powder-filled shells Artillery Firing Range: Powder Train Time Fuze 1907-M fuzes, 75mm HE and ejection rounds and fuzes Lusk Reservoir: Powder Train Time Fuze 1907-M fuzes, 75mm HE and ejection rounds and fuzes	NC, diphenylamine, picric acid, potassium nitrate, sulfur, TNT, ammonium nitrate, mercury fulminate, NG, iron, lead, mercury

Table A-1: Summary of Potential MEC and MC (continued)

Munitions Response Area	Potential Munitions	Potential Primary Release Mechanism	Potential MEC at Firing Point*	Potential MC at Firing Point	Potential MEC Down Range*	Potential MC Down Range
Grey Ghost Housing Area	Small arms	.22 caliber machine guns, .30 caliber machine guns, .22 caliber rifle	No MEC is expected	N/A (firing point is not located within the MRS)	No MEC is expected	Lead, TNT, black powder, copper, antimony
	Anti-tank Gun	37mm canister	Not applicable (firing point is not located within the MRS)	N/A (firing point is not located within the MRS)	Projectiles and fuzes, HE	Copper, zinc, lead, iron, manganese, sulfur, phosphorus, magnesium, cobalt, chromium, cadmium, aluminum, tin, bismuth, vanadium, potassium nitrate, antimony sulfide, titanium, potassium sulfide, 2-nitrodiphenyl amine, calcium resinate, calcium stearate, nickel, calcium carbonate, zinc stearate, TNT, tetryl, barium stearate, strontium peroxide, RDX, lead styphnate, lead thiocyanate, potassium chlorate, lead azide, diphenylamine, sodium sulfate, antimony sulfide
	Mortars	3-inch Stokes Mortars	Complete mortars	NC, NG, diphenylamine, diethylphthalate, ethyl centralite, potassium chlorate, lead thiocyanate, antimony sulfide, and TNT	Mortar casing	NC, NG, diphenylamine, diethylphthalate, ethyl centralite, potassium chlorate, lead thiocyanate, antimony sulfide, and TNT

Table A-1: Summary of Potential MEC and MC (continued)

Munitions Response Area	Potential Munitions	Potential Primary Release Mechanism	Potential MEC at Firing Point*	Potential MC at Firing Point	Potential MEC Down Range*	Potential MC Down Range
North Athletic Field	Artillery	Large caliber HE and practice rounds Siege Battery: Iron 6-pounders, 4½-inch rifled gun, 30-lb. Parrott gun, 10-inch smooth bore siege mortars, 8-inch smooth bore siege mortars, 3.2-inch field guns, 5-inch steel breech-loading gun, 7-inch steel breech-loading howitzers, 7-inch howitzers, 7-inch breech-loading mortars, 7-inch breech-loading rifle howitzers, 6-inch disappearing coastal defense gun Fort Clinton: Brass 4-pounder, brass mortars, iron 12-pounder, iron 18-pounder, 75mm guns	Not Applicable (no firing occurred in this area)	Not Applicable (no firing occurred in this area)	Fuzes, black powder-filled projectiles, HE and shrapnel loaded projectiles Siege Battery: Fuzes, black powder-filled projectiles, canisters, HE and shrapnel loaded projectiles Fort Clinton: Powder Train Time Fuze 1907-M fuzes, 75mm HE and ejection rounds and fuzes	NC, diphenylamine, picric acid, potassium nitrate, sulfur, TNT, ammonium nitrate, mercury fulminate, NG, iron, lead, mercury
	Small arms	.22 caliber rifles	No MEC is expected	NC, NG, picric acid, TNT, DNT, mercury fulminate, lead	No MEC is expected	Lead, copper, antimony
Seacoast Battery	Artillery	8-inch Rodman rifle, 10-inch Rodman rifle, 15-inch Rodman rifle, 100-lb Parrott gun, 200-lb Parrott gun, 300-lb Parrott gun, 8-inch muzzle loading rifle, 15-inch smooth bore Rodman guns, 13-inch smooth bore mortar, 12-inch breech-loading rifle mortar Siege Battery: Iron 6-pounders, 4½-inch rifled gun, 30-lb. Parrott gun, 10-inch smooth bore siege mortars, 8-inch smooth bore siege mortars, 3.2-inch field guns, 5-inch steel breech-loading gun, 7-inch steel breech-loading howitzers, 7-inch howitzers, 7-inch breech-loading mortars, 7-inch breech-loading rifle howitzers, 6-inch disappearing coastal defense gun	Not Applicable (firing point is within Siege Battery MRS)	Not Applicable (firing point is within Siege Battery MRS)	Fuzes, black powder-loaded shells Siege Battery: Fuzes, black powder-filled projectiles, canisters, HE and shrapnel loaded projectiles	NC, diphenylamine, picric acid, potassium nitrate, sulfur, TNT, ammonium nitrate, mercury fulminate, NG, iron, lead, mercury

Table A-1: Summary of Potential MEC and MC (continued)

Munitions Response Area	Potential Munitions	Potential Primary Release Mechanism	Potential MEC at Firing Point*	Potential MC at Firing Point	Potential MEC Down Range*	Potential MC Down Range
Siege Battery	Artillery	Iron 6-pounders, 4½-inch rifled gun, 30-lb. Parrott gun, 10-inch smooth bore siege mortars, 8-inch smooth bore siege mortars, 3.2-inch field guns, 5-inch steel breech-loading gun, 7-inch steel breech-loading howitzers, 7-inch howitzers, 7-inch breech-loading mortars, 7-inch breech-loading rifle howitzers, 6-inch disappearing coastal defense gun	Fuzes associated with discarded full rounds, black powder propelling charges, black powder-loaded projectiles, NC propelling charges, HE and shrapnel loaded projectiles, friction primers, percussion primers, sub-caliber cartridges	Mercury fulminate, potassium nitrate, sulfur, NC, NG, picric acid, diphenylamine, TNT, ammonium nitrate, lead styphnate, lead azide, lead thiocyanate, antimony sulfate, antimony sulfide, potassium chlorate, aluminum powder, tetracene, PETN, iron, lead, mercury	Fuzes, black powder-filled projectiles, canisters, HE and shrapnel loaded projectiles	NC, diphenylamine, picric acid, potassium nitrate, sulfur, TNT, ammonium nitrate, mercury fulminate, NG, iron, lead, mercury
		Fort Clinton: Brass 4-pounder, brass mortars, iron 12-pounder, iron 18-pounder, 75mm guns	Fort Clinton: Not applicable (firing point is not located within MRS)		Fort Clinton: Powder Train Time Fuze 1907-M fuzes, 75mm HE and ejection rounds and fuzes	
		Artillery Firing Range: 2.95-inch Mountain Howitzers, 75mm gun M1897, 75mm gun M1907, 6-inch high capacity gun, 15-inch mortar, 16-inch mortar	Artillery Firing Range: Not applicable (firing point is not located with MRS)		Artillery Firing Range: Powder Train Time Fuze 1907-M fuzes, 75mm HE and ejection rounds 15-inch and 16-inch mortars, and fuzes	
		Seacoast Battery: 8-inch Rodman rifle, 10-inch Rodman rifle, 15-inch Rodman rifle, 100-lb Parrott gun, 200-lb Parrott gun, 300-lb Parrott gun, 8-inch muzzle loading rifle, 15-inch smooth bore	Seacoast Battery: Friction primers, percussion primers, fuzes, black powder		Seacoast Battery: Fuzes, black powder-loaded shells	

Table A-1: Summary of Potential MEC and MC (continued)

Munitions Response Area	Potential Munitions	Potential Primary Release Mechanism	Potential MEC at Firing Point*	Potential MC at Firing Point	Potential MEC Down Range*	Potential MC Down Range
		Rodman guns, 13-inch smooth bore mortar, 12-inch breech-loading rifle mortar	propelling charges, unfired black powder shells			
	Mortars	3-inch Stokes Mortars	Complete mortars	NC, NG, diphenylamine, diethylphthalate, ethyl centralite, potassium chlorate, lead thiocyanate, antimony sulfide, and TNT	Mortar casing	NC, NG, diphenylamine, diethylphthalate, ethyl centralite, potassium chlorate, lead thiocyanate, antimony sulfide, and TNT
Target Hill	Artillery	Large caliber HE and practice rounds Siege Battery: Iron 6-pounders, 4½-inch rifled gun, 30-lb. Parrott gun, 10-inch smooth bore siege mortars, 8-inch smooth bore siege mortars, 3.2-inch field guns, 5-inch steel breech-loading gun, 7-inch steel breech-loading howitzers, 7-inch howitzers, 7-inch breech-loading mortars, 7-inch breech-loading rifle howitzers, 6-inch disappearing coastal defense gun Fort Clinton: Brass 4-pounder, brass mortars, iron 12-pounder, iron 18-pounder, 75mm guns	Not Applicable (no firing occurred in this area)	Not Applicable (no firing occurred in this area)	Fuzes, black powder-filled projectiles, HE and shrapnel loaded projectiles Siege Battery: Fuzes, black powder-filled projectiles, canisters, HE and shrapnel loaded projectiles Fort Clinton: Powder Train Time Fuze 1907-M fuzes, 75mm HE and ejection rounds and fuzes	NC, diphenylamine, picric acid, potassium nitrate, sulfur, TNT, ammonium nitrate, mercury fulminate, NG, iron, lead, mercury

Table A-1: Summary of Potential MEC and MC (continued)

Munitions Response Area	Potential Munitions	Potential Primary Release Mechanism	Potential MEC at Firing Point*	Potential MC at Firing Point	Potential MEC Down Range*	Potential MC Down Range
Lusk Reservoir	Artillery	2.95-inch Mountain Howitzers, 75mm gun M1897, 75mm gun M1907, 6-inch high capacity gun, 15-inch mortar, 16-inch mortar	75mm munitions, 6-inch MK 34 projectiles, Powder Train Time Fuze 1907-M fuzes, 75mm HE and ejection rounds, and fuzes, friction primers, percussion primers	Mercury fulminate, potassium nitrate, sulfur, NC, NG, diphenylamine, TNT, ammonium nitrate	Powder Train Time Fuze 1907-M fuzes, 75mm HE and ejection rounds and fuzes	NC, diphenylamine, picric acid, potassium nitrate, sulfur, TNT, ammonium nitrate, mercury fulminate, NG, iron
	Small Arms	Grey Ghost Housing Area: .22 caliber machine guns, .30 caliber machine guns, .22 caliber rifle	No MEC is expected	black powder, NC, NG, picric acid, TNT, DNT, mercury fulminate, lead		Not applicable (target area is not within MRS)
Redoubt No. 2	Artillery	2.95-inch Mountain Howitzers, 75mm gun M1897, 75mm gun M1907, 6-inch high capacity gun, 15-inch mortar, 16-inch mortar	75mm munitions, 6-inch MK 34 projectiles, Powder Train Time Fuze 1907-M fuzes, 75mm HE and ejection rounds, and fuzes, friction primers, percussion primers	Mercury fulminate, potassium nitrate, sulfur, NC, NG, diphenylamine, TNT, ammonium nitrate	Powder Train Time Fuze 1907-M fuzes, 75mm HE and ejection rounds and fuzes	NC, diphenylamine, picric acid, potassium nitrate, sulfur, TNT, ammonium nitrate, mercury fulminate, NG, iron

Table A-1: Summary of Potential MEC and MC (continued)

Munitions Response Area	Potential Munitions	Potential Primary Release Mechanism	Potential MEC at Firing Point*	Potential MC at Firing Point	Potential MEC Down Range*	Potential MC Down Range
Michie Stadium	Artillery	3-inch Stokes Mortars	Stokes Mortars	Not applicable	Mortar casing	NC, NG, diethylphthalate, ethyl centralite, potassium chlorate, lead thiocyanate, antimony sulfide, and TNT, iron, lead

Notes:

* Solid shot, grapeshot, and canisters might be found at artillery firing points and down range. These items are not potential MEC because they are inert and contain no explosive hazards.

APPENDIX H – TECHNICAL PROJECT PLANNING 1 MEETING MINUTES

DEPARTMENT OF THE ARMY
UNITED STATES ARMY ENVIRONMENTAL COMMAND
UNITED STATES ARMY CORPS OF ENGINEERS
UNITED STATES ARMY GARRISON – WEST POINT

Technical Project Planning Meeting 1
Military Munitions Response Program
U.S. Army Garrison – West Point

29 July 2010

Project: **Military Munitions Response Program (MMRP) Remedial Investigation (RI), U.S. Army Garrison – West Point**

Points of Contact: U.S. Army Garrison – West Point, MMRP Manager: Jeff Sanborn/ 845-938-5041
USACE – Design Team Leader: Brooke Conway/ 410-962-6805
Contractor, Weston Solutions, Inc., Project Manager: John Gerhard/ 610-701-3793

On 29 July 2010, the representatives from the following stakeholder organizations attended the first Technical Project Planning (TPP) meeting at the United States Army Garrison – West Point (West Point) Directorate of Public Works (DPW) Conference Room. The purpose of this meeting was to bring all of the stakeholders together to identify and discuss project goals and data quality objectives, and ultimately agree upon the path forward for successfully completing this RI.

MEETING ATTENDEES

Name	Organization / Title	Email	Telephone Number
Travis McCoun	U.S. Army Corps of Engineers – Baltimore District (USACE-CENAB)/MMRP Program Manager	travis.mccoun@usace.army.mil	410-962-6728
Brooke Conway	USACE-CENAB/Project Manager	brooke.e.conway@usace.army.mil	410-962-6805
Jeff Sanborn	DPW-Environmental Management Division (EMD)/MMRP Manager	jeffrey.sanborn@us.army.mil	845-938-5041
Chawyer Jones	Directorate of Plans, Training, Mobilization and Security (DPTMS)/Chief, Tag SPJ Div	chawyer.jones@usma.edu	845-938-8559
Deb DeGraw	Public Affairs Office (PAO)/Community Relations	deborah.degraw@usma.edu	845-938-3614
Mary Sardo	Evolution, Ecology, and Behavior (EEB)/Intern	mary.sardo@usma.edu	914-443-4763
Brad Brown	EEB/Intern	bradley.brown@usma.edu	845-913-8294
Chris Albright	EEB/Intern	chrsitopher.albright@usma.edu	845-938-4845
Paul Patel	New York State Department of Environmental Conservation (NYSDEC)/Sr. Engineer	appatel@gw.dec.state.ny.us	518-402-8602
Keith Gronwald	NYSDEC/Geologist	khgronwa@gw.dec.state.ny.us	518-402-8594

Name	Organization / Title	Email	Telephone Number
Bill Roach	U.S. Environmental Protection Agency (EPA)/Project Manager	roach.bill@epa.gov	212-637-4335
Eric Stahl	Weston Solutions, Inc. (WESTON)/Client Services Manager	eric.stahl@westonsolutions.com	610-701-3732
John Gerhard	WESTON/Project Manager	j.gerhard@westonsolutions.com	610-701-3793
Ryan Steigerwalt	WESTON/Project Geophysicist	ryan.steigerwalt@westonsolutions.com	410-612-5900
Marty Holmes	WESTON/Senior Unexploded Ordnance Supervisor (SUXOS)	marty.holmes@westonsolutions.com	484-354-0146
Brian Junck	WESTON/Site Geophysicist	brian.junck@westonsolutions.com	610-209-9472
Gene Barber	TLI Solutions, Inc. (TLI)/ MMRP Advisor	gbarber@tlisolutions.com	303-763-7188
Mary Franquemont	TLI/Community Outreach Specialist	mfranquemont@tlisolutions.com	303-763-7188
Rebecca Pisha	TLI/Environmental Researcher	rpisha@tlisolutions.com	303-763-7188

Key discussion points and results of the TPP 1 meeting are presented below:

- Attendee introductions (all)

- MMRP overview and the purpose of the MMRP RI TPP 1 meeting (Mr. Travis McCoun – USACE-CENAB)

- West Point MMRP RI TPP 1 presentation (Mr. John Gerhard and Mr. Ryan Steigerwalt – WESTON)

  - The presentation provided a summary of the project performance work statement (PWS). The PWS performance objectives include achieving an RI at 11 West Point munitions response sites (MRSs).

  - An overview of the West Point MMRP RI was presented to the group. The overview included a discussion of the RI objectives (characterizing nature and extent of munitions and explosives of concern (MEC) and munitions constituents (MC)), planning documentation (work plan and various sub-plans), field investigation (data collection), and reporting requirements (RI Report with revised conceptual site models, hazard assessments, risk assessments, and Munitions Response Site Prioritization Protocol update).

  - The overall goal of the West Point MMRP RI is to gather information to support the evaluation of a no further action (NFA) or remedial action alternative for each MRS. Mr. Bill Roach, EPA, asked what would determine an NFA recommendation for a MRS. It was explained that an NFA recommendation would be made if a MEC or MC release did not occur. If it cannot be proven during the course of the RI that a MEC or MC release did not occur, land use controls would be the minimum recommendation. Mr. Roach mentioned that NFA recommendations on MMRP projects were sometimes considered controversial.

- Mr. Chawyer Jones, DPTMS, asked if there was a time line or milestones for this project. Mr. McCoun responded that the RI is expected to be an approximately 5-year-long project with multiple milestones and an anticipated completion goal of Fiscal Year (FY) 2014.

- Details of the proposed investigative field activities were presented. The field investigation includes an overarching statistical approach for geophysical survey (including mag and dig surveys and digital geophysical mapping). MC sampling strategies and techniques were developed to fully characterize potential MEC releases. It was noted that a statistical approach is used to ensure full characterization of an MRS since it is often impractical to perform 100% investigations on large areas.

- Mr. Patel, NYSDEC, inquired if any sites were identified for NFA. Mr. Barber replied that sites went NFA during the Site Inspection (SI). Portions of larger sites where a MEC or MC release did not occur were broken out.

- Mr. Roach asked about the reliability of the probabilistic characterization method and if it was used on other project sites. Mr. McCoun explained that the method is based on USACE guidance documents and the method has been used at numerous installations under the MMRP and is used programmatically for these types of projects. Mr. Roach affirmed that the sampling plan was logical.

- Mr. Roach inquired whether mag and dig activities are considered a clearance. Mr. McCoun stated that this is an investigation to determine the nature and extent of MEC and MC and not a removal of all MEC within a site. He clarified that clearance means there is knowledge of a MEC release that requires removal. While the field team will be removing MEC items that are discovered during the RI, this is considered part of the investigation and not a clearance.

- Mr. Steigerwalt presented the technical approach for each MRS included in the PWS. Each MRS was presented independently. The presentation included current and future land use, former military munitions-related activities, and potential munitions types for each MRS. SI results and recommendations were also presented. The RI technical approach included locations and quantities of geophysical surveys and MC sampling requirements for each site.

- Mr. Roach asked what MC sampling methods were implemented during the SI. Mr. Gene Barber, TLI, replied that spoke and hub composite sampling was utilized and biased to recovered MEC or munitions debris (MD) items. Mr. McCoun added that a decision matrix will be used during the RI to determine the proper MC sampling methodologies to be used when a potential MEC release is identified.

- The following MRSs were discussed in detail:

– Artillery Firing Range (WSTPT-001-R-01)
– Battery Knox – TD Land (WSTPT-004-R-02)
– Fort Clinton – West (WStPT-008-R-01)
– Grey Ghost Housing Area (WSTPT-010-R-01)

  - North Athletic Field (WSTPT-011-R-01)
  - Seacoast Battery (WSTPT-013-R-01)
  - Siege Battery (WSTPT-015-R-01)
  - Target Hill (WSTPT-017-R-01)
  - Lusk Reservoir (WSTPT-019-R-01)
  - Redoubt No. 2 (WSTPT-020-R-01)
  - Michie Stadium (WSTPT-022-R-01)
- After each MRS presentation, the stakeholders were asked if they had questions concerning the technical approaches. Follow-on discussions were held for Fort Clinton, Grey Ghost Housing Area, Battery Knox – TD Land, Target Hill, and Michie Stadium. Questions were not raised for the other MRSs at West Point. The following paragraphs capture the discussions held during and after the technical approach presentations:

  - <u>Fort Clinton West MRS</u> – Mr. Roach asked if safety zones would be required during the investigation of subsurface anomalies. Mr. Steigerwalt answered that exclusion zones will be required during the RI. The exclusion zones are documented in the approved Explosives Site Plan and they are based on the hazardous fragmentation distance of the MEC items that potentially could be recovered in the MRS. It is anticipated that a minimum of 200 feet will be required for each dig location in the Fort Clinton – West MRS.

  - Mr. Paul Patel, asked about the original size and design of the Fort Clinton – West MRS. Ms. Mary Franquemont, TLI, indicated that the size and design of the MRS as depicted is the original boundary for the MRS. She clarified that the actual range fan would have been larger further from the firing point; however, that portion of the range fan is currently over operational range area and is not included in this investigation.

  - Mr. Patel said he assumed that the sampling team will be changing the analytes based on anticipated munitions. Mr. Steigerwalt affirmed that the analytes will be based on the components of the munitions identified for each MRS.

  - <u>Grey Ghost Housing Area MRS</u> – The MD items found during the SI field effort were discussed in the presentation. It is unknown how the MD items were released in the MRS. Mr. Chawyer Jones asked if the items could have been transported in the fill used during development of the housing area. The MD was found in undeveloped areas beyond the extent of any fill that would have been used for the housing development.

  - At the conclusion of the technical approach for the Grey Ghost Housing Area MRS, Mr. Gerhard asked the regulators if the proposed sampling plan made sense and seemed logical. Mr. Patel agreed that the approach seemed to make sense.

  - Mr. Roach asked about the anticipated MEC detection depth for mag and dig surveys. Mr. Gerhard answered that it depends on the size and orientation of the buried item. Mr. Barber noted that they do not expect a deep penetration depth due to the amount of rock and proximity to bedrock. Mr. Jones said that he would not expect anything to be found deeper than 2 feet.

– Battery Knox – TD Land MRS – Mr. Patel inquired about the location of the firing point for the former Battery Knox Range. The firing point was located on the west bank of the Hudson River, across from the MRS. However, sampling or surveys will not be conducted at the firing point since structures now exist where the battery was located. The firing point was listed as NFA during the SI due to the level of development in that area.

– Target Hill MRS – New rugby fields have been constructed in the Target Hill MRS. Mr. Patel asked what kind of sampling was completed on the soil that was recently removed for the construction. The group was unsure, but it is likely that sampling did not occur.

– Michie Stadium MRS – Mr. McCoun stated that the end result for this MRS likely will be some type of land use control. It is not possible to characterize the entire MRS due to the level of development. Any future redevelopment or construction would require further investigation for MEC and MC. RI fieldwork will be performed in undeveloped areas of the MRS. Mr. Patel agreed that an investigation should be performed on the undeveloped areas.

- At the conclusion of the meeting, Mr. Gerhard asked for additional questions from the stakeholders. Mr. Roach mentioned that he was unsure if EPA Region 2 had an unexploded ordnance (UXO) expert who would be available to review the project documents. Mr. Roach did not have any additional questions at this time.

- Mr. McCoun inquired as to whether or not a 45-day document review period would be acceptable for project documents. The regulators agreed that a 45-day review and comment period is reasonable.

ACTION ITEMS

Item	Responsible Party	Due Date
Complete and distribute TPP 1 Meeting Minutes	WESTON	August 2010
Complete and send the RI Work Plan	WESTON	October 2010
Update stakeholder contact lists	WESTON	As needed

As required by the TPP process, the following is a list of stakeholders who were unable to attend the TPP 1 meeting and presentation:

USAEC
Douglas Scarborough
Environmental Restoration Manager
410-436-3152
douglas.scarborough@us.army.mil

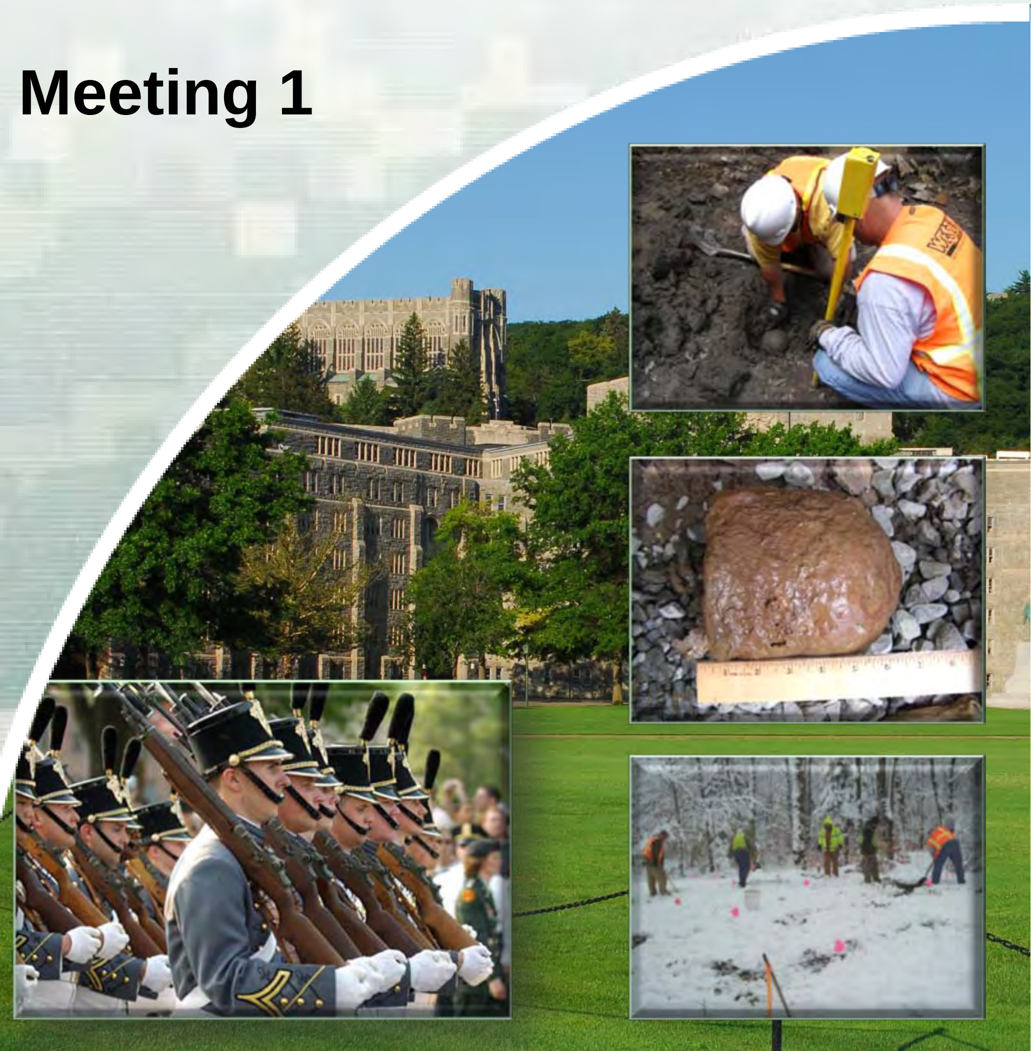
USACE
Tom Meyer
Project Manager
410-962-0032
tom.meyer@usace.army.mil

MMRP Remedial Investigations

West Point, NY

Technical Project Planning Meeting 1

29 July 2010



US Army Corps of Engineers
BUILDING STRONG®

Agenda

- Introductions
- Performance Work Statement (PWS)
- West Point Military Munitions Response Program (MMRP) Remedial Investigation (RI)
- Review of Background Information
- Overall Proposed RI Field Activities
- Munitions Response Site (MRS) Specific Background and Proposed RI Approach
- Schedule
- Summary

Introductions

- **U.S. Army Garrison West Point**
  - Jeff Sanborn, MMRP Lead
- **New York State Department of Environmental Conservation (NYSDEC)**
  - Paul Patel, Environmental Engineer, Division of Solid and Hazardous Waste
  - Keith Gronwald, Senior Engineering Geologist, Division of Solid and Hazardous Waste
- **U.S. Environmental Protection Agency (USEPA)**
  - Bill Roach, Remedial Project Manager
- **U.S. Army Corps of Engineers (USACE) - Baltimore District**
  - Travis McCoun, Military Munitions Design Center (MMDC) Program Manager
  - Tim Peck, Contracting Officers Representative (COR)
  - Tom Meyer, Project Manager
  - Brooke Conway, Design Team Leader
  - Deborah McKinley, Environmental Engineer
  - Tom Colozza, Geophysics
  - Maria Orosz, Geophysics

Introductions (cont'd)

- **U.S. Army Environmental Command (USAEC)**
  - Douglas Scarborough
- **Weston Solutions, Inc. (WESTON)**
  - Greg Daloisio, Program Manager
  - John Gerhard, Project Manager
  - Laura Pastor, MMRP Technical Manager
  - Ryan Steigerwalt, Geophysics
  - Brian Junck, Geophysics
  - Gene Barber (TLI Solutions, Inc.), MMRP Advisor
  - Mary Franquemont (TLI Solutions, Inc.), Community Outreach

Performance Work Statement

- Achieve Remedial Investigations at 11 sites:
  - Artillery Firing Range (WSTPT-001-R-01)
  - Battery Knox – TD Land (WSTPT-004-R-02)
  - Fort Clinton – West (WSTPT-008-R-01)
  - Grey Ghost Housing Area (WSTPT-010-R-01)
  - North Athletic Field (WSTPT-011-R-01)
  - Seacoast Battery (WSTPT-013-R-01)
  - Siege Battery (WSTPT-015-R-01)
  - Target Hill (WSTPT-017-R-01)
  - Lusk Reservoir (WSTPT-019-R-01)
  - Redoubt No. 2 (WSTPT-020-R-01)
  - Michie Stadium (WSTPT-022-R-01)*

  *Remedy-In-Place Option

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Military Munitions Response Program (MMRP) Flow Chart

CERCLA Process		Goals
Identify Releases		Identify Releases
Site Inspection		Identify Sites Needing Further Investigation
Remedial Investigation • Sites recommended for NFA, prepare close-out documentation including ESS • Optional CLIN: Achieve remedy-in-place for Michie Stadium (WSTPT-022-R-01)	Current stage of MMRP work	Characterize Nature and Extent of MEC/MC • Prepare Risk/Hazard Assessments • Recommend future CERCLA activities based on RI results
Feasibility Study		Evaluate Alternatives and Identify Preferred Remedy
Proposed Plan		Propose Selected Remedy
Public Comment		Encourage Public Participation
Decision Document		Authorize Selected Remedy
Remedial Design		Prepare Work Plan for Remedy
Remedial Action		Implement Chosen Remedy

Acronym List

APP	Accident Prevention Plan
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response, Compensation Liability Act
COR	Contracting Officers Representative
CSM	Conceptual Site Model
DGM	Digital Geophysical Mapping
EM	Engineering Manual
ESP	Explosives Site Plan
FS	Feasibility Study
GPS	Global Positioning System
GSV	Geophysical System Verification
HFD	Hazardous Fragmentation Distance
HRR	Historical Records Review
IRIS	Integrated Risk Information System
IS	Incremental Sampling
IVS	Instrument Verification Strip
MC	Munitions Constituents
MD	Munitions Debris
MEC	Munitions and Explosives of Concern
MECHA	Munitions and Explosives of Concern Hazard Assessment
MMDC	Military Munitions Design Center
MMRP	Military Munitions Response Program
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
NFA	No Further Action
NYSDEC	New York State Department of Environmental Conservation
PWS	Performance Work Statement
RI	Remedial Investigation
RTK	Real Time Kinematic
SCO	Soil Cleanup Objectives
SI	Site Inspection
SSHP	Site Specific Safety and Health Plan
TCRA	Time Critical Removal Action
TPP	Technical Project Planning
UFP-QAPP	Uniform Federal Policy for Quality Assurance Project Plans
USACE	United States Army Corps of Engineers
USAEC	United States Army Environmental Command
USEPA	United States Environmental Protection Agency
USMAPS	United States Military Academy Prepratory School
UXO	Unexploded Ordnance
VSP	Visual Sample Plan
XRF	X-Ray Fluorescence

West Point MMRP RI Overview

- Overall Goal:
  - Gather sufficient information to determine the nature and extent of MEC/MC and assess the potential risks/hazards to support the evaluation of a no further action or remedial action alternative (through a Feasibility Study)
- RI Objectives:
  - Conduct field investigation to characterize MRSs
    - Determine the type (nature), density and distribution (extent) of MEC
    - Determine the concentrations (if any) and extent of MC
  - Assess potential risks/hazards to human health, safety and the environment
  - Assess Munitions Response Site (MRS) boundaries

West Point MMRP RI Overview (cont'd)

- Develop Planning Documents for Team Review
  - Technical Project Planning (TPP) Meetings
  - Final TPP Meeting Minutes
  - Work Plan - Including Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP) and Accident Prevention Plan (APP)/Site Safety and Health Plan (SSHP)
- Conduct Field Investigations
  - Collect data to characterize the nature and extent of MEC and MC
- Prepare RI Report
  - Update Conceptual Site Models (CSMs), as appropriate
  - Present Findings
  - Conduct MEC Hazard Assessment and MC Risk Assessments
- Update Munitions Response Site Prioritization Protocol (MRSPP)

Background- Site Location

Background – Site Information

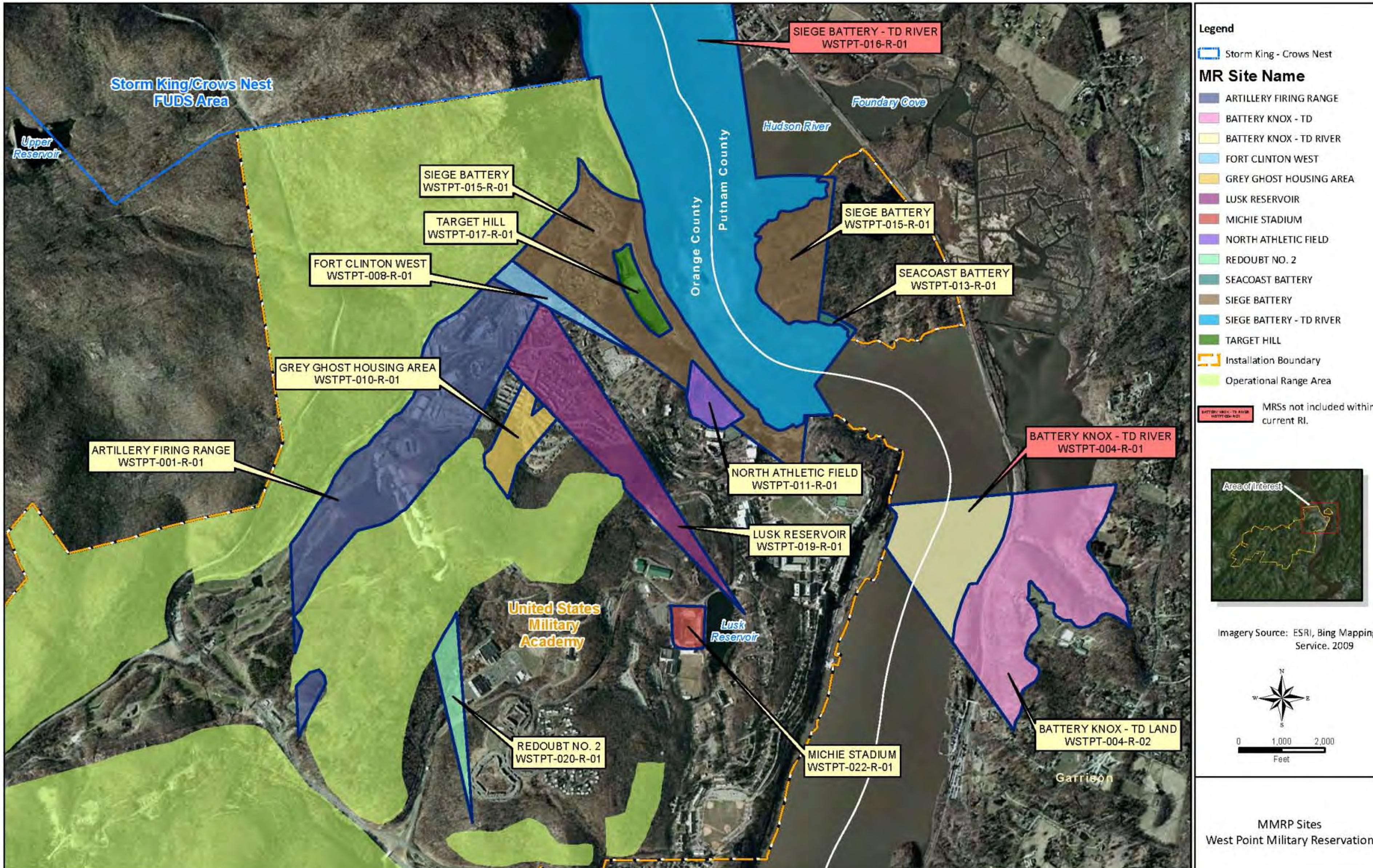
- West Point is located in Orange and Putnam Counties, New York
  - 50 miles north of New York City
  - 13 miles south of Newburgh

- Major Landholdings
  - Main Post or Campus – 2,530 acres
  - Military Reservation – 13,444 acres
- Occupied by the U.S. Army since January 27, 1778, and is the oldest occupied military post in America to have continuously flown the nation's flag
- Primary Mission: "To educate, train, and inspire the Corps of Cadets so that each graduate is a commissioned leader of character committed to the values of Duty, Honor, Country and prepared for a career of professional excellence and service to the Nation as an officer in the United States Army"
- Military Reservation is largely undeveloped and contains operational training facilities such as firing ranges and bivouac areas used during the summer to house and train cadets

Background – Previous Work

- Historical Records Review (HRR), March 2006
- Site Inspection (SI), January 2007
- Time Critical Removal Action (TCRA) at Artillery Firing Range MRS (WSTPT-001-R-01)
  - In support of Base Realignment and Closure (BRAC) United States Military Academy Preparatory School (USMAPS), June 2009
  - Ongoing construction support
- Numerous items have been recovered during construction projects and geophysical surveys across the installation

Background – Location of MRSs



Proposed RI Field Activities

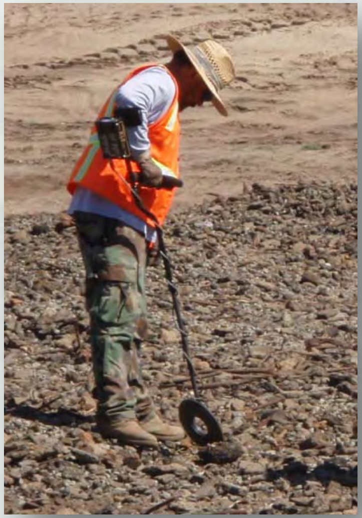
- **MEC Characterization**
  - Developed geophysical characterization strategy based on USACE guidance, Engineering Manual (EM) 1110-1-4009
    - Utilized statistical tools *UXO Estimator* and *Visual Sample Plan (VSP)*
    - Investigate the acreage derived from UXO Estimator to be 95% confident that there is no more than 0.5 MEC/acre
    - Investigate transects as calculated by VSP to detect and delineate potential releases of MEC
  - Geophysical Survey Methods
    - Mag and dig transect surveys using all metals detectors
    - Digital geophysical mapping (DGM) surveys using electromagnetic systems
  - Reacquisition and anomaly investigation
    - Assess anomalies to determine if MEC, MD or cultural debris
    - Investigation results will be entered into UXO Estimator to verify no more than 0.5 MEC/acre exist within the MRS

Proposed RI Field Activities

- **MC Characterization**
  - Determine if a potential MEC release is present in MRSs and implement investigation strategy to characterize nature and extent of MC
  - MC investigations will be initiated when encountering the following criteria:
    - Based on SI recommendations for further investigation of MC at Battery Knox-TD Land (WSPT-004-R-02) and Siege Battery (WSPT-015-R-01)
    - At firing points not sampled during the SI where MC may be present without indicators of a MEC release: Artillery Firing Range (WSTPT-001-R-01), Siege Battery (WSTPT-015-R-01), Lusk Reservoir (WSTPT-019-R-01), Redoubt No. 2 (WSTP-020-R-01)
    - Where geophysical survey results identify areas indicative of a potential MEC release based on physical evidence of surface and/or subsurface MEC and MD
    - Individual MEC item locations where soil staining or visible evidence of a potential MC release is observed
  - Analyze samples for Metals and Explosives compounds based on the former munitions types used at the MRSs
  - Prepare memorandums documenting specific sampling strategies based on RI results and achieve stakeholder concurrence

MEC Characterization – Geophysical Surveys

- **Mag and Dig Transect Surveys**
  - Identify munitions-related features, (e.g., MEC, MD, craters, and structures associated with munitions use)
  - Transects spaced at pre-specified intervals to ensure complete coverage and assessment of the MRSs
  - Conduct surveys using all-metals detectors
  - Swath width of 10 ft (2 personnel @ 5 ft per instrument)
  - Transects and features logged using global positioning system (GPS)
  - Anomalies will be intrusively investigated as team advances

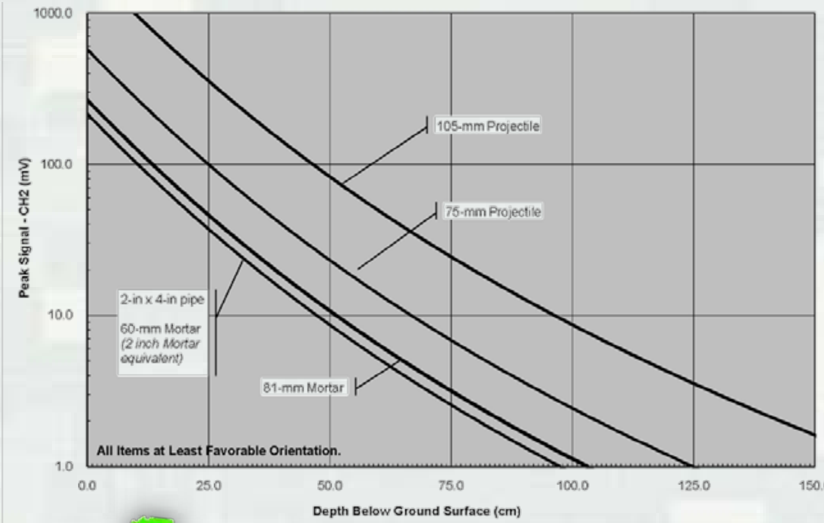


MEC Characterization – Geophysical Surveys

- **Digital Geophysical Mapping Surveys**
  - Combination of DGM transects and grids will be used to determine the type and density of MEC
  - EM61-MK2 sensors will be deployed in a cart or gurney configuration
  - Positioning based on MRS conditions and will include real-time kinematic (RTK) GPS, Robotic Total Station or line and fiducial methods
  - Digital geophysical data will be processed and interpreted for subsurface anomalies

MEC Characterization – Geophysical Surveys

- **Quality Control – Geophysical System Verification (GSV)**
  - Used to verify and monitor geophysical equipment functionality (performed daily)
  - Instrument Verification Strip (IVS) is installed with known industry seed items and/or anticipated target items (known munitions items)
  - DGM sensor responses from seed items will be compared to instrument response curves to confirm detection capability
  - Similar seed items in IVS will be used as blind seed items in DGM grids to validate detection capability
  - Analog instruments will also be tested on IVS



MEC Characterization - Intrusive Activities

- Mag and dig anomalies will be investigated as detected
- DGM anomalies selected during data processing will be reacquired and excavated to determine nature of the item
- The location, size, depth, description and orientation of the items will be recorded
- Intrusive activities conducted in accordance with project work/safety plans, and government-approved Explosives Site Plan (ESP)
- The hazardous fragmentation distance (HFD) used to establish exclusion zones during intrusive activities
- Minimize the need for evacuations and/or road closures by careful grid placement and scheduling intrusive work activities during low-use hours
- Careful coordination with tenants and stakeholders during intrusive activities, as appropriate

MC Characterization

- Incremental Sampling (IS):
  - Number and placement of sampling units will be dependent upon size of potential MEC release, terrain, structures, accessibility, etc.
  - Collect 30 to 50 increments per sampling unit (0.5-acre to 1-acre in size)
  - Sample depths will be based on depth of MEC recovered during geophysical surveys
- Discrete Sampling:
  - Focused sampling at individual MEC item locations where soil staining or other visible evidence of a MC release is observed
  - Use composite sampling method (spoke and hub) if visible contamination is distributed around item
- X-Ray Fluorescence (XRF) Screening
  - Use to assess metals contamination in situations such as small arms ranges if observed
  - Perform in-situ and ex-situ analysis with confirmation samples analyzed by an offsite laboratory

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Risk and Hazard Assessments

- MEC Hazard Assessment (MEC HA)
- Assessment of human health and ecological risk based on EPA's Integrated Risk Information System (IRIS) database or NYDEC recommended Soil Cleanup Objectives (SCOs) for metals

MRS Technical Approaches

Fort Clinton West MRS (WSTPT-008-R-01)

Fort Clinton West MRS – Site Information (WSTPT-008-R-01)

- Size: 14.4 Acres
- Land Use:
  - Current use: Extensively developed with residential housing and recreational areas. Southern portion is heavily forested.
  - Future use: No change to current use is anticipated.
- Former Military Munitions Related Activities:
  - Part of the Fort Clinton Range fan.
  - The direction of fire was to the northwest from the firing point located at Gees Point.
  - No known impact or target areas are within the Fort Clinton West MRS.
- Potential Munitions Types:
  - Artillery, large caliber. Fuzes; black powder filled projectiles, HE and shrapnel rounds

Fort Clinton West MRS – SI Results (WSTPT-008-R-01)

- No MEC was observed during the SI.
- MD was identified throughout the western portion of the MRS. Fragments from Civil War era munitions were observed including frag from a possible Parrott round.
- MC Sampling
  - Explosives and metals concentrations below the USEPA Region 9 PRGs, except iron which is believed to be naturally occurring in the soils
- SI Recommendations
  - It is recommended that this site be further investigated for MEC.
  - Further evaluation of MC is not warranted at this time. If further investigation of MEC identifies areas of concern, additional sampling may be required.

Fort Clinton West MRS – SI Results (WSTPT-008-R-01)

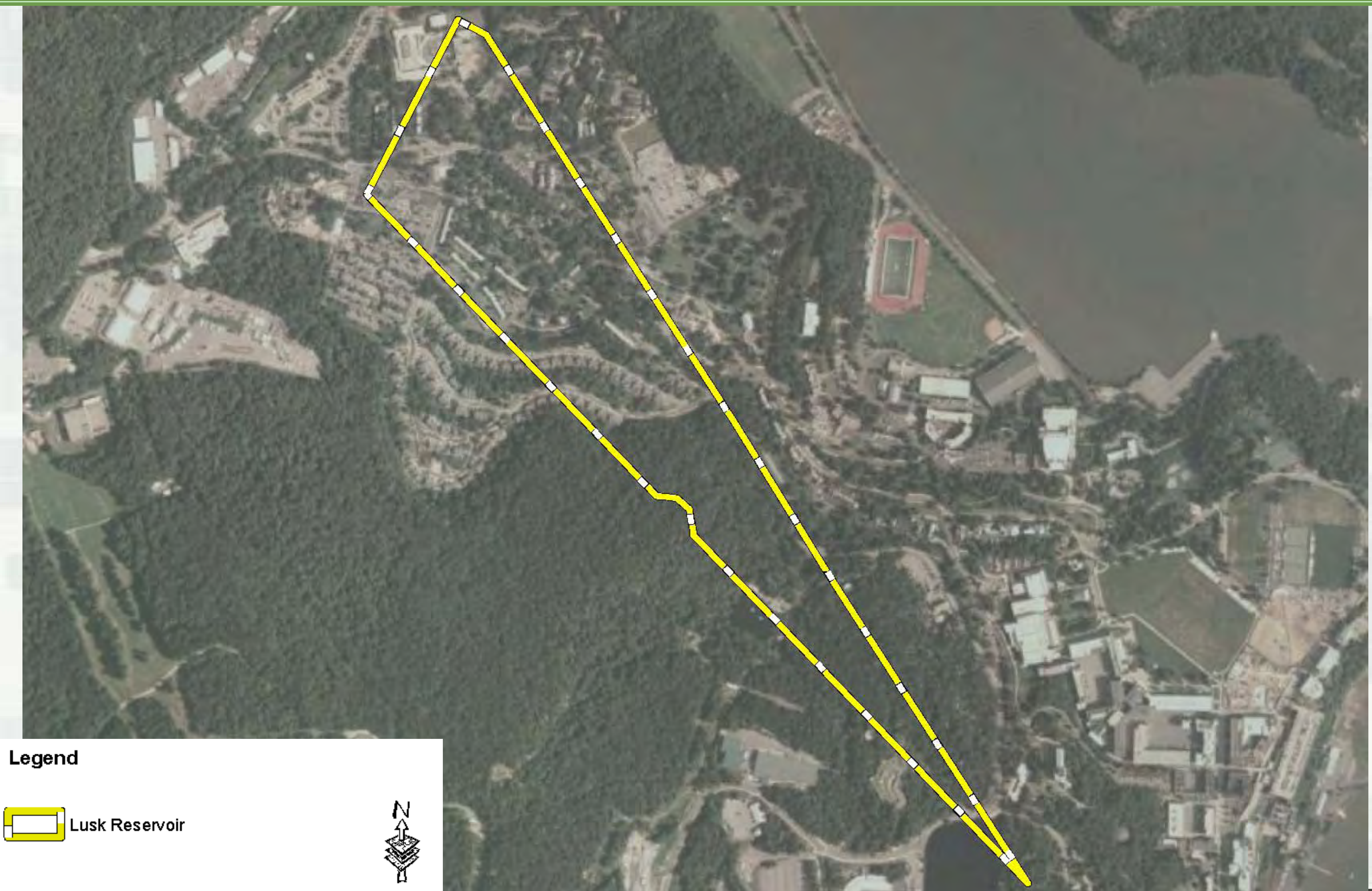
Fort Clinton West MRS - Technical Approach (WSTPT-008-R-01)

MRS Total Area (Acres)	Recommended Coverage per EM 1110-1-4009	Calculated Coverage per *UXO Estimator*		MRS Survey Design			
				Transects - 10' Swath		Grids - 100'x100'	
		MRS %	Acres	Acres	Mileage	Acres	Quantity
14.4	7.50%	30.44%	4.26	1.97	1.62	2.29	10

- **MEC/MC Characterization Strategy**
  - Mag and Dig and DGM surveys on 4.3 acres
  - DGM grids (100' x 100') will be randomly distributed across the MRS in accessible areas to the instrumentation
  - Anomalies will be selected, reacquired and investigated
  - Perform IS and discrete sampling based on geophysical survey results

Fort Clinton West MRS - Technical Approach (WSTPT-008-R-01)

Lusk Reservoir MRS
(WSTPT-019-R-01)



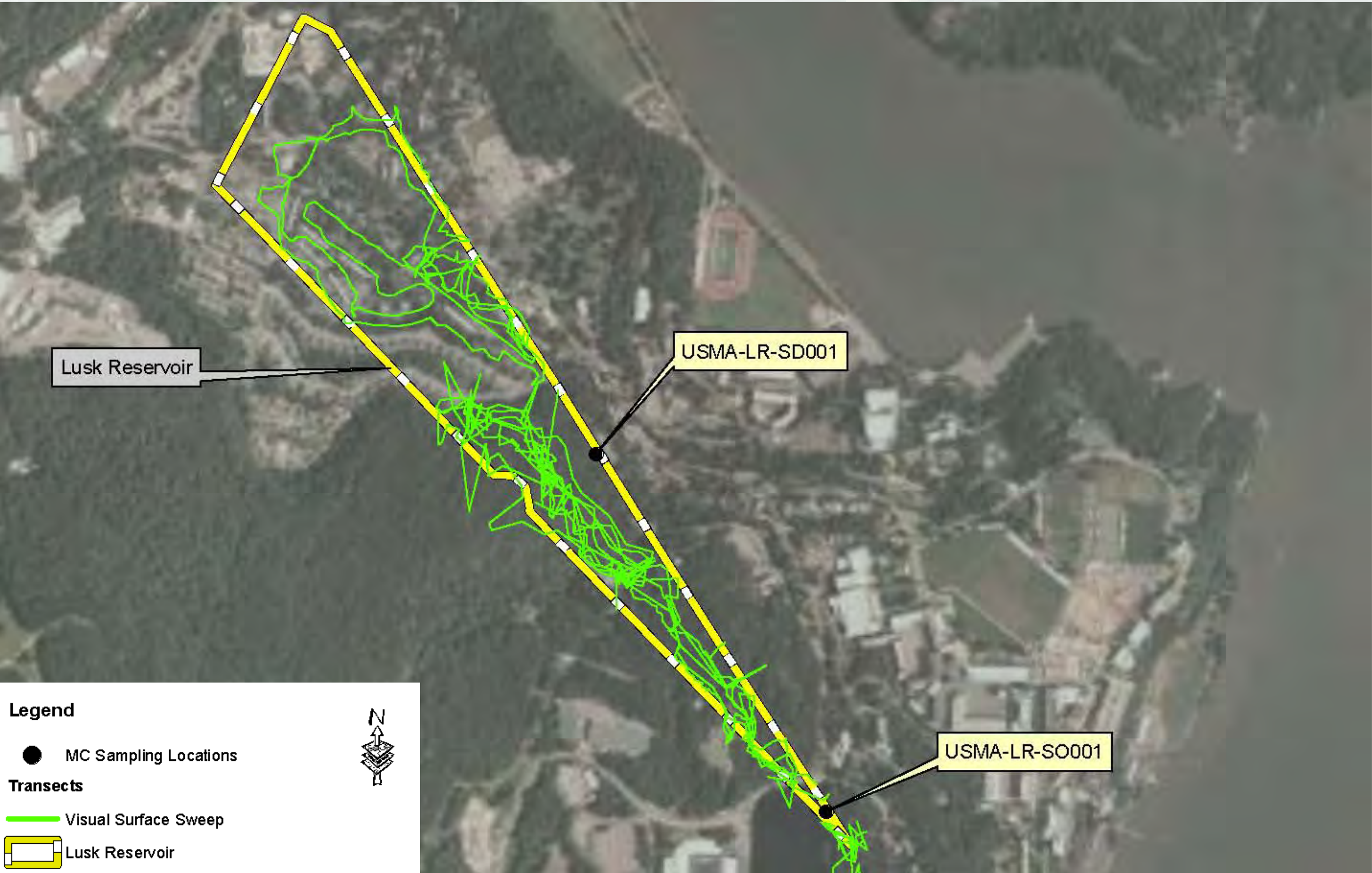
Lusk Reservoir MRS – Site Information (WSTPT-019-R-01)

- Size: 83 Acres
  - Located in the central portion of the West Point campus
  - Majority of the MRS is undeveloped and includes steep, heavily-wooded terrain
- Land Use:
  - Current use: The western end of the site has been developed and includes portions of the Grey Ghost Housing Area and West Point Elementary School.
  - Future use: No change to current use is anticipated
- Former Military Munitions Related Activities:
  - The Lusk Reservoir artillery range was used between 1909 and 1916
  - The firing point was located east of Lusk Reservoir with direction of fire to the northwest toward the Crows Nest FUDS
  - There are no known impact areas within the Lusk Reservoir MRS
- Potential Munitions Types:
  - Artillery. Fuzes; HE and shrapnel projectiles

Lusk Reservoir MRS – SI Results (WSTPT-019-R-01)

- No MEC was observed during the SI. Two metal items were identified but it is uncertain if they were related to military munitions
  - During the 2001 geophysical anomaly investigation at West Point Elementary School, three ‘ordnance or ordnance-related’ items were identified: a 6.5-inch projectile, rifled; a portion of an 8-inch Parrott round; and a fragment from an 8-inch Parrott round
- MC Sampling
  - One soil and one sediment sample were collected. Trace amounts of 4-amino-2,6-dinitrotoluene and 1,3,5-trinitrobenzene were detected in the sediment sample, but below PRG’s. No explosives were detected in the soil sample.
  - Metals were detected at levels below screening criteria in both samples.
- SI Recommendations
  - Recommended that this site be further investigated for MEC
  - Further evaluation of MC is not warranted at this time. If further investigation of MEC identifies areas of concern, additional sampling may be required

Lusk Reservoir MRS – SI Results (WSTPT-019-R-01)

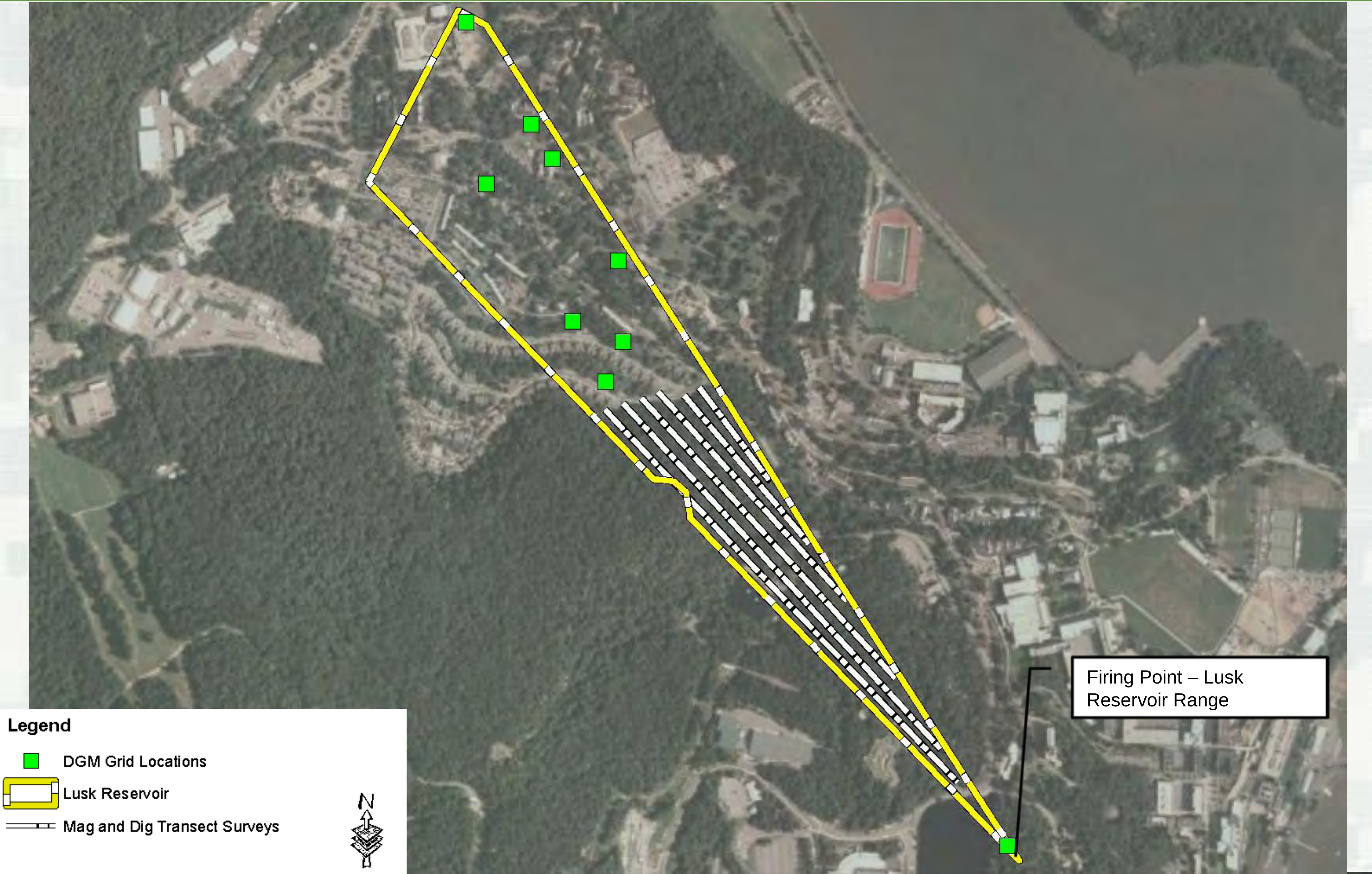


Lusk Reservoir MRS – Technical Approach (WSTPT-019-R-01)

MRS Total Area (Acres)	Recommended Coverage per EM 1110-1-4009	Calculated Coverage per *UXO Estimator*		MRS Survey Design			
				Transects - 10' Swath		Grids - 100'x100'	
		MRS %	Acres	Acres	Mileage	Acres	Quantity
83	4.50%	6.66%	5.75	3.68	3.04	2.07	9

- **MEC/MC Characterization Strategy**
  - Mag and Dig and DGM surveys on 5.8 acres
  - DGM grids (100’ x 100’) will be randomly distributed across the MRS
  - DGM grid will be placed at firing point to detect burial features
  - Anomalies will be selected, reacquired and investigated
  - Establish one IS sampling unit at the firing point location and collect up to 50 incremental samples
  - Perform additional IS and discrete sampling based on geophysical survey results

Lusk Reservoir MRS – Technical Approach (WSTPT-019-R-01)



Redoubt No. 2 MRS
(WSTPT-020-R-01)

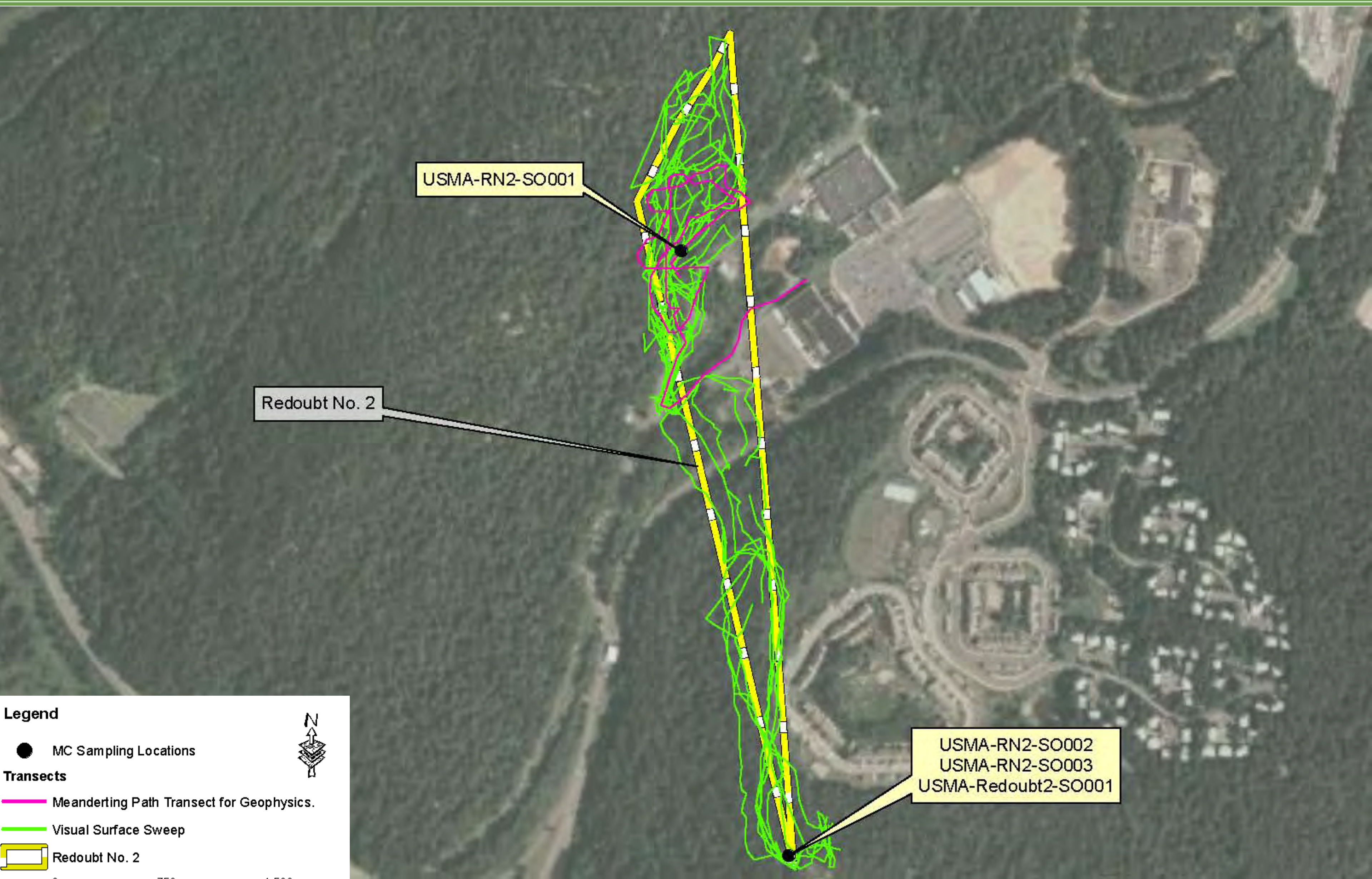
Redoubt No. 2 MRS – Site Information (WSTPT-020-R-01)

- Size: 20 Acres
  - This MRS is primarily undeveloped with several roads crossing the site and a few buildings spaced intermittently throughout the site
- Land Use:
  - Current use: Used primarily for recreation and open land
  - Future use: No change to current use is anticipated
- Former Military Munitions Related Activities:
  - Portion of an artillery range fan used between 1915 and 1916 for field artillery target practice
  - Direction of fire was to the north toward targets on Crows Nest
  - There are no known impact areas within the MRS
- Potential Munitions Types:
  - Artillery. Fuzes; HE and shrapnel projectiles

Redoubt No. 2 MRS – SI Results (WSTPT-020-R-01)

- No MEC or MD was observed during the SI
  - In 1996, eight 105mm artillery casings were found near Building 1245 while excavating fill dirt several inches below the surface
- MC Sampling
  - Four surface soil samples were collected
  - Trace amounts of 4-amino-2,6-dinitrotoluene, 2,4-dinitrotoluene, and 1,3,5-trinitrobenzene were detected in various samples, but below PRGs
  - Copper, iron, lead, mercury, potassium, zinc, and trace amounts of antimony were detected at levels below screening criteria
- SI Recommendations
  - Recommended that this site be further investigated for MEC
  - Further evaluation of MC is not warranted at this time. If further investigation of MEC identifies areas of concern, additional sampling may be required

Redoubt No. 2 MRS – SI Results (WSTPT-020-R-01)

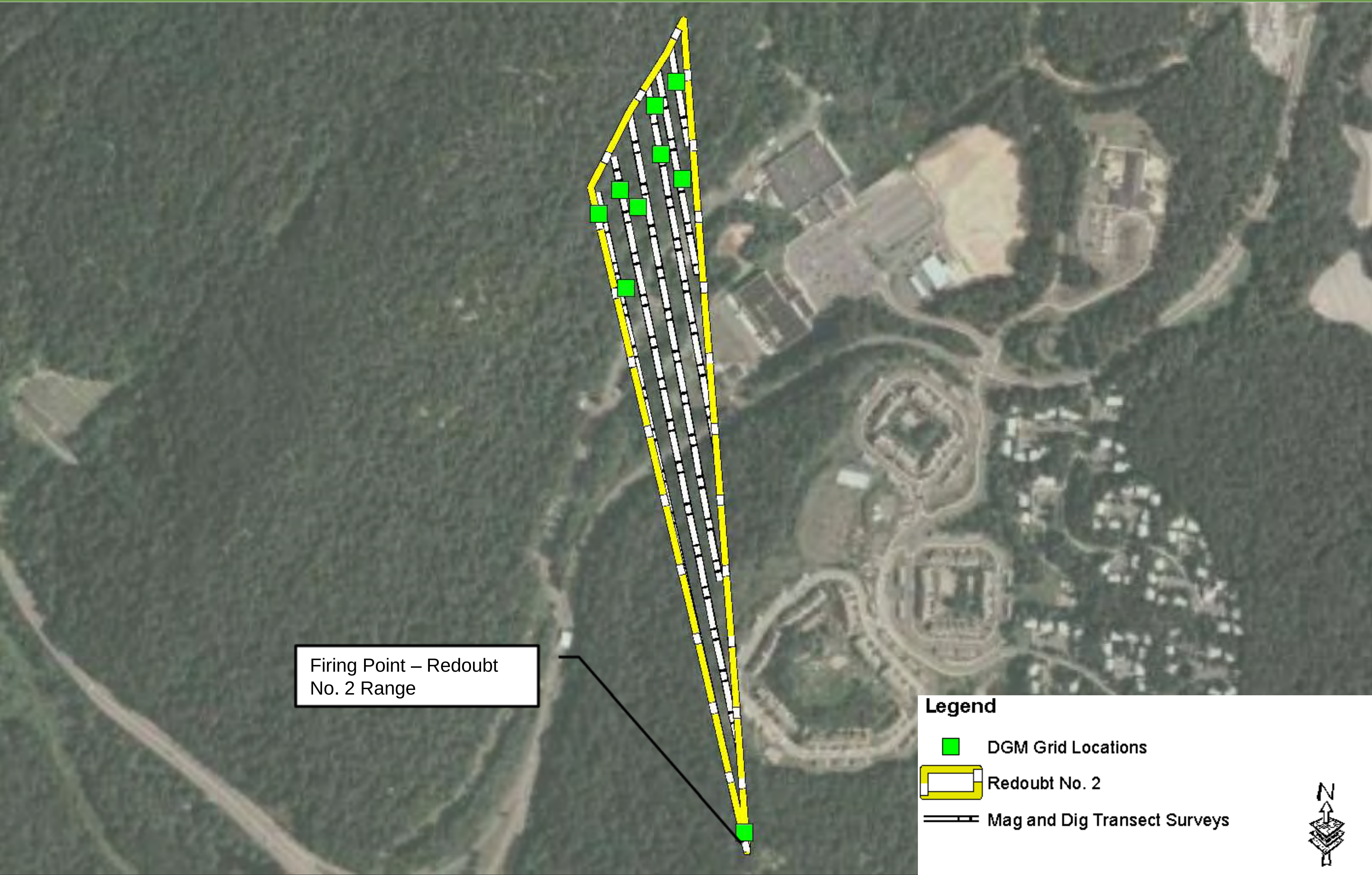


Redoubt No. 2 MRS –Technical Approach (WSTPT-020-R-01)

MRS Total Area (Acres)	Recommended Coverage per EM 1110-1-4009	Calculated Coverage per *UXO Estimator*		MRS Survey Design			
				Transects - 10' Swath		Grids - 100'x100'	
		MRS %	Acres	Acres	Mileage	Acres	Quantity
20	7.50%	25.10%	4.92	3.08	2.55	1.84	8

- **MEC/MC Characterization Strategy**
  - Mag and Dig and DGM surveys on 5 acres
  - DGM grids (100' x 100') will be randomly distributed across the MRS in accessible areas to the instrumentation
  - DGM grid will be placed at firing point to detect burial features
  - Anomalies will be selected, reacquired and investigated
  - Establish one IS sampling unit at the firing point location and collect up to 50 incremental samples
  - Perform additional IS and discrete sampling based on geophysical survey results

Redoubt No. 2 MRS –Technical Approach (WSTPT-020-R-01)



Grey Ghost Housing Area MRS (WSTPT-010-R-01)

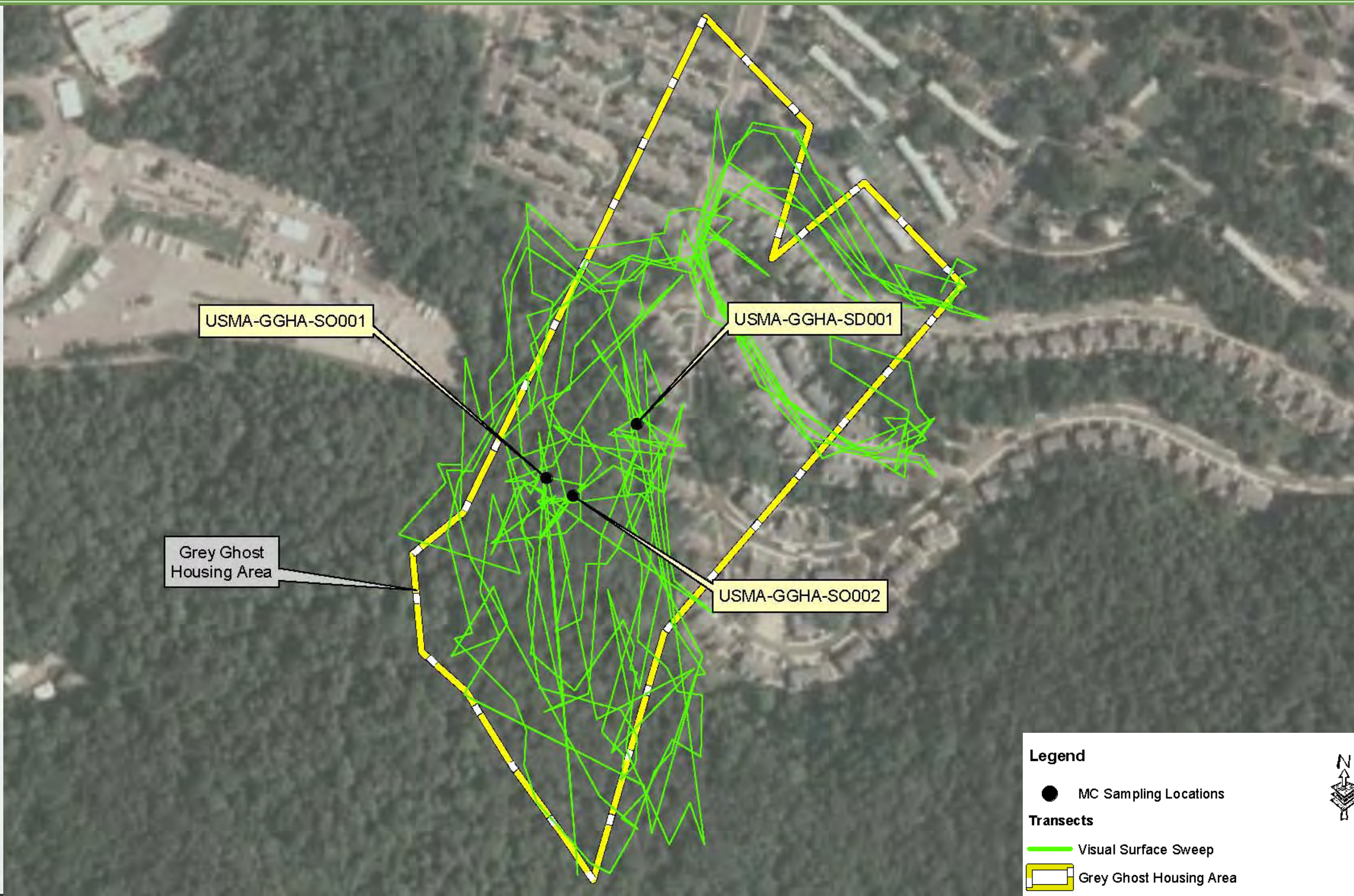
Grey Ghost Housing Area MRS – Site Information (WSTPT-010-R-01)

- Size: 24 Acres
- Land Use:
  - Current use: Residential use as a multi-family complex since 1950. Portions of the MRS are undeveloped and forested.
  - Future use: No change in current use anticipated.
- Former Military Munitions Related Activities:
  - MRS is part of a range complex that includes a 1,000-inch machine gun range and rifle/pistol range.
  - The area was used by cadets for small arms training.
  - Firing was directed from north to south into the steep hillside.
  - Operations at the site were conducted between 1920 to 1940
- Potential Munitions Types:
  - Small arms..22 cal and .30 cal rounds

Grey Ghost Housing Area MRS – SI Results (WSTPT-010-R-01)

- No MEC was observed during the SI.
- MD observed during the SI includes a sand-filled Stokes mortar and fragments from a Stokes mortar and 37mm projectile
- No evidence of pistol, rifle or machine gun use was found at the MRS
- MC Sampling
  - All explosives and metals concentrations were below the USEPA Region 9 PRGs, with the exception of iron, believed to be naturally occurring in the soils
- SI Recommendations
  - It is recommended that this MRS be further investigated for MEC.
  - Further evaluation of MC is not warranted at this time. If further investigation of MEC identifies areas of concern, additional sampling may be required.

Grey Ghost Housing Area MRS – SI Results (WSTPT-010-R-01)

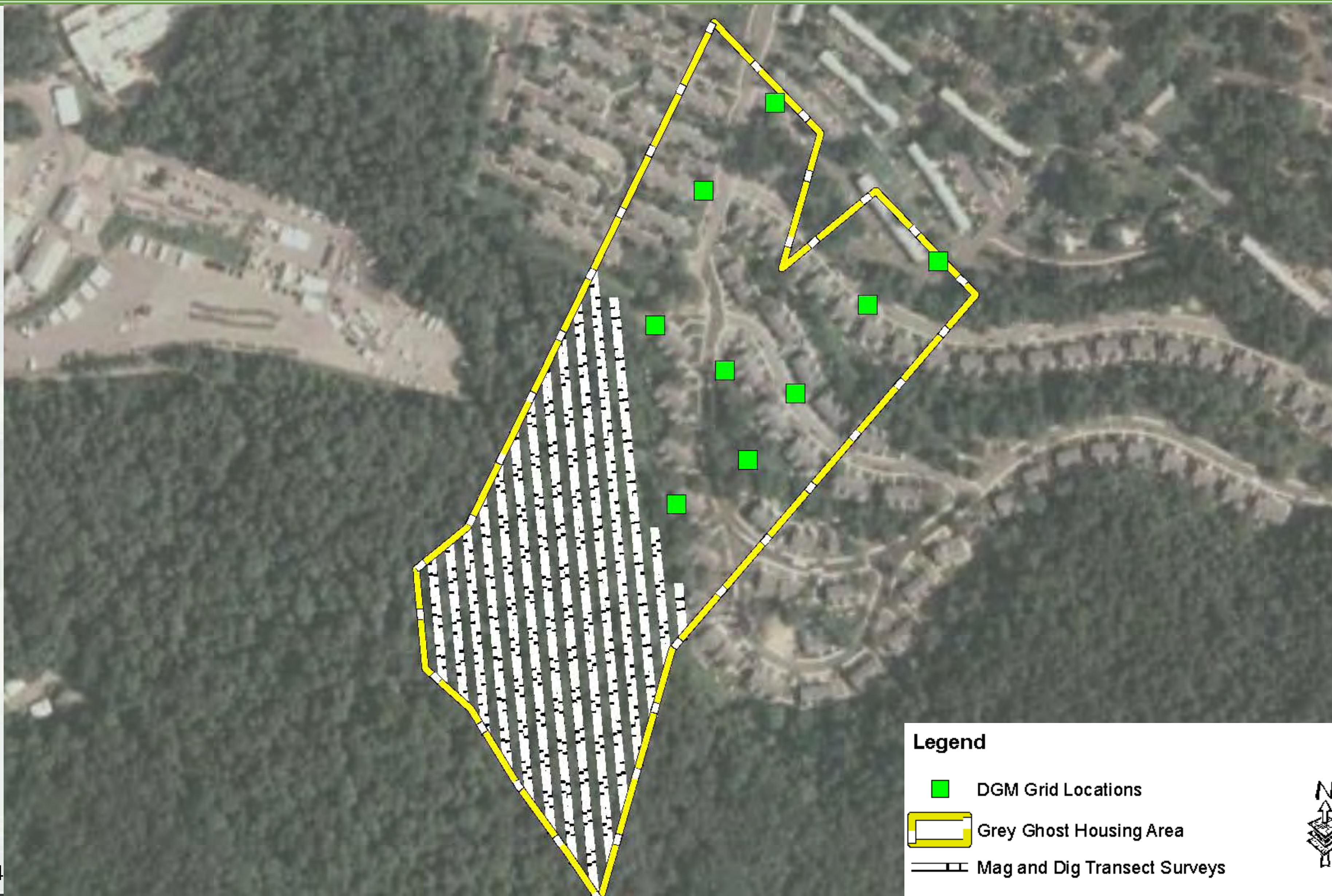


Grey Ghost Housing Area MRS - Technical Approach (WSTPT-010-R-01)

MRS Total Area (Acres)	Recommended Coverage per EM 1110-1-4009	Calculated Coverage per *UXO Estimator*		MRS Survey Design			
				Transects - 10' Swath		Grids - 100'x100'	
		MRS %	Acres	Acres	Mileage	Acres	Quantity
24	7.50%	20.15%	4.78	2.71	2.24	2.07	9

- **MEC/MC Characterization Strategy**
  - Mag and Dig and DGM surveys on 4.8 acres
  - Mag and Dig transects designed at a 43-ft spacing to identify impact areas for 37-mm projectiles and larger
  - DGM grids (100’ x 100’) will be randomly distributed across the MRS in accessible areas to the instrumentation
  - Anomalies will be selected, reacquired and investigated
  - Perform IS and discrete sampling based on geophysical survey results

Grey Ghost Housing Area MRS - Technical Approach (WSTPT-010-R-01)



North Athletic Field MRS (WSTPT-011-R-01)

North Athletic Field MRS – Site Information (WSTPT-011-R-01)

- Size: 14 Acres
  - The site is located near the western shore of the Hudson River within the central campus area of West Point
- Land Use:
  - Current use: Maintained for recreational use and is currently used for track and field, softball/baseball, lacrosse, soccer, and other recreational sports
  - Future use: No change to the current use is anticipated
- Former Military Munitions Related Activities:
  - In 1937, soil from Target Hill, which had been used as an artillery target area from 1903 until 1935, was moved to the North Athletic Field MRS to increase the surface area of fields
  - Material from Target Hill may have contained munitions that were fired into the hill from the early 1800s until the late 1930s
- Potential Munitions Types:
  - Artillery and small arms. Fuzes; black powder, HE and shrapnel projectiles. .22 cal rounds.

North Athletic Field MRS – SI Results (WSTPT-011-R-01)

- No MEC or MD observed during the SI
  - In June 1999, a UXO item identified as a 76mm M339, Armor Piercing-Tracer (AP-T) was found at the site during renovation of the bleachers
- MC Sampling
  - One surface soil sample was collected and analyzed for TAL metals and explosives
  - Analytical results indicated a trace amount of 4-amino-2,6-dinitrotoluene (no PRG for this isomer). Six TAL metals detected at levels below screening criteria.
- SI Recommendations
  - Recommended for further investigation of MEC to include confirmation sampling of anomalies identified during the geophysical survey
  - Further evaluation of MC is not warranted at this time. If further investigation of MEC identifies areas of concern, additional sampling may be required

North Athletic Field MRS – SI Results
(WSTPT-011-R-01)

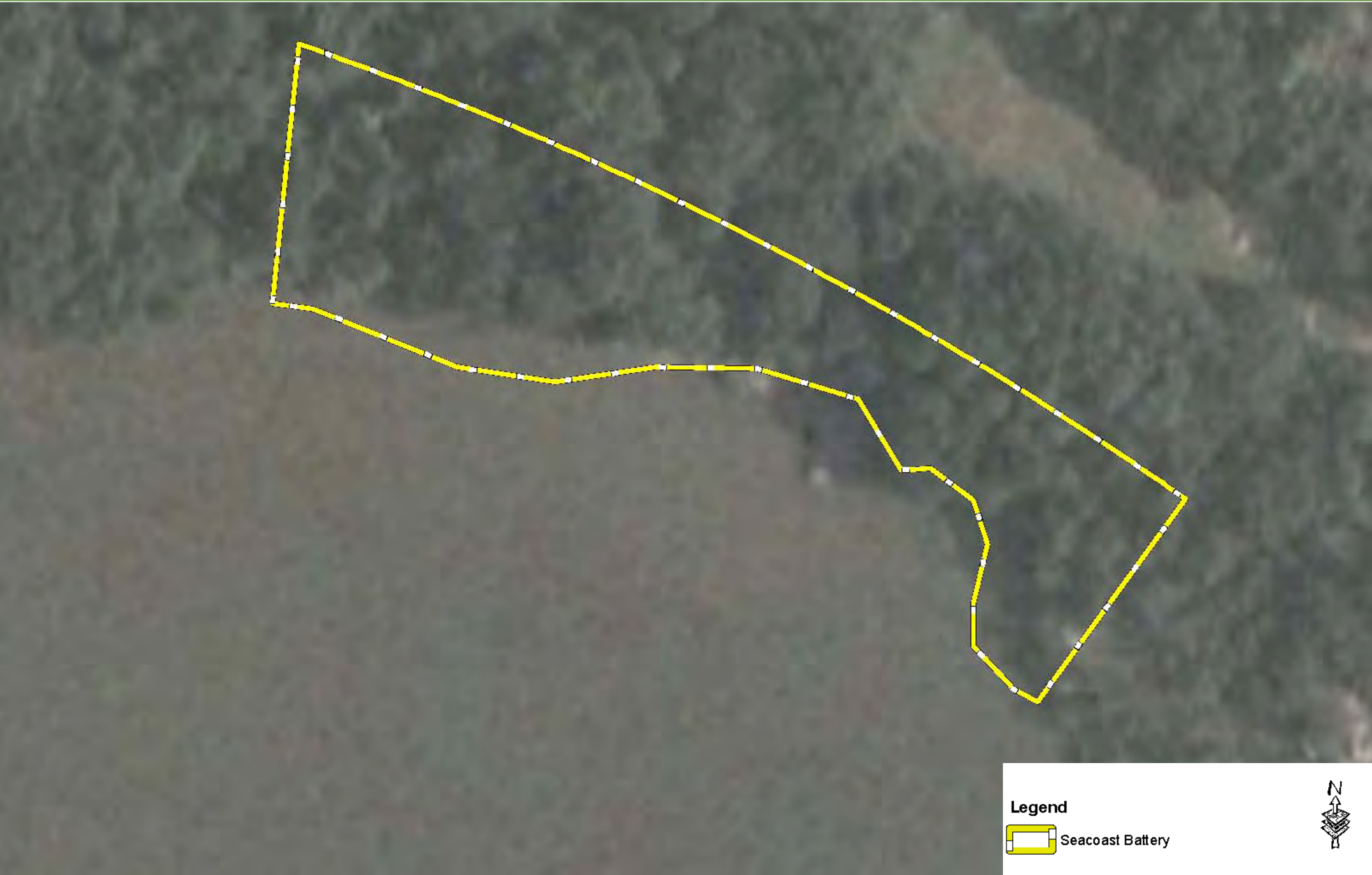
North Athletic Field MRS – Technical Approach (WSTPT-011-R-01)

MRS Total Area (Acres)	Recommended Coverage per EM 1110-1-4009	Calculated Coverage per *UXO Estimator*		MRS Survey Design			
				Transects - 10' Swath		Grids - 100'x100'	
		MRS %	Acres	Acres	Mileage	Acres	Quantity
14	7.50%	31.03%	4.36	N/A	N/A	4.36	19

- **MEC/MC Characterization Strategy**
  - DGM surveys on 4.4 acres
  - DGM grids (100' x 100') will be randomly distributed across the MRS
  - Anomalies will be selected, reacquired and investigated
  - Perform IS and discrete sampling based on geophysical survey results

North Athletic Field MRS – Technical Approach (WSTPT-011-R-01)

Seacoast Battery MRS (WSTPT-013-R-01)



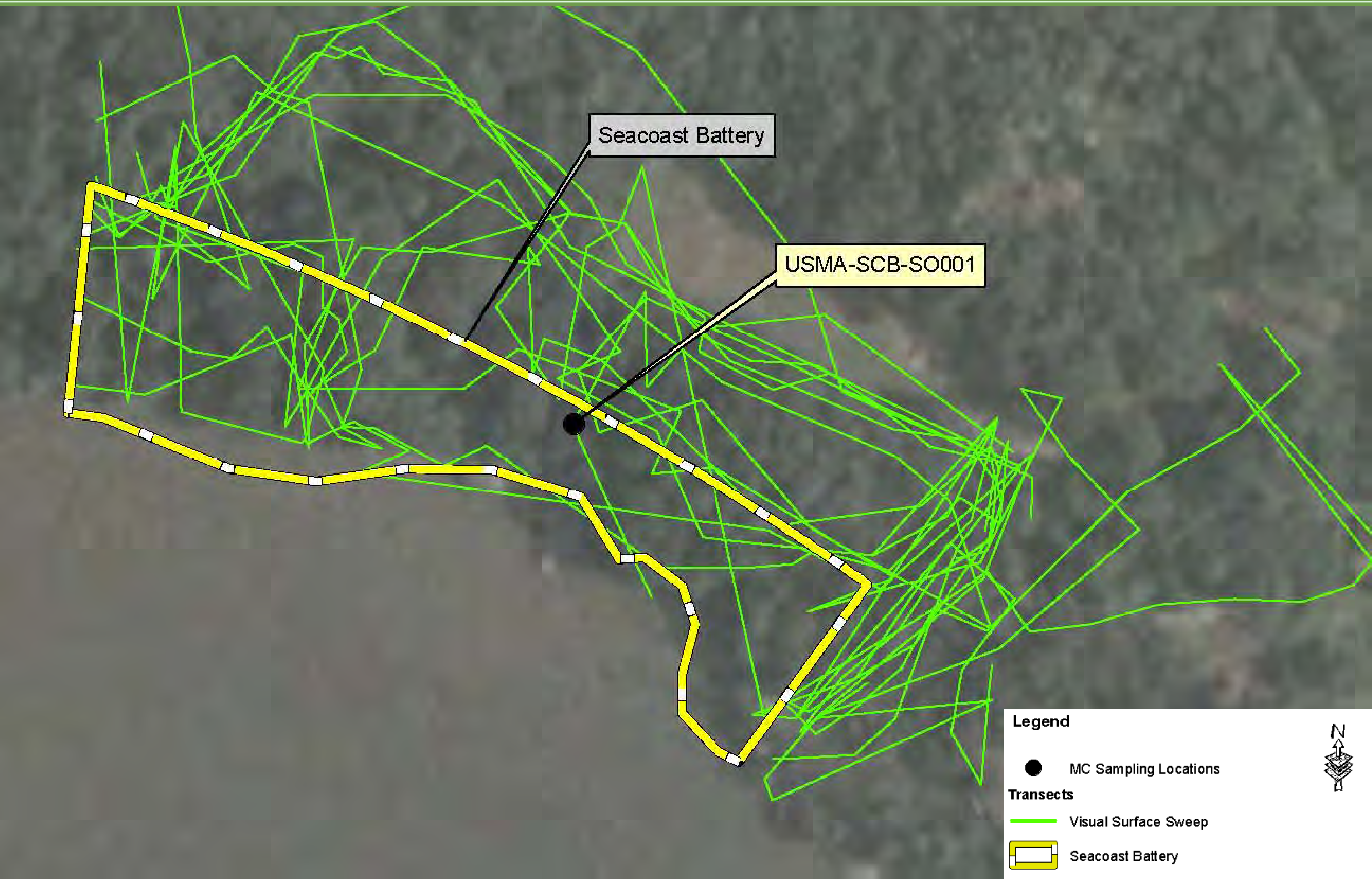
Seacoast Battery – Site Information (WSTPT-013-R-01)

- Size: 2 Acres
  - The site is located on Constitution Island, which is within the boundaries of West Point installation
- Land Use:
  - Current use: Currently used for recreation
  - Future use: No change in current use is anticipated
- Former Military Munitions Related Activities:
  - The Seacoast Battery MRS is the land area on Constitution Island which was part of the Seacoast Battery Range fan and where impact of projectiles may have occurred
  - The Seacoast Battery was established as a range between 1836 and 1850, and was demolished sometime during WWII
  - The firing point of the battery was located in the North Dock Area, and the direction of fire was to the north towards the bluffs on Constitution Island
- Potential Munitions Types:
  - Artillery. Fuzes; black powder filled projectiles

Seacoast Battery MRS – SI Results (WSTPT-013-R-01)

- No MEC or MD was observed during the SI
- MC Sampling
  - One surface soil sample was collected from a small depression
  - No explosives were detected in the sample
  - Copper, iron, lead, mercury, potassium, and zinc were all detected in both samples collected within the Seacoast Battery MRS
  - All concentrations were below the applicable screening criteria
- SI Recommendations
  - Recommended that this site be further investigated for MEC
  - Further evaluation of MC is not warranted at this time. If further investigation of MEC identifies areas of concern, additional sampling may be required

Seacoast Battery MRS – SI Results (WSTPT-013-R-01)



Seacoast Battery MRS – Technical Approach (WSTPT-013-R-01)

MRS Total Area (Acres)	Recommended Coverage per EM 1110-1-4009	Calculated Coverage per *UXO Estimator*		MRS Survey Design			
				Transects - 10' Swath		Grids - 100'x100'	
		MRS %	Acres	Acres	Mileage	Acres	Quantity
2	7.50%	76.30%	1.6	2	1.65	NA	NA

- **MEC/MC Characterization Strategy**
  - Full coverage Mag and Dig surveys across MRS
  - Investigate all anomalies
  - Anomalies will be selected, reacquired and investigated
  - Perform IS and discrete sampling based on geophysical survey results

Seacoast Battery MRS – Technical Approach (WSTPT-013-R-01)

Siege Battery MRS
(WSTPT-015-R-01)

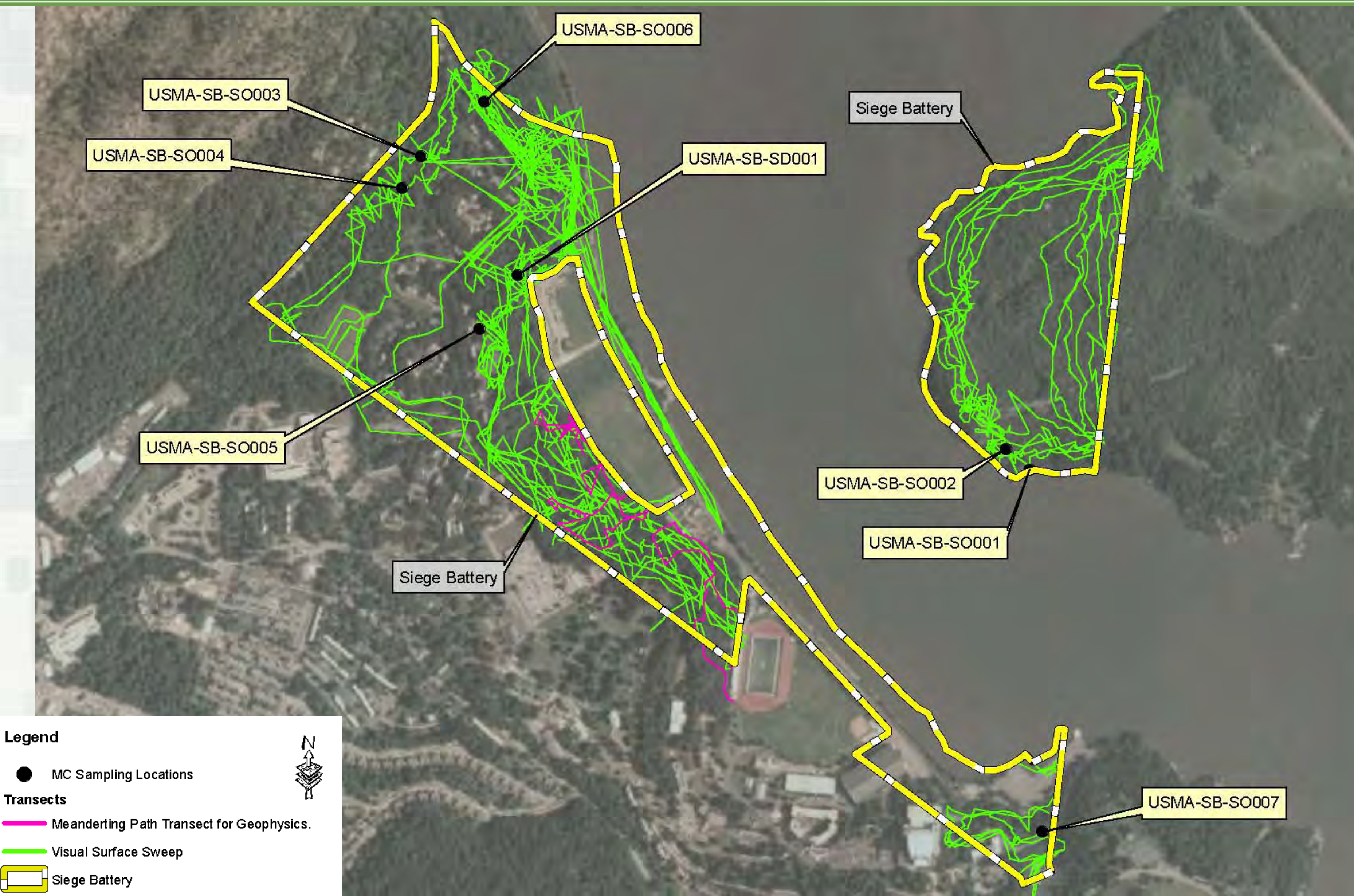
Siege Battery MRS – Site Information (WSTPT-015-R-01)

- Size: 179.3 Acres
  - The western portion of the Siege Battery MRS is developed and includes roads, parking lots, buildings, and the Lee Housing Area
  - The eastern portion of the MRS is located on Constitution Island and is undeveloped
- Land Use:
  - Current use: The site is being used for residential and Military Academy housing, classrooms, and recreation.
  - Future use: No change to the current use is anticipated
- Former Military Munitions Related Activities:
  - The Siege Battery MRS is part of the former Siege Battery Range fan. There are no known impact areas within the MRS. Over shots potentially could have impacted the Constitution Island portion of the MRS.
  - The firing point was located on the bluff south of North Dock area with the direction of fire to the north at water targets, and to the northwest toward the Crows Nest area
  - Target butts for 1,000-yard rifle range were located within the MRS
- Potential Munitions Types:
  - Artillery. Fuzes; black powder, HE, shrapnel projectiles; small arms

Siege Battery MRS – SI Results (WSTPT-015-R-01)

- One MEC item, a 3-inch Stokes mortar round, was found on Constitution Island during the SI.
- MD were observed during the SI and include:
  - Constitution Island: Cannonball fragments, partial Mark IV fuze, unidentifiable fragments
  - Lee Housing Area: Brass rotating bands to Parrott rounds, base plate (bottom portion of shell), shrapnel ball, various unidentifiable fragments. Also small arms including .30-06 dummy rounds (training round solid inert slug with casing)
- MC Sampling
  - Trace amounts of explosives were detected. Copper, lead, mercury, potassium, zinc, and antimony were all detected, but were below the applicable screening criteria
  - Iron was detected in two samples that was above screening criteria. These samples were located near MD
- SI Recommendation
  - Recommended that this site be further investigated for MEC
  - Recommended that this site be further investigated for MC

Siege Battery MRS – SI Results (WSTPT-015-R-01)



Siege Battery MRS – Technical Approach (WSTPT-015-R-01)

MRS Total Area (Acres)	Recommended Coverage per EM 1110-1-4009	Calculated Coverage per *UXO Estimator*		MRS Survey Design			
				Transects - 10' Swath		Grids - 100'x100'	
		MRS %	Acres	Acres	Mileage	Acres	Quantity
179.3	1.50%	3.25%	5.86	3.79	3.13	2.07	9

- **MEC Characterization Strategy**
  - Mag and Dig and DGM surveys on 5.9 acres
  - DGM grids (100’ x 100’) will be randomly distributed across the MRS
  - Anomalies will be selected, reacquired and investigated
  - Establish one IS sampling unit at the firing point location and collect up to 50 incremental samples
  - Perform additional IS and discrete sampling based on geophysical survey results

Siege Battery MRS – Technical Approach (WSTPT-015-R-01)

Battery-Knox TD Land MRS
(WSTPT-004-R-02)

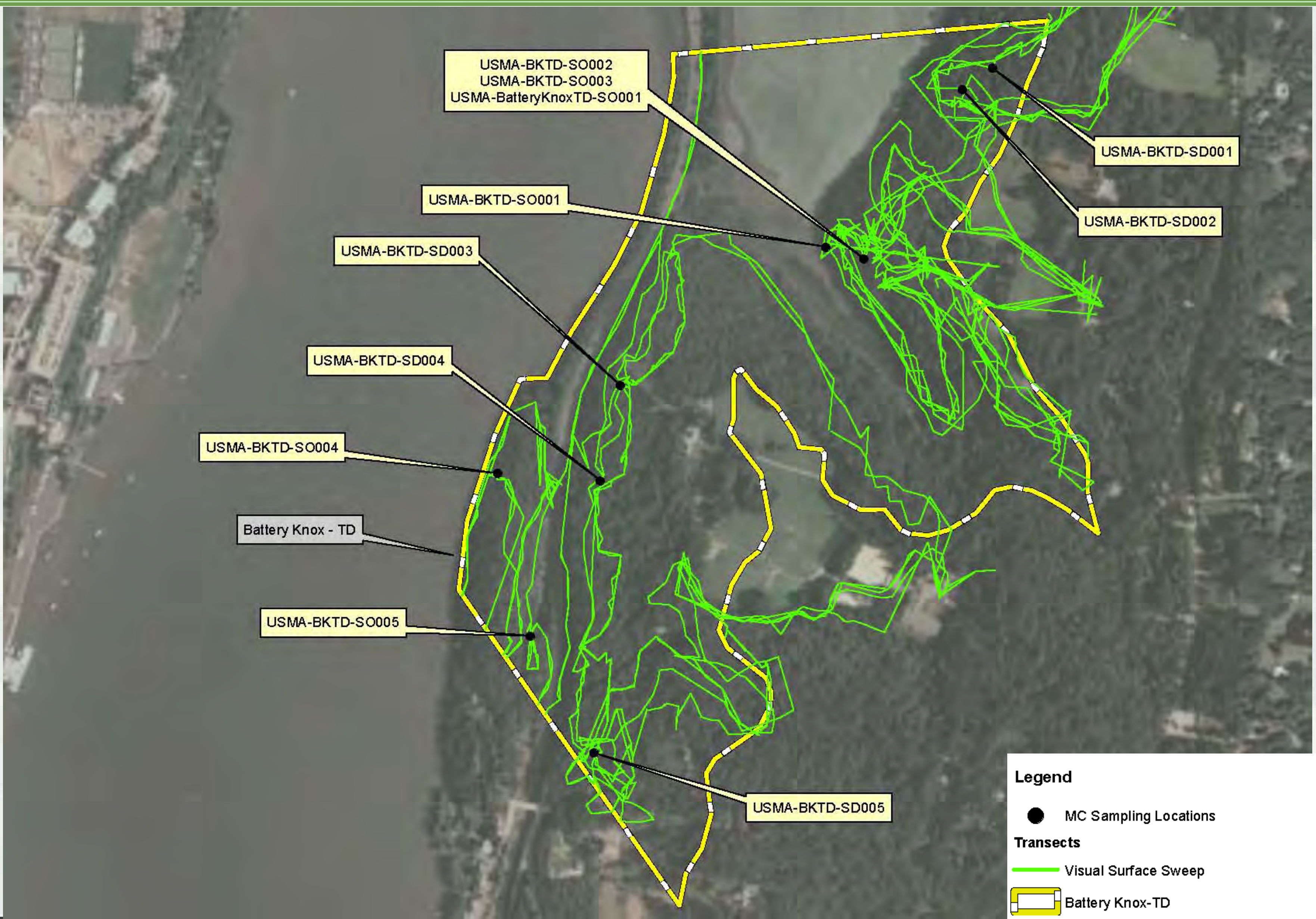
Battery-Knox TD Land MRS– Site Information (WSTPT-004-R-02)

- Size: 141 Acres
  - Consists of 11 privately owned parcels and a railroad line passing through the western side of the MRS adjacent to the Hudson River
- Land Use:
  - Current Use: Recreational (boaters, fisherman, hikers, athletic fields), commercial, private residences, private school
  - Future Use: No change in current use is anticipated
- Former Military Munitions Related Activities:
  - Part of range fan for Battery Knox Range
  - Firing from the battery located on the western bank of Hudson River towards the east at established targets within the river
  - Potential for over shots impacting the eastern bank of the Hudson River
- Potential Munitions Types:
  - Artillery, large caliber. Fuzes; black powder filled projectiles

Battery-Knox TD Land MRS – SI Results (WSTPT-004-R-02)

- No MEC or MD observed during the SI
- MC Sampling
  - Trace amounts of explosives were detected in seven soil samples, but below the USEPA Region 9 PRGs
  - Metals concentrations were below the USEPA Region 9 PRGs except iron, which is believed to be naturally occurring in the soils
- SI Recommendations
  - Since no explanation for the presence of these trace explosives can be determined at this time, the Stakeholders have requested that further investigation of this site be performed, including additional soil sampling and possible geophysical investigation.

Battery-Knox TD Land MRS– SI Results (WSTPT-004-R-02)

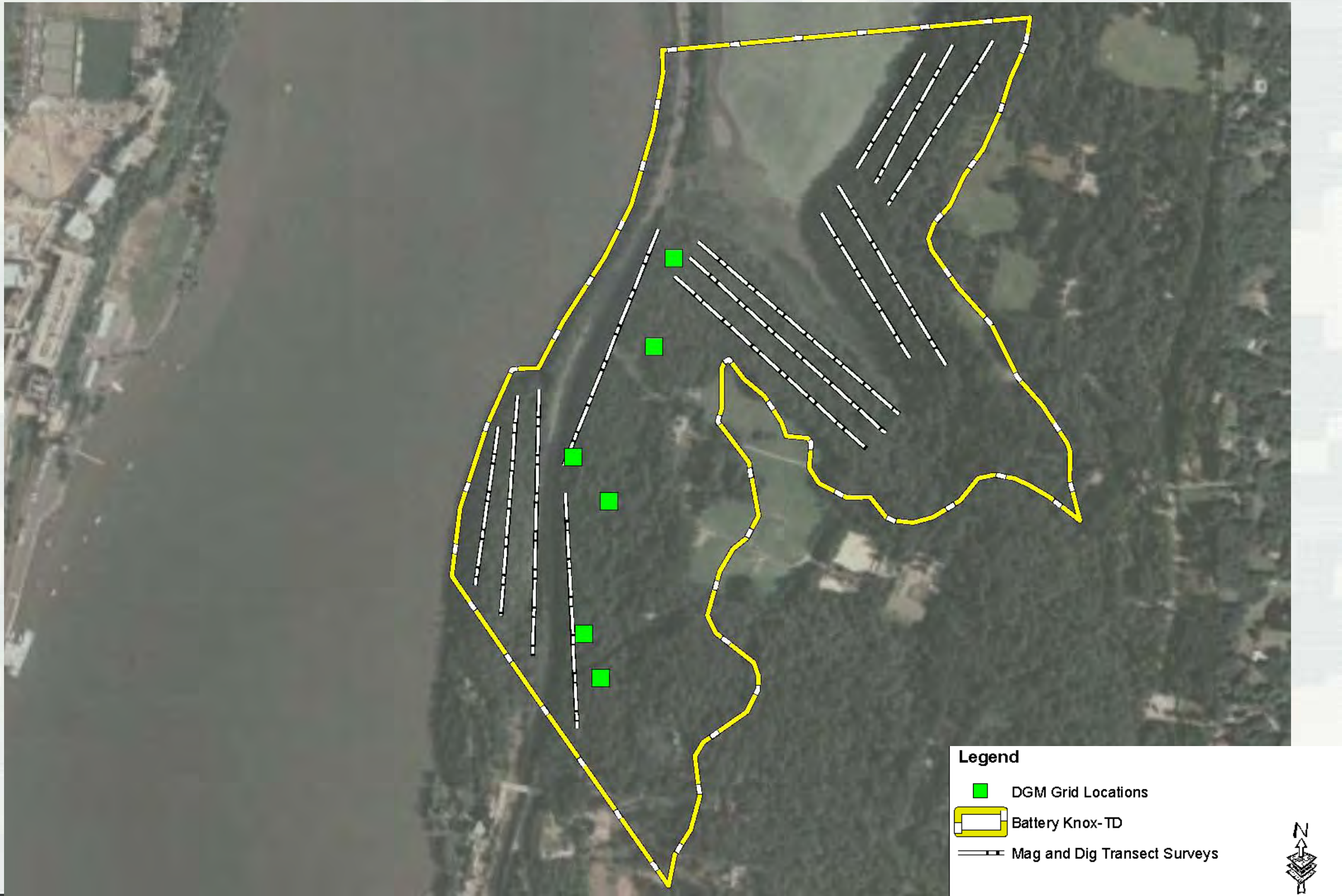


Battery-Knox TD Land MRS - Technical Approach (WSTPT-004-R-02)

MRS Total Area (Acres)	Recommended Coverage per EM 1110-1-4009	Calculated Coverage per *UXO Estimator*		MRS Survey Design			
				Transects - 10' Swath		Grids - 100'x100'	
		MRS %	Acres	Acres	Mileage	Acres	Quantity
141	3.00%	4.09%	5.78	4.40	3.63	1.38	6

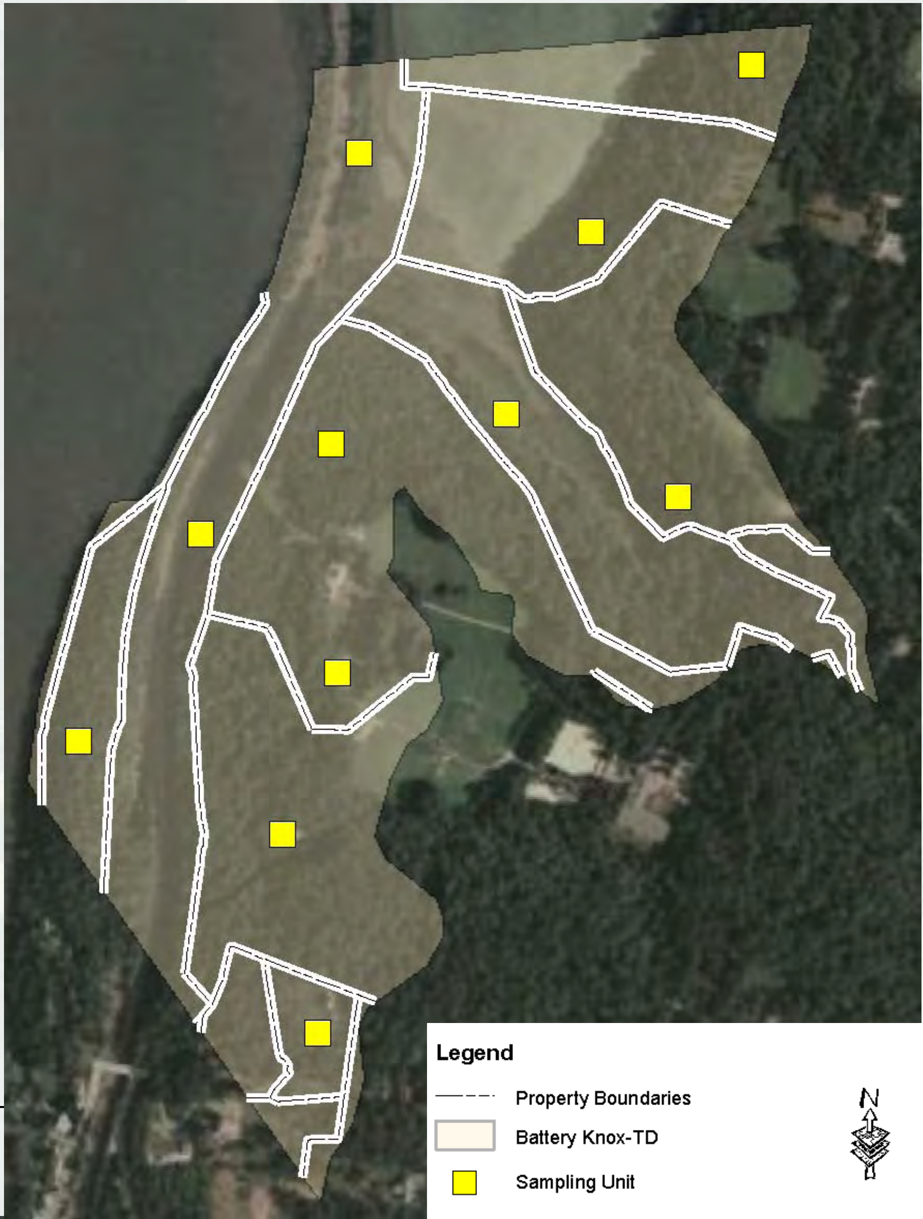
- **MEC Characterization Strategy**
  - Mag and Dig and DGM surveys on 5.8 acres
  - DGM grids (100’ x 100’) will be randomly distributed across the MRS in accessible areas to the instrumentation
  - Anomalies will be selected, reacquired and investigated

Battery-Knox TD Land MRS - Technical Approach (WSTPT-004-R-02)



Battery-Knox TD Land MRS - Technical Approach (WSTPT-004-R-02)

- **MC Characterization Strategy**
  - Place 11, 1-acre IS sampling units across the MRS
  - Each sampling unit will consist of 50 increments
  - Placement of sampling units will be dependent on terrain, structures, accessibility, etc.
  - Perform additional IS and discrete sampling based on geophysical survey results



Target Hill MRS
(WSTPT-017-R-01)

Target Hill MRS – Site Information (WSTPT-017-R-01)

- Size: 14 Acres
- Land Use:
  - Current use: Recreational use including soccer fields and Rugby Center
  - Future use: No change to current use is anticipated
- Former Military Munitions Related Activities:
  - Former target area for artillery training.
  - Firing toward Target Hill may have begun as early as 1812 from Cold Spring Foundry located across the Hudson River
  - Target Hill was then used for target practice for batteries located along the north side of the installation
  - Target Hill continued to be used as an impact area until the late 1930s for short-range artillery training
  - Target butts for the 1,000 yard small arms range fired from the North Athletic Field MRS location
  - 60,000 square yards of level ground were added to the North Athletic Field. This material was removed from Target Hill in 1944 to construct the athletic fields.
- Potential Munitions Types:
  - Artillery. Fuzes; black powder, HE and shrapnel projectiles

Target Hill MRS – SI Results (WSTPT-017-R-01)

- No MEC/MD were observed during the SI
- MC Sampling
  - One surface soil sample was collected. Trace amounts of 4-amino-2,6-dinitrotoluene and 1,3,5-trinitrobenzene were detected, but below PRG. Copper, iron, lead, mercury, potassium, and zinc were detected at levels below screening criteria
- SI Recommendations
  - Recommended for further investigation of MEC to include confirmation sampling of the anomalies identified during the geophysical survey
  - Further evaluation of MC is not warranted at this time. If further investigation of MEC identifies areas of concern, additional sampling may be required

Target Hill MRS – SI Results (WSTPT-017-R-01)

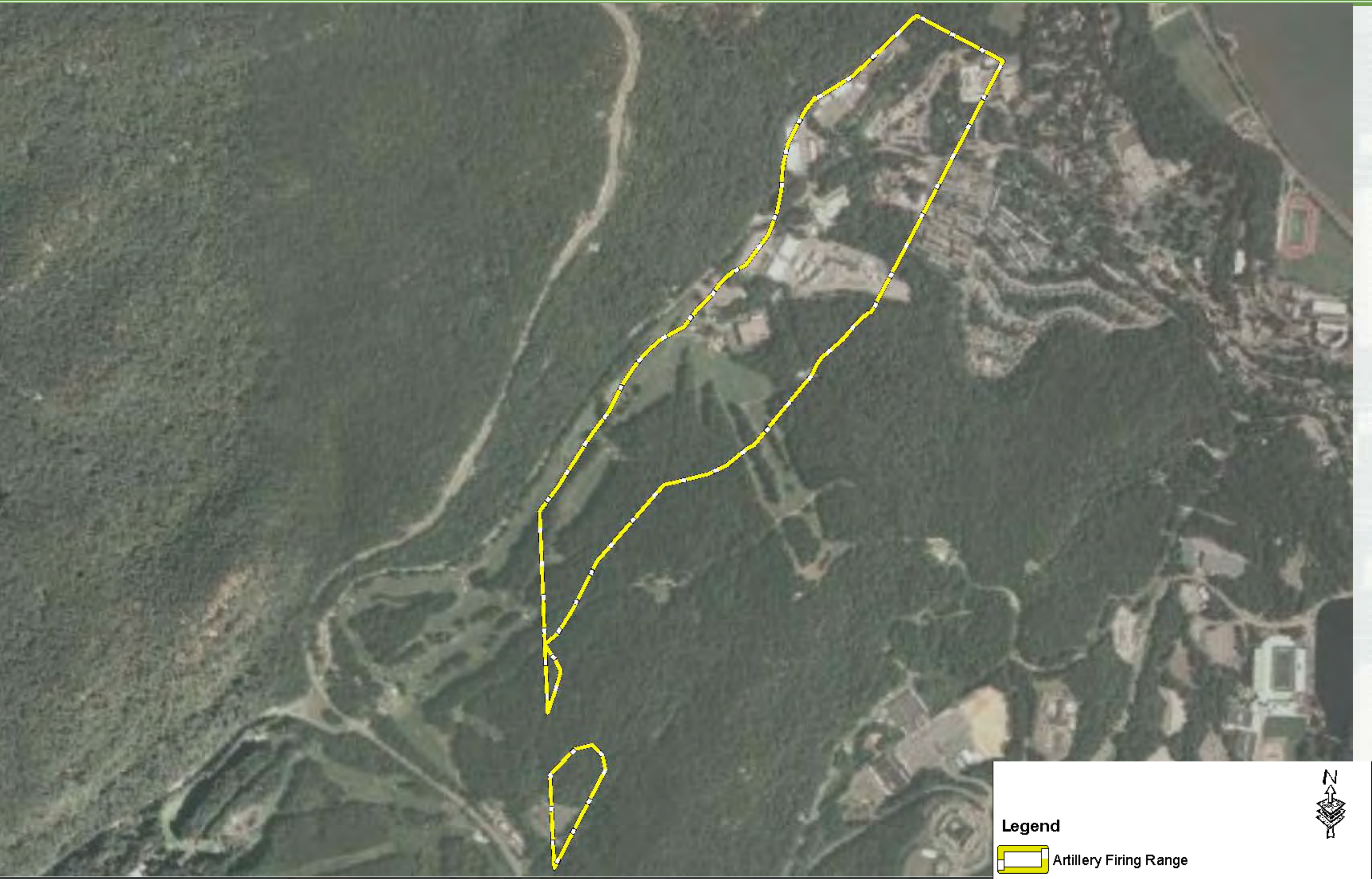
Target Hill MRS – Technical Approach (WSTPT-017-R-01)

MRS Total Area (Acres)	Recommended Coverage per EM 1110-1-4009	Calculated Coverage per *UXO Estimator*		MRS Survey Design per VSP			
				DGM Transects - 3' Swath		Grids - 100'x100'	
		MRS %	Acres	Acres	Mileage	Acres	Quantity
14	7.50%	NA	NA	0.74	1.9	0.9	4

- **MEC/MC Characterization Strategy**
  - DGM transect surveys developed by VSP
  - Transects spaced at 52-ft to identify impact areas
  - Evaluate above background anomaly density
  - Position DGM grids (100’ x 100’) based on anomaly density to determine nature of anomalies
  - Anomalies within DGM grids will be selected, reacquired and investigated
  - Perform IS and discrete sampling based on geophysical survey results

Target Hill MRS – Technical Approach
(WSTPT-017-R-01)

Artillery Firing Range MRS (WSTPT-001-R-01)



Artillery Firing Range MRS – Site Information (WSTPT-001-R-01)

- Size: 172.4 Acres
  - MRS is split into three parcels of land located to the south and west of main campus

- Land Use:
  - Current Use: Recreational (ski area, golf course), residential housing, industrial. Location of the USMAPS construction site.
  - Potential Future Use: Construction of buildings and athletic fields may occur at this MRS.

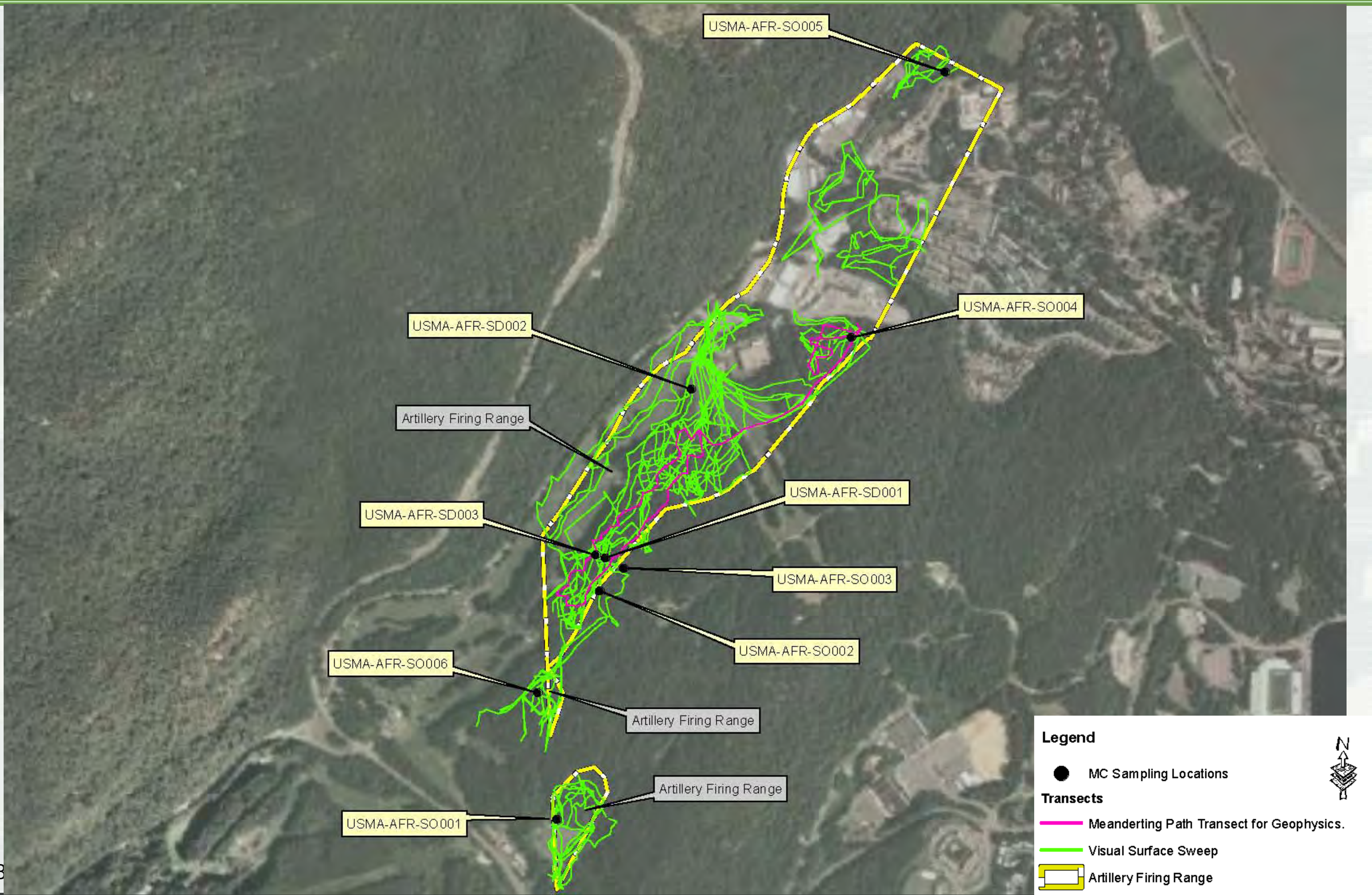
- Former Military Munitions Related Activities:
  - MRS is associated with three overlapping former artillery ranges
    - Sacred Heart Cemetery Range, the Silver Depository Range, Adolph's Pond Range
    - MRS also includes portions of the range fans from both Lusk Reservoir (WSTPT-019-R-01), and Redoubt No. 2 (WSTPT-020-R-01) MRS's
  - Operational between approximately1906 until the late 1930s
  - Former firing points for Sacred Heart Cemetery Range and Silver Depository Range are located within the MRS

- Potential Munitions Types:
  - Artillery, large caliber. Fuzes; HE and shrapnel projectiles

Artillery Firing Range MRS – SI/TCRA Results (WSTPT-001-R-01)

- No MEC observed during SI. MD observed during SI includes:
  - One Slap flare, two signal flares, fragments (Civil War era munitions, signal flares and components, hand grenade fuze and components). Small arms (.30-06 blank casing expended, 5.56mm blanks expended).
- TCRA performed Jan 2009, in area south of Motor Pool and New Water Tower area in support of USMAPS project. MD recovered during TCRA:
  - MK1A1 training hand grenade, M21 practice hand grenade, Fragments from 75mm & 37mm HE projectiles, Expended carrier for signal illumination round. Small arms (.30-06 blanks).
- MC Sampling
  - Explosives and metals concentrations below EPA 9 PRG except iron (believed to be naturally occurring in the soils)
- SI Recommendations
  - Recommended that the site be further investigated for MEC.
  - Further evaluation of MC is not warranted at this time. If further investigation of MEC identifies areas of concern, additional sampling may be required.

Artillery Firing Range MRS – SI Results (WSTPT-001-R-01)

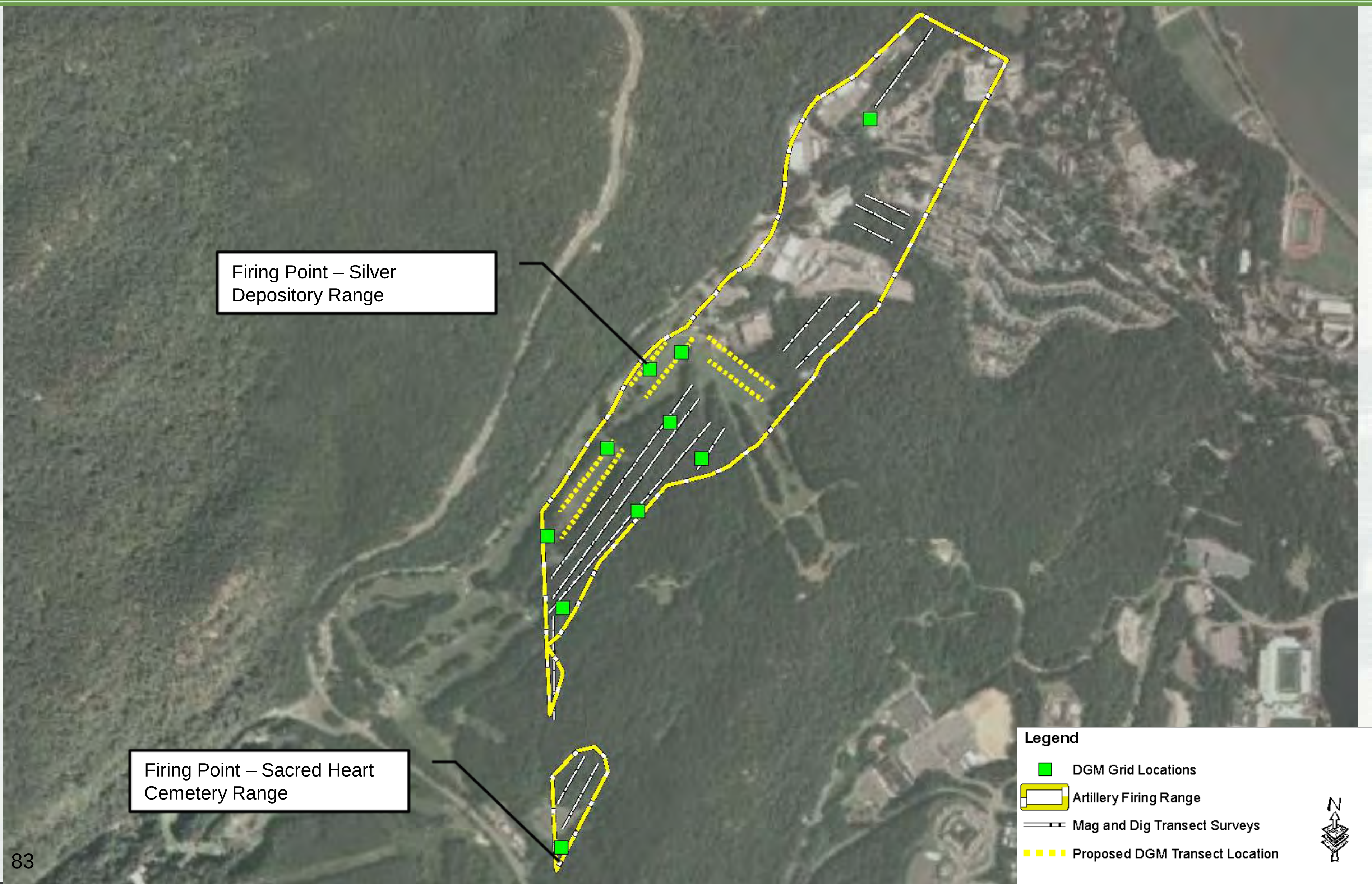


Artillery Firing Range MRS Technical Approach (WSTPT-001-R-01)

MRS Total Area (Acres)	Recommended Coverage per EM 1110-1-4009	Calculated Coverage per *UXO Estimator*		MRS Survey Design			
				Transects Swath Mag and Dig – 10’ DGM – 3’		Grids - 100'x100'	
		MRS %	Acres	Acres	Mileage	Acres	Quantity
172.4	1.50%	3.39%	5.78	3.49	2.88	2.29	10

- **MEC/MC Characterization Strategy**
  - Mag and Dig and DGM surveys on 5.8 acres
  - DGM transects (approx. 1 mile) will be utilized within open recreation areas to minimize impacts to golf course and ski slope
  - DGM grids (100’ x 100’) will be randomly distributed across the MRS in accessible areas to the instrumentation
  - Anomalies will be selected, reacquired and investigated
  - Establish one IS sampling unit at each firing point location and collect up to 50 incremental samples
  - Perform additional IS and discrete sampling based on geophysical survey results

Artillery Firing Range MRS Technical Approach (WSTPT-001-R-01)



Michie Stadium MRS
(WSTPT-022-R-01)

Michie Stadium MRS – Site Information (WSTPT-022-R-01)

- Size: 9.4 Acres
  - The site is almost 100% developed and currently encompasses the area in and around Michie Stadium
- Land Use:
  - Current use: Sports complex area
  - Future use: No change in current use is anticipated
- Former Military Munitions Related Activities:
  - The former munitions use at this site is unknown
  - 14 stokes mortars were recovered during construction activities in 2001 and 2003
  - It is not known when or how munitions were brought to the site
  - Potential source may have been munitions discarded after training in the area or brought in with fill used for the construction of the stadium and surrounding buildings
- Potential Munitions Types:
  - Artillery. Mortars

Michie Stadium MRS – SI Results (WSTPT-022-R-01)

- No MEC or MD was observed during the SI
  - In 2001, five 3-inch MK1 Stokes mortar rounds were found during seismic upgrades to the west stands of Michie Stadium. In 2003, nine additional Stokes mortars were found during the construction of Randall Hall
- MC Sampling
  - One surface soil sample was collected within Michie Stadium MRS in the northeast corner of the site. Trace amount of 4-amino-2,6-dinitrotoluene was detected, but below PRGs. Copper, iron, lead, mercury, potassium, and zinc were detected at levels below screening criteria
- SI Recommendations
  - Recommended that this site be further investigated for MEC
  - Further evaluation of MC is not warranted at this time. If further investigation of MEC identifies areas of concern, additional sampling may be required

Michie Stadium MRS – SI Results (WSTPT-022-R-01)

Michie Stadium MRS – Technical Approach (WSTPT-022-R-01)

MRS Total Area (Acres)	Recommended Coverage per EM 1110-1-4009	Calculated Coverage per *UXO Estimator*		MRS Survey Design			
				Transects - 10' Swath		Grids - 100'x100'	
		MRS %	Acres	Acres	Mileage	Acres	Quantity
9.4	7.50%	3.91%	0.37	NA	NA	0.23	2

- **MEC/MC Characterization Strategy**
  - DGM surveys on 0.23 acres based on estimated accessible/undeveloped area
  - Full coverage DGM surveys where possible
  - Anomalies will be selected, reacquired and investigated
  - Perform discrete sampling based on geophysical survey results

Michie Stadium MRS – Technical Approach (WSTPT-022-R-01)

West Point MMRP RI Schedule

- Work Plan - Submit to Regulators October-November 2010
- Regulator Review - October – November 2010
- TPP Meeting 2 – November - December 2010
- Final Work Plan – Submit January 2011
- RI Field Effort Mob #1 - February 2011 – Late March 2011
- RI Field Effort Mob #2 - February 2012 – Late April 2012
- RI Field Effort Mob #3 - Late May 2012 – Late July 2012
- RI Reports - Submit after Field Effort Mob #1 and Mob #3

APPENDIX I – MRS-SPECIFIC FIELD INVESTIGATION PLANS

APPENDIX I-1: ARTILLERY FIRING RANGE (WSTPT-001-R-01)

SITE PROFILE

Site Stats	Acres	Description
Total Acreage	172.4	Includes portions of a golf course, ski slope, wooded and developed areas.

Location: This MRS is divided into three separate parcels of land. The MRS is located to the south and west of the main campus.

Topography/Terrain: This area of West Point has relatively level terrain within the golf course and developed areas, and is steeply sloped on the southeast side approaching the ski slope.

Current Land Use: Recreational (ski area, golf course), residential housing, industrial land uses. The U.S. Military Academy Preparatory School is being built on a portion of this project area.

Future Land Use: Potential construction of buildings and athletic fields may occur at this MRS.

Former Military Munitions Related Activities: This MRS is associated with three overlapping artillery ranges (Sacred Heart Cemetery Range, Silver Depository Range and Adolph's Pond Range).

Firing points for the Sacred Heart Cemetery Range and Silver Depository Range are located within the MRS.

The MRS also includes portions of the range fans from both Lusk Reservoir MRS and Redoubt No. 2 MRS.

Ranges were operational between approximately 1906 until the late 1930s.

Potential Munitions Types: Artillery, large caliber. Fuzes, HE and shrapnel projectiles.

PREVIOUS INVESTIGATIONS

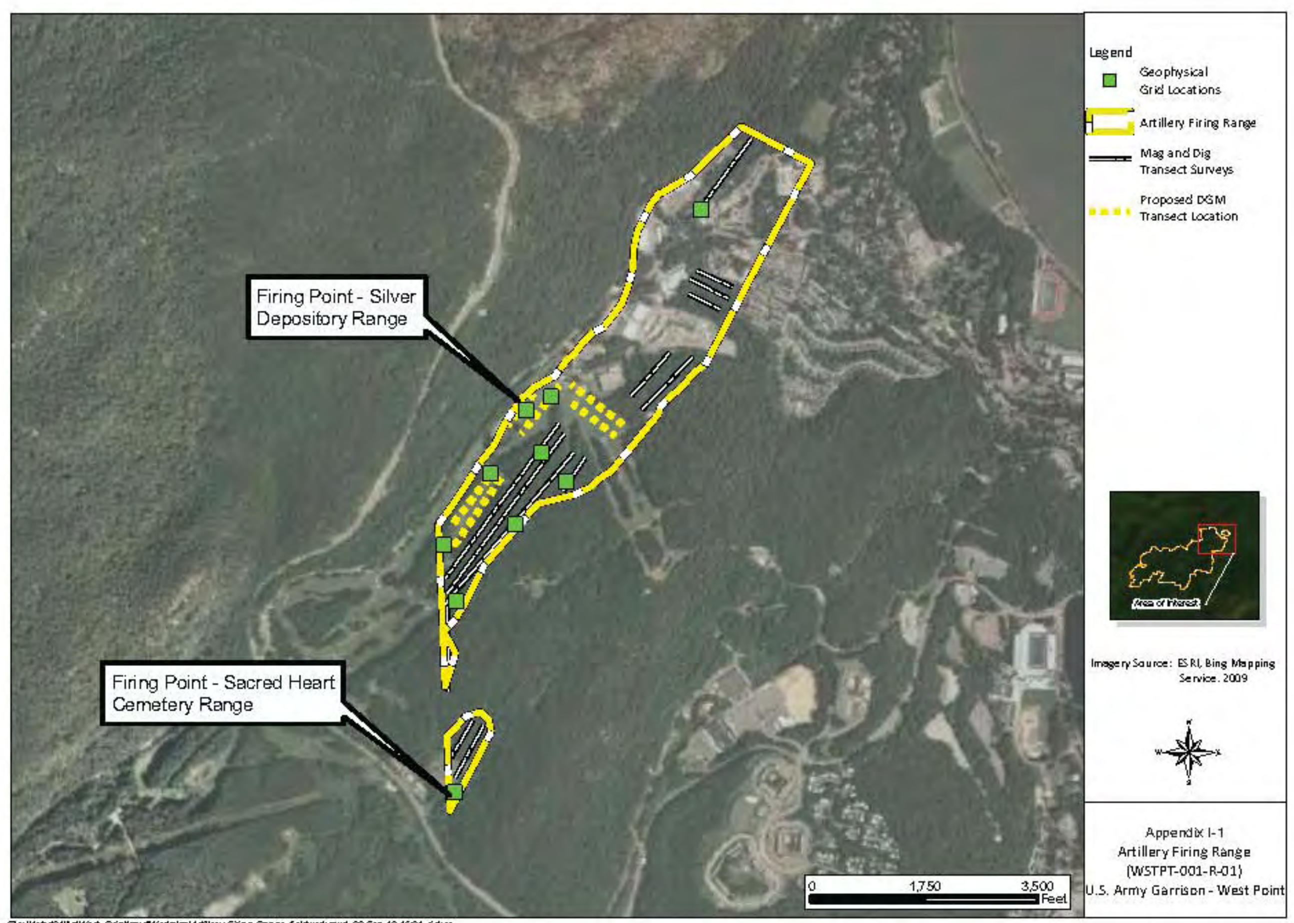
Site Inspection Results: No MEC was observed during SI visual surveys.

- MD was observed and includes: one slap flare, two signal flares, frag (Civil War era munitions, signal flares and components, hand grenade fuze and components). Small arms (.30-06 blank casing expended, 5.56mm blanks expended).
- MC – All explosives and metals concentrations were below the USEPA Region 9 PRGs, with the exception of iron, which is believed to be naturally occurring in the soils.

TCRA: Performed in January 2009. Located in the area south of the existing motor pool and new water tower area of the MRS.

- MD items recovered include MK1A1 training hand grenade M21, practice hand grenade, 30.06 cal. small arms blanks, frag of a 75mm HE projectile, 37mm HE projectile frag, and expended carrier for signal illumination round. Small arms (.30-06 blanks).

SITE MAP



RI – MEC SAMPLING STRATEGY

- RI coverage developed using UXO Estimator since no known impact areas are present within MRS.
- Confirm to a 95% confidence level that there is less than 0.5 MEC per acre within the MRS based on the MRS CSM.
- Perform geophysical surveys (mag & dig and DGM) randomly distributed over 5.8 acres of the MRS.

Recommended Coverage per EM 1110-1-4009	Calculated Coverage per *UXO Estimator*		MRS Survey Design			
			Transects Swath Mag & Dig – 10' DGM – 3'		Grids - 100'x100'	
	MRS %	Acres	Acres	Mileage	Acres	Quantity
1.50%	3.39%	5.78-ac.	3.49-ac.	2.88-mi.	2.29-ac.	10

- **Transect Surveys:** Mag & dig transect surveys will cover approximately 1.9 miles. Transects coverage will be approximately 10-ft wide. UXO Technicians will use White's XLT all metals detectors to perform the transect surveys. Anomalies will be investigated as they are detected. DGM surveys will cover approximately 1 mile. An EM61-MK2 sensor will be utilized within open recreational areas to minimize impacts to the golf course and ski slope.
- **Grid Surveys:** Grids will be randomly distributed across the MRS. DGM surveys will be performed in grids accessible to the instrumentation. Mag & dig surveys will be used in grids with difficult or rough terrain. One grid will be placed at each of the two firing points to detect potential burial features. All anomalies detected within the grids will be reacquired and intrusively investigated.
- A detailed description of MEC/MD recovered during the RI will be recorded in RespondFast®-UXO Investigation, and will capture type of MEC/MD, depth, and condition of the item. Coordinates of each MEC item will be documented using DGPS. MEC/MPPEH disposal operations will be performed in accordance with the approved ESP and per DOD and USACE guidance.

Minimum Separation Distances (MSD)					
	Unintentional Detonations		Intentional Detonations		
MGFD	HFD	TSD/ K40	MFD	Using Eng. Controls	Consolidated Shots
75mm HE	238-ft	50-ft	1,702-ft	200-ft	N/A

RI – MC SAMPLING STRATEGY

- Establish an IS sampling unit at potential MEC releases detected by the geophysical surveys. Number of units and unit size will be based on size of MEC release.
- Establish 1-acre sampling units at each of the two firing points within the MRS. Collect up to 50 increments within the sampling unit.
- Collect discrete samples where corroded or leaking munitions items are observed.
- Samples will be analyzed for select metals and explosives based on Appendix G.
- Independent data validation.
- Upload analytical data to ERIS after RI data approved.

APPENDIX I-2 BATTERY KNOX – TD LAND (WSTPT-004-R-02)

SITE PROFILE

Site Stats	Acres	Description
Total Acreage	141	Overshoot area of the Battery-Knox range fan located on the eastern bank of the Hudson River in Putnam County.

Location: The MRS is located on the eastern bank of the Hudson River in Putnam County. The MRS extends from the river's edge toward the east.

Topography/Terrain: The site is steeply sloped on the north and west sides. The terrain levels toward the Hudson River.

Current Land Use: This MRS spans 11 privately owned parcels. A railroad line passes through the western side of the MRS adjacent to the Hudson River. The property is used for recreation (boaters, fisherman, hikers, athletic fields), commercial, private residences and private school.

Future Land Use: No change in current use is anticipated.

Former Military Munitions Related Activities: MRS is part of the Battery-Knox range fan. Firing direction was east toward targets located in the Hudson River. This MRS is associated with potential overshoots west of the targets. No known impact areas are present within the MRS. No firing points fall within the MRS.

Potential Munitions Types: Artillery, large caliber. Fuzes, black powder filled projectiles.

PREVIOUS INVESTIGATIONS

Site Inspection Results: No MEC or MD was observed during visual surveys performed as part of the SI.

- MC – Seven soil samples were collected during the SI. Trace amounts of explosives were detected in seven samples; however, all of these concentrations were below the corresponding USEPA Region 9 PRGs.

  Metals concentrations in the samples were below the USEPA Region 9 PRGs, with the exception of iron. Iron is believed to be naturally occurring in the soils of this area.

SITE MAP

RI – MEC SAMPLING STRATEGY

- RI coverage developed using UXO Estimator since no known impact areas are present within the MRS.
- Confirm to a 95% confidence level that there is less than 0.5 MEC per acre within the MRS based on the MRS CSM.

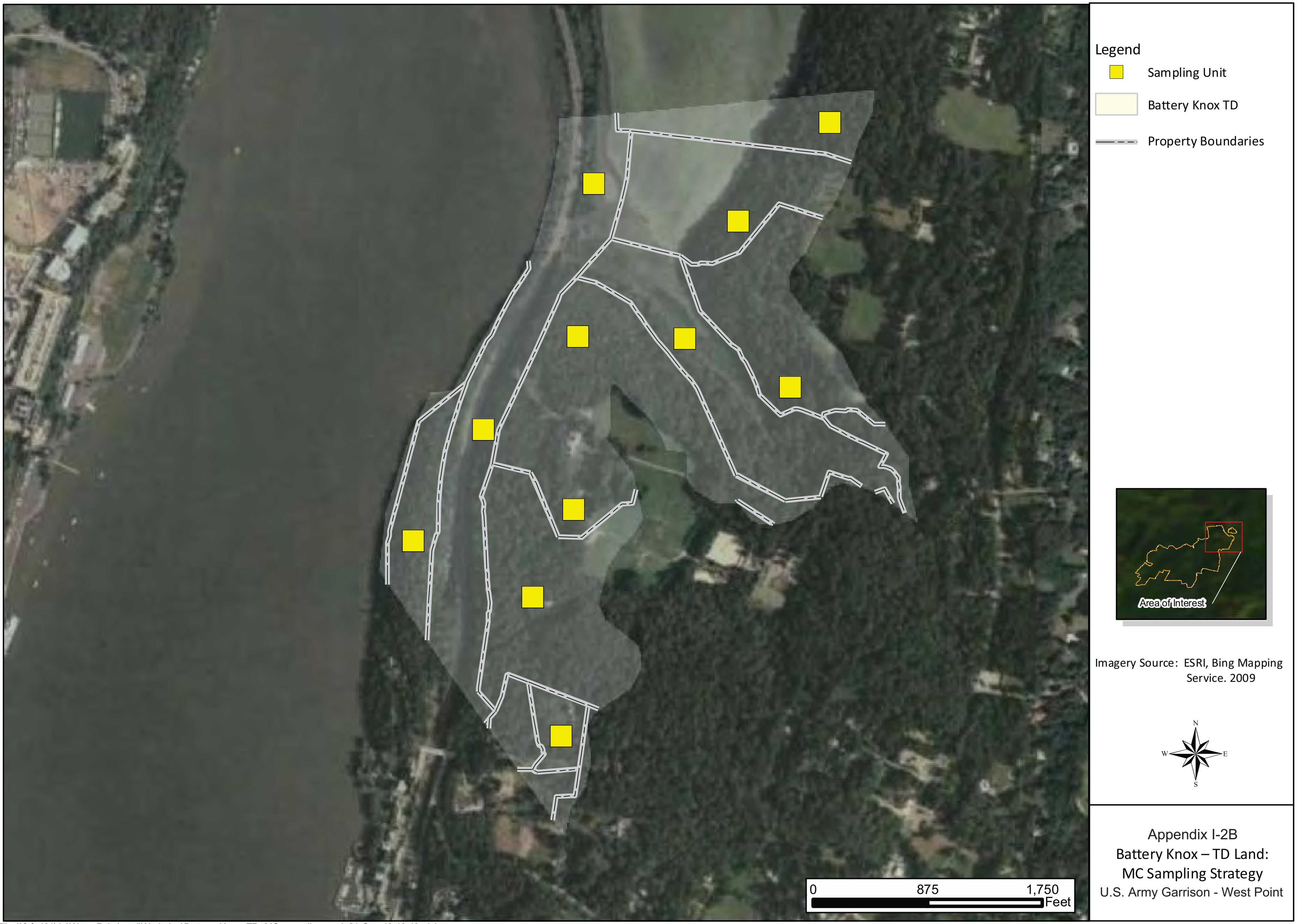
Recommended Coverage per EM 1110-1-4009	Calculated Coverage per *UXO Estimator*		MRS Survey Design			
			Transects - 10' Swath		Grids - 100'x100'	
	MRS %	Acres	Acres	Mileage	Acres	Quantity
3.00%	4.09%	5.78-ac.	4.40-ac.	3.63-mi.	1.38-ac.	6

- Perform geophysical surveys (mag & dig and DGM) randomly distributed over 5.8 acres of the MRS.
- **Transect Surveys:** Mag & dig transect surveys will cover approximately 3.6 miles. Transect coverage will be approximately 10-ft wide. UXO Technicians will use White's XLT all metals detectors to perform the transect surveys. Anomalies will be investigated as they are detected.
- **Grid Surveys:** Grids are randomly distributed across the MRS. DGM surveys will be performed in grids accessible to the instrumentation. Mag & dig surveys will be used in grids with difficult or rough terrain. All anomalies detected within the grids will be reacquired and intrusively investigated.
- A detailed description of MEC/MD recovered during the RI will be recorded in RespondFast®-UXO Investigation, and will capture type of MEC/MD, depth, and condition of the item. Coordinates of each MEC item will be documented using DGPS. This information will be uploaded to the project GIS database.

Minimum Separation Distances (MSD)					
	Unintentional Detonations		Intentional Detonations		
MGFD	HFD	TSD/ K40	MFD	Using Eng. Controls	Consolidated Shots
8-in. Parrott	197-ft	39-ft	2,620-ft	220-ft	N/A

RI – MC SAMPLING STRATEGY

- Establish an IS sampling unit at a potential MEC release detected by the geophysical surveys. Number of units and unit size will be based on size of MEC release.
- Place eleven (11) 1-acre IS units across the MRS. Collect up to 50 increments within a sampling unit. Placement of units will be dependent on terrain, structures, accessibility, etc. MC sampling strategy is presented in the figure on the following page.
- Collect discrete samples where corroded or leaking munitions items are observed.
- Samples will be analyzed for select metals and explosives based on Appendix G.
- Independent data validation.
- Upload analytical data to ERIS after RI data approved.



Appendix I-2B
Battery Knox – TD Land:
MC Sampling Strategy
U.S. Army Garrison - West Point

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APPENDIX I-3 FORT CLINTON WEST (WSTPT-008-R-01)

SITE PROFILE

Site Stats	Acres	Description
Total Acreage	14.4	Part of a former range fan. Includes residential, open, and wooded areas.

Location: MRS is located to the west of Target Hill athletic fields on the east side of West Point.

Topography/Terrain: The site is steeply sloped at the western end near Highway 218, and relatively level across the remainder of the MRS to the east.

Current Land Use: Extensively developed with residential housing and recreational areas. Parts of the northern and southern portions of the MRS are heavily wooded.

Future Land Use: No change to current use is anticipated.

Former Military Munitions Related Activities: This MRS is only a portion of the larger former Fort Clinton firing range fan used for artillery training. The direction of fire was to the northwest from the firing point located at Gees Point. No known impact areas are present within the MRS. No firing points fall within the MRS.

Potential Munitions Types: Artillery, large caliber. Fuzes; black powder filled projectiles, HE and shrapnel rounds.

PREVIOUS INVESTIGATIONS

Site Inspection Results: No MEC was observed during the SI visual surveys.

- MD was observed throughout the western portion of the MRS. Fragments from Civil War era munitions were identified including frag from a possible Parrott round.
- MC – All explosives and metals concentrations were below the USEPA Region 9 PRGs, with the exception of iron, which is believed to be naturally occurring in the soils.

SITE MAP

RI – MEC SAMPLING STRATEGY

- RI coverage developed using UXO Estimator since no known impact areas are present within the MRS.
- Confirm to a 95% confidence level that there is less than 0.5 MEC per acre within the MRS based on the MRS CSM.

Recommended Coverage per EM 1110-1-4009	Calculated Coverage per *UXO Estimator*		MRS Survey Design			
			Transects - 10' Swath		Grids - 100'x100'	
	MRS %	Acres	Acres	Mileage	Acres	Quantity
7.50%	30.44%	4.26-ac.	1.97-ac.	1.62-mi.	2.29-ac.	10

- Perform geophysical surveys (mag & dig and DGM) randomly distributed over 4.26 acres of the MRS.
- **Transect Surveys:** Mag & dig transect surveys will cover approximately 1.6 miles based on the pre-designed spacing. Transect coverage will be approximately 10-ft wide. UXO Technicians will use White's XLT all metals detectors to perform the transect surveys. Anomalies will be investigated as they are detected.
- **Grid Surveys:** Grids are randomly distributed across the MRS. DGM surveys will be performed in grids accessible to the instrumentation. Mag & dig surveys will be used in grids with difficult or rough terrain. All anomalies detected within the grids will be reacquired and intrusively investigated.
- A detailed description of MEC/MD recovered during the RI will be recorded in RespondFast®-UXO Investigation, and will capture type of MEC/MD, depth, and condition of the item. Coordinates of each MEC item will be documented using DGPS. This information will be uploaded to the project GIS database.

Minimum Separation Distances (MSD)					
	Unintentional Detonations	Intentional Detonations			
MGFD	HFD	TSD/ K40	MFD	Using Eng. Controls	Consolidated Shots
75mm HE	238-ft	50-ft	1,702-ft	200-ft	N/A

RI – MC SAMPLING STRATEGY

- Discrete and incremental sampling will be performed based on geophysical survey results.
- Establish an IS sampling unit at a potential MEC release detected by the geophysical surveys. Number of units and unit size will be based on size of MEC release. Collect up to 50 increments within the sampling unit.
- Collect discrete samples where corroded or leaking munitions items are observed.
- Samples will be analyzed for select metals and explosives.
- Independent data validation.
- Upload analytical data to ERIS after RI data approved.

APPENDIX I-4 GREY GHOST HOUSING AREA (WSTPT-010-R-01)

SITE PROFILE

Site Stats	Acres	Description
Total Acreage	24	Includes a portion of the Grey Ghost Housing Area.

Location: The MRS is located at the Grey Ghost Housing Area, centrally located in West Point.

Topography/Terrain: The southwestern end of the site is steeply sloped toward the residential area to the northeast. The residential area consists primarily of level terrain. The southern end of the MRS is heavily wooded.

Current Land Use: Residential use as a multi-family complex since 1950. Portions of the MRS are undeveloped and forested.

Future Land Use: No change in current use is anticipated.

Former Military Munitions Related Activities: This MRS is part of a former range complex that includes a 1,000 inch machine gun range and rifle/pistol range. The area was used by cadets for small arms training. Firing was directed from the north to south into the steep hillside. Operations at the site were conducted between 1920 and 1940.

Potential Munitions Types: Small arms .22 and .30 cal rounds.

PREVIOUS INVESTIGATIONS

Site Inspection Results: No MEC was observed during the SI visual surveys.

- MD observed during the SI includes a sand-filled Stokes mortar and frag from a Stokes mortar and a 37mm projectile.
- No evidence of pistol, rifle or machine gun use was found at the MRS.
- MC – All explosives and metals concentrations were below the USEPA Region 9 PRGs, with the exception of iron, which is believed to be naturally occurring in the soils.

RI – MEC SAMPLING STRATEGY

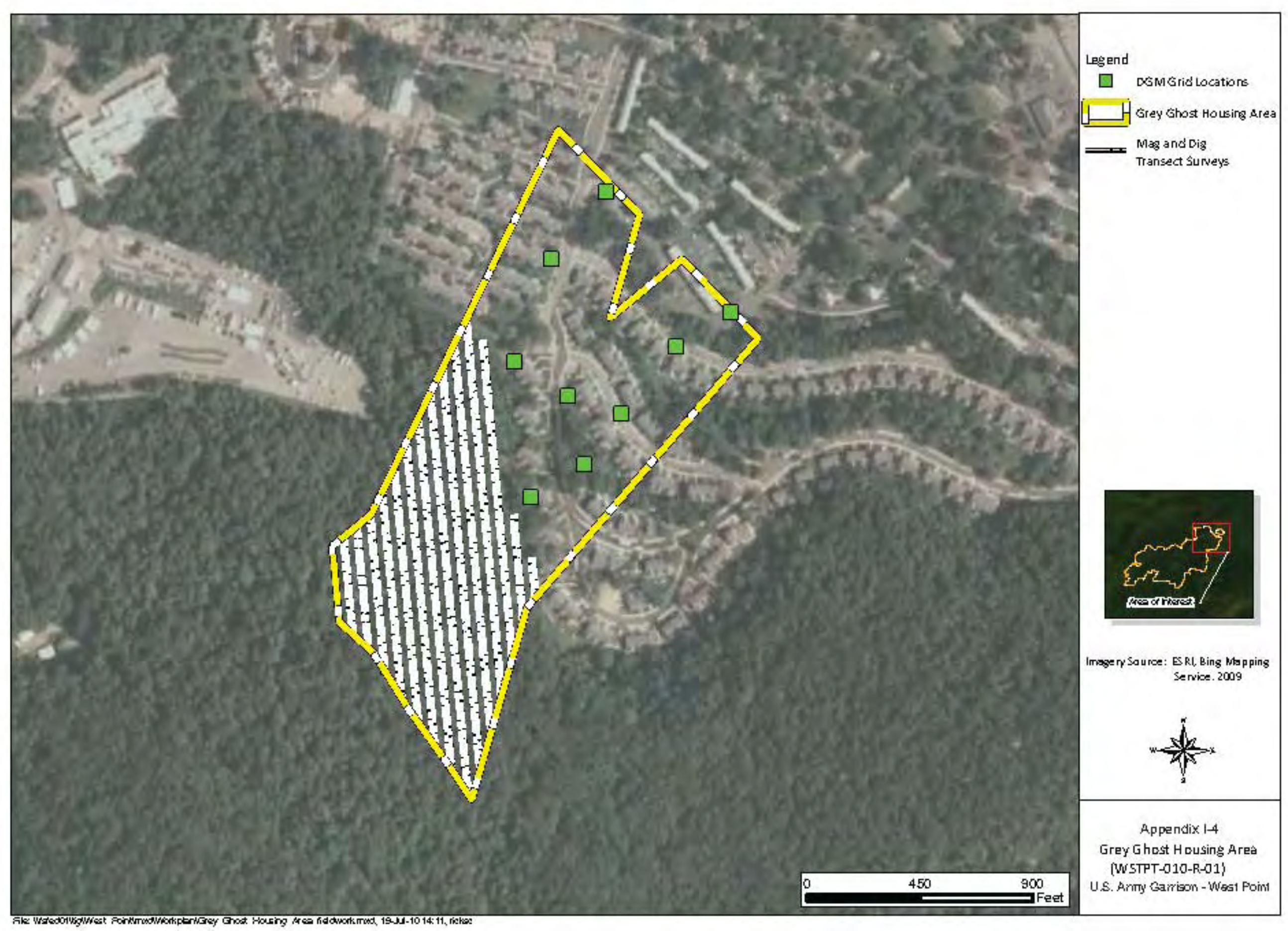
- RI coverage developed using UXO Estimator since no known impact areas are present within the MRS.
- Confirm to a 95% confidence level that there is less than 0.5 MEC per acre within the MRS based on the MRS CSM.

Recommended Coverage per EM 1110-1-4009	Calculated Coverage per *UXO Estimator*		MRS Survey Design			
			Transects - 10' Swath		Grids - 100'x100'	
	MRS %	Acres	Acres	Mileage	Acres	Quantity
7.50%	20.15%	4.78-ac.	2.71-ac.	2.24-mi.	2.07-ac.	9

- Perform geophysical surveys (mag & dig and DGM) randomly distributed over 4.78 acres of the MRS.
- **Transect Surveys:** Mag & dig transect surveys will cover approximately 2.24 miles based on the pre-designed 43-ft spacing. VSP was used to develop the transect spacing to encounter a 37mm impact area. Transect coverage will be approximately 10-ft wide. UXO Technicians will use White's XLT all metals detectors to perform the transect surveys. Anomalies will be investigated as they are detected.
- **Grid Surveys:** Grids are randomly distributed across the MRS. DGM surveys will be performed in grids accessible to the instrumentation. Mag & dig surveys will be used in grids with difficult or rough terrain. All anomalies detected within the grids will be reacquired and intrusively investigated.
- A detailed description of MEC/MD recovered during the RI will be recorded in RespondFast®-UXO Investigation, and will capture type of MEC/MD, depth, and condition of the item. Coordinates of each MEC item will be documented using DGPS. This information will be uploaded to the project GIS database.

Minimum Separation Distances (MSD)					
	Unintentional Detonations		Intentional Detonations		
MGFD	HFD	TSD/ K40	MFD	Using Eng. Controls	Consolidated Shots
3" Stokes HE	219-ft	54-ft	1,346-ft	200-ft	N/A

SITE MAP



RI – MC SAMPLING STRATEGY

- Establish an IS sampling unit at a potential MEC release detected by the geophysical surveys. Number of units and unit size will be based on size of MEC release. Collect up to 50 increments within the sampling unit.
- Collect discrete samples where corroded or leaking munitions items are observed.
- Samples will be analyzed for select metals and explosives based on Appendix G.
- XRF screening will conducted if berms or target areas for small arms ranges are identified during the geophysical survey. Based on the results of the SI, no small arms berms or target areas are anticipated to be located within the MRS. However, in the event that one is identified, XRF will be employed to assess the potential for lead contamination.
- Independent data validation.
- Upload analytical data to ERIS after RI data approved.

APPENDIX I-5 NORTH ATHLETIC FIELD (WSTPT-011-R-01)

SITE PROFILE

Site Stats	Acres	Description
Total Acreage	14	The site currently encompasses several athletic fields including the softball field complex, track, and a football field. The northern edge of the site is bounded by railroad tracks, a road, and the Hudson River.

Location: The site is located near the western shore of the Hudson River within the central campus area of West Point.

Topography/Terrain: The area is level and well traveled.

Current Land Use: This MRS is maintained for recreational use (track and field, softball, baseball, lacrosse, soccer, and other sports).

Future Land Use: No change in current use is anticipated.

Former Military Munitions Related Activities: In 1937, fill from Target Hill, which had been used as an artillery target area from 1903 until 1935, was moved to this MRS to increase the surface area of fields. Material from Target Hill may have contained munitions that were fired into the hill.

Potential Munitions Types: Artillery and small arms. Fuzes; black powder, HE and shrapnel projectiles. .22 cal rounds.

PREVIOUS INVESTIGATIONS

Site Inspection Results: No MEC or MD was observed during the SI visual surveys. MEC – None identified during SI.

- MC – One surface soil sample was collected and analyzed for TAL metals and explosives. Analytical results indicated a trace amount of 4-amino-2,6-dinitrotoluene (no PRG for this isomer). Six TAL metals detected at levels below screening criteria.

Previous Findings: In June 1999, a UXO item identified as a 76mm M339, Armor Piercing-Tracer (AP-T) was found at the site during renovation of the bleachers.

RI – MEC SAMPLING STRATEGY

- RI coverage developed using UXO Estimator since no known impact areas are present within the MRS.
- Confirm to a 95% confidence level that there is less than 0.5 MEC per acre within the MRS based on the MRS CSM.

Recommended Coverage per EM 1110-1-4009	Calculated Coverage per *UXO Estimator*		MRS Survey Design			
			Transects - 10' Swath		Grids - 100'x100'	
	MRS %	Acres	Acres	Mileage	Acres	Quantity
7.50%	31.03%	4.36-ac.	N/A	N/A	4.36-ac.	19

- Perform geophysical surveys (DGM) randomly distributed over 4.4 acres of the MRS.
- **Grid Surveys:** Grids are randomly distributed across the MRS. All anomalies detected within the grids will be reacquired and intrusively investigated. No grids will be placed within the main field.
- A detailed description of MEC/MD recovered during the RI will be recorded in RespondFast®-UXO Investigation, and will capture type of MEC/MD, depth, and condition of the item. Coordinates of each MEC item will be documented using DGPS. This information will be uploaded to the project GIS database.

Minimum Separation Distances (MSD)					
	Unintentional Detonations		Intentional Detonations		
MGFD	HFD	TSD/ K40	MFD	Using Eng. Controls	Consolidated Shots
75mm HE	238-ft	50-ft	1,702-ft	200-ft	N/A

SITE MAP

RI – MC SAMPLING STRATEGY

- Establish an IS sampling unit at a potential MEC release detected by the geophysical surveys. Number of units and unit size will be based on size of MEC release. Collect up to 50 increments within the sampling unit.
- Collect discrete samples where corroded or leaking munitions items are observed.
- Samples will be analyzed for select metals and explosives based on Appendix G.
- Independent data validation.
- Upload analytical data to ERIS after RI data approved.

APPENDIX I-6 SEACOAST BATTERY (WSTPT-013-R-01)

SITE PROFILE

Site Stats	Acres	Description
Total Acreage	2	Portion of a range fan that overlaps Constitution Island where impact of projectiles may have occurred.

Location: This MRS is located on Constitution Island. Constitution Island falls within West Point boundaries.

Topography/Terrain: The area is undeveloped with portions of the site covered with thick brambles and extremely steep slopes and cliffs.

Current Land Use: This area of Constitution Island is used for recreation.

Future Land Use: No change to current use is anticipated.

Former Military Munitions Related Activities: This MRS is part of the former Seacoast Battery firing range fan. The Battery was established as a range between 1836 and 1850 and was demolished sometime during WWII. The firing point of the battery was located in the North Dock Area and the direction of fire was to the north towards the bluffs on Constitution Island. No known impact areas are present within the MRS. No firing points fall within the MRS.

Potential Munitions Types: Artillery. Fuzes; black powder filled projectiles.

ENVIRONMENTAL ISSUES

Site Inspection Results: No MEC or MD was observed during the SI visual surveys.

- MC – One surface soil sample was collected from a small depression. No explosives were detected in the sample.
- Copper, iron, lead, mercury, potassium, and zinc were detected in the sample. All metals concentrations were below the USEPA Region 9 PRGs.

SITE MAP

RI – MEC SAMPLING STRATEGY

- Due to the relatively small size of this MRS, a full coverage mag & dig survey will be performed across the MRS.
- Mag & dig transect surveys will cover all accessible areas of the MRS. UXO Technicians will use White's XLT all metals detectors to perform the transect surveys. Anomalies will be investigated as they are detected.
- Portions of the MRS are known to be too steep to be accessed by UXO Teams. Bound the areas of these inaccessible areas and track in the project GIS.
- A detailed description of MEC/MD recovered during the RI will be recorded in RespondFast®-UXO Investigation, and will capture type of MEC/MD, depth, and condition of the item. Coordinates of each MEC item will be documented using DGPS. This information will be uploaded to the project GIS database.

Recommended Coverage per EM 1110-1-4009	Calculated Coverage per *UXO Estimator*		MRS Survey Design			
			Transects - 10' Swath		Grids - 100'x100'	
	MRS %	Acres	Acres	Mileage	Acres	Quantity
7.50%	76.30%	1.6-ac.	2-ac.	1.86-mi	N/A	N/A

Minimum Separation Distances (MSD)					
	Unintentional Detonations		Intentional Detonations		
MGFD	HFD	TSD/ K40	MFD	Using Eng. Controls	Consolidated Shots
3" Stokes HE	219-ft	54-ft	1,346-ft	200-ft	N/A

RI – MC SAMPLING STRATEGY

- Establish an IS sampling unit at a potential MEC release detected by the geophysical surveys. Number of units and unit size will be based on size of MEC release. Collect up to 50 increments within the sampling unit.
- Collect discrete samples where corroded or leaking munitions items are observed.
- Samples will be analyzed for select metals and explosives based on Appendix G.
- Independent data validation.
- Upload analytical data to ERIS after RI data approved.

APPENDIX I-7 SIEGE BATTERY (WSTPT-015-R-01)

SITE PROFILE

Site Stats	Acres	Description
Total Acreage	179.3	The western portion of the Siege Battery MRS is developed and includes roads, parking lots, buildings, and the Lee Housing Area. The eastern portion of the MRS is located on Constitution Island and is undeveloped.

Location: Includes two non-contiguous parcels of land. One portion of the site includes the former location of the firing point in the main campus area and extends to the northwest toward Crows Nest. The other portion of the site is located on Constitution Island, and encompasses part of the range fan associated with the battery.

Topography/Terrain: Undeveloped areas within the site are steep, heavily wooded terrain.

Current Land Use: The site is being used for residential and Military Academy housing, classrooms, and recreation. A solid waste landfill is located within the western area of the MRS.

Future Land Use: There are no plans to change current land use.

Former Military Munitions Related Activities: This MRS is a portion of the former Siege Batter firing range fan. Live firing had been conducted from Siege Battery as well as storage of ammunition. The firing point was located on the bluff south of North Dock area with the direction of fire to north at water targets, and to the northwest toward the Crows Nest area. During the late 1800s, Siege Battery was used for training with Parrott rifles. Target butts for 1,000-yard rifle range were located within the MRS. The Battery was last used between 1906 and 1910. No known impact areas are present within the MRS.

Potential Munitions Types: Artillery. Fuzes; black powder, HE, shrapnel projectiles; small arms.

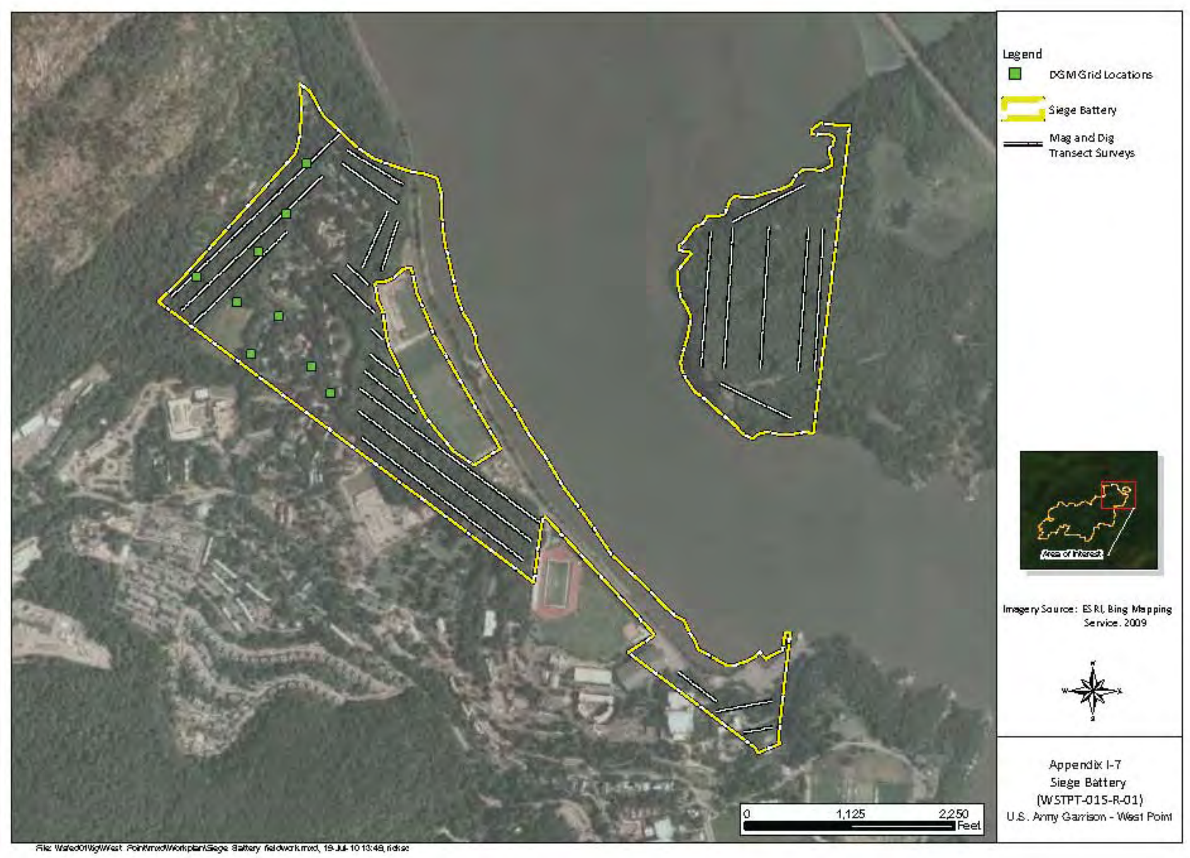
PREVIOUS INVESTIGATIONS

Site Inspection Results:

- MEC – One MEC item, a 3-inch Stokes mortar round, was found on Constitution Island.
- MD – Numerous MD items were observed. Cannon ball fragments, partial Mark IV fuze, unidentifiable fragments were identified on Constitution Island. Brass rotating bands to Parrott rounds, base plate, shrapnel ball, and various unidentifiable fragments were observed in Lee Housing Area.
- MC – One sediment sample and seven surface soil samples were collected. Trace amounts of explosives were detected in the surface soil samples. Copper, lead, mercury, potassium, zinc, and antimony were all detected in the samples, but were below the applicable screening criteria.

  Iron was detected above screening criteria in two samples. One sample was collected from Constitution Island; the second was downgradient of the Lee Housing Area.

SITE MAP



RI – MEC SAMPLING STRATEGY

- RI coverage developed using UXO Estimator since no known impact areas are present within MRS.
- Confirm to a 95% confidence level that there is less than 0.5 MEC per acre within the MRS based on the MRS CSM.
- Perform geophysical surveys (mag & dig and DGM) randomly distributed over 5.9 acres of the MRS.

Recommended Coverage per EM 1110-1-4009	Calculated Coverage per *UXO Estimator*		MRS Survey Design			
			Transects - 10' Swath		Grids - 100'x100'	
	MRS %	Acres	Acres	Mileage	Acres	Quantity
1.50%	3.25%	5.86-ac.	3.79-ac.	3.13-mi.	2.07-ac.	9

- **Transect Surveys:** Mag & dig transect surveys will cover approximately 3.1 miles. Transects coverage will be approximately 10-ft wide. UXO Technicians will use White's XLT all metals detectors to perform the transect surveys. Anomalies will be investigated as they are detected. Mag & dig transects will be placed at the firing point to detect potential burial features.
- **Grid Surveys:** Grids will be randomly distributed across the MRS. DGM surveys will be performed in grids accessible to the instrumentation. Mag & dig surveys will be used in grids with difficult or rough terrain. All anomalies detected within the grids will be reacquired and intrusively investigated.
- A detailed description of MEC/MD recovered during the RI will be recorded in RespondFast®-UXO Investigation, and will capture type of MEC/MD, depth, and condition of the item. Coordinates of each MEC item will be documented using DGPS. MEC/MPPEH disposal operations will be performed in accordance with the approved ESP and per DOD and USACE guidance.

Minimum Separation Distances (MSD)					
	Unintentional Detonations		Intentional Detonations		
MGFD	HFD	TSD/ K40	MFD	Using Eng. Controls	Consolidated Shots
3" Stokes HE	219-ft	54-ft	1,346-ft	200-ft	N/A

RI – MC SAMPLING STRATEGY

- Establish an IS sampling unit at a potential MEC release. Unit size will be based on size of MEC release. Collect up to 50 increments within the sampling unit.
- Establish 1-acre sampling unit at the firing point located within the MRS. Collect up to 50 increments within the sampling unit. Collect discrete samples where corroded or leaking munitions items are observed.
- Samples will be analyzed for select metals and explosives based on Appendix G.
- XRF screening will conducted if berms or target areas for small arms ranges are identified during the geophysical survey. Based on the results of the SI, no small arms berms or target areas are anticipated to be located within the MRS. However, in the event that one is identified, XRF will be employed to assess the potential for lead contamination.
- Independent data validation.
- Upload analytical data to ERIS after RI data approved

APPENDIX I-8 TARGET HILL (WSTPT-017-R-01)

SITE PROFILE/HISTORY

Site Stats	Acres	Description
Total Acreage	14	The Target Hill MRS is an open area of land that contains the Rugby Center in the northern half and soccer fields in the southern portion. The site served as an impact area with firing points from the Cold Spring Foundry located across the Hudson River and Target Flats located in the area of the North Athletic Field. Siege Battery surrounds Target Hill, and range fans for Siege Battery and Fort Clinton overlap the site.

Location: The site is located within the West Point campus area north of the athletic fields. The Hudson River and the West Shore Railroad mark the eastern boundary of the site. The western boundary is located at the base of the Lee Housing Area.

Topography/Terrain: The site has been completely developed and is an open flat area that is well traveled.

Current Land Use: The Target Hill MRS is currently maintained for recreational use.

Future Land Use: There are no current plans to change the current land use.

Former Military Munitions Related Activities: Firing toward Target Hill may have begun as early as 1812. Target Hill was used as target practice for batteries located along the north side of West Point from approximately 1890 until the 1930s for short-range artillery training. In the early 1900s, target butts were identified on the site with their associated firing points located on Target Flats. During the mid 1940s, 60,000 square yards of dirt were removed for construction of the North Athletic Field.

Potential Munitions Types: Munitions may include artillery, fuzes, black powder, HE, and shrapnel projectiles.

PREVIOUS INVESTIGATIONS

Site Inspection Results: No MEC or MD was observed during SI visual surveys.

- MC – One surface soil sample was collected. Trace amounts of 4-amino-2,6-dinitrotoluene and 1,3,5-trinitrobenzene were detected, but below PRG. Copper, iron, lead, mercury, potassium, and zinc were detected at levels below screening criteria.

SITE MAP

RI – MEC SAMPLING STRATEGY

- RI coverage developed using *Visual Sample Plan (VSP)* at the MRS former impact area.
- Locate an impact feature with a 100-ft diameter and an anomaly density of 50 anomalies per acre.

Recommended Coverage per EM 1110-1-4009	Calculated Coverage per *Visual Sample Plan*		MRS Survey Design			
			DGM Transects - 3' Swath		Grids - 100'x100'	
	MRS %	Acres	Acres	Mileage	Acres	Quantity
7.50%	11.71	1.64	N/A	1.9	0.9-ac.	4

- **Transect Surveys:** DGM transect surveys will cover approximately 1.9 miles. Transects will be spaced 52 feet on center to identify impact areas. Evaluate anomaly distribution and place grid surveys for additional mapping and intrusive investigations for MEC.
- **Grid Surveys:** Four (4) 100'x100' grids will be distributed across the MRS based on anomaly densities as calculated from DGM transect data. Areas with anomaly densities above background will be evaluated, and DGM grids will be placed to determine the nature of anomalies. A range of anomalies detected within the grids will be reacquired and intrusively investigated.
- A detailed description of MEC/MD recovered during the RI will be recorded in RespondFast®-UXO Investigation, and will capture type of MEC/MD, depth, and condition of the item. Coordinates of each MEC item will be documented using DGPS. MEC/MPPEH disposal operations will be performed in accordance with the approved ESP and per DOD and USACE guidance.

Minimum Separation Distances (MSD)					
	Unintentional Detonations		Intentional Detonations		
MGFD	HFD	TSD/K40	MFD	Using Eng. Controls	Consolidated Shots
75mm HE	238-ft	50-ft	1,702-ft	200-ft	N/A

RI – MC SAMPLING STRATEGY

- Establish an IS sampling unit at a potential MEC release. Unit size will be based on size of MEC release. Collect up to 50 increments within the sampling unit.
- Collect discrete samples where corroded or leaking munitions items are observed.
- Samples will be analyzed for select metals and explosives based on Appendix G.
- Independent data validation.
- Upload analytical data to ERIS after RI data approved.

APPENDIX I-9 LUSK RESERVOIR (WSTPT-019-R-01)

SITE PROFILE/HISTORY

Site Stats	Acres	Description
Total Acreage	83	The Lusk Reservoir MRS contains numerous buildings, including homes, schools, and water and electrical facilities in the western end of the site. The eastern end of the site is largely undeveloped. The firing point is situated to the east of Lusk Reservoir with the fan extending to the northwest.

Location: The site is located in the central portion of the West Point campus, with the firing point located east of the Lusk Reservoir.

Topography/Terrain: The southern half of the site has steep, rocky, and heavily wooded terrain. The northern half of the site is heavily developed.

Current Land Use: The Lusk Reservoir MRS is currently used for schools and residential housing. Delafield Pond is used for swimming.

Future Land Use: There are no current plans to change the current land use.

Former Military Munitions Related Activities: This MRS is part of the former Lusk Reservoir firing range fan. The range was used between 1909 and 1916 with the firing point located east of Lusk Reservoir at the southern apex of the MRS. Firing was directed to the northwest toward the Crows Nest. In 1915 to 1916, firing was described as sub-caliber and service target practice. There are no known impact areas within the MRS.

Potential Munitions Types: Artillery; fuzes; HE and shrapnel projectiles.

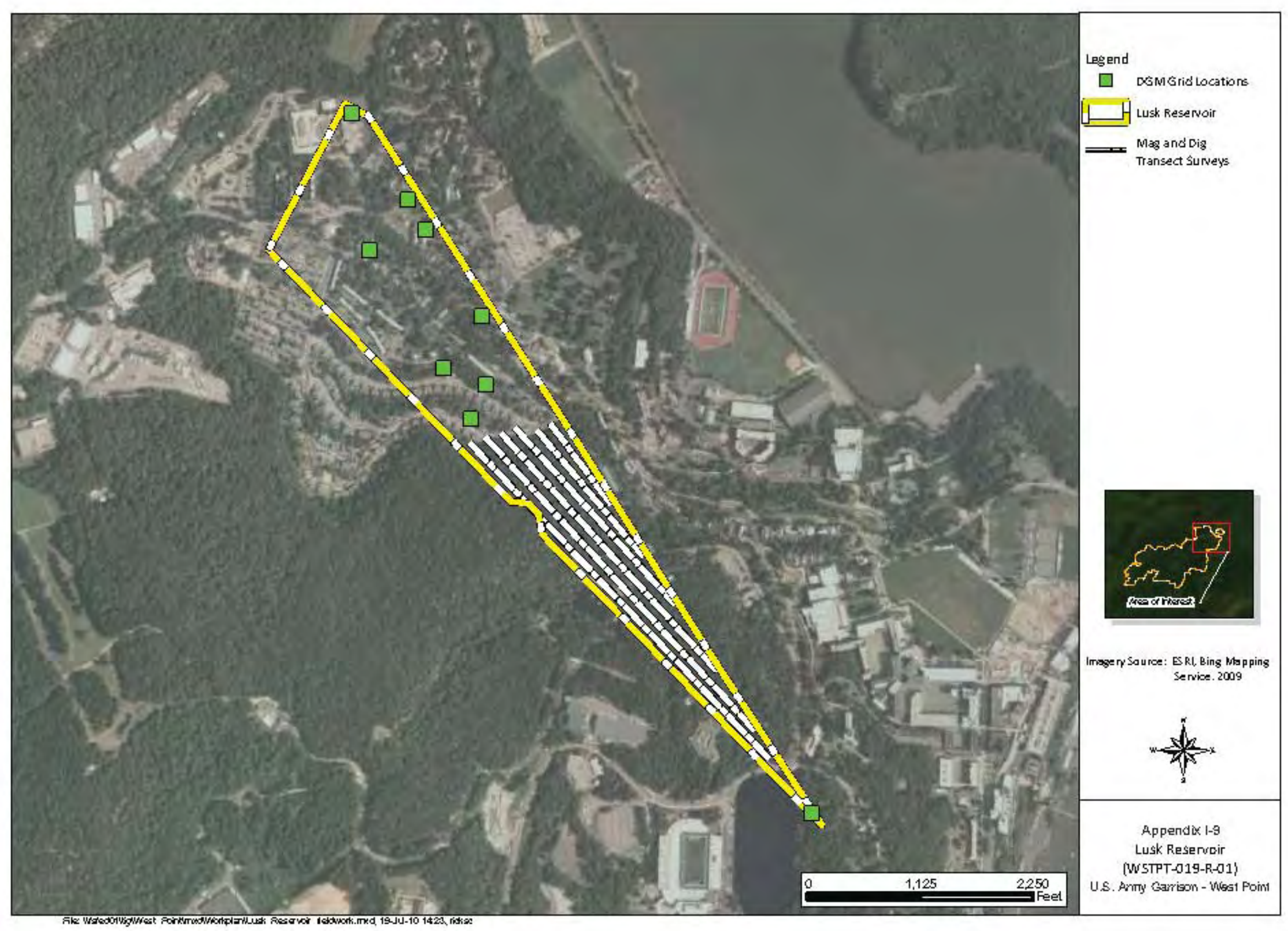
PREVIOUS INVESTIGATIONS

Site Inspection Results: No MEC was observed during SI visual surveys. Two metal items were identified, but it is uncertain whether they were related to military munitions.

- MC – One surface soil sample and one sediment sample were collected. Trace amounts of 4-amino-2,6-dinitrotoluene and 1,3,5-trinitrobenzene were detected, but below PRG. Copper, iron, lead, mercury, potassium, zinc, and antimony were detected at levels below screening criteria. No traces of explosives were detected.

Previous Findings: During the 2001 UXO removal, three items were identified: a 6.5-inch projectile, rifled; a portion of a 9-inch Parrott round; and a fragment from an 8-inch Parrott round.

SITE MAP



RI – MEC SAMPLING STRATEGY

- RI coverage developed using UXO Estimator since no known impact areas are present within MRS.
- Confirm to a 95% confidence level that there is less than 0.5 MEC per acre within the MRS based on the MRS CSM.

Recommended Coverage per EM 1110-1-4009	Calculated Coverage per *UXO Estimator*		MRS Survey Design			
			Transects - 10' Swath		Grids - 100'x100'	
	MRS %	Acres	Acres	Mileage	Acres	Quantity
4.50 %	6.66%	5.75-ac.	3.68-ac.	3.04-mi.	2.07-ac.	9

- Perform geophysical surveys (mag & dig and DGM) randomly distributed over 5.8 acres of the MRS.
- **Transect Surveys:** Mag & dig transect surveys will cover approximately 3 miles. Transect coverage will be approximately 10-ft wide. UXO Technicians will use White's XLT all metals detectors to perform the transect surveys. Anomalies will be investigated as they are detected.
- **Grid Surveys:** Grids will be randomly distributed across the MRS. DGM surveys will be performed in grids accessible to the instrumentation. Mag & dig surveys will be used in grids with difficult or rough terrain. One grid will be placed at the firing point to detect potential burial features. All anomalies detected within the grids will be reacquired and intrusively investigated.
- A detailed description of MEC/MD recovered during the RI will be recorded in RespondFast®-UXO Investigation, and will capture type of MEC/MD, depth, and condition of the item. Coordinates of each MEC item will be documented using DGPS. MEC/MPPEH disposal operations will be performed in accordance with the approved ESP and per DOD and USACE guidance.

Minimum Separation Distances (MSD)					
	Unintentional Detonations		Intentional Detonations		
MGFD	HFD	TSD/ K40	MFD	Using Eng. Controls	Consolidated Shots
75mm HE	238-ft	50-ft	1,702-ft	200-ft.	N/A

RI – MC SAMPLING STRATEGY

- Establish an IS sampling unit at a potential MEC release. Unit size will be based on size of MEC release. Collect up to 50 increments within the sampling unit.
- Establish a 1-acre sampling unit at the firing point located within the MRS. Collect up to 50 increments within the sampling unit.
- Collect discrete samples where corroded or leaking munitions items are observed.
- Samples will be analyzed for select metals and explosives based on Appendix G.
- Independent data validation.
- Upload analytical data to ERIS after RI data approved.

APPENDIX I-10 REDOUBT NO. 2 (WSTPT-020-R-01)

SITE PROFILE/HISTORY

Site Stats	Acres	Description
Total Acreage	20	The Redoubt No. 2 MRS is primarily undeveloped with several roads crossing the site and a few buildings spaced intermittently throughout the site. The firing point of the range is located south of the Stony Lonesome Housing Area and adjacent to the historic Redoubt No. 2.

Location: The site is located northeast of Highway 9W and west of Dassori Pond in the southern portion of the installation. The site has no distinct boundaries.

Topography/Terrain: The site is heavily wooded with some wetlands and steep rocky terrain.

Current Land Use: Redoubt No. 2 is currently used for recreational activities and open land.

Future Land Use: There are no plans to change current land use.

Former Military Munitions Related Activities: The MRS is a portion of the former Redoubt No. 2 firing range fan. Between 1915 and 1916, the site was used for field artillery target practice with the firing point located in the vicinity of historic Redoubt No. 2 at the southern apex of the MRS. Direction of fire was to the north toward targets on Crows Nest. No known impact areas are present within the MRS.

Potential Munitions Types: Artillery. Fuzes; HE and shrapnel projectiles.

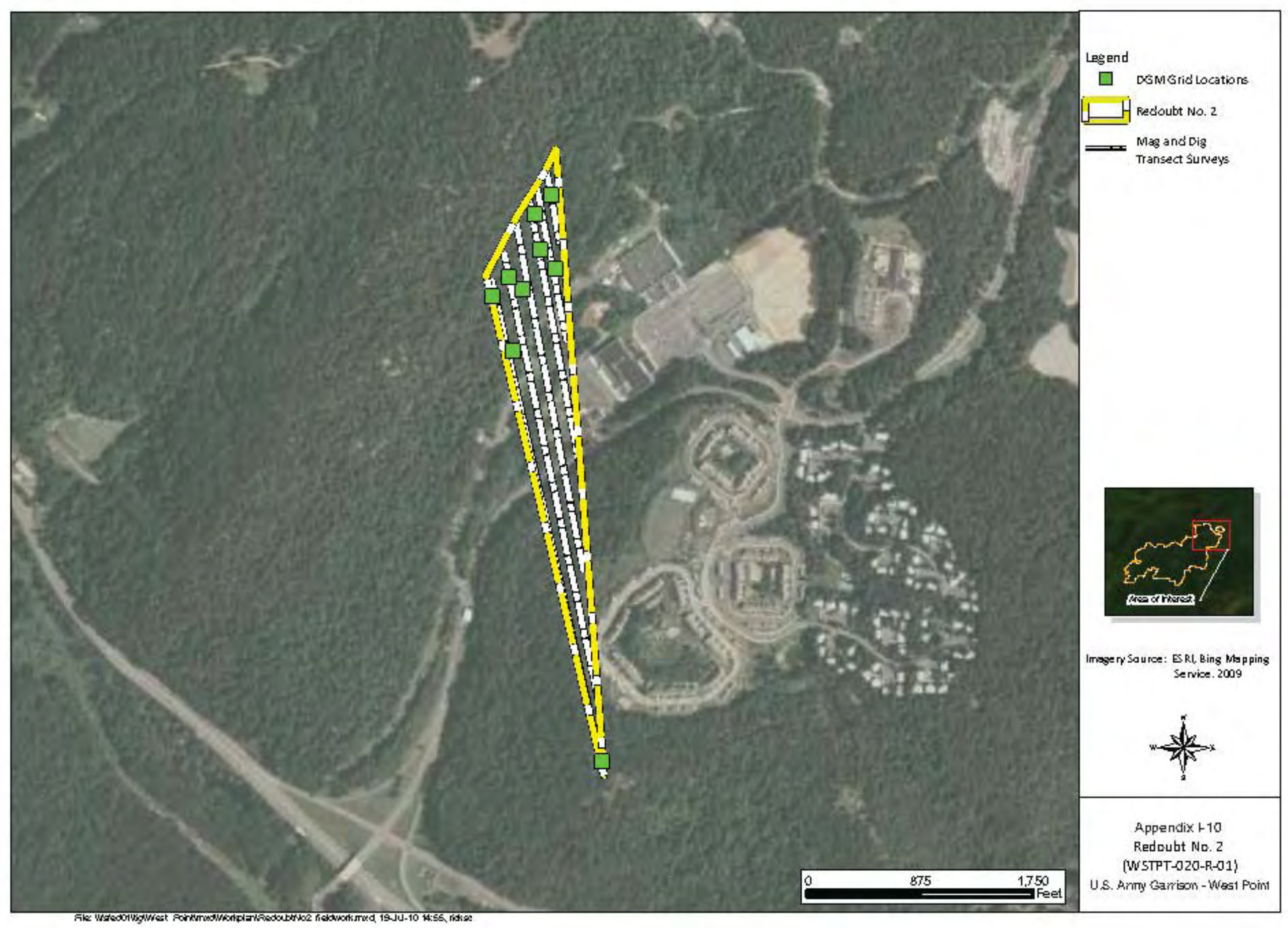
PREVIOUS INVESTIGATIONS

Site Inspection Results: No MEC or MD was observed during SI visual surveys. 258 anomalies were identified during DGM surveys.

- MC – Four surface soil samples were collected. One sample was collected near a depression in the northern end of the site. One sample was collected in the vicinity of the firing point. Trace amounts of 4-amino-2,6-dinitrotoluene, 2,4-dinitrotoluene, and 1,3,5-trinitrobenzene were detected, but below PRG. Copper, iron, lead, mercury, potassium, zinc, and trace amounts of antimony were detected at levels below screening criteria.

Previous Findings: In 1996, eight 105mm artillery casings were found near Building 1245 while excavating fill dirt several inches below the surface.

SITE MAP



RI – MEC SAMPLING STRATEGY

- RI coverage developed using UXO Estimator since no known impact areas are present within MRS.
- Confirm to a 95% confidence level that there is less than 0.5 MEC per acre within the MRS based on the MRS CSM.
- Perform geophysical surveys (mag & dig and DGM) randomly distributed over 4.9 acres of the MRS.

Recommended Coverage per EM 1110-1-4009	Calculated Coverage per *UXO Estimator*		MRS Survey Design			
			Transects - 10' Swath		Grids - 100'x100'	
	MRS %	Acres	Acres	Mileage	Acres	Quantity
7.50%	25.10%	4.92-ac.	3.08-ac.	2.55-mi.	1.84-ac.	8

- **Transect Surveys:** Mag & dig transect surveys will cover approximately 2.6 miles. Transect coverage will be approximately 10-ft wide. UXO Technicians will use White's XLT all metals detectors to perform the transect surveys. Anomalies will be investigated as they are detected.
- **Grid Surveys:** Grids will be randomly distributed across the MRS. DGM surveys will be performed in grids accessible to the instrumentation. Mag & dig surveys will be used in grids with difficult or rough terrain. One grid will be placed at the firing point to detect potential burial features. All anomalies detected within the grids will be reacquired and intrusively investigated.
- A detailed description of MEC/MD recovered during the RI will be recorded in RespondFast®-UXO Investigation, and will capture type of MEC/MD, depth, and condition of the item. Coordinates of each MEC item will be documented using DGPS. This information will be uploaded to the project GIS database.

Minimum Separation Distances (MSD)					
	Unintentional Detonations		Intentional Detonations		
MGFD	HFD	TSD/ K40	MFD	Using Eng. Controls	Consolidated Shots
75mm HE	238-ft	50-ft	1,702-ft	200-ft	N/A

RI – MC SAMPLING STRATEGY

- Establish an IS sampling unit at a potential MEC release. Unit size will be based on size of MEC release. Collect up to 50 increments within the sampling unit.
- Establish a 1-acre sampling unit at the firing point within the MRS. Collect up to 50 increments within the sampling unit.
- Collect discrete samples where corroded or leaking munitions items are observed.
- Samples will be analyzed for select metals and explosives based on Appendix G.
- Independent data validation.
- Upload analytical data to ERIS after RI data approved.

APPENDIX I-11 MICHIE STADIUM (WSTPT-022-R-01)

SITE PROFILE

Site Stats	Acres	Description
Total Acreage	9.4	The site is almost 100% developed and currently encompasses the area in and around Michie Stadium, which is located near the center of the Main Post and to the west of Lusk Reservoir.

Location: The site is located near the center of the Main Post to the west of Lusk Reservoir. Stony Lonesome Road and Howze Field mark the northern and southern boundaries of the site with terraced parking lots to the west.

Topography/Terrain: The site has been extensively developed with athletic complexes, parking lots, and roads. A small area of wooded hilly terrain occupies the northern edge of the site.

Current Land Use: The Michie Stadium site is maintained for recreational use.

Future Land Use: No change in current use is anticipated.

Former Military Munitions Related Activities: The stadium was constructed in 1924 with additional construction projects completed around the stadium in 2001 and 2003. It is not known when or how munitions were brought to the site. Munitions might have been discarded after training in the area or brought in with fill dirt used for the construction of the stadium and surrounding buildings.

Potential Munitions Types: Munitions associated with Michie Stadium include 3- and 4-inch MK1 Stokes mortars.

PREVIOUS INVESTIGATIONS

Site Inspection Results: No MEC or MD was observed during SI visual surveys.

- MC – One surface soil sample was collected within the MRS in the northeast corner of the site. Trace amount of 4-amino-2,6-dinitrotoluene was detected, but below the PRGs. Copper, iron, lead, mercury, potassium, and zinc were detected at levels below screening criteria.

Previous Findings: In 2001, five 3-inch MK1 Stokes mortar rounds were found during seismic upgrades to the west stands of Michie Stadium. In 2003, nine additional Stokes mortars were found during the construction of Randall Hall.

SITE MAP

RI – MEC SAMPLING STRATEGY

- Develop RI coverage using UXO Estimator since no known impact areas are present within MRS.
- The RI will include DGM operations on accessible/undeveloped areas within the MRS (approximately 0.23 acres). Survey locations are biased due to the limited accessible surveyable area.

Recommended Coverage per EM 1110-1-4009	Calculated Coverage per *UXO Estimator*		MRS Survey Design			
			Transects - 10' Swath		DGM – Full Coverage	
	MRS %	Acres	Acres	Mileage	Acres	Quantity
7.50%	3.91%	0.37-ac.	N/A	N/A	0.23-ac.	N/A

- **Grid Surveys:** DGM data will be collected on the north side of the stadium and will achieve full coverage where possible. DGM data will be collected using an EM61-MK2 all-metals detector. All anomalies selected from the DGM data will be reacquired and investigated.

.

- A detailed description of MEC/MD recovered during the RI will be recorded in RespondFast®-UXO Investigation, and will capture type of MEC/MD, depth, and condition of the item. Coordinates of each MEC item will be documented using DGPS. MEC/MPPEH operations will be performed in accordance with the approved ESP, and per DOD and USACE guidance.

Minimum Separation Distances (MSD)					
	Unintentional Detonations		Intentional Detonations		
MGFD	HFD	TSD/ K40	MFD	Using Eng. Controls	Consolidated Shots
3" Stokes HE	219-ft	54-ft	1,346-ft	200-ft	N/A

RI – MC SAMPLING STRATEGY

- Establish an IS sampling unit at a potential MEC release. Unit size will be based on size of MEC release. Collect up to 50 increments within the sampling unit.
- Collect discrete samples where corroded or leaking munitions items are observed.
- Samples will be analyzed for select metals and explosives.
- Independent data validation.
- Upload analytical data to ERIS after RI data approved.

REMEDY IN PLACE

- If this MRS is carried forward through the CERCLA process to the RIP phase, prepare Feasibility Study. This is based on the discovery of MEC during previous construction operations; however, these finds are believed to be transported into the area via fill material.

  We anticipate the FS will support a recommended remedial alternative of Land Use Controls (e.g., MEC awareness, education brochures and video).
- Implementation of preferred remedial alternative.
- Project documentation that will be completed as part of achieving RIP includes, but is not limited to, a Proposed Plan, Decision Document, Remedial Design, and LTM Plan.

APPENDIX J – UNIFORM FEDERAL POLICY-QUALITY ASSURANCE PROJECT PLAN

DRAFT FINAL

UNIFORM FEDERAL POLICY
QUALITY ASSURANCE PROJECT PLAN

REMEDIAL INVESTIGATION
FOR MILITARY MUNITIONS RESPONSE PROGRAM SITES
U.S. Army Garrison – West Point,
WEST POINT, NY

CONTRACT NO.: W912DR-09-D-0006

Prepared for:

U.S. ARMY CORPS OF ENGINEERS,
BALTIMORE DISTRICT
10 SOUTH HOWARD STREET
BALTIMORE, MD 21201-1715

West Point
The United States Military Academy

U.S. ARMY GARRISON - WEST POINT,
ENVIRONMENTAL ENGINEERING BRANCH
667A RUGER ROAD
WEST POINT, NY 10996-1952

Prepared by

WESTON SOLUTIONS

WESTON SOLUTIONS, INC.
1400 WESTON WAY
WEST CHESTER, PA 19380
WESTON Project No.: 03886.551.001.0020

January 2011

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ATTACHMENTS

LIST OF ACRONYMS

%R	percent recovery
%D	percent difference
APP	Accident Prevention Plan
BS	blank spike
CA	Corrective Action
CAR	Corrective Action Report
CCB	continuing calibration blank
CCV	continuing calibration verification
CLP	Contract Laboratory Program
COC	Chain-of-Custody
cm	centimeter
CPR	cardiopulmonary resuscitation
CSM	Conceptual Site Model
CVAA	Cold Vapor Atomic Absorption
DGM	Digital Geophysical Mapping
DMM	discarded military munitions
DoD	Department of Defense
DOT	Department of Transportation
DQCR	Data Quality Control Report
DQI	Data Quality Indicator
DQO	Data Quality Objective
EDD	electronic data deliverable
ELAP	Environmental Laboratory Accreditation Program
ERIS	Environmental Restoration Information System
ft	feet
GIS	Geographic Information System
HMX	Octogen
HPLC	High Performance Liquid Chromatography
HRR	Historical Records Review
IATA	International Air Transport Association
ICAL	initial calibration
ICB	initial calibration blank
ICP	inductively coupled plasma
ICV	initial calibration verification

IDW	investigation derived waste
IS	incremental sampling
ISO	Industry Standard Object
IVS	Instrument Verification Strip
kg	kilogram
L	liter
LCS	laboratory control sample
LIMS	Laboratory Information Management System
LOD	Limit of Detection
LOQ	Limit of Quantitation
MB	method blank
MC	munitions constituent
MCGI	Meridian Consultant Group, Inc.
MD	munitions debris
MEC	munitions and explosives of concern
µg	microgram
mg	milligram
MMRP	Military Munitions Response Program
MPC	Measurement Performance Criteria
MPPEH	Material Potentially Presenting an Explosive Hazard
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
MS	matrix spike
MSD	matrix spike duplicate
N/A	not applicable
NELAC	National Environmental Laboratory Accreditation Conference
nT	nanoTesla
NYSDEC	New York State Department of Environmental Conservation
OSHA	Occupational Safety and Health Administration
PAO	Public Affairs Office
PQO	Project Quality Objective
QA	quality assurance
QAM	Quality Assurance Manual
QAPP	Quality Assurance Project Plan

LIST OF ACRONYMS (concluded)

QC	quality control
QSM	Quality System Manual
RCI	Residential Communities Initiative
RDX	cyclotrimethylene trinitramine
RI	Remedial Investigation
RPD	relative percent difference
RSD	relative standard deviation
SI	Site Investigation
SDR	Sample Discrepancy Report
S/N	signal-to-noise
SOP	Standard Operating Procedure
SSHP	Site Safety and Health Plan
TAL	target analyte list
TAT	turnaround time
TBD	to be determined
TLI	TLI Solutions, Inc.
TPP	Technical Project Planning
TSA	Technical System Audit
U.S.	United States
USACE	U.S. Army Corps of Engineers
USAEC	U.S. Army Environmental Command
USEPA	U.S. Environmental Protection Agency
UFP	Uniform Federal Policy
UXO	unexploded ordnance
West Point	U.S. Army Garrison – West Point
WESTON®	Weston Solutions, Inc.
WP	Work Plan
XRF	X-Ray Fluorescence

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Introduction

MRSs at West Point are associated with former artillery and small arms training, which occurred from as early as the Revolutionary War up to World War II. Many of the MRSs are portions of former artillery range fans that are bisected by operational range areas or areas being addressed through other programs (e.g. the Formerly Used Defense Sites [FUDS] MMRP) that fall outside of the objectives of the RI. Based on the Site Inspection (SI) (TLI 2007), no known impact areas exist within the MRSs. However, historical records reviews indicate that several former firing point positions may be present.

As part of the RI, geophysical surveys will be performed to investigate the potential presence of MEC on the ground surface and in the subsurface. If the geophysical surveys identify areas of high anomaly densities, these areas will be investigated to determine if MEC or munitions debris (MD) is present. The presence of significant amounts of MEC or MD may indicate the potential presence of MC. In addition, the identification of a single MEC item that appears to be a low order detonation, cracked, or leaking may also indicate a release of MC has occurred.

This Quality Assurance Project Plan (QAPP) has been developed to support the Military Munitions Response Program (MMRP) Remedial Investigation (RI) of 11 Munitions Response Sites (MRS) associated with the U.S. Army Garrison – West Point, West Point, NY (West Point). The QAPP provides information on five areas: (1) Project Management and Objectives, (2) Measurement and Data Acquisition, (3) Field Sampling Rationale, (4) Assessment and Oversight, and (5) Data Review. This document meets the requirements and elements set forth in the Department of Defense (DoD) Quality System Manual Version 4.2 (QSM), and the Uniform Federal Policy-Quality Assurance Project Plan Manual (United States Environmental Protection Agency, EPA505-B-04-900A, Version 1, 2005 [UFP-QAPP]). This QAPP provides a process for obtaining data of sufficient quality and quantity to satisfy project needs. It describes policy, organization, functional activities, and the data quality objectives, and measures necessary to obtain adequate data for a given purpose. Additionally, it clearly identifies the rationale for selection of the proposed sampling locations, analysis, and specific procedures for collecting data during the RI. The field work and data evaluation will be completed in accordance with this QAPP. As any new procedure is required, addendums to this document will be issued.

All staff participating in project/field efforts are required to read this plan and become familiar with the analytical procedures and the implementation of these procedures to ensure that analytical/sample goals are met consistently. In addition, key personnel are responsible to mentor assigned staff in aspects of this UFP-QAPP that would have a potential impact on the work assigned to them.

Worksheet 1 — Title and Approval Page

Document Title: Draft Final UFP-QAPP. Remedial Investigation, West Point

Lead Organization: U.S. Army Garrison – West Point (West Point) and U.S. Army Corps of Engineers – Baltimore District (USACE-Baltimore)

Preparer's Name and Organizational Affiliation: Mary Franquemont
TLI Solutions, Inc.

Preparer's Address, Telephone Number, E-mail Address: 560 Golden Ridge Road
Suite 130
Golden, CO 80401
303-763-7188
mfranquemont@tlisolutions.com

Preparation Date (Day/Month/Year): January 2011

Investigative Organization's Senior Chemist: John P. Gerhard
for Kelly Spittler/Weston Solutions, Inc.

Investigative Organization's Project Manager: John P. Gerhard
John Gerhard/Weston Solutions, Inc.

Investigative Organization's QA Manager: B Dubinski
Barry Dubinski/Weston Solutions, Inc.

Approval Signatures:

Lead Organization's Program Manager: ______________________________
Tom Meyer, Project Manager/USACE-Baltimore

Regulatory Organization: ______________________________
Paul Patel/New York State Department of Environmental Quality

Worksheet 2 — QAPP Identifying Information

Site Name/Project Name:	West Point MMRP RI (11 MRSs)
Site Location:	West Point, NY
Site Number/Code:	Artillery Firing Range (WSTPT-001-R-01); Battery Knox-TD Land (WSTPT-004-R-02); Fort Clinton - West (WSTPT-008-R-01); Grey Ghost Housing Area (WSTPT-010-R-01); North Athletic Field (WSTPT-011-R-01); Seacoast Battery (WSTPT-013-R-01); Siege Battery (WSTPT-015-R-01); Target Hill (WSTPT-017-R-01); Lusk Reservoir (WSTPT-019-R-01); Redoubt No. 2 (WSTPT-020-R-01); Michie Stadium (WSTPT-022-R-01)
Operable Unit:	Not Applicable (N/A)
Contractor Name:	Weston Solutions, Inc.
Contract Number:	W912DR-09-D-0006
Contract Title:	Military Munitions Response Program Remedial Investigation, U.S. Army Garrison – West Point
Work Assignment Number:	N/A

1. Identify guidance used to prepare QAPP: Uniform Federal Policy for Quality Assurance Project Plans: Part 1 UFP-QAPP Manual (March 2005).

2. Identify regulatory program: Military Munitions Response Program

3. Identify approval entities: West Point, USACE-Baltimore, and New York State Department of Environmental Conservation (NYSDEC)

4. The QAPP is: Project-Specific

5. List dates scoping sessions that were held:
   a) RI Client/Contractor Kick-off Meeting – June 15, 1010
   b) Technical Project Planning (TPP)-1 – July 29, 2010
   c) TPP-2 – To be held February 3, 2011

6. List dates and titles of QAPP documents written for previous site work, if applicable:

Title	Received Date
Final Site Inspection Work Plan, TLI Solutions, Inc.	April 2006

7. List organizational partners (stakeholders) and connection with lead organization: NYSDEC, U.S. Environmental Protection Agency (EPA) Region 2, West Point Public Affairs Office (PAO), and West Point Residential Communities Initiative (RCI)

8. List data users: NYSDEC, EPA Region 2, West Point, USACE-Baltimore, U.S. Army Environmental Command (USAEC), Weston Solutions, Inc. (WESTON), and TLI Solutions, Inc. (TLI)

9. If any required QAPP elements and required information are not applicable to the project, then circle the omitted QAPP elements and required information on the attached table. Provide an explanation for their exclusion below: All QAPP worksheets are applicable.

Worksheet 2 — QAPP Identifying Information (Continued)

Required QAPP Element(s) and Corresponding QAPP Worksheet(s)	Crosswalk to Required Documents	Optional Worksheet in QAPP Workbook	Required Information
Project Management and Objectives			
2.1 Title and Approval Page	RI WP* Signature Page	1	- Title and Approval Page
2.2 Document Format and Table of Contents 2.2.1 Document Control Format 2.2.2 Document Control Numbering System 2.2.3 Table of Contents 2.2.4 QAPP Identifying Information	RI WP Table of Contents	2	- Table of Contents - QAPP Identifying Information
2.3 Distribution List and Project Personnel Sign-Off Sheet 2.3.1 Distribution List 2.3.2 Project Personnel Sign-Off Sheet	RI WP Cover Letter APP/SSHP+ Signature page	3 4	- Distribution List - Project Personnel Sign-Off Sheet
2.4 Project Organization 2.4.1 Project Organizational Chart 2.4.2 Communication Pathways 2.4.3 Personnel Responsibilities and Qualifications 2.4.4 Special Training Requirements and Certification	RI WP Section 4 APP/SSHP Section 5	5 6 7 8	- Project Organizational Chart - Communication Pathways - Personnel Responsibilities and Qualifications Table - Special Personnel Training Requirements Table
2.5 Project Planning/Problem Definition 2.5.1 Project Planning (Scoping) 2.5.2 Problem Definition, Site History, and Background	RI WP Sections 1, 2	9 10	- Project Planning Session Documentation (including Data Needs tables) - Project Scoping Session Participants Sheet - Problem Definition, Site History, and Background - Site Maps (historical and present)
2.6 Project Quality Objectives and Measurement Performance Criteria 2.6.1 Development of Project Quality Objectives Using the Systematic Planning Process 2.6.2 Measurement Performance Criteria	RI WP Section 2.7	11 12	- Site-Specific Project Quality Objectives (PQOs) - Measurement Performance Criteria Table
2.7 Secondary Data Evaluation		13	- Sources of Secondary Data and Information - Secondary Data Criteria and Limitations Table
2.8 Project Overview and Schedule 2.8.1 Project Overview 2.8.2 Project Schedule	RI WP Sections 2.5, 3, Appendix K	14 15 16	- Summary of Project Tasks - Reference Limits and Evaluation Table - Project Schedule/Timeline

Worksheet 2 — QAPP Identifying Information (Continued)

Required QAPP Element(s) and Corresponding QAPP Worksheet(s)	Crosswalk to Required Documents	Optional Worksheet in QAPP Workbook	Required Information
			Table
Measurement/Data Acquisition			
3.1 Sampling Tasks 3.1.1 Sampling Process Design and Rationale 3.1.2 Sampling Procedures and Requirements 3.1.2.1 Sampling Collection Procedures 3.1.2.2 Sample Containers, Volume, and Preservation 3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures 3.1.2.4 Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures 3.1.2.5 Supply Inspection and Acceptance Procedures 3.1.2.6 Field Documentation Procedures	RI WP Section 3.10	17 18 19 20 21 22	- Sampling Design and Rationale - Sample Location Map - Sampling Locations and Methods/Standard Operating Procedure (SOP) Requirements Table - Analytical Methods/SOP Requirements Table - Field Quality Control Sample Summary Table - Sampling SOPs - Project Sampling SOP Reference Table - Field Equipment Calibration, Maintenance, Testing, and Inspection Table (not applicable)
3.2 Analytical Tasks 3.2.1 Analytical SOPs 3.2.2 Analytical Instrument Calibration Procedures 3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures 3.2.4 Analytical Supply Inspection and Acceptance Procedures	QAPP Attachment A	23 24 25	- Analytical SOPs - Analytical SOP References Table - Analytical Instrument Calibration Table - Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table
3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures 3.3.1 Sample Collection Documentation 3.3.2 Sample Handling and Tracking System 3.3.3 Sample Custody	RI WP Section 3.10	26 27	- Sample Handling System - Sample Collection, Documentation Handling, Tracking, and Custody SOPs - Sample Custody Requirements Table - Sample Container Identification - Sample Handling Flow Diagram

Worksheet 2 — QAPP Identifying Information (Continued)

Required QAPP Element(s) and Corresponding QAPP Worksheet(s)	Crosswalk to Required Documents	Optional Worksheet in QAPP Workbook	Required Information
			- Example Chain-of-Custody (COC) Form and Seal
3.4 Quality Control Samples 3.4.1 Sampling Quality Control Samples 3.4.2 Analytical Quality Control Samples	RI WP Section 3.10.8	28	- Quality Control (QC) Samples Table - Screening/Confirmatory Analysis Decision Tree
3.5 Data Management Tasks 3.5.1 Project Documentation and Records 3.5.2 Data Package Deliverables 3.5.3 Data Reporting Formats 3.5.4 Data Handling and Management 3.5.5 Data Tracking and Control	RI WP Section 3.10.9	29 30	- Project Documents and Records Table - Analytical Services Table - Data Management SOPs
Assessment/Oversight			
4.1 Assessments and Response Actions 4.1.1 Planned Assessments 4.1.2 Assessment Findings and Corrective Action Responses	RI WP Section 5	31 32	- Planned Project Assessments Table - Assessments and Response Actions - Audit Checklists - Assessment Findings and Corrective Action Responses Table
4.2 Quality Assurance (QA) Management Reports	RI WP Section 5	33	- QA Management Reports Table
4.3 Final Project Report			- All information obtained during RI Field work
Data Review			
5.1 Overview			
5.2 Data Review Steps 5.2.1 Step I: Verification 5.2.2 Step II: Validation 5.2.2.1 Step IIa Validation Activities 5.2.2.2 Step IIb Validation Activities 5.2.3 Step III: Usability Assessment 5.2.3.1 Data Limitations	RI WP Section 3.10.11	34 35 36 37	- Sampling and Analysis Verification (Step I) Process Table - Sampling and Analysis Validation (Steps IIa and IIb) Process Table - Sampling and Analysis Validation (Steps IIa and IIb) Summary Table - Data Usability Assessment

Worksheet 2 — QAPP Identifying Information (Continued)

Required QAPP Element(s) and Corresponding QAPP Worksheet(s)	Crosswalk to Required Documents	Optional Worksheet in QAPP Workbook	Required Information
and Actions from Usability Assessment 5.2.3.2 Activities	RI WP Section 3.12		
5.3 Streamlining Data Review 5.3.1 Data Review Steps To Be Streamlined 5.3.2 Criteria for Streamlining Data Review 5.3.3 Amounts and Types of Data Appropriate for Streamlining			

* Work Plan (WP)
+Accident Prevention Plan/Site Safety and Health Plan (APP/SSHP)

Worksheet 3 — Distribution List

QAPP Recipients	Title	Organization	Number of Copies	Telephone Number	E-Mail Address
Tom Meyer	Project Manager	USACE-Baltimore	1	401-962-0032	tom.meyer@usace.amry.mil
Brooke Conway	Design Team Leader	USACE-Baltimore	1	410-962-6805	brooke.e.conway@usace.army.mil
Douglas Scarborough	Environmental Restoration Manager	USAEC	1	410-436-3152	douglas.scarborough@us.army.mil
Jeff Sanborn	Environmental Engineer	West Point	1	845-938-5041	jeff.sanborn@usma.edu
Deb DeGraw	Chief of Community Relations	West Point	1	845-938-3614	deborah.degraw@us.army.mil
Paul Patel	Environmental Engineer	NYSDEC	1	518-402-8602	appatel@gw.dec.state.ny.us
Bill Roach	Remedial Project Manager	EPA Region 2	1	212-637-4335	roach.bill@epa.gov
John Gerhard	Project Manager	WESTON	1	610-701-3793	J.Gerhard@westonsolutions.com
Barry Dubinski	QA Manager	WESTON	1	610-701-3137	Barry.Dubinski@westonsolutions.com
Ryan Steigerwalt	MMRP Technical Manager	WESTON	1	410-612-5940	Ryan.Steigerwalt@westonsolutions.com
Dave Carlin	Senior Unexploded Ordnance (UXO) Supervisor/ Site Manager	WESTON	1	610-701-3000	Dave.Carlin@westonsolutions.com
Kelly Spittler	Chemist	WESTON	1	610-701-3953	K.Spittler@westonsolutions.com
Sherif Mina	Data Validator	MCGI	1	301-803-9207	S.Mina@meridiancgi.com
Joseph Carabillo	Project Manager	TestAmerica	1	802-923-1038	joseph.carabillo@testamericainc.com
Mary Franquemont	Technical Team Leader	TLI Solutions	1	303-763-7188	mfranquemont@tlisolutins.com

A hard copy of the Work Plan will also be made available to the field team during RI activities.

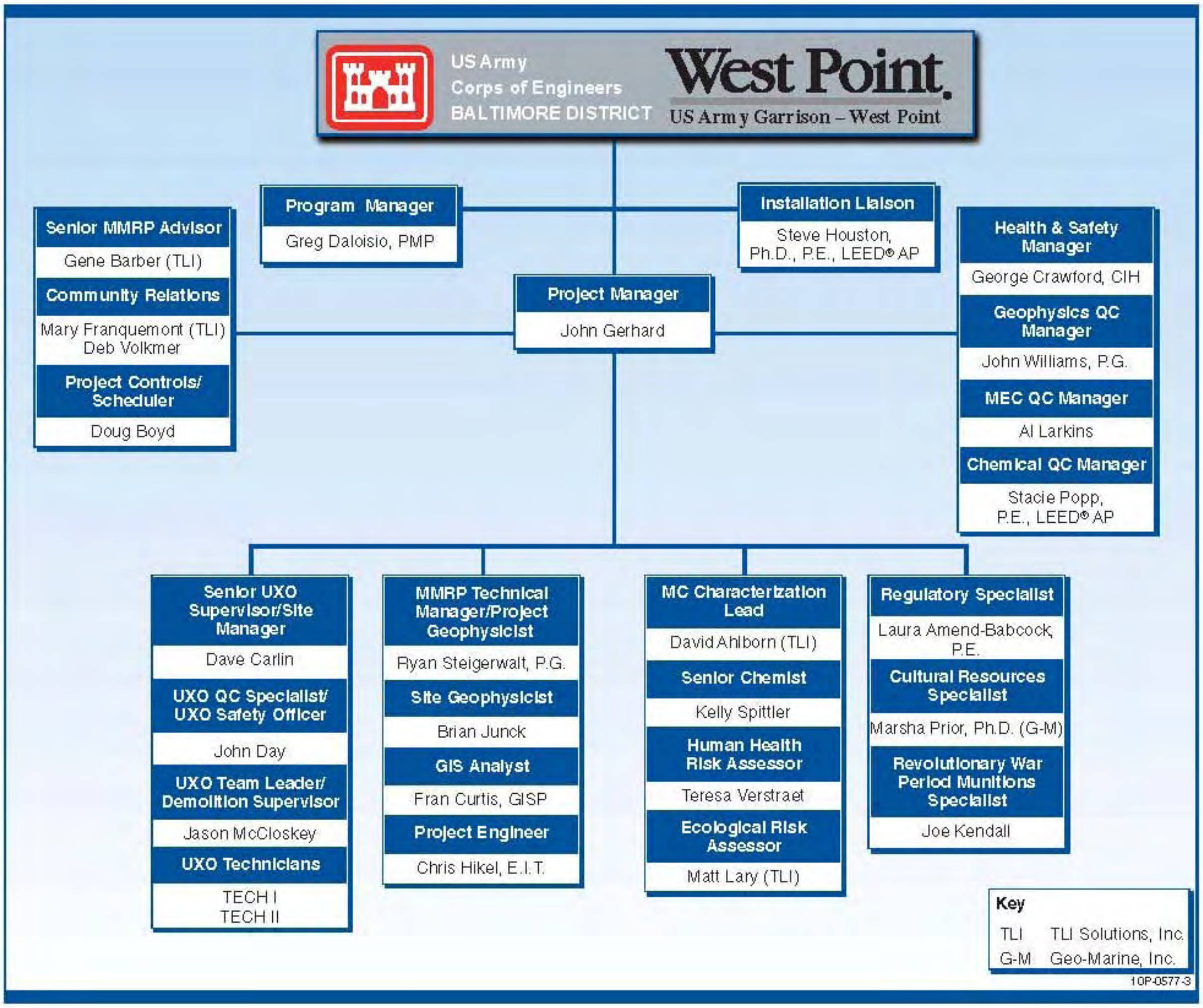
Worksheet 4 — Project Personnel Sign-Off Sheet

Project Personnel	Organization	Title	Signature	Date QAPP Read E-Mail Receipt
Tom Meyer	USACE-Baltimore	Project Manager		
Brooke Conway	USACE-Baltimore	Design Team Leader		
Douglas Scarborough	USAEC	Environmental Restoration Manager		
Bill Roach	EPA Region 2	Remedial Project Manager		
Jeff Sanborn	West Point	Environmental Engineer		
Deb DeGraw	West Point	Chief of Community Relations		
Paul Patel	NYSDEC	Environmental Engineer		
John Gerhard	WESTON	Project Manager		
Ryan Steigerwalt	WESTON	MMRP Technical Manager		
Barry Dubinski	WESTON	QA Manager		

Worksheet 4 — Project Personnel Sign-Off Sheet (Continued)

Project Personnel	Organization	Title	Signature	Date QAPP Read E-Mail Receipt
Dave Carlin	WESTON	Senior UXO Supervisor/ Site Manager		
Kelly Spittler	WESTON	Chemist		
Sherif Mina	MCGI	Data Validator		
Joseph Carabillo	TestAmerica	Project Manager		
Mary Franquemont	TLI Solutions	Technical Team Leader		
To Be Determined (TBD)	WESTON	Field Personnel		
TBD	WESTON	Field Personnel		
TBD	TLI Solutions	Field Sampling Personnel		
TBD	TLI Solutions	Field Sampling Personnel		

Worksheet 5 — Project Organizational Chart



Worksheet 6 — Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathways, etc.)
Point of Contact with USACE/West Point	WESTON Project Manager	John Gerhard	610-701-3793	Reporting of project information to the USACE/West Point Project Managers through work plans, monthly progress reports, E-mail updates, teleconference calls, and meetings.
Manage All Project Phases	WESTON Project Manager	John Gerhard	610-701-3793	Primary modes of communication are telephone, E-mail, letter, document submittal; timing dependent on nature of communication and predefined schedules, as applicable and as requested by agencies.
QAPP Changes in the Field, Daily Field Progress Reports, Field Corrective Action	WESTON MMRP Technical Lead	Ryan Steigerwalt	410-612-5940	Notify WESTON Project Manager and Project Chemist of changes to QAPP in the field and rationale for changes. Document changes in field daily progress reports and memoranda to WESTON, and USACE/West Point Project Managers. Field Engineer will complete daily field progress reports and forward to WESTON. Need for field corrective action will be determined by the Technical Manager and Project Manager and will be documented in the daily field progress reports and memoranda to WESTON and USACE/West Point Project Managers.
Reporting Laboratory Data Quality Issues	TestAmerica Laboratory Project Manager	Joseph Carabillo	802-923-1038	All QA/QC issues with project field samples will be reported by the laboratory to the Project Chemist and Contractor QA Officer.

Worksheet 6 — Communication Pathways (Continued)

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathways, etc.)
Laboratory Analytical Corrective Actions	Project Chemist Laboratory Project Manager	Kelly Spittler Joseph Carabillo	610-701-3953 802-923-1038	Need for laboratory corrective actions will be determined by the Project Chemist and/or laboratory Project Manager or QA Manager and will be documented in memoranda to WESTON and USACE/West Point Project Managers.
Data Tracking and Management, Release of Analytical Data, QAPP Amendments	Project Chemist	Kelly Spittler	610-701-3953	Project Chemist or her delegated representative will track data from collection of samples through login at laboratory to delivery by technical report/sample data group and electronic data delivery into database. Final analytical data cannot be released until validation is complete and Project Chemist has approved release. Changes to the QAPP will be approved by the WESTON and USACE/West Point Project Managers.

Worksheet 7 — Personnel Responsibilities and Qualifications Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Gregory Daloisio, PMP	Program Manager	WESTON	Single Point of Contact (POC). Ensures satisfaction of all contractual requisites, such as cost/schedule/technical/quality goals. Communicates with CENAB on Delivery Order (DO) cost/schedule/quality progress. Monitors small business (SB) participation. Develops/enforces systems for administrative quality control (QC), and DO closeout. Holds regular status meetings with CENAB Program Manager/COR.	B.S., Mechanical Engineering, 26 years of environmental experience, more than 20 years of Project Management experience
John Gerhard	Project Manager	WESTON	Provides overall management of the contract including cost, schedule and technical quality. Manages project staffing, day-to-day project operations and activities, deliverable completion, field investigations, quality control, and health and safety. Acts as the single point of contact for the contract. Maintains communication and coordination with West Point and USACE for the duration of the project, including progress and detailed cost reporting. Oversees the management and coordination between Contractor staff, subcontractors, West Point, and USACE.	B.S., Environmental Resource Management, 13 years of environmental experience
Ryan Steigerwalt, P.G.	MMRP Technical Lead	WESTON	Responsible for assisting Project Manager and providing senior technical support on	B.S, Geology; M.S. Geology/Geophysics, More than 9 years of in-depth

Worksheet 7 — Personnel Responsibilities and Qualifications Table (Continued)

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
			MMRP/CERCLA process documents, sampling program design and implementation, and project team coordination. Initiates field corrective action if deemed necessary.	experience managing and executing MMRP, CERCLA and RCRA projects for DOD and DOE.
Dave Carlin	Senior UXO Supervisor/ Site Manager	WESTON	Responsible for all aspects of UXO field activities including management of munitions and explosives of concern (MEC)/Material Potentially Presenting an Explosive Hazard (MPPEH) and UXO field teams. Responsible for ensuring quality and safety during all field activities.	Graduate of Naval EOD School, Indian Head. Over 10 years of experience as EOD/UXO Specialist and Supervisor.
Barry Dubinski	QA/QC Manager	WESTON	Responsible for program quality management, including training and programmatic quality processes and controls. Provides senior technical support on CERCLA process documents and sampling program design and implementation.	Ph.D. Marine Biology and Biochemistry, M.S. Biology, B.A. Environmental Science. Over 25 years of CERCLA hazardous waste site investigation and cleanup experience.

Worksheet 7 — Personnel Responsibilities and Qualifications Table (Continued)

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Kelly Spittler	Project Chemist	WESTON	Manages analytical and data validation subcontractors. Negotiates project specifications and coordinates the sample collection activity with laboratory capacity. Tracks all samples from collection through analysis, data validation, and report generation. Serves as the primary chemist for all analytical issues. Initiates corrective actions as deemed appropriate. Supervises the electronic loading for all analytical data to ensure compliance with contract requirements.	B.S., Chemistry, Data Validation Certifications; 23 years of project chemistry and data validation experience
Mary Franquemont	Technical Team Leader	TLI Solutions, Inc.	Manages all aspects of subcontract including oversight of Munitions Constituent (MC) field sampling teams and all community relations activities. Provides support to WESTON project management as requested.	B.S. Public and Environmental Affairs; 18 years environmental experience with 6 years MMRP experience
William Cicero	Laboratory Manager	TestAmerica	Supervises all laboratory personnel and provides guidance and direction as needed. Responsible for ensuring compliance and integration of facility operation with corporate and regulatory policies and procedures.	B.S., Biology; 13 years industry experience

Worksheet 7 — Personnel Responsibilities and Qualifications Table (Continued)

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Kirstin McCracken	Laboratory Quality Assurance Manager	TestAmerica	Overall responsibility for the development, implementation and maintenance of the laboratory's quality system and QC activities. Performs internal system and technical audits. Creates corrective action plans and recommends projects for process improvement. Troubleshoots and resolves problems and provides technical and administrative guidance to laboratory staff. Obtains and maintains laboratory license and permits and oversees laboratory accreditation and certification programs. Serves as the liaison between the laboratory and regulatory offices.	B.A., Geography; 15 years industry experience
Joe Carabillo	Laboratory Project Manager	TestAmerica	Serves as the laboratory's primary contact for the project. Utilizes a variety of project management tools for forecasting, and production status tracking. Assures laboratory compliance with project needs in both QC and project deliverables.	B.S., Biology; 10 years industry experience
Sherif Mina	Data Validator	Meridian Consulting Group, Inc.	Responsible for operations management and technical support. Attends data validation training refreshers in EPA Regions I, II and III. Performs data validation for analytical analyses under this contract, per the EPA Region III guidelines.	B.S., Chemistry, M.S., Applied Chemistry; 24 years experience in environmental laboratory operations; 17 years of data validation experience.

Worksheet 8 — Special Personnel Training Requirements Table

Project Function	Specialized Training by Title or Description of Course	Training Provider	Training Date[1]	Personnel / Groups Receiving Training	Personnel Titles / Organizational Affiliation	Location of Training Records/Certificates[2]
Field Sampling Team Lead	40-Hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Site Worker Training; 8-Hour OSHA Refresher Training; First Aid Cardiopulmonary Resuscitation (CPR)	Registered Training Organization – Various[1]	Varies	All	Various	Certificates available upon request and maintained at project field office.
Field Technicians, Geologists, Environmental Scientists, Engineers	40-Hour OSHA Hazardous Waste Site Worker Training; 8-Hour OSHA Refresher Training; First Aid CPR	Registered Training Organization – Various[1]	Varies	All	All team personnel assisting in the performance of this contract.	Certificates available upon request and maintained at project field office.

[1] Training Provider and date of training will vary from person to person due to individual scheduling of training.

[2] Training records and/or certificates are on file at the Weston Solutions, Inc., West Chester, Pennsylvania office and on-site in the project field office.

Worksheet 9 — Project Scoping Session Participants Sheet

Project Name: West Point MMRP Remedial Investigation (RI) **Projected Dates of Sampling:** March-August 2011 **Project Manager:** John Gerhard, WESTON	**Site Names:** Artillery Firing Range (WSTPT-001-R-01); Battery Knox-TD Land (WSTPT-004-R-02); Fort Clinton - West (WSTPT-008-R-01); Grey Ghost Housing Area (WSTPT-010-R-01); North Athletic Field (WSTPT-011-R-01); Seacoast Battery (WSTPT-013-R-01); Siege Battery (WSTPT-015-R-01); Target Hill (WSTPT-017-R-01); Lusk Reservoir (WSTPT-019-R-01); Redoubt No. 2 (WSTPT-020-R-01); Michie Stadium (WSTPT-022-R-01) **Site Location:** West Point, NY
Date of Session: TPP1: July 29, 2010; TPP2: February 3, 2011 **Scoping Session Purpose:** Technical Project Planning	
See Appendix Hof the Work Plan for meeting minutes from the TPP meetings.	

Comments/Decisions:

Scoping sessions will be an ongoing feature of the project as activities progress. Bi-weekly project status meetings (as needed) between WESTON/TLI project personnel, West Point, and USACE are conducted to discuss the following:

- Summary of progress for the project
- Key milestones / deliverables
- Upcoming site activities
- Issues
- Status of action items

Action Items:

See Appendix H of the Work Plan for meeting minutes from the TPP meetings.

Consensus Decisions:

See Appendix H of the Work Plan for meeting minutes from the TPP meetings.

Worksheet 10 — Problem Definition

A SI was completed in January 2007. As a result, 11 MRSs were recommended for further investigation to determine the nature and extent of potential contamination associated with MEC and/or MC. Additional information regarding this historical use of the 11 MRSs is included in the Work Plan.

Existing information on the nature and extent of potential munitions and explosives of concern (MEC) and munitions constituents (MC) contamination associated with 11 MRSs at West Point that have historically been used for munitions training activities is insufficient to evaluate and recommend remedial alternatives.

Worksheet 11 — Project Quality Objectives/Systematic Planning Process Statements

The geophysical plan was developed based on applicable guidance criteria (i.e., EM 1110-1-4009) and other pertinent documents, along with a combination of geophysical mapping tools (including analog and digital instruments), survey patterns (transects and grids), and statistical tools [i.e., geographic information system (GIS) spatial analyses, Visual Sample Plan and USACE UXO-Estimator calculator].

The Data Quality Objectives (DQOs) for MEC/MC characterization are presented in Section 3 of the Work Plan.

Worksheet 12 — Measurement Performance Criteria Tables

Worksheet 12.1 — Measurement Performance Criteria Table – Explosives Method SW-846 8330B

Matrix	Soil, Sediment
Analytical Group	Explosive Compounds
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria (MPC)	QC Samples and/or Activity to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S and A)
Explosives in Soil/Sediment Sample placed in a glass jar. (SOPs SS-3, G-9)	SW-846 8330B (SOPs A-1)	Field Precision	1 per 20 samples relative percent difference (RPD) < 50% (soil)	Field Duplicate	S and A
		Field Representativeness/ Accuracy/Bias	1 per 20 samples <½ reporting limit (LOQ)	Equipment Rinsate	S and A
.		Accuracy/ Precision	One set per extraction batch when sufficient sample volume is provided or as requested per client See Table 15.1	Matrix Spike and Matrix Spike Duplicate	S and A
		Accuracy/Precision	One every 3 months All analytes within ±15% of expected value	High Calibration Standard	A
		Accuracy/Precision	Five-point calibration for all analytes prior to sample analysis Mean relative standard deviation (RSD) for all analytes $\leq$ 20% Correlation Coefficient R $\geq$ 0.995	Initial Calibration	A

Worksheet 12.1 — Measurement Performance Criteria Table – Explosives Method SW-846 8330B (Continued)

Matrix	Soil, Sediment
Analytical Group	Explosive Compounds
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria (MPC)	QC Samples and/or Activity to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S and A)
		Accuracy/Bias	After each initial calibration Within ±20% of expected value	Initial Calibration Verification	A
		Precision	After every 20 samples and at end of sequence All analytes within ±20% of expected value	Continuing Calibration Verification	A
		Laboratory Representativeness/ Accuracy/Bias	Prior to sample analysis and after every 20 samples and at end of sequence <½ LOQ	Instrument Blank Solution	A
		Accuracy/Bias	Every sample See Table 15.1	Surrogate	A
		Laboratory Representativeness/ Accuracy/Bias	1 per batch per matrix or 1 per 20 samples, whichever is more frequent <½ LOQ	Method Blank	A
		Laboratory Accuracy/Sensitivity	1 per batch per matrix or 1 per 20 samples, whichever is more frequent See Table 15.1	Laboratory Control Sample	A

Worksheet 12.2 — Measurement Performance Criteria Table – Metal Analytes Method SW-846 6010B

Matrix	Soil, Sediment
Analytical Group	Metal Analytes
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria (MPC)	QC Samples and/or Activity to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S and A)
Metals in Soil/Sediment Sample placed in a glass or plastic jar. (SOPs SS-3, G-9) .	SW-846 6010B (SOP A-2)	Field Precision	1 per 20 samples RPD of ±20%, if concentration is ≥ 5x LOQ; or ± the LOQ if the concentration is < 5x LOQ	Field Duplicate	S and A
		Field Representativeness/ Accuracy/Bias	1 per 20 samples <½ LOQ	Equipment Rinsate	S and A
		Accuracy/Bias	1 per 20 samples per matrix See Table 15.2	Matrix Spike	A
		Laboratory Precision	1 per 20 samples per matrix See Table 15.2	Laboratory Duplicate (Replicate)	A
		Accuracy/Precision	Daily prior to sample analysis (minimum 1 standard and a blank)	Initial Calibration	A
		Accuracy/Bias	Daily after initial calibration All analytes within ±10% of expected value	Initial Calibration Verification	A

Worksheet 12.2 — Measurement Performance Criteria Table – Metal Analytes Method SW-846 6010B (Continued)

Matrix	Soil, Sediment
Analytical Group	Metal Analytes
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria (MPC)	QC Samples and/or Activity to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S and A)
		Accuracy/Bias	After every calibration/verification No analytes detected ≥ LOQ	Calibration Blank Initial Calibration Blank/Continuing Calibration Blank (ICB/CCB)	A
		Precision/Accuracy	At beginning of analytical sequence, after every 10 samples and at the end of the analysis sequence All analytes within ±10% of expected value and RSD of replicate integrations <5%	Calibration Verification (Instrument Check Standard)	A
		Precision	At beginning of analytical run ± 20% of the expected value	Interference Check Solution	A
		Precision/Accuracy	Each digestion batch 5x dilution must agree within 10% of the original sample; only applicable if the analyte concentration is > a factor of 50 above the level of detection (LOD)	Serial Dilution	A
		Accuracy/Bias	Each digestion batch Percent recovery (%R) within 75 – 125%	Post Digestion Blank	A
		Laboratory Representativeness/ Accuracy/Bias	1 per batch per matrix or 1 per 20 samples, whichever is more frequent No analyte ≥ LOQ	Method Blank	A

Worksheet 12.2 — Measurement Performance Criteria Table – Metal Analytes Method SW-846 6010B (Continued)

Matrix	Soil, Sediment				
Analytical Group	Metal Analytes				
Concentration Level	Low				
Sampling Procedure	**Analytical Method/SOP**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria (MPC)**	**QC Samples and/or Activity to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S and A)**
		Laboratory Accuracy/ Sensitivity	1 per batch per matrix or 1 per 20 samples, whichever is more frequent See Table 15.2	Laboratory Control Sample	A

Worksheet 12.3 — Measurement Performance Criteria Table – Mercury Methods SW-846 7471A

Matrix	Soil, Sediment
Analytical Group	Mercury
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria (MPC)	QC Samples and/or Activity to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S and A)
Mercury in Soil/Sediment Sample placed in a glass or plastic jar. (SOPs SS-3, G-9) .	SW-846 7471A (SOP A-3)	Field Precision	1 per 20 samples RPD < 50% (soil)	Field Duplicate	S and A
		Field Representativeness/ Accuracy/Bias	1 per 20 samples <½ LOQ	Equipment Rinsate	S and A
		Accuracy/Bias	1 per 20 samples See Table 15.2	Matrix Spike	A
		Laboratory Precision	1 per 20 samples per matrix RPD <20%	Laboratory Duplicate (Replicate)	A
		Accuracy/Precision	Daily prior to sample analysis Correlation coefficient ≥0.995 for linear regression	Initial Calibration	A

Worksheet 12.3 — Measurement Performance Criteria Table – Mercury Methods SW-846 7471A (Continued)

Matrix	Soil, Sediment
Analytical Group	Mercury
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria (MPC)	QC Samples and/or Activity to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S and A)
		Accuracy/Bias	Once after each initial calibration Analyte within ±10% of expected value	Second Source Calibration Check Standard	A
		Laboratory Representativeness/ Accuracy/Bias	After every initial calibration verification (ICV) and continuing calibration verification (CCV), every 10 samples, and at end of the analysis sequence No analyte detected ≥ LOQ	Calibration Blank	A
		Precision	Daily, after every 10 samples, and at end of the analysis sequence Analyte within ±20% of expected value	Calibration Verification	A
		Laboratory Representativeness/ Accuracy/Bias	1 per batch per matrix or 1 per 20 samples, whichever is more frequent No analyte ≥ LOQ	Method Blank	A
		Laboratory Accuracy/Sensitivity	1 per batch per matrix or 1 per 20 samples, whichever is more frequent See Table 15.2	Laboratory Control Sample	A

Worksheet 12.4 — Measurement Performance Criteria Table – DGM Surveys

Quality Control Parameter	Frequency	Instrument	Data Quality Indicators (DQIs)	Measurement Performance Criteria (MPC)	Activity Used to Assess Measurement Performance
Background Noise	Evaluate each dataset	Geonics EM61-MK2	Accuracy	Standard deviation of < 2.5 mV for CH1, CH2, CH3, and CH4.	Window an anomaly free area of data and calculate standard deviation. Compare dataset result to MPC.
Mean Acquisition Speed	Evaluate each dataset	Geonics EM61-MK2	Accuracy	Maintain speed of <3 mph to achieve along-track measurement MPC. 95% of data to be within max <3 mph or GSV demonstrated speed.	Run statistics on velocity between points in each file (create “velocity channel”).
Along-Track Measurements	Evaluate each dataset	Geonics EM61-MK2	Accuracy	Point to point separation <0.5-ft. 95% of data to be within max <0.5-ft or GSV demonstrated separation.	Run statistics on distance between points in each dataset.
Cross-Track Measurements	Evaluate each dataset	Geonics EM61-MK2	Accuracy	The across-track line spacing will not exceed 3 ft. on 95% of the data. 5% of the data may lie between 2.5 and 3 ft. This will allow for variation in spacing reporting caused by rough terrain.	Run statistics on distance between data lines in each dataset and perform a spatial analysis on gridded data between lines.
Coverage (focused grids)	Evaluate each dataset	Geonics EM61-MK2	Accuracy	>90% coverage at project design spacing.	Coverage maps will be created per grid or data set.
Dynamic Detection Repeatability	Evaluate each dataset	Geonics EM61-MK2	Precision	Grids – Test item anomaly peak response repeatable, with allowable variation +/- 25%. QC Industry Standard Object (ISO) test item anomaly peak response repeatable within calculated response curves, with allowable variation.	Perform survey over IVS daily as part of GSV process. Seed a minimum of one QC test item or industry standard object per grid.
GPS Accuracy	Instrument setup	Trimble RTK GPS 5800	Accuracy	Kinematic positional error at known monuments will not exceed +/- 20 cm.	Perform QC audit of positioning system error test records.
Instrument Latency	Evaluate each dataset using latency test	Geonics EM61-MK2	Accuracy	No zig-zag or chevron effects.	Evaluate latency test results. Apply correction factor to entire dataset. Confirm chevron effects were removed and anomaly peaks for known seed items.

Worksheet 12.4 — Measurement Performance Criteria Table – DGM Geophysical Surveys (Continued)

Quality Control Parameter	Frequency	Instrument	Data Quality Indicators (DQIs)	Measurement Performance Criteria (MPC)	Activity Used to Assess Measurement Performance
Dynamic Positioning Repeatability		Geonics EM61-MK2/ GPS	Accuracy	Transects – Demonstrate Instrument Verification Strip (IVS) reacquisition (reacquisition amplitude. ~ original and offset <=1m).	Perform repeat of the IVS twice daily.
				Grids – Position offset of test item target <= 35-cm +1/2 line spacing; (<=50cm +1/2 line spacing for fiducially positioned data).	Perform repeat of the IVS and QC seed program data.
Standard Response		Geonics EM61-MK2	Precision	Response above background to standard object will not vary more than +/-20%.	Perform standardization tests: QC audit of response test records.
Drift Correction		Geonics EM61-MK2	Accuracy	Correct for sensor response drift to within background noise MPC.	Use consistent drift correction parameters in Geosoft.
Target Selection		Geonics EM61-MK2	Accuracy	All dig list targets are selected according to project design/selection criteria and classification scheme.	By grid or dataset. Manual review by Project Geophysicist.
Anomaly Resolution		Geonics EM61-MK2	Accuracy	Resolved is defined as: (1) there is no geophysical signal remaining at the flagged/selected location, or (2) a signal remains but it is too low or too small to be associated with MEC, or (3) a signal remains but is associated with surface material which when moved results in low, or no signal at the interpreted location, or 4) a signal remains and a complete rationale for its presence exists.	Per anomaly, based on UXOQCS findings.

Worksheet 12.5 – Measurement Performance Criteria Table – QC Tests for DGM Surveys

Quality Control Parameter	Frequency	Instrument	Data Quality Indicators (DQIs)	Measurement Performance Criteria	Activity Used to Assess Measurement Performance
Six-line Test	1st Day of Project	Geonics EM61-MK2	Accuracy/Precision	The positions of the anomaly peak from the six passes will be evaluated to ensure the data are being located accurately.	Six passes over a known point. Passes 1 and 2 will have no spike object present. Passes 3 through 6 will have a spike object. Pass five will be walked slowly, and the sixth pass will be walked quickly.
Static Test/Static Response Test	Start and End of Day	Geonics EM61-MK2	Precision	Pre- and post-survey responses should be within 20% of one another. Daily tests will be repeatable.	The test will record background responses for 1 minute at the "QC stand," followed by a 1-minute static spike test over a standard QC item to introduce a response.
Cable Connection Test	Start of Day	Geonics EM61-MK2	Accuracy	Readings should remain at background with no apparent spikes.	The operator will test connections to ensure that cables and connectors are in good working order.
Latency Test	Start and End of Day	Geonics EM61-MK2/GPS	Accuracy	Apply correction value based on the lag or time difference observed in anomaly peak positions for the spike objects.	Traverse over a spike object at the end of the IVS, bi-directionally.
Repeatability Test	Evaluated as part of GSV process	Geonics EM61-MK2	Precision	Data are repeatable +/-20% of response amplitude, +/-20 cm for positional accuracy.	The operator will survey the IVS twice daily. Values will be compared to response curves. Positions will be plotted to monitor precision.
False Positives	Duration of Project	Field Operations / Geonics EM61-MK2	Accuracy/Precision	The project goal is to achieve a false positive rate below 15%.	False positives will be documented in the database so that the 15% false positive metric can be monitored.

Worksheet 12.6 — Measurement Performance Criteria Table – Mag and Dig Surveys

Quality Control Parameter	Frequency	Instrument	Data Quality Indicators (DQIs)	Measurement Performance Criteria (MPC)	Activity Used to Assess Measurement Performance
Instrument functionality and repeatability	Start of day at IVS	White's XLT	Accuracy/ Precision	All items in IVS detected. Train ear on audible tone of each item.	Audits by UXOQCS to monitor performance. UXO Tech to confirm instrument functionality on daily check out sheet.
Coverage and repeatability (focused grids)	Each grid	White's XLT	Accuracy	All blind seeds shall be detected in focused grids.	Continue seeding program similar to GSV process. Monitor the detection of seeds in each grid.
Coverage (transects)	Each transect	White's XLT	Accuracy	Achieve specified transect coverage in each MRS. Includes both distance and area.	Evaluate actual paths walked by UXO Technicians using GPS waypoints collected during mag and dig transect surveys.

Worksheet 13 — Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (originating organization, report title and date)	Data Generator(s) (originating organization, data types, data generation / collection dates)	How Data Will Be Used	Limitations on Data Use
Site Inspection (SI)	TLI Solutions, Inc., *Final Site Inspection Report, United States Military Academy, West Point, New York,* January 2007	Background information on nature and distribution of MEC Geophysical and visual surveys indicating location and distribution of MEC, munitions debris (MD), and subsurface anomalies MC sampling and analysis indicating exceedances for screening criteria Identification of MRSs requiring further investigation Data collection completed in April/May 2006 and September 2006	Revision of Conceptual Site Model (CSM), if needed. Development of RI approach for delineating nature and extent of MEC Guide MC sampling approach	Data gaps exist. Due to the age of the munitions used, insufficient information is available regarding MEC and MC potentially associated with munitions. MEC surveys limited. Scope of work prohibited intrusive investigation to identify subsurface anomalies. MC sampling data limited. Insufficient sampling of firing points within artillery firing ranges
Historical Records Review (HRR)	TLI Solutions, Inc., *Final Historical Records Review, United States Military Academy, West Point, New York,* March 2006	Background information on training activities conducted at MRSs including periods of use and potential munitions usage	Background information assists in delineating areas potentially impacted by MEC and MC	Due to the age of the munitions used and time period of use, insufficient information is available regarding MEC and MC potentially associated with MRSs

Worksheet 14 — Summary of Project Tasks

This worksheet provides the laboratory project tasks following MC sample collection and analysis. Section 3.13 of the Work Plan provides details of MC sampling project tasks (e.g., sampling, analysis, data management, document and record, and assessment tasks).

Data Reduction

Data reduction is the process for collecting and transforming measurements, through mathematical and/or statistical formulas, into final reportable measurements. The calculations may be performed manually or electronically. This worksheet describes the quality assurance processes that will be applied during data reduction to ensure that data collected at the site and data generated at the laboratory are valid.

Laboratory Data Reduction

Data reduction is performed by the analyst and consists of calculating concentrations in samples from the raw data. The complexity of the data reduction depends on the analytical method and the number of discrete operations involved (e.g., extractions, dilutions, instrument readings, and concentrations). The analyst calculates the final results from the raw data or uses appropriate computer programs to assist in the calculation of final reportable values. Copies of all raw data and the calculations used to generate the final results, such as bound laboratory notebooks, strip-charts, chromatograms, spreadsheets, and computer record files, are retained on file, as specified in this QAPP.

Calculations and data reduction steps for various methods are summarized in the respective laboratory SOPs (see Attachment A) or program requirements.

Data Review

Data review is performed to assess whether the quality control requirements are met. Data review will be performed on 100% of the data deliverables.

Laboratory Data Review

The individual analyst continually reviews the quality of data through calibration checks, quality control sample results, and performance evaluation samples. The analyst initiates data review during, immediately following, and after the completed analysis. The Laboratory Supervisor, analyst, or data specialist performs a secondary review of the data. The peer reviewer is trained by the QA Worksheet, Worksheet Manager, or Unit Leader to perform the data review.

Documentation and Records

Laboratory Documentation

Analytical reports comprise final results (uncorrected for blanks and recoveries, unless specified), methods of analysis, levels of reporting, surrogate recovery data, and method blank data. In addition, special analytical problems will be noted in the case narratives. The number of significant figures reported will be consistent with the limits of uncertainty inherent in the analytical method. Consequently, most analytical results will be reported to no more than two or three significant figures. Data are normally reported in units commonly used for the analyses performed.

Concentrations in liquids are expressed in terms of weight or activity per unit volume (e.g., micrograms per liter [µg/L], or milligrams per liter [mg/L]). Concentrations in solid or semisolid matrices are expressed in terms of weight or activity per unit weight of sample (e.g., micrograms per kilogram [µg/kg], or milligrams per kilogram [mg/kg]). Solid and semisolid matrices will also be reported on a dry weight basis. Reporting limits take into account all appropriate concentration, dilution, and/or extraction factors.

If any analytical anomalies are encountered during the analyses (e.g., an out-of-control matrix duplicate), it is documented in a case narrative and copies of the Sample Discrepancy Reports (SDRs) or Corrective Action Reports (CARs) must be included in the laboratory data packages. Contract Laboratory Program (CLP)-type data packages will be submitted for this program. Samples will be submitted to the laboratory on a 21-day turnaround (quick turnaround time (TAT) may be requested, as needed). Both the full documentation package and electronic data will be provided on the actual due date.

Laboratory Record Keeping

At a minimum, subcontracted laboratories will retain all data related to sample preparation, analysis, and general observations in appropriate hardbound laboratory notebooks or files. Laboratory notebook pages must be reviewed, signed, and dated by the author and receive an independent secondary review by a peer or supervisor who signs/initials and dates the data pages.

Corrections to notebook entries are made by drawing a single line through the erroneous entry and writing the correct entry next to the one that is crossed out. All corrections are initialed and dated by the individual performing the correction.

After delivering acceptable hard copy and/or electronic data deliverables, the laboratory will store the original project data for at least 5 years unless otherwise specified in the subcontract agreement.

Assessment and Audit Tasks

A subcontractor laboratory Technical System Audit (TSA) audit may be performed at any time during this program. In the event that laboratory performance does not meet QAPP requirements and/or significant data quality issues arise, WESTON reserves the right to perform additional system/project audits at any time throughout the program.

Checklists are to be used to ensure that all salient points are addressed and documented. The checklists are filled out legibly and reproducibly, in ink, by the auditor, and are signed and dated by the auditor when completed. The audit checklist is based on EPA laboratory evaluation criteria, the DoD QSM Version 4.2, the provisions of the Laboratory Quality Assurance Manual (QAM), and the laboratory SOPs.

Each system audit is immediately followed by a debriefing in which the auditor discusses his/her findings with the laboratory representatives. The debriefing serves a two-fold purpose: (1) laboratory management is afforded an early summary of findings, which allows them to begin formulating corrective strategies; and (2) the auditor has a chance to test preliminary conclusions and to correct any misconceptions before drafting his/her report.

The records from these assessments will be included in the project file. An abbreviated summary of the audits, including the name of the laboratory, the project for which the audit was performed, and the overall rating of the laboratory (acceptable or unacceptable), will be submitted to procurement for tracking. If a laboratory is assessed unacceptable, corrective actions will be implemented.

Data Verification Tasks

Data quality assessment is performed by evaluating the results of data verification, data evaluation, and/or data validation to determine the usability of the data for the original project objectives. Data verification, data evaluation, and data validation are each separate levels of review that can be performed by themselves or in conjunction with each other. Each of these levels of review is defined in the subworksheets below with the requirements for this project. While it is possible to apply these levels of review to field data, they are almost always associated only with analytical data from laboratories for field analyses.

Initially, data are received at WESTON in both pdf (laboratory data package) and electronic data deliverable (EDD) formats, as discussed previously. Upon receipt of the laboratory deliverables, a data management staff member will verify that:

- Results were received for each requested analysis for each sample. If a result is missing, the staff member will determine whether the laboratory submitted a deficiency report that accounts for the missing data.

- The data deliverable will be inspected for completeness based on the requirements specified in this plan. Inspection will verify only that the report Worksheets are present, not that the data within the report Worksheets are complete.

- WESTON will perform data verification on every report submitted by a laboratory. Field results will be reviewed for completeness. In addition, once the EDD is verified, it will be loaded into the project's electronic database management program as "unvalidated" for user access on the network. These analytical results will be considered preliminary until data validation is complete.

Electronic Data Verification

WESTON's standardized Electronic Data Management Program, developed by Geotech Computer Systems of Englewood, Colorado, is EnviroData. The EnviroData EDD is in an ASCII text file format, which can interface with Geographic Information System (GIS), allowing exportation of electronic deliverables in order to meet agency standard formats. All analytical results are required to be submitted in the WESTON format. See EDD specification in Figure 14-1. Additionally, as required by the USACE-Baltimore, an Environmental Restoration Information System (ERIS) EDD format will be uploaded on a quarterly basis.

The EDDs will be compared to the pdf version of the laboratory data package by the WESTON Data Management Coordinator. WESTON will perform a cursory review of the electronic data results. If a discrepancy is identified, the laboratory will be requested to correct the error, or WESTON will use the result reported in the hard copy data by the laboratory.

Table 14-1 EDD Specification

Field Name	Data Type	Record Size	Description	Table
Site Name	Text	50	Site Name	Sites
Station Name	Text	25	Station identifier or name	Stations
Sample Date_D	Date/Time	8	Date sample was taken	Samples
Sample Matrix	Text	15	Sample matrix	Samples
Sample Top	Number(Sg)		Sample top	Samples
Sample Bottom	Number(Sg)		Sample Bottom	Samples
Depth Units	Text	15	Units for sample top and sample bottom	Samples
Duplicate Sample	Number(Int)		Duplicate samples	Samples
Field Sample ID	Text	20	Client assigned field sample ID	Samples
Lab Sample ID	Text	20	Lab sample ID	Samples
Alt Sample ID	Text	20	Alternate sample identification	Samples
Cooler ID	Text	20	Cooler ID number - for QA/QC	Samples
Sampler	Text	50	Name of person taking sample	Samples
Description	Text	50	Sample description	Samples
COC Number	Text	20	COC number	Samples
Delivery Group	Text	10	Sample delivery group	Samples
Filtered Sample	Text	20	Filter size	Samples
QC Sequence ID	Text	15	QC sequence identifier	Samples
QC Sample Code	Text	3	QC code for this sample	Samples
Task Number	Text	20	Task number under which sampling is done	Samples
Primary Sample	Text	20	Primary sample to which QC sample is tied	Samples
Sample Result	Text	255	Result of attempted sampling	Samples
Parameter Name	Text	60	Name of material analyzed for	Analyses
CAS Number	Text	20	CAS number of material analyzed for	Analyses
Alt Parameter Number	Text	20	Alternative number for parameter	Analyses
Superseded	Number(Int)		Analysis superseded by re-analysis?	Analyses
Analytic Method	Text	25	Method for performing analysis	Analyses
Value	Number(Sg)		Value measured during analysis	Analyses
Reporting Units	Text	15	Units of the analysis	Analyses

Table 14-1 EDD Specification (Continued)

Field Name	Data Type	Record Size	Description	Table
Flag Code	Text	4	Data qualifier	Analyses
Problem Code	Text	4	Problems encountered during analysis	Analyses
Validation Code	Text	4	Code from data validation	Analyses
Detected Result	Text	1	Was analyte detected	Analyses
Detect	Number(Sg)		Detection limit	Analyses
Limit Type	Text	4	Detection limit type	Analyses
Detect2	Number(Sg)		2nd detection limit	Analyses
LimitType2	Text	4	2nd detection limit type	Analyses
Error	Number(Sg)		Error range for this analysis	Analyses
Dilution Factor	Number(Sg)		Dilution factor	Analyses
Basis	Text	1	Analyzed wet or dry	Analyses
Filtered Analysis	Text	20	Filter/measure basis at analytical level	Analyses
Leach Method	Text	20	Leaching method	Analyses
Prep Method	Text	20	Lab preparation method	Analyses
Reportable Result	Text	1	Designates analysis as reportable result	Analyses
Anal Date_D	Date/Time	8	Date the analysis was performed	Analyses
Extract Date_D	Date/Time	8	Date the extraction was performed	Analyses
Lab Report Date_D	Date/Time	8	Lab analysis reporting date	Analyses
Lab	Text	10	Name of lab conducting analysis	Analyses
Lab Comments	Text	50	Lab comments about this analysis	Analyses
Analysis Lab ID	Text	20	Lab identification number for analysis	Analyses
Analytical Batch	Text	40	Lab batch ID number	Analyses
Value Code	Text	6	Differentiates between different results	Analyses
Run Code	Text	5	Run code for GC analyses	Analyses
QC Analysis Code	Text	3	QC code for this analysis	Analyses

Field Name Description:

Site Name – The name of the Site from which the sample was taken. Required.
Station Name – The name of the Station from which the sample was taken. Required.
Sample Date_D – The date on which the sample was taken. Required.
Sample Matrix – The material that the sample is primarily composed of. Provide the full Sample Matrix name, such as “Soil”. Required.
Sample Top and *Sample Bottom* – Soil sample depths or elevations, as instructed by the client. The fields should contain only numeric values. If these fields are not applicable (i.e., water samples) or are unknown to the laboratory, then they should be populated with zeros, for compatibility with ODBC databases. Required.

Table 14-1 EDD Specification (Continued)

Depth Units – Units for sample top and sample bottom. This is a coded field that is linked to the Reporting Units lookup table. If this information is unavailable to the lab, "Unknown" should be reported. These units can be entered into the import file by a Data Administrator. Required.

Duplicate Sample – This field is discussed previously. It should be a zero unless this is a duplicate sample. All analyses must have an entry for this field, with multiple QC samples entered as values incremented from one. Required.

Field Sample ID – The client-assigned field ID number for each sample. Optional.

Lab Sample ID – The sample identification number used internally by the laboratory. Optional.

Alt Sample ID – Another sample identification number if needed. Optional.

Cooler ID – Number to identify cooler in which primary samples and QC samples were shipped. Optional.

Sampler – Person taking the sample. Optional.

Description – Description of the sample, such as its condition. Optional.

COC Number – Chain-of-custody tracking number. Optional.

Delivery Group – Sample delivery group. This field is provided for use as a lab tracking field. It could be used to define a group of parameters. Optional.

Filtered Sample – Filter information at the sample level. Was the sample filtered, and if so, what size filter was used? It could also be used to identify whether the filtering occurred in the field or the lab. Entries are compared to the Filtered look-up table in the database. The lab can supply either the code or the Filter description, whichever is most consistent with their system (i.e., TOT vs. total), but must coordinate this with the client. Required.

QC Sequence ID – QC sequence identifier. This field is another lab tracking field, used to relate field samples to lab samples. Optional.

QC Sample Code – Code to identify QC samples. It ties to the **QC Codes** table, which contains codes for both the sample and analysis levels. The lab should supply the code if available, e.g., DUP for duplicate sample, or O for original sample. If this information is not available to the lab, enter "z" for Unknown. Required.

Task Number – The administrative task number under which sampling is done. Optional.

Primary Sample – Stores the Field Sample ID of the primary sample to which the QC sample is tied. This field is blank for original samples, may be blank for field QC samples that have been submitted blind to the lab. This number can be entered into the temporary import table by a Data Administrator. The import routine converts this to the sample number of the primary sample before storing it in the database. Optional.

Sample Result – The result of the sampling process, such as "successful", "dry", "no access". Its primary use is to indicate that obtaining a sample was attempted unsuccessfully. If not available from the lab, this field can be entered into the temporary import table by a Data Administrator. Optional. If a sample was attempted unsuccessfully, the sample fields should be filled in; however, all fields associated with analyses, including parameter name, CAS Number, and Alt Parameter Number, should be left blank. The system will then only attempt to import the sample information.

Parameter Name, CAS Number, Alt Parameter Number – Various combinations of these fields are used to identify the Parameter Name. Parameter Name should be always be provided. The system compares the Parameter name to the entries in the Parameters and Parameter Alias lookup tables. CAS Number and Alt Parameter Number are not required, but should be provided if possible to help ensure the correct parameter name assignment. If the Parameter Name does not match a lookup entry, the system compares either the CAS Number, or the Alt Parameter Number (frequently used for Storet codes), to Parameter table entries. Care should be taken that consistent numbers be provided. If Parameter Name is left blank, but a CAS Number or Alt Parameter Number is provided, the system assigns a parameter name from the lookup tables based on a number match. Using only numbers to designate the parameter is not recommended, since the program does not request confirmation of the parameter name that is assigned.

Superseded – This field is discussed above. It should be a zero unless the analysis is superseded by a later value in the same file, in which case the entry should be 1. This field is used in conjunction with the Value Code field, discussed later in this Worksheet. All analyses should have an entry. Required.

Analytic Method – Method used to perform the analysis. Optional

Value – Measured result of the analysis. Optional, but should almost always be provided. For laboratory control spike and matrix spike samples, the results should be reported in percent recovery, with the units in %. Moisture content should be reported as a separate analytical record, with the units in %. They should be entered on a "by weight" basis, based on total weight.

Reporting Units – Units of the analysis. The entry provided should be the full abbreviation, such as "mg/L". Entries must match an entry in the Reporting Units lookup table in the database. Detection limits and radiologic error must be reported in the same units as the value. Required.

Table 14-1 EDD Specification (Continued)

Flag Code – One to four coded entries for the analytical flag describing the analysis. Each character in the field must match an entry in the Analytic Flags lookup table in the database. More than one flag can be entered. For example, if “b” (detected in blank) and “j” (estimated value) are both entered in the lookup table, then “bj” can be entered as an analytic flag (estimated value, detected in blank). If the analysis is considered a usable value, and would not otherwise have a flag, this field should contain the code for Detected Value (usually a “v”). If the flag is unknown, the field should contain a “z”. Required.

Problem Code – Analytic problems are usually described in the narrative, and not included in the electronic format. If this field data is not provided, the field should contain a “z” for unknown. If the laboratory chooses to supply problems in the electronic file, then the codes must match entries in the Analytic Problems table. As with the Flag Code field, the entry can consist of from one to four approved codes. Required.

Validation Code – One to four flags associated with validation of analyses. The data validation organization usually provides this field, which can contain from one to four of these codes. Others should place a “z” for Unknown in this field. Required.

Detected Result – Supplied by the lab, this field should contain either “y” for yes, the analyte was detected, or “n” for no, the analyte was not detected. This field overlaps slightly with Flag Code. The purpose of this field is to separate the non-detect flag from other lab qualifiers, such as “j” or “b”, for statistical, evaluation and validation purposes. Optional.

Detect – Detection limit for the analysis. Detection limits must be reported in the same units as the value. Optional.

Limit Type – Type of limit contained in the Detect field, such as “LOD”, “PQL”, “LOQ”, etc. Optional.

Detect2 – A second detection limit. Standards should be set for which type of limit should be entered in each field for a given site, for example: IDL or LOD in the first column, CRDL or PQL in the second. Optional.

LimitType2 – Limit type for second detection limit. Optional.

Error – Standard error for radioactivity measurements. Optional.

Dilution Factor – Amount that the sample was diluted prior to analysis. Optional.

Basis – Analyzed wet or dry. Should be “w” for wet or “d” for dry. Can also report “n” for not applicable, or “z” for unknown. Required.

Filtered Analysis –Filter or measure basis information at the analysis level. Entries are compared to the Filtered look-up table in the database. As with the Filtered Sample field, the lab can supply either the code or the description for this field. Required.

Leach Method – Method used to leach sample. Entries are compared to the Leach Method lookup table to maintain consistency. Lab should supply the full name of the method. If the analysis was not leached, “None” should be reported. Required.

Prep Method – Method used to prepare sample separate from leaching. Optional.

Reportable Result – Flag for whether the result is to be used in reports. Report “Y” for yes, or “N” for no. Reported by labs or selected by Project Managers for multiple analyses from a selected sample, such as analyses at multiple dilutions. Optional.

Anal Date_D – Date on which the analysis was performed. Optional.

Extract Date_D – Date on which the material was extracted for analysis. Optional.

Lab Report Date_D – Date on which the lab reported the analysis. Optional.

Lab – Name of the laboratory performing the analysis. Optional.

Lab Comments – Lab comments about this analysis. Optional.

Analysis Lab ID – Lab identification number at the analysis level. LabSampleID tracks lab analyses at the sample level. This field is for identification numbers at the analysis level. Optional.

Analytical Batch – Lab batch identification number. Optional.

Value Code – Parameter value classification. This field identifies the analytical trial, and supplies the reason for a superseded analysis. It is a coded entry enforced by a lookup table. The lab should report the code, such as “RE” for re-extracted, “DL” for dilution, etc., or “O” for original analysis. Required.

Run Code – Confirmation run identification. This is a coded entry enforced by a lookup table. The lab should supply the code, such as “PR” for primary run, “n” for not applicable, or “z” for Unknown. Required.

QC Analysis Code – QC code at the analysis level. It ties to the **QC Codes** table, which contains codes for both the sample and analysis levels. The lab should supply the code for this field, such as “TIC” for tentatively identified compound, or “O” for original analysis. Required.

Data Evaluation

Data evaluation is performed to assess whether the quality control requirements for field duplicates, laboratory duplicates, field blanks, trip blanks, surrogates, matrix spikes, percent solids, laboratory blanks, and laboratory control samples were met.

Data evaluation will be performed on 100% of the laboratory deliverables generated during this program. In addition, some technical review will be performed by WESTON's Project Chemist.

Data Validation

Data validation is a systematic process to ensure that all chemical analytical information meet uniform requirements and to determine that the usability and defensibility of the data are adequate for their intended use. Analytical results will be independently evaluated by a third party; according to the appropriate agency data validation guidelines applicable for the site location (see Worksheet 36). In conjunction with the data validation guidelines, the project chemist will examine the project-specific Work Plan, the method-specific criteria, and the laboratory SOPs to determine the overall usability of the analytical results. All applicable analytical data packages will be validated to ensure compliance with specified analytical, QA/QC requirements, data reduction procedures, data reporting requirements and required accuracy, precision, and completeness criteria.

Data validation will be performed on 100% of the CLP-type data deliverables.

The CLP-type data packages will be validated at Manual Level M3 for organic compounds and Manual Level IM2 for inorganic compounds, following the most recently promulgated versions of the EPA Region III *Modifications to the National Functional Guidelines* for organic and inorganic data review, and the EPA Region III *Innovative Approaches to Data Validation.* Methods for which no data validation guidelines exist will be validated following the *National Functional Guidelines* deemed most appropriate by the data validator.

Upon completion, the data validator will provide a data validation report that is compliant with the guidelines established in the previously referenced documents. In addition, the validator will provided an annotated EDD that contains all data result qualifiers. These data qualifiers will then be uploaded into the project database, which will then be made accessible to the WESTON project team and will be available for upload to ERIS.

Worksheet 15 — Reference Limits and Evaluation Tables

Worksheet 15.1 — Reference Limits and Evaluation Table – Explosives Method SW-846 8330B (Soil/Sediment)

		Human Health Values		Ecological Values		Achievable Laboratory Limits		Precision and Accuracy Method Performance Criteria[7]	
		EPA Residential RSL[2]	NYSDEC Unrestricted Use SCO[3]	Recommended Ecological Screening Value[4]	PAL[5]	Project LOQ	LOD	LCS/MS/MSD * Recovery Limits	LCS/MS/MSD Precision
		Soil	Soil	Soil	Soil	Soil[6]	Soil	Soil	
Analyte[1]	CAS Number	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	%	RPD <
Octogen (HMX)	2691-41-0	380 n	NBA	NBA	380	0.1	0.0083	75-125	20
Cyclotrimethylene trinitramine (RDX)	121-82-4	5.5 c	NBA	NBA	5.5	0.1	0.0081	70-135	20
1,3,5-Trinitrobenzene	99-35-4	220 n	NBA	0.38	0.38	0.1	0.01	75-125	20
1,3-Dinitrobenzene	99-65-0	0.61 n	NBA	0.66	0.61	0.1	0.0082	80-125	20
Nitrobenzene	98-95-3	4.8 c	3.70	1.31	1.31	0.1	0.014	75-125	20
Tetryl	479-45-8	24 n	NBA	NBA	24	0.097	0.020	10-150	20
2,4,6-Trinitrotoluene	118-96-7	3.6 n	NBA	NBA	3.6	0.1	0.013	55-140	20
4-Amino-2,6-dinitrotoluene	19406-51-0	15 n	NBA	NBA	15	0.097	0.016	80-125	20
2-Amino-4,6-dinitrotoluene	35572-78-2	15 n	NBA	NBA	15	0.1	0.0099	80-125	20
2,6-Dinitrotoluene	606-20-2	6.1 n	1.03	0.03	0.03	0.1	0.015	80-120	20
2,4-Dinitrotoluene	121-14-2	1.6 c	NBA	1.28	1.6	0.1	0.014	80-125	20
2-Nitrotoluene	88-72-2	2.9 c	NBA	NBA	2.9	0.097	0.023	80-125	20
4-Nitrotoluene	99-99-0	24 n	NBA	NBA	24	0.097	0.021	75-125	20
3-Nitrotoluene	99-08-1	0.61 n	NBA	NBA	0.61	0.097	0.021	75-120	20
1, 2-Dinitrobenzene (surrogate)	528-29-0	NA	NA	NA	NA	0.098	12	80-125[8]	NA

[1] This list includes the complete Target Compound List (TCL) Explosives; however, samples will only be analyzed for the MC identified in the MC Sampling Memorandum included with the Work Plan.

[2] Residential Screening Levels were obtained from ORNL Regional Screening Levels for Chemical Contaminants at Superfund Sites Table (May 2010). The RSLs are shown at a target risk (TR) of 1.0E-6 or a target hazard quotient (THQ) of 0.1.

[3]New York Department of Environmental Conservation. 2006. Remedial Program Soil Cleanup Objectives – http://www.dec.ny.gov/regs/15507.html
[4]The primary source for the Recommended Screening Value is the NY DEC value. If a NY DEC value was not available, the following hierarchy was used to select the screening value: USEPA EcoSSL, EPA Region 5 ESL, ORNL Benchmark 1, ORNL Benchmark 2.
[5]For the purpose of contracting with the analytical laboratory, the PAL (Preventative Action Limit) is the lesser of "EPA Residential RSL", "NYSDEC Unrestricted Use SCO" or "Recommended Ecological Screening Value".
[6]If % solids is <30%, additional sample needs to be analyzed to ensure the detection limits are met.
[7]The QA/QC criteria presented in this table reflect the most recently promulgated values as reported by the laboratory; therefore, they may differ from those values presented in the associated SOP found in Attachment A.
[8]Surrogate Control Limits.
**laboratory control sample (LCS)/matrix spike (MS)/matrix spike duplicate (MSD)*

Worksheet 15.2 — Reference Limits and Evaluation Table – Metals Methods SW-846 6010B/7471A (Soil/Sediment)

		Human Health Values		Ecological Values		Achievable Laboratory Limits		Precision and Accuracy Method Performance Criteria[7]	
		EPA Residential RSL[2]	NYSDEC Unrestricted Use SCO[3]	Recommended Ecological Screening Value[4]	PAL[5]	Project LOQ	LOD	LCS/MS/MSD Recovery Limits	LCS/MS/MSD Precision
Analyte[1]	CAS Number	Soil (mg/kg)	Soil (mg/kg)	Soil (mg/kg)	Soil (mg/kg)	Soil[6] (mg/kg)	Soil (mg/kg)	Soil %	Soil RPD <
Aluminum	7429-90-5	7,700 n	NBA	pH < 5.5 or 0.14	7,000	20	5.6	80-120	20
Antimony	7440-36-0	3.1 n	NBA	0.27	0.27[8]	6	.33	80-120	20
Arsenic	7440-38-2	0.39 c	13.0	13	0.39[8]	1.0	.40	80-120	20
Barium	7440-39-3	1,500 n	350	433	350	20	.44	80-120	20
Beryllium	7440-41-7	16 n	7.20	10	7.20	0.5	.052	80-120	20
Cadmium	7440-43-9	7 n	2.50	4	2.50	0.5	.057	80-120	20
Calcium	7440-70-2	NBA	NBA	NBA	NA	500	12	80-120	20
Chromium	7440-47-3	12,000 n	30.0	41	30.0	1	.08	80-120	20
Cobalt	7440-48-4	2.30 n	NBA	13	2.30	5	.075	80-120	20
Copper	7440-50-8	310 n	50.0	50	50.0	2.5	.21	80-120	20
Iron	7439-89-6	5,500 n	2,000	0.054	0.054[8]	20	2.7	80-120	20
Lead	7439-92-1	400	63.0	63	63	1.0	0.35	80-120	20
Magnesium	7439-95-4	NBA	NBA	NBA	NA	500	4.9	80-120	20
Manganese	7439-96-5	180 n	1,600	1600	180	1.5	0.024	80-120	20
Mercury *(Method 7471A)*	7439-97-6	0.56 n	0.18	0.18	0.18	.033	0.011	87-111	20
Nickel	7440-02-0	150 n	30.0	30	30	4	0.13	80-120	20
Potassium	7440-09-7	NBA	NBA	NBA	NA	500	20	80-120	20
Selenium	7782-49-2	39 n	3.90	3.9	3.90	3.5	0.59	80-120	20
Silver	7440-22-4	39 n	2.00	2	2.00	1	0.19	75-120	20
Sodium	7440-23-5	NBA	NBA	NBA	NA	500	5.1	80-120	20
Thallium	7440-28-0	NBA	NBA	0.057	0.057	2.5	0.28	80-120	20
Vanadium	7440-62-2	0.55 n	100	7.8	0.55	5	0.077	80-120	20
Zinc	7440-66-6	2,300 n	109	109	109	2	0.094	80-120	20

[1]This list includes the complete Target Analyte List (TAL) Metals; however, samples will only be analyzed for the MC identified in the MC Sampling Memorandum included with the Work Plan.

[2] Residential Screening Levels were obtained from ORNL Regional Screening Levels for Chemical Contaminants at Superfund Sites Table (May 2010). The RSLs are shown at a target risk (TR) of 1.0E-6 or a target hazard quotient (THQ) of 0.1.
[3]New York Department of Environmental Conservation. 2006. Remedial Program Soil Cleanup Objectives – http://www.dec.ny.gov/regs/15507.html
[4]The primary source for the Recommended Screening Value is the NY DEC value. If a NY DEC value was not available, the following hierarchy was used to select the screening value: USEPA EcoSSL, EPA Region 5 ESL, ORNL Benchmark 1, ORNL Benchmark 2.
[5]For the purpose of contracting with the analytical laboratory, the PAL (Preventative Action Limit) is the lesser of "EPA Residential RSL", "NYSDEC Unrestricted Use SCO" or "Recommended Ecological Screening Value".
[6]If % solids is <30%, additional sample needs to be analyzed to ensure the detection limits are met.
[7]The QA/QC criteria presented in this table reflect the most recently promulgated values as reported by the laboratory; therefore, they may differ from those values presented in the associated SOP found in Attachment A.
[8]For compounds where the PAL is lower than the LOD achievable by the laboratory, the LOD was will used as the screening criteria for review of analytical results.

Worksheet 16 — Project Schedule/Timeline Table

Activities	Organization	Dates (MM/DD/YY)		Deliverable	Deliverable Due Date
		Anticipated Dates(s) of Initiation	Anticipated Date of Completion		
TPP Meeting 1 (Kickoff and CSM)	WESTON, USACE, West Point, NYSDEC, EPA, TLI	7/29/10	7/29/10	Written Meeting Agenda Written Meeting Minutes	8/27/10
Draft RI WP/QAPP	WESTON	4/28/10	9/21/10	Draft RI WP with Appendices	9/21/10
Army Review / Comments – WP/QAPP	West Point, USACE	9/22/10	10/22/10	Written Review Comments	10/22/10
Draft Final RI WP/QAPP	WESTON	10/23/10	1/14//11	Draft Final RI WP with Appendices	1/14/11
Stakeholder Review / Comment – WP/QAPP	NYSDEC, EPA	1/15/11	2/15/11	Written Review Comments	2/15/11
Final RI WP/QAPP	WESTON	2/16/11	3/25/11	Final RI WP with Appendices	3/25/11
TPP Meeting 2 (WP and FW Approach)	WESTON, USACE, West Point, NYSDEC, EPA, TLI	2/3/11	2/3/11	Written Meeting Agenda Written Meeting Minutes	2/3/11
RI Fieldwork (MEC)	WESTON	3/21/11	8/11/11	Safety and field logs and forms, Photographic log, DGM data table, Daily reports, and Daily Data Quality Control Report (DQCR) – to be included in the appendices to the RI Report	8/11/11
RI Fieldwork (MC)	WESTON, TLI	3/21/11	8/11/11	MC Sampling Logs, Data Analysis to be included in RI Report	8/11/11

Worksheet 16 — Project Schedule/Timeline Table (Continued)

Activities	Organization	Dates (MM/DD/YY)		Deliverable	Deliverable Due Date
		Anticipated Dates(s) of Initiation	Anticipated Date of Completion		
Draft RI Report	WESTON, TLI	8/11/11	12/16/11	Draft RI Report with Appendices	12/16/11
Army Review / Comments – RI Report	West Point, USACE	12/19/11	1/30/12	Written Review Comments	1/30/12
Draft Final RI Report	WESTON, TLI	1/31/12	3/27/12	Draft Final RI Report with Appendices	3/27/12
Stakeholder Review / Comment – RI Report	NYSDEC, EPA	3/28/12	6/21/12	Written Review Comments	6/21/12
TPP Meeting 3 (RI Recommendations)	WESTON, USACE, West Point, NYSDEC, EPA, TLI	6/13/12	6/13/12	Written Meeting Agenda Written Meeting Minutes	6/13/12
Final RI Report	WESTON, TLI	6/22/12	8/27/12	Final RI Report with Appendices	8/27/12

Worksheet 17 — Sampling Design and Rationale

The sampling methodologies to characterize MC contamination in soil that may be utilized based on the potential MEC releases at West Point MRSs include:

- Incremental Sampling (IS) – IS protocol will be implemented at MRSs recommended for further MC investigation in the SI (Battery Knox-TD Land), at former firing point locations (Artillery Firing Range, Siege Battery, Lusk Reservoir, and Redoubt No. 2), and where geophysical survey results identify areas indicative of a potential MEC release. IS samples will be collected using an IS sampling tool. Sampling units will be selected in the field based on visual survey and geophysical survey observations. Sampling units will range in size from 0.5 to 2.0 acres. A minimum of 30 increments and a maximum of 50 increments will be collected from within each sampling unit. Increments will be collected using a systematic random approach based on the following number of increments:

  - 0.25 – 0.5 acres – 30 increments
  - 0.51 – 1.5 acres –50 increments
  - 1.51 – 2.5 acres – 100 increments

  If an area of greater than 2.5 acres is identified for sampling, multiple sampling units will be identified and sampled within the area. All sampling units within a decision unit will be the same size with the same number of increments collected from within each sampling unit.

  Sample size will be one kilogram at a minimum. Samples will be collected in a resealable plastic bag. The bags will be labeled with the appropriate sample identification information. Samples will then be double-bagged prior to shipment to the laboratory. Triplicate samples will be collected at a rate of 10% for each type of sampling unit. For example, a triplicate sample will be collected from 10% of the artillery firing points and a triplicate sample will be collected from 10% of the samples collected from within the Battery Know-TD Land MRS. If additional types of IS samples are needed, triplicates will be collected in conjunction with these samples as well.

- Discrete Sampling – Focused sampling at individual MEC item locations where soil staining or other visible evidence of a MC release is observed. There is a potential for discrete samples to be collected from all MRSs based on the results of geophysical surveys. If a single, intact MEC item is observed, a discrete soil sample will be collected in proximity to the item. If it appears that the MEC item partially functioned or was leaking and an area of approximately 3-6 feet in diameter may have been impacted by the item, a composite sample (spoke and hub) will be collected in proximity to the item.

Finally, if MEC or MD items are identified in a widespread area covering 0.25 acres or more, an IS sample will be collected as discussed above.

Discrete samples will be collected using disposal plastic scoops. Samples will be collected in a resealable plastic bag. The soil will be homogenized and organic material and rocks will be removed from the sample. The sample will then be transferred to the appropriate size sample container, which will be labeled, for transport to the laboratory. QC samples (field duplicates) will be collected at a rate of 10%.

- X-Ray Fluorescence (XRF) Screening – Use to assess metals contamination in situations such as small arms ranges if observed. Perform in-situ and ex-situ analysis with confirmation samples analyzed by an offsite laboratory for correlation. In-situ analysis will be performed if small arms target berms are identified. The in-situ samples will assist in delineating the extent of potential metals contamination. XRF screening will be conducted if berms or target areas for small arms ranges are identified during the geophysical survey. Based on the results of the SI, no small arms berms or target areas are anticipated to be located within the MRSs even though the small arms ranges were historically associated with the Grey Ghost Housing Area and Siege Battery MRSs. However, in the event that one is identified, XRF will be employed to assess the potential for lead contamination. Once an area of contamination has been identified, ex-situ samples will be collected in quart-size resealable plastic bags. The soil in the bag will be analyzed three times and an average concentration will be calculated. The soil will then be transferred to an appropriate size sample container, which will be labeled, for transport to the laboratory. QC samples (field duplicates) will be collected at a rate of 10%.

Primarily, samples will be collected from surface soils (0-6 inches below ground surface). An IS tool will be used to allow for samples to be consistently collected from the entire vertical thickness of an IS sampling unit and all sampling units within a decision unit will be sampled in the same manner. If evidence of buried munitions (MEC or significant MD) is identified during the geophysical survey, samples will be collected from the depth at which the item(s) were observed. In the event that a subsurface IS sample is collected, all increments within the sampling unit/decision unit will be collected from the same depth.

In many instances, the types of samples to be collected will be determined in the field based on observations and geophysical survey results. All field decisions will be documented on a memorandum and provided to the stakeholders for review and approval.

Worksheet 18 — Sampling Locations and Methods/SOP Requirements Table

Generally, sample locations will be selected in the field based on the results of the geophysical and visual surveys. The type of sample to be collected at each location will be determined based on the rationale presented in Worksheet 17 and will be analyzed for metals in the target analyte list (TAL) in addition to explosives. Incremental samples will be collected at 11 locations with the Battery Knox-TD Land MRS. In addition, incremental samples will be collected at the artillery firing points within the following MRSs: Artillery Firing Range, Siege Battery, Lusk Reservoir, and Redoubt No. 2. Table 18-1 lists the number of environmental and background samples anticipated.

Table 18-1 Samples Expected

MRS	Sampling Location / ID Number	Matrix	Depth (inches)	Analytical Group	Number of Samples/Sample Type[1] (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
Artillery Firing Range	WPR01-SS01-00	Soil	0-6	TAL Metals, Explosives	1/IS	Worksheet 21, Table 21-1	Sacred Heart Cemetery artillery range firing point
Artillery Firing Range	WPR01-SS02-00	Soil	0-6	TAL Metals, Explosives	1/IS	Worksheet 21, Table 21-1	Silver Depository artillery range firing point
Artillery Firing Range	WPR01-TBD	Soil	TBD	TAL Metals, Explosives	TBD/IS, D, or C	Worksheet 21, Table 21-1	Sample location based on results of MEC field work
Battery Knox-TD Land	WPR02-SS03-00 through WPR02-SS15-00	Soil	0-6	TAL Metals, Explosives	11/IS 1/IS Duplicate 1/IS Triplicate	Worksheet 21, Table 21-1	Sampling Unit locations selected based on areas most likely to have been impacted by artillery firing
Fort Clinton - West	WPR03-TBD	Soil	TBD	TAL Metals, Explosives	TBD/IS, D, or C	Worksheet 21, Table 21-1	Sample location based on results of MEC field work
Grey Ghost Housing Area	WPR04-TBD	Soil	TBD	TAL Metals, Explosives	TBD/IS, D, or C	Worksheet 21, Table 21-1	Sample location based on results of MEC field work
North Athletic Field	WPR05-TBD	Soil	TBD	TAL Metals, Explosives	TBD/IS, D, or C	Worksheet 21, Table 21-1	Sample location based on results of MEC field work
Seacoast Battery	WPR06-TBD	Soil	TBD	TAL Metals, Explosives	TBD/IS, D, or C	Worksheet 21, Table 21-1	Sample location based on results of MEC field work
Siege Battery	WPR07-SS16-00	Soil	0-6	TAL Metals, Explosives	1/IS	Worksheet 21, Table 21-1	Siege Battery artillery range firing point
Siege Battery	WPR07-TBD	Soil	TBD	TAL Metals, Explosives	TBD/IS, D, or C	Worksheet 21, Table 21-1	Sample location based on results of MEC field work
Target Hill	WPR08-TBD	Soil	TBD	TAL Metals, Explosives	TBD/IS, D, or C	Worksheet 21, Table 21-1	Sample location based on results of MEC field work
Lusk Reservoir	WPR09-SS17-00	Soil	0-6	TAL Metals, Explosives	1/IS	Worksheet 21, Table 21-1	Lusk Reservoir artillery range firing point

Worksheet 18 — Sampling Locations and Methods/SOP Requirements Table (Continued)

MRS	Sampling Location / ID Number	Matrix	Depth (inches)	Analytical Group	Number of Samples/Sample Type[1] (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
Lusk Reservoir	WPR09-TBD	Soil	TBD	TAL Metals, Explosives	TBD/IS, D, or C	Worksheet 21, Table 21-1	Sample location based on results of MEC field work
Redoubt No. 2	WPR10-SS18-00	Soil	0-6	TAL Metals, Explosives	1/IS	Worksheet 21, Table 21-1	Redoubt No. 2 artillery range firing point
Lusk Reservoir	WPR10-TBD	Soil	TBD	TAL Metals, Explosives	TBD/IS, D, or C	Worksheet 21, Table 21-1	Sample location based on results of MEC field work
Michie Stadium	WPR11-TBD	Soil	TBD	TAL Metals, Explosives	TBD/IS, D, or C	Worksheet 21, Table 21-1	Sample location based on results of MEC field work

[1] IS = Incremental Sample
D = Discrete Sample
C = Composite Sample

Worksheet 19 — Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method / SOP Reference	Sample Size	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation / analysis)
Soil / Sediment[1]	Explosives	Low	SW-846 8330B (SOP A-1)	1 Kg	Glass/Bag	Cool 4±2°C	14 days to extract/40 days to analysis
Soil / Sediment[1]	Metals	Low	SW-846 6010B[2] (SOP A-2)	5 grams (discrete)/ 10 grams (IS)	Glass or Plastic	Cool 4±2°C	6 months
Soil / Sediment[1]	Mercury	Low	SW-846 7471A (SOP A-3)	Not applicable	Analyze from metals jar	Cool 4±2°C	28 days

[1]All sediment samples should have % solids ≥30%. If the % solids is <30%, additional sample needs to be collected and analyzed to ensure that detection limits are met.

[2]Note that IS samples for metals analysis will be prepared in accordance with USACE protocol in which the sample is first dried and sieved. Next, 30 aliquots are collected to make up 10 grams for digestion/analyses. These steps are completed prior to the remainder of the sample being ground and prepared for explosives analysis by Method 8330B.

Worksheet 20 — Field Quality Control Sample Summary Table

Matrix	Analytical Group	Analytical and Preparation Method/ SOP Reference	No. of Sampling Locations	No. of Field Duplicate Pairs	No. of MS	No. of Field Blanks	No. of Equip. Blanks	No. of PT Samples	Total No. of Samples to Laboratory
Soil / Sediment	Explosives	SW-846 8330B (SOP A-1)	Unknown	1 per 20 samples	1 per 20 samples	1 per day	1 per day	0	Unknown
Soil / Sediment	Metals	SW-846 6010B (SOP A-2)	Unknown	1 per 20 samples	1 per 20 samples	1 per day	1 per day	0	Unknown
Soil / Sediment	Mercury	SW-846 7471A (SOP A-3)	Unknown	1 per 20 samples	1 per 20 samples	1 per day	1 per day	0	Unknown

Worksheet 21 — Project Sampling SOP References Table

The field sampling is being performed in accordance with WESTON SOPs provided in Appendix F of the Work Plan. Table 21-1 provides a list of applicable SOPs.

Table 21-1 List of Applicable SOPs

TLI SOP NO.	WESTON SOP NO.	TASK
GENERAL SOPs		
03-01-03 03-02-03	G-1	Field Documentation
	G-3	Field Sample Numbering
	G-4	Quality Assurance/Quality Control Sampling
02-03-02	G-6	Decontamination
02-04-02	G-7	Management of Investigation Derived Waste (IDW)
02-05-02	G-8	Sample Chain-of-Custody
04-01-01 04-02-01	G-9	Sample Packing and Shipping
	G-10	Surveying
15-01-00	G-11	MEC Anomaly Avoidance
MEDIA-SPECIFIC SOPs		
	Soil and Sediment	
	SS-2	Sediment Sampling
07-03-01	SS-3	Soil Sampling

Worksheet 22 — Field Sampling Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Activity	Maint. Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Resp. Person	SOP Reference
Innov-X XRF Analyzer	Equipment standardize-tion[1]	NA – If equipment maintenance is required, instrument will be returned to manufacturer	NIST Soil Standard[2]	The sampler will inspect the analyzer to ensure the sampling window is free of dirt and debris and that the analyzer is properly recording data	• Calibration will be performed each time the instrument is turned on. • Testing will occur at the beginning and ending of each day or any time the instrument is turned off for more than 30 minutes. • Inspection activities will be completed prior to each sample analysis	• Within calibration range as designated by manufac-turer • Within standard range as designated by manufac-turer • No evidence of dirt or debris and data properly recorded	• If the equipment is not properly calibrating, it must be returned to manufacturer for repair • Contact manufacturer technical support to determine required corrective action • If dirt or debris is present, clean the sampling window • If data is not properly recorded, Contact manufacturer technical support to determine required corrective action	Field Sampling Manager	TLI SOP 15-16-00

[1]A standardization clip is provided with the equipment
[2]A National Institute of Standards Soil Standard will be provided by the manufacturer

Worksheet 23 — Analytical SOP References Table

Reference Number	Title, Revision Date, and / or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
A-1	Nitroaromatics, Nitroamines, and Nitrate Esters by HPLC (SW-846 8330B) SOP No. BR-LC-003 Rev 15, 08/25/09	Definitive	Explosives	HPLC*	TestAmerica-Burlington	N
A-2	Metals by ICP-OES (SW-846 6010B) SOP NO. BR-ME-005, Rev 11, 03/05/10	Definitive	Metals	ICP+	TestAmerica-Burlington	N
A-3	Mercury by Cold Vapor Atomic Absorption (CVAA) (SW-846 7471A) SOP No. BR-ME-004, Rev 12, 03/05/10	Definitive	Mercury	Cold Vapor	TestAmerica-Burlington	N
A-4	Uniform Federal Policy for Quality Assurance Project Plans	Definitive	Various	N/A	TestAmerica-Burlington	N
A-5	Quality Assurance Manual No. BR-QAM, Rev. 2, 05/10/2010	Definitive	Various	Various	TestAmerica-Burlington	N

*High Performance Liquid Chromatography (HPLC)
+inductively coupled plasma (ICP)

Worksheet 24 — Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
HPLC	SW-846 8330B	Five-point calibration for all analytes prior to sample analysis	≤ 20% RSD	Instrument maintenance, standard, inspection, recalibration	Laboratory Analyst	SOP A-1
ICP	SW-846 6010B	Daily prior to sample analysis ICV daily after initial calibration	All analytes within ±10% of expected value	Instrument maintenance, standard, inspection, recalibration	Laboratory Analyst	SOP A-2
Cold Vapor	SW-846 7471A	Daily prior to sample analysis	Correlation Coefficient $R \geq 0.995$	Instrument maintenance, standard, inspection, recalibration	Laboratory Analyst	SOP A-3

Worksheet 25 — Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
HPLC	Change transfer lines, replace guard column, replace analytical column, replace or clean pump head check valves, change plunger seals, change suppressor, change eluent generator cartridge and CR-ATC	Check transfer lines, check guard and analytical columns, inspect pump head check valves and plunger seals, check suppressor, check eluent generator cartridge and CR-ATC	As required	Passing CCV	Perform maintenance, check standards, recalibrate	Laboratory Analyst	SOP A-5
ICP	Clean torch, replace torch, fill rinse vessel, fill is vessel, fill standards cup, empty waste vessel, clean cones, perform auto peak adjustment	Check peristaltic pump tubing, check rinse vessel, check is vessel, check waste vessel, check cones	Daily or as required	Passing calibration	Perform maintenance, check standards, recalibrate	Laboratory Analyst	SOP A-5
CVAA	Lubricate autosampler rods, clean autosampler, fill rinse vessel, fill stannous chloride, empty waste vessel	Check peristaltic pump tubing, check rinse vessel, check stannous chloride, check waste vessel	Daily or as required	Passing calibration	Perform maintenance, check standards, recalibrate	Laboratory Analyst	SOP A-5

Worksheet 26 — Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): TLI, Golden, CO
Sample Packaging (Personnel/Organization): TLI, Golden, CO
Coordination of Shipment (Personnel/Organization): TLI, Golden, CO
Type of Shipment/Carrier: Laboratory Courier/Federal Express –Priority Overnight
SAMPLE RECEIPT AND ANALYSIS, See Laboratory QAM, Appendix A
Sample Receipt (Personnel/Organization): Receiving Supervisor, TestAmerica, Burlington, VT
Sample Custody and Storage (Personnel/Organization): Sample Custodian, TestAmerica, Burlington, VT
Sample Preparation (Personnel/Organization): Organic and/or Inorganic Prep Supervisor, TestAmerica, Burlington, VT
Sample Determinative Analysis (Personnel/Organization): Organic and/or Inorganic Laboratory Analyst, TestAmerica, Burlington, VT
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample analysis): 60 days
Sample Extract/Digestate Storage (No. of days from extraction/digestion): 60 days
SAMPLE DISPOSAL
Personnel/Organization: TestAmerica, Burlington, VT
Number of Days from Analysis: >60 days

Worksheet 27 — Sample Custody Requirements

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to the laboratory):

To maintain a record of sample collection, transfer between personnel, shipment, and receipt by the laboratory, a COC record (Figure 27-1) will be completed for each sample shipment by the field team. The COC, which may be more than one page long, will list each sample in a shipping container (cooler). The COC will be placed in a resealable plastic bag and taped to the inside lid of the container. Each time the samples are transferred, the signatures of the persons relinquishing and receiving the samples, as well as the date and time of transfer, will be documented. The transfer from the field team to the shipper and from the shipper to the laboratory will be documented by the airbill instead of the COC. The laboratory is required to maintain a copy of the COC and airbill as part of the laboratory's project records.

COC seals (see Figure 27-2) are used to determine whether any tampering has occurred during transport of samples. These signed and dated seals will be fastened to the right and left sides of each shipping cooler by the person responsible for packaging for both on-site and off-site sample analyses. If the coolers are opened before receipt at the laboratory, the seals will not be intact.

WESTON expects to ship samples on the same day the samples are collected. When it is not possible to ship the samples on the day of collection, the field team will store the samples in refrigerators designated for sample storage at the site or in coolers. If the samples are stored in coolers and the sample preservation requirements include refrigeration, ice or the equivalent will be used to keep the samples cold. The coolers or refrigerators will be secured in either a locked room or compartment or otherwise sealed to prevent tampering until the samples are transferred to the shipping service. Specific details for field sample storage are discussed in Subsection 3.10.9.4 of the Work Plan.

Unless previous screening results, site knowledge, or other information indicate the samples are hazardous, all samples collected and shipped for analysis will be treated as environmental samples. Samples, whether classified as hazardous or as environmental samples, will be shipped in compliance with the applicable regulations. The United States Department of Transportation (DOT) and the International Air Transport Association (IATA) has established specific regulations governing the packaging of hazardous and environmental samples for shipment. These regulations include specifications for packing materials, shipping containers, and shipping labels. All samples will be shipped in accordance with these regulations based on the best available knowledge of the samples being collected. See Subsection 3.10.10 of the Work Plan.

Electronic Sample Tracking

The electronic sample tracking process is initiated with the receipt of the hard copy COC and the associated sample attribute forms. The field sample coordinator is responsible for emailing these documents to WESTON's Project Chemist at the end of each sampling day. The receipt date is stamped on these documents and an analytical batch file is created for storage of all hard copy documentation related to the specific batch. WESTON's data management sample coordinator compares the COC and the laboratory confirmation for discrepancies; any issues are documented and reconciled.

Sample Identification Procedures:

Samples collected at the site must be uniquely labeled with the Installation Identification, Site Identification, Sample Type, and Sequential Sample Number. An example of a sample number is WSTPT-004-SS-01. This identifies the sample as the first (01) soil sample (SS) take in the Battery Knox-TD Land MRS (004) at West Point (WSTPT). All samples will be identified with a label attached directly to the container (see Figure 27-3). Sample label information will be completed using waterproof black marker. The labels will contain the following information:

- Sample ID
- Time and date of collection
- Project Name
- Analysis Requested
- Preservative (if any)
- Sample source/location
- Sampler's initials

From a data management perspective, the key requirement for the field sample identifier is that it is a unique name. In addition, for sample tracking purposes, the identifier has implicit coding of sample information, including site, location ID, sample type, sample depth or date collected.

Laboratory Sample Custody Procedures (receipt of samples, archiving, and disposal):

The designated sample custodian(s) and staff are responsible for samples received at the laboratory. In addition to receiving samples, the sample receipt staff is also responsible for documentation of sample receipt and storage before and after sample analysis. Summaries of the minimal laboratory receipt procedures are:

- Upon receipt, sign, date, and document the time of sample receipt on the airbills or other shipping manifests received from the couriers.

- Sign the COC assuming custody of the samples. If a COC is not received with a set of samples, the laboratory will immediately notify the WESTON Project Manager.

- Inspect the sample cooler for integrity and then document the following information:

  - Type of courier and whether the samples were shipped or hand delivered (copies of the airbills are maintained).

  - Availability and condition of custody information.

  - Sample temperature ambient or chilled.

  - Actual temperature of the temperature blank.

  - Presence of leaking or broken containers and indication of sample preservation.

  - Verify the holding time is not exceeded. If a sample has exceeded holding time, then the WESTON Project Chemist will be notified.

  - Match the sample container information (e.g., sample tag/label), COC records, and all pertinent information associated with the sample. The sample custodian then verifies sample identity to ensure that all information is correct. Any inconsistencies are resolved with WESTON through the Laboratory Project Manager and corrective action measures are documented before sample analysis proceeds.

  - Samples submitted to off-site laboratories will be stored at 4 to 6°C for a minimum of 60 days following the completion of analyses and/or issue of final reports. Sample extracts and metals digestates will be stored for a period of 1 year following submittal of final reports. Laboratories are also responsible for the proper management and disposal of all sample residuals and extracts, following all applicable federal, state, and local laws; rules; and regulations.

Figure 27-1 Example Chain-of-Custody Record

Chain of Custody Record

WESTON SOLUTIONS
Restoring Resource Efficiency

Client ____________ Contact Name ____________
Site Name ____________ Contact Phone No. ____________
W.O. ____________ Turn-around-Time ____________
Laboratory ____________ Sampler ____________

Analysis Requested by Group by Container
(number listed for total containers per analysis group)
Preservative

Lab Batch Number:

Lab ID	Sample ID	Matrix QC MS	MSD	DUP	Total Num of Containers	Matrix	Date Collected	Sample Time	App.IX VOA	Total PCBs by Aroclors	Homologs	Congeners		Herbicide	Dioxin/Furan	Appx. IX Metals	CN	Sulfide	TOC	Grain Size	Method TO-4 (Air)				

Field Remarks/Comments

Lab Use Only

	Y	N
COC Tape was present on outer package	Y	N
COC Tape was unbroken on outer package	Y	N
COC Tape was present on sample	Y	N
COC Tape was unbroken on sample	Y	N
Received in good condition	Y	N
Labels Indicate Properly Preserved	Y	N
Received within Holding Time	Y	N

Temp of Cooler when Received, C°

1	2	3	4

Relinquished by	Received by	Date	Time	Relinquished by	Received by	Date	Time

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Figure 27-2 Chain-of-Custody Seal

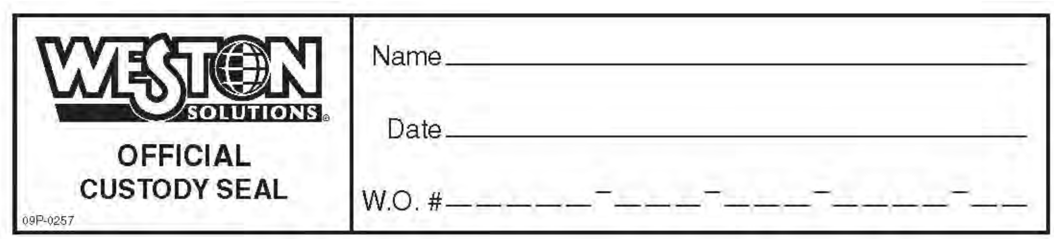

Figure 27-3 Jar/Bottle Label

PROJECT NAME	
SAMPLE ID	SAMPLE DATE
SAMPLED BY	SAMPLE TIME
PRESERVATIVE	____ GRAB ____ COMPOSITE
ANALYSIS REQUESTED	

Worksheet 28 — QC Samples Tables

Worksheet 28.1 – QC Samples Table – Explosives in Soil/Sediment

Matrix	Soil, Sediment
Analytical Group	Explosives
Concentration Level	Low
Sampling SOP	G-4
Analytical Method / SOP Reference	SW-846 8330B (SOP A-1)
Sampler's Name	TLI – TBD
Field Sampling Organization	TLI
Analytical Organization	TestAmerica, Burlington, VT
Number of Sample Locations	TBD

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Initial Calibration (ICAL)	Five-point calibration for all analytes prior to sample analysis	%RSD <20%, or Correlation coefficient R ≥0.995	Correct problem and repeat initial calibration.	Analyst	Laboratory Accuracy	%RSD <20%, or Correlation coefficient R≥0.995
Initial calibration verification (ICV)	1 per ICAL, analyzed after ICAL, before field samples	Percent Difference (%D) ≤20% (%D for 2,6-diamino-nitrotoluene; 2,4-diamino-nitrotoluene; and picric acid ≤30%)	Correct problem and verify second source standard. If that fails repeat calibration. NOTE: SW-846 Method 8330B allows continuation of analysis for analytes that fail criteria so long as these results are considered estimated.	Analyst	Laboratory Accuracy	%D ≤20% (%D for 2,6-diamino-nitrotoluene; 2,4-diamino-nitrotoluene; and picric acid ≤30%)

Worksheet 28.1 — QC Samples Table – Explosives in Soil/Sediment (Continued)

Continuing Calibration Verification (CCV)	After every 20 samples and at end of sequence	%D ≤20%	Re-analyze once, if still outside criteria perform corrective action, sequence can be re-started if two successive CCVs meet criteria otherwise repeat ICAL. The following exceptions apply: If the CCV is exceeded high and the associated samples are non-detects, the non-detects may be reported; if the CCV is exceeded low, sample results may be reported if the results exceed the maximum regulatory level.	Analyst	Laboratory Accuracy	%D ≤20%
Method Blank (MB)	1 per batch per matrix or 1 per 20 samples, whichever is more frequent	< ½ LOQ	Reprocess MB and associated samples if the target analyte or any common laboratory contaminant in the MB is greater than 1/10 the amount detected in any sample or 1/10 the regulatory limit, whichever is greater – otherwise data may be reported with appropriate data qualifiers. If insufficient sample to reprocess, report data with appropriate data qualifiers.	Analyst/Prep analyst	Absence of interference/ contamination	< ½ LOQ
Laboratory Control Sample (LCS)	1 per batch per matrix or 1 per 20 samples, whichever is more frequent	%Recovery = (Calculated Value/True Value) *100%[1] Evaluated against DoD Control Limits	Reprep and reanalyze samples for failed analytes. If reanalysis is not possible due to insufficient sample volume, report data with appropriate data qualifiers.	Analyst/Prep analyst	Laboratory Accuracy/Method bias in ideal matrix	%Recovery = (Calculated Value/True Value) *100%

Worksheet 28.1 — QC Samples Table – Explosives in Soil/Sediment (Continued)

Field Duplicate	1 per 20 field samples	All Target Compounds RPD <50% (soil/sediment)	If the criterion is not met for the field duplicates, a careful examination of the sampling techniques, sample media, and analytical procedure in conjunction with other analytical quality control criteria will be conducted to identify the cause of the high RPD and the usefulness of the data. If one of the duplicate pair is detected above the method LOQ and the remaining pair is non-detect, then the data will be qualified as estimated or rejected depending upon the severity (i.e. >2LOQ).	Field Personnel/ WESTON Chemist	Sampling Precision	All Target Compounds RPD<50% (soil/sediment)
Matrix Spike (MS)	One per extraction batch when sufficient sample volume is provided or as requested per client	%Recovery = (Calculated Value - Sample Value/True Value) *100%[1]	Evaluate to determine if there is a matrix effect or analytical error. If analytical error, reanalyze or reprocess as appropriate.	Analyst/Prep analyst	Precision and Accuracy in field samples	%Recovery = (Calculated Value - Sample Value/True Value) *100%

Worksheet 28.1 — QC Samples Table – Explosives in Soil/Sediment (Continued)

Matrix Spike Duplicates (MSD)	One per extraction batch when sufficient sample volume is provided or as requested per client	%Recovery = (Calculated Value – Sample Value/True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2[1]	Evaluate to determine if there is a matrix effect or analytical error. If analytical error, reanalyze or reprocess as appropriate.	Analyst/Prep analyst	Precision and Accuracy in field samples	%Recovery = (Calculated Value – Sample Value/True Value) *100%RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2
Surrogate Spikes	Every sample	%Recovery = (Calculated Value/True Value) *100%[1]	Reason for poor recoveries is investigated and eliminated before further analytical activities. Corrective actions are: 1. High bias, samples ND – report without qualification. 2. Low bias – re-extract and reanalyze. Insufficient volume – qualify and footnote	Analyst/Prep analyst	Individual sample preparation efficiency control	%Recovery = (Calculated Value/True Value) *100%
Cooler Temperature Blank	One per cooler	4±2°C	Notify WESTON Project Chemist. WESTON will evaluate effect on samples and indicate to laboratory whether to proceed with analysis. Resampling may be required.	Sample Custodian/WESTON Project Chemist	Accuracy in field samples	4±2°C

[1] *Acceptance criteria for surrogates, LCSs, MSs, and MSDs are included under the appropriate method in Worksheet 15.*

Worksheet 28.2 – QC Samples Table – Metals in Soil/Sediment

Matrix	Soil, Sediment
Analytical Group	Metals
Concentration Level	Low
Sampling SOP	G-4
Analytical Method / SOP Reference	SW-846 6010B (SOP A-2)
Sampler's Name	TLI – TBD
Field Sampling Organization	TLI
Analytical Organization	TestAmerica, Burlington, VT
Number of Sample Locations	TBD

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Blank	1 per 20 field samples or per day	All Target Compounds <LOQ	If the criterion is not met for the blanks, a careful examination of the sampling techniques, sample media, and analytical procedure in conjunction with other analytical quality control criteria will be conducted to identify the cause of the blank contamination and usefulness of the data. Data qualifiers will be applied as appropriate.	Field Personnel/ WESTON Chemist	Field Accuracy/Bias Contamination and Representativeness	All Target Compounds <LOQ

Worksheet 28.2 – QC Samples Table – Metals in Soil/Sediment (Continued)

Equipment Rinsate	1 per 20 samples	All Target Compounds <LOQ	If the criterion is not met for the blanks, a careful examination of the sampling techniques, sample media, and analytical procedure in conjunction with other analytical quality control criteria will be conducted to identify the cause of the blank contamination and usefulness of the data. Data qualifiers will be applied as appropriate.	Field Personnel/ WESTON Chemist	Field Accuracy/Bias Contamination and Representativeness	All Target Compounds <LOQ
Field Duplicate	1 per 20 samples	RPD of ±20%, if concentration is $\geq$ 5x LOQ; or ± the LOQ if the concentration is < 5x LOQ	If the criterion is not met for the field duplicates, a careful examination of the sampling techniques, sample media, and analytical procedure in conjunction with other analytical quality control criteria will be conducted to identify the cause of the high RPD and the usefulness of the data. If one of the duplicate pair is detected above the method LOQ and the remaining pair is nondetect, then the data will be qualified as estimated or rejected depending upon the severity (i.e. >2LOQ).	Field Personnel/ WESTON Chemist	Sampling Precision	All Target Compounds RPD ≤50% (soil/sediment)
Initial Calibration	Daily prior to sample analysis	%RSD <5%, or Correlation coefficient R>0.995	If the acceptance criteria were not met, re-calibration is performed before any samples may be analyzed	Analyst	Laboratory Accuracy	%RSD <5%, or Correlation coefficient R>0.995
Initial Calibration Verification	Daily after initial calibration	%D ≤10%	If the acceptance criteria were not met, re-calibration is performed before any samples may be analyzed.	Analyst	Laboratory Accuracy	%D <10%

Worksheet 28.2 – QC Samples Table – Metals in Soil/Sediment (Continued)

CCV	At beginning of analytical sequence, after every 10 samples and at the end of the analysis sequence	%D ≤10%	If the criterion has not achieved corrective action, re-calibration is performed before any samples may be analyzed. Corrective action may include reanalysis of the samples.	Analyst	Laboratory Accuracy	%D <10%
MB	1 per batch per matrix or 1 per 20 samples, whichever is more frequent	No analytes ≥ LOQ	The source of the contamination is investigated and eliminated before proceeding with further analysis. Corrective actions are: 1. Samples ND – report without qualification 2. Samples >10X contamination level – report with qualification 3. Samples <10x contamination – re-extract and reanalyze. Insufficient sample -qualify and footnote	Analyst/Prep analyst	Absence of interference/ contamination	<LOQ
LCS	1 per batch per matrix or 1 per 20 samples, whichever is more frequent	%Recovery = 80-120% (Calculated Value/True Value) *100%[1]	Source of poor recovery is investigated and eliminated before proceeding with further analysis, corrective actions are: 1. Biased high, samples ND – report without qualifications. 2. Biased low – re-extract and reanalyze. Insufficient volume – qualify and footnote	Analyst/Prep analyst	Laboratory Accuracy/Method bias in ideal matrix	%Recovery = 80-120% (Calculated Value/True Value) *100%[1]

Worksheet 28.2 – QC Samples Table – Metals in Soil/Sediment (Continued)

MS	1 per 20 samples	%Recovery = 80-120% (Calculated Value - Sample Value/True Value) *100%[1]	If the recoveries indicate that the problem is procedure related, re-extraction and reanalysis is required. If the recoveries indicate that the failures are matrix-related, refer to Blank Spike as measure of method performance in clean matrix. The WESTON Project Chemist will be contacted and a decision will be made to either report the data as is with a notation in the analytical narrative or if the samples should be re-extract and reanalyzed.	Analyst/Prep analyst	Precision and Accuracy in field samples	%Recovery = 80-120% (Calculated Value Sample Value/True Value) *100%[1]
Lab Duplicate	1 per 20 samples	All Target Compounds RPD of ±20%, if concentration is $\geq$ 5x LOQ; or ± the LOQ if the concentration is < 5x LOQ	If the criterion is not met for the lab dup, the sample set should be reanalyzed. The analytical QC results should be evaluated and entire batch re-digested if necessary.	Analyst/Prep analyst	Precision in field samples	All Target Compounds RPD <20.
Cooler Temperature Blank	One per cooler	4±2°C	Notify WESTON Project Chemist. WESTON will evaluate effect on samples and indicate to laboratory whether to proceed with analysis. Resampling may be required.	Sample Custodian/ WESTON Project Chemist	Accuracy in field samples	4±2°C

[1] *Acceptance criteria for LCSs, MSs, and MSDs are included under the appropriate method in Worksheet 15.*

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Worksheet 28.3 – QC Samples Table – Mercury in Soil/Sediment

Matrix	Soil, Sediment
Analytical Group	Mercury
Concentration Level	Low
Sampling SOP	G-4
Analytical Method / SOP Reference	SW-846 7471A (SOP A-3)
Sampler's Name	TLI – TBD
Field Sampling Organization	TLI
Analytical Organization	TestAmerica, Burlington, VT
Number of Sample Locations	TBD

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
ICAL	Daily prior to sample analysis	Correlation coefficient R ≥ 0.995	Correct problem, repeat calibration	Analyst	Laboratory Accuracy	Correlation coefficient R ≥ 0.995
ICV	Once after each initial calibration	%D ≤10%	Correct problem and verify second source standard. If that fails, repeat calibration.	Analyst	Laboratory Accuracy	%D ≤10%
CCV	Daily, after every 10 samples, and at end of the analysis sequence	%D ≤20%	Correct problem, reanalyze CCV. If that fails, repeat calibration and reanalyze all samples since last successful calibration.	Analyst	Laboratory Accuracy	%D ≤20%
MB	1 per batch per matrix or 1 per 20 samples, whichever is more frequent	No analytes ≥ LOQ	Correct problem, redigest and reanalyze MB and associated samples.	Analyst/Prep analyst	Absence of interference/ contamination	<LOQ
LCS	1 per batch per matrix or 1 per 20 samples, whichever is more frequent	%Recovery = 85-115% (Calculated Value/True Value) *100%[1]	Correct problem, redigest and reanalyze LCS, MB and associated samples for failed analytes if sufficient sample volume is available.	Analyst/Prep analyst	Laboratory Accuracy/Method bias in ideal matrix	%Recovery = 85-115% (Calculated Value/True Value) *100%

Worksheet 28.3 – QC Samples Table – Mercury in Soil/Sediment (Continued)

Field Duplicate	1 per 20 samples	All Target Compounds RPD <50% (soil/sediment)	If the criterion is not met for the field duplicates, a careful examination of the sampling techniques, sample media, and analytical procedure in conjunction with other analytical quality control criteria will be conducted to identify the cause of the high RPD and usefulness of the data. If one of the duplicate pair is detected above the LOQ and the remaining pair is nondetect, then the data will be qualified as estimated or rejected depending upon the severity (i.e. >2LOQ).	Field Personnel/ WESTON Chemist	Sampling Precision	All Target Compounds RPD <50% (soil/sediment)
MS	1 per 20 samples or one for each extraction batch	%Recovery = (Calculated Value - Sample Value/True Value) *100%[1]	Examine project DQO's with Project Manager. Evaluate data to determine if outage is related to analytical error or matrix effect	Analyst/Prep analyst	Precision and Accuracy in field samples	%Recovery = (Calculated Value – Sample Value/True Value) *100%
Lab Duplicate	1 per 20 samples or one for each extraction batch	RPD $\leq$ 20%	Examine project DQO's with Project Manager. Evaluate data to determine source of difference between results.	Analyst/Prep analyst	Precision and Accuracy in field samples	RPD $\leq$ 20%
Cooler Temperature Blank	One per cooler	4±2°C	Notify WESTON Project Chemist. WESTON will evaluate effect on samples and indicate to laboratory whether to proceed with analysis. Resampling may be required.	Sample Custodian/ WESTON Project Chemist	Accuracy in field samples	4±2°C

[1] *Acceptance criteria for LCSs, MSs, and MSDs are included under the appropriate method in Worksheet 15.*

Worksheet 29 — Project Documents and Records Table

Sample Collection Documents and Records	On-Site Analysis Documents and Records	Off-Site Analysis Documents and Records	Data Assessment Documents and Records
▪ Field Notebooks ▪ DQCR ▪ Site Maps ▪ Chain-of-Custody Records ▪ Custody Seals ▪ Air Bills	▪ Daily observations and notes, personnel on site, samples collected, date, time, tailgate safety meeting items, unusual incidents/events, etc. ▪ Documenting sample points, notations of true site conditions ▪ Soil lithology, sample depth, sample numbers, nos. of containers, requested analyses, preservation. ▪ Field surveys	▪ COC Forms ▪ Sample Receipt, Sample Condition, Custody, and Internal Tracking Records ▪ Laboratory Information Management System (LIMS) login ▪ Run logs – sample chronology ▪ Standard traceability logs ▪ Calibration logs ▪ Non-conformance records ▪ Communications logbooks ▪ QC Sample identification (blanks, replicates, duplicates, LCS, MS/MSD) ▪ Laboratory data qualifiers ▪ Instrument calibration logs ▪ Instrument maintenance logs ▪ Electronic data deliverables ▪ Case narrative ▪ Laboratory sample identification ▪ Reporting forms ▪ QA/QC forms ▪ LOD/LOQ Studies ▪ Laboratory Accreditation Certificates ▪ QAM ▪ Analytical SOPs ▪ Sample disposal records	▪ QAM ▪ Laboratory Accreditation Certificates ▪ Communication logbooks ▪ EDDs with site-specific goals evaluation ▪ PDF of Final Laboratory Technical Report ▪ Weekly health and safety communications ▪ Safety audit checklists ▪ Validation reports on applicable samples

Worksheet 30 — Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Locations/ ID Number	Analytical SOP+	Data Package Turnaround Time	Laboratory/Organization (name and address, contact person and telephone number)	Backup Laboratory/ Organization (name and address, contact person and telephone number)
Soil, Sediment	Explosives 8330B	Low	TBD	SW-846 8330B SOP A-1	Level IV 21 calendar days	TestAmerica Laboratories, Inc. 30 Community Drive Suite 11 South Burlington, VT 05403 (office) 802-660-1990 (fax) 802-660-1919	TestAmerica National Network
	ICP Metals 6010B	Low		SW-846 6010B SOP A-2			
	Mercury 7471A	Low		SW-846 7471A SOP A-3			

+ See Worksheet 19 for complete list of applicable methods for preparation, cleanup and analysis.

Worksheet 31 — Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CA) (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (title and organizational affiliation)
Review of QAPP, SOPs and DCQR with Field Staff	1/prior to sampling start up	Internal	TLI	Mary Franquemont Technical Team Lead TLI	John Gerhard Project Manager WESTON	Mary Franquemont Technical Team Lead TLI	John Gerhard Project Manager WESTON
Daily Logbook and Field Forms	Daily	Internal	WESTON	Mary Franquemont Technical Team Lead TLI	John Gerhard Project Manager WESTON	John Gerhard Project Manager WESTON	John Gerhard Project Manager WESTON
Laboratory Assessment for appropriate Certifications, Capacity and QAPP Review with Staff	1/prior to sampling start up	Internal	WESTON	Kelly Spittler Project Chemist WESTON	Joseph Carabillo Project Manager TestAmerica	Joseph Carabillo Project Manager TestAmerica	Kelly Spittler Project Chemist WESTON
Daily Tailgate Safety Meeting	Daily	Internal	WESTON	Mary Franquemont Technical Team Lead TLI	John Gerhard Project Manager WESTON	Mary Franquemont Technical Team Lead TLI	John Gerhard Technical Manager WESTON
Field Sampling and Chain-of-Custody Review Against QAPP Requirements	Daily	Internal	WESTON	Kelly Spittler Project Chemist WESTON	John Gerhard Project Manager WESTON Mary Franquemont Technical Team Lead TLI	Mary Franquemont Technical Team Lead TLI	Kelly Spittler Project Chemist WESTON
Laboratory Report Deliverables and Analytical Results Against QAPP Requirements	Per Sample Delivery Group	Internal	WESTON	Kelly Spittler Project Chemist WESTON	Joseph Carabillo Project Manager TestAmerica	Joseph Carabillo Project Manager TestAmerica	Kelly Spittler Project Chemist WESTON
Validation	Per Sample Delivery Group	Internal	MCGI	Sherif Mina Data Validator MCGI	Kristen McCracken QA Manager TestAmerica	Kristen McCracken QA Manager TestAmerica	Sherif Mina Data Validator MCGI

Worksheet 32 — Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (name, title, organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (name, title, organization)	Timeframe for Response
Review of QAPP with Field Staff	Contained with written report Daily QC Report for that day.	John Gerhard Project Manager, WESTON Mary Franquemont Technical Team Lead TLI	Immediately not to exceed with 24 hours.	Daily QC Report would be amended with corrective action.	Kelly Spittler Project Chemist WESTON	Immediate within 24 hours.
Laboratory Assessment for appropriate Certifications, Capacity and QAPP Review with Staff	Receipt of copies of certifications. Email traffic concerning lab capacity prior to sampling start-up. QAPP Sign-off sheet received from laboratory.	John Gerhard Project Manager, WESTON	Immediate.	Response to email.	John Gerhard Program Manager, WESTON Kelly Spittler Project Chemist WESTON	48 hours after notification.
Daily Safety Meeting	Verbal debriefing and daily sign off log. If a safety violation occurs, a Supervisor Injury Employee Report is completed.	John Gerhard Project Manager, WESTON Mary Franquemont Technical Team Lead TLI	Immediately not to exceed 24 hours.	Included as part of the process of the Supervisor Injury Employee Report.	John Gerhard Project Manager, WESTON	Immediate within 24 hours.

Worksheet 32 — Assessment Findings and Corrective Action Responses (Continued)

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (name, title, organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (name, title, organization)	Timeframe for Response
Daily Field Reporting and Field Forms	Contained with written report.	John Gerhard Project Manager, WESTON Mary Franquemont Technical Team Lead TLI	Immediately not to exceed 24 hours.	Daily QC Report would be amended with corrective action.	John Gerhard Project Manager, WESTON	Immediate within 24 hours.
Field Sampling and Chain-of-Custody Review Against QAPP Requirements	Communication may be in the form of email traffic	John Gerhard Project Manager, WESTON Mary Franquemont Technical Team Lead TLI	24 hours after sampling.	Response to email.	John Gerhard Program Manager, WESTON Kelly Spittler Project Chemist WESTON	48 hours after notification.
Laboratory Report Deliverables and Analytical Results Against QAPP Requirements	Communication may be in the form of email traffic	John Gerhard Program Manager, WESTON Kelly Spittler Project Chemist WESTON	24 hours after completion of analytical.	If required laboratory reports will be amended and corrections noted in the analytical narrative.	John Gerhard Program Manager, WESTON Kelly Spittler Project Chemist WESTON	72 hours after notification.
Data Verification	Communication may be in the form of email traffic requesting additional laboratory forms, back up data that may be missing and or clarification of the analytical report.	Kristen McCracken QA Manager, TestAmerica	24 hours after finding deficiency.	If required laboratory reports will be amended and corrections noted in the analytical narrative and contained with the validation report.	Kelly Spittler Project Chemist, WESTON	Up to 7 days.

Worksheet 32 — Assessment Findings and Corrective Action Responses (Continued)

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (name, title, organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (name, title, organization)	Timeframe for Response
Validation	Communication may be in the form of Email traffic requesting additional laboratory forms, back up data that may be missing and or clarification of the analytical report.	Joseph Carabillo Project Manager, TestAmerica	24 hours after finding deficiency.	If required laboratory reports will be amended and corrections noted in the analytical narrative and contained with the validation report.	Kelly Spittler Project Chemist, WESTON Sherif Mina Data Validator, MCGI	Up to 7 days.

Worksheet 33 — QA Management Reports Table

Type of Report	**Frequency** (daily, weekly monthly, quarterly, annually, etc.)	**Projected Delivery Date(s)**	**Person(s) Responsible for Report Preparation** (title and organizational affiliation)	**Report Recipient(s)** (title and organizational affiliation)
Progress Reports	Monthly Progress Reports	Monthly after project start up	John Gerhard Project Manager WESTON	Brooke Conway Design Team Leader USACE-Baltimore Jeff Sanborn MMRP Project Manager West Point
Validation Report	For each round of soil/sediment or other media sampling	30 days after completion of analytical data	Sherif Mina – Data Validator, MCGI	Kelly Spittler Project Chemist WESTON
Final Report	Completed as Draft, Draft Final, and Final RI Report		John Gerhard Project Manager, WESTON	Brooke Conway Design Team Leader USACE-Baltimore Jeff Sanborn MMRP Project Manager West Point

Worksheet 34 – Sampling and Analysis Verification (Step I) Process Table

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
Field Staff Training	Personnel assigned to the project, including field personnel and subcontractors, will be qualified to perform the tasks to which they are assigned. Field personnel will have basic field investigation knowledge for multimedia sampling. This includes but is not limited to basic sampling techniques, field testing methodology, monitoring wells installation, task-specific sampling methods, decontamination of field sampling equipment, maintenance of environmental paperwork, and how to avoid cross contamination. In addition to education and experience, specific training may be required to qualify individuals to perform certain activities. Training will be documented appropriately and the forms placed in the project file as a record. Project personnel will receive an orientation to the Work Plan and the Accident Prevention Plan as appropriate to their responsibilities before participation in project activities. Training of field personnel will be provided by the Site Supervisor, the QA Officer, or by a qualified designee.	Internal	John Gerhard, WESTON Kelly Spittler, WESTON Mary Franquemont, TLI
QAPP	A copy of the reviewed and approved version of the QAPP will be distributed to the laboratory and be available for review for all WESTON/personnel involved in this project. It is the responsibility of the WESTON Project Chemist to ensure delivery of a copy of QAPP to the laboratory. The laboratory QA manager is responsible for review of QAPP with laboratory staff. The WESTON project manager and Technical Manager will be responsible for ensuring that all staff has reviewed the final QAPP.	Internal / External	John Gerhard, WESTON Kelly Spittler, WESTON Mary Franquemont, TLI Joseph Carabillo, TestAmerica, Burlington, VT Kristen McCracken (QA Manager), TestAmerica, Burlington, VT
Laboratory QAM	TestAmerica has a detailed Quality Manual, Rev. 2, dated 05/10/2010, that is designed to meet the quality program requirements of National Environmental Laboratory Accreditation Conference (NELAC) and ISO Guide 25. This Quality Manual is included in Attachment B. TestAmerica is both NELAC and DoD Environmental Laboratory Accreditation Program (ELAP) certified.	Internal / External	Kelly Spittler, WESTON Joseph Carabillo, TestAmerica, Burlington, VT Kristen McCracken (QA Manager), TestAmerica, Burlington, VT

Worksheet 34 – Sampling and Analysis Verification (Step I) Process Table (Continued)

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
Laboratory Staff Training	Laboratory senior management staff retains oversight responsibility for the data integrity program and retains the ultimate responsibility for execution of the data integrity program elements. Senior laboratory management staff is responsible for providing the resources required to conduct SOPs, ethics training, and operate data integrity evaluation procedures. Laboratory employees receive technical ethics training during new employee orientation. All employees are required to attend ethics refresher training and to sign an ethical conduct agreement annually, which verifies their understanding of the laboratories ethics policy and the analyst's ethical responsibilities. Training on data integrity procedures and SOPs are conducted by the individual departments' group leaders within the laboratory. All records of training are retained at the laboratory in the individual staff training folders and are maintained by the laboratory quality assurance officer. All information related to staff qualifications, experience, external training courses, and education are placed into the individuals training file. Verification documentation for laboratory orientation, health and safety, and quality assurance training is also maintained with the training file. Additional training documentation is added to the files as it occurs. This includes data for initial and continuing demonstrations of proficiency, performance evaluations, study data and notes, and attendance lists from individual and group training sessions.	Internal	Organic and Inorganic Worksheet Managers* Joseph Carabillo, TestAmerica, Burlington, VT Kristen McCracken (QA Manager), TestAmerica, Burlington, VT
Laboratory Certifications	TestAmerica has current National Environmental Laboratories Accreditation Conference NELAC and DoD ELAP certifications.	Internal / External	Joseph Carabillo, TestAmerica, Burlington, VT Kelly Spittler, WESTON
Field Logbooks	The sample number will be traceable to the site, location, and depth (where applicable). The sample identification and description will be recorded by the Task Order Manager or representative in the sample collection logs. Task Order Manager will perform daily reviews of field log books each day of sampling.	Internal	John Gerhard, WESTON Mary Franquemont, TLI
Sample Location Verification	The Task Order Manager will verify that the sample technicians have collected the samples from the proper locations and depths as described in Worksheet 18.	Internal	John Gerhard, WESTON Mary Franquemont, TLI

Worksheet 34 – Sampling and Analysis Verification (Step I) Process Table (Continued)

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
Chain-of-Custody – Field Level	WESTON sample coordinator will generate COCs forms prior to field sampling in accordance to the sample matrices and analytical tests required as described in Worksheet 19. Upon, completion of the COCs forms by the field technicians and prior to placement in the cooler the Task Order Manager will review the COCs against the field logbooks, Worksheet 18 and Worksheet 19 to insure that the samples, sample volumes, and sample nomenclature match the COC forms and the required analytical tests have been notated. A review of the COC form for completeness will also be conducted.	Internal	John Gerhard, WESTON Mary Franquemont, TLI
Chain-of-Custody – WESTON Project Chemist	Upon, completion of the COC the field technician will either fax or email the completed COC form to the WESTON Project Chemist. A review of the COC form against Worksheet 18 and Worksheet 19 will be conducted to ensure proper analytical test	Internal	Kelly Spittler, WESTON
Chain-of-Custody – Analytical Laboratory	All samples to be analyzed by the fixed-base laboratory will be shipped via overnight courier service. Upon receipt, a representative of the laboratory shall check the integrity of the custody seals, then locate, sign, and date the COC. The laboratory is responsible for verifying that the COC and containers are in agreement. The COC, a Cooler Receipt Form, and information regarding any discrepancies between the COC and bottle labels will be faxed to the Project Chemist prior to preparation for analysis. The Laboratory Information Management System will provide evidence of sample custody from receipt by the laboratory until appropriate disposal.	Internal	TestAmerica Sample Management Technicians*
LIMs Login – Analytical Laboratory	A review of the COC form against the laboratory LIMs login and the project analytical requirement as contained within Worksheet 19 will be conducted to ensure proper analytical tests have been assigned and a review of the login for correctness will be conducted.	Internal	Joseph Carabillo, TestAmerica, Burlington, VT
LIMs Login –WESTON Project Chemist	A secondary review of the COC form against the laboratory LIMs login and the project analytical requirement as contained within Worksheet 19 will be conducted to ensure proper analytical tests have been assigned and a review of the login for correctness will be conducted.	External	Kelly Spittler, WESTON
Sample Receipt Form – WESTON Project Chemist	TestAmerica will provide within 48 hours of receipt of samples a copy of the sample receipt form, any discrepancies between the COC and the sample containers will be noted and contained as part of the analytical record.	External	Kelly Spittler, WESTON

Worksheet 34 – Sampling and Analysis Verification (Step I) Process Table (Continued)

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
Laboratory Corrective Action and Report Procedure	Routine corrective action is defined as procedures used to return out of control analytical systems back to control. This level of corrective action applies to all analytical quality control parameters and analytical system specification as defined in the laboratory SOPs. Bench analysts have full responsibility and authority for performing routine corrective action. Routine corrective actions are documented as part of the analytical record. Defective processes, holding time violations, systematic errors and quality defects that occur are to be reported by the bench chemist immediately to the Worksheet supervisor and a non-conformance record initiated. The Worksheet supervisor will notify the designated Laboratory Project Manager (Joseph Carabillo) who will then notify the WESTON Project Chemist (Kelly Spittler). All notifications must be made in a timely manner. The non-conformance record should become part of the analytical record.	Internal / External	Joseph Carabillo, TestAmerica, Burlington, VT Kelly Spittler, WESTON
Analytical Data Package – Laboratory	All data produced by the laboratory will be required to undergo several levels of review, which will include two levels of management review at the laboratory. The laboratory will review the data packages internally for completeness and verify that all of the required forms and raw data are included for each data package type. Random data packages may be chosen by the TestAmerica, QA Officer for additional audits.	Internal	Joseph Carabillo, TestAmerica, Burlington, VT
Analytical Data Package / Laboratory Quality Control – WESTON Project Chemist	The WESTON Project Chemist will verify that data has been received for all samples that have been sent to the laboratory. An evaluation of this data will be performed to determine whether the laboratory met the QC requirements for the analytical as stated in the analytical methods and laboratory SOPs. Refer to Worksheets 19 and 28.	External	Kelly Spittler, WESTON
Laboratory Electronic Data Deliverables	The laboratory will provide an electronic data deliverables in ASCII text format that has been generated by the laboratory LIMs system. The WESTON Project Chemist will review these files for correctness and completeness. Project specific action goals as defined in Worksheet 15 will be added and evaluated. Any quality control issues that may impact the data use will be evaluated. The project manager and site manager will be notified immediately of any samples that exceed the project action goals.	External	Kelly Spittler, WESTON

* Refer to the Laboratory QAM in Attachment B.

Worksheet 35 — Sampling and Analysis Validation (Steps IIa and IIb) Process Table

Step IIa / IIb	Validation Input	Description	Responsible for Validation (name, organization)
IIa	Field Sampling	Ensure that all sampling protocols were followed according to the SOPs attached.	John Gerhard, WESTON Mary Franquemont, TLI
IIa	Analytical SOPs	Ensure that all laboratory analytical SOPs were followed.	Joseph Carabillo, TestAmerica, Burlington, VT
IIa	Documentation of Method QC Results	Establish that all method quality control were analyzed for and in control as listed in the analytical SOPS. If method QA was not in control, the laboratory will have contacted WESTON of non-conformant situation prior to report generation for guidance.	Kelly Spittler, WESTON
IIa/IIb	Documentation of QAPP QC Samples Results	Establish that all QAPP required QC samples were collected. Establish that the collected QC samples met the required limits as established in the QAPP.	John Gerhard, WESTON Kelly Spittler, WESTON
IIa/IIb	Documentation of Analytical Reports for Completeness	Ensure that from the COC generated in the field to the delivery of the analytical data that the appropriate analytical samples have been collected, appropriate site identifications have been used, and the correct analytical methods have been applied. Review the analytical reports to establish that all required forms, case narratives, samples, COCs, logbooks, and raw data have been included.	Kelly Spittler, WESTON Mary Franquemont, TLI
IIb	Project Quantitation Limits	Review laboratory analytical results to ensure they met the project quantitation limits specified in QAPP worksheet 15.	Kelly Spittler, WESTON
IIa/IIb	Project Action Limits	Review and add project action limits to the laboratory electronic data deliverable. Flag samples and notify project manager of samples that exceed the project action limits.	Kelly Spittler, WESTON
IIa/IIb	Data Verification	Perform data verification on all samples to ensure that sample analysis was performed as stated in the QAPP and per the laboratory SOPs.	Kelly Spittler, WESTON
IIa/IIb	Data Validation	Perform data validation on all samples. Project Validation Criteria as per QAPP worksheets 12, 15, 19, and 28 and cited EPA SW-846 methodology. Validation Qualifiers applied as Manual Level M3 for organic compounds and Manual Level IM2 for inorganic compounds following the most recent version of the EPA Region III *Modifications to the National Functional Guidelines* for organic and inorganic data review, and the EPA Region III *Innovative Approaches to Data.* Methods for which no data validation guidelines exist will be validated following the *National Functional Guidelines* deemed most appropriate by the data validator. The data validator will receive all laboratory packages and analytical results electronically. Additionally, the validator will be required to submit final validation reports via pdf format and must provide an annotated laboratory analytical result EDD with applicable data validation qualifiers and/or result value modifications.	Sherif Mina, MCGI, Data Validator**

Worksheet 36 — Sampling and Analysis Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Validation Level	Validation Criteria	**Data Validator** (title and organizational affiliation)
IIa/IIb	Soil Sediment	Explosives SW8330B ICP Metals SW6010B	Tier IV	Project Validation Criteria as per QAPP worksheets 12, 15, 19, 28, 37 and cited EPA SW-846 methodology. Validation Qualifiers applied as per Manual Level M3 for organic compounds and Manual Level IM2 for inorganic compounds following the most recent version of the EPA Region III *Modifications to the National Functional Guidelines* for organic and inorganic data review, and the EPA Region III *Innovative Approaches to Data Validation*. Methods for which no data validation guidelines exist will be validated following the *National Functional Guidelines* deemed most appropriate by the data validator.	Sherif Mina, MCGI Validator*

*Meridian Consultant Group, Inc. (MCGI), 1997 Annapolis Exchange Parkway, Suite 300, Annapolis, MD 21401.

Worksheet 37 — Data Usability Assessment

Based on the current oversight responsibilities and limited analytical scope, this data usability assessment worksheet outlines the approach that will be taken as the analytical scope expands during the contract period of performance.

DQIs, such as precision, accuracy, completeness, representativeness, and comparability measurements, aid in the evaluation process and are discussed below.

Precision

The most commonly used estimates of precision are the RPD for cases in which only two measurements are available, and the %RSD when three or more measurements are available. This is especially useful in normalizing environmental measurements to determine acceptability ranges for precision because it effectively corrects for the wide variability in sample analyte concentration indigenous to samples.

Precision is represented as the RPD between measurement of an analyte in duplicate samples or in duplicate spikes. RPD is defined as follows:

$$\mathrm{RPD} = \frac{|C_1 - C_2|}{\frac{C_1 + C_2}{2}} \times 100$$

Where:
C_1 = First measurement value
C_2 = Second measurement value

The % RSD is calculated by the standard deviation of the analytical results of the replicate determinations relative to the average of those results for a given analyte. This method of precision measurement can be expressed by the formula:

$$\%\mathrm{RSD} = \frac{\sqrt{\sum_{I-1}^{N}\left(\frac{\mathrm{RF_i} - \mathrm{RF}}{\mathrm{N-1}}\right)}}{\mathrm{RF}} \times 100$$

Where:
RF = Response factor
N = Number of measurements

Precision control limits for evaluation of sample results are established by the analysis of control samples. The control samples can be method blanks fortified with surrogates (e.g., for organics), or LCS purchased commercially or prepared at the laboratory. The LCS is typically identified as blank spikes (BS) for organic analyses.

For multi-analyte methods, the LCS or BS may contain only a representative number of target analytes rather than the full list.

The RPD for duplicate investigative sample analysis provides a tool for evaluating how well the method performed for the respective matrix.

Accuracy/Bias

Accuracy control limits are established by the analysis of control samples, which are water and/or solid/waste matrices.

For organic analyses, the LCS may be a surrogate compound in the blank or a select number of target analytes in the blank spike. The LCS is subjected to all sample preparation steps. When available, a solid LCS may be analyzed to demonstrate control of the analysis for soil. The amount of each analyte recovered in an LCS analysis is recorded and entered into a database to generate statistical control limits. These empirical data are compared with available method reference criteria and available databases to establish control criteria.

The % R for spiked investigative sample analysis (e.g., matrix spike) provides a tool for evaluating how well the method worked for the respective matrix. These values are used by the client to assess a reported result within the context of the project data quality objectives. For results that are outside control limits provided as requirements in the QAPP, corrective action appropriate to the project will be taken and the deviation will be noted in the case narrative accompanying the sample results. Percent recovery is defined as follows:

$$\%\,\text{Recovery} = \frac{(A_T - A_0)}{A_F}\ x\,100$$

Where:

A_T = Total amount recovered in fortified sample
A_0 = Amount recovered in unfortified sample
A_F = Amount added to sample

Accuracy for some procedures is evaluated as the degree of agreement between a new set of results and a historical database or a table of acceptable criteria for a given parameter. This is measured as %D from the reference value, and is primarily used by the laboratory as a means for documenting acceptability of continuing calibration.

The %D is calculated by expressing, as a percentage, the difference between the original value and new value relative to the original value. This method for precision measurement can be expressed by the formula:

$$\%\,D = \frac{C_1 - C_2}{C_1}\ x\,100$$

Where:

C_1 = Concentration of analyte in the initial aliquot of the sample.
C_2 = Concentration of analyte in replicate.

Completeness

Project-specific completeness goals account for all aspects of sample handling, from collection through data reporting. The level of completeness can be affected by loss or breakage of samples during transport, as well as external problems that prohibit collection of the sample. The following calculation is used for determining the percent complete:

$$\text{Completeness} = \frac{A}{B} \times 100$$

Where:
A = Number of usable data points.
B = Total number of data points collected.

The formula for sampling completeness is:

$$\text{Sampling Completeness} = \frac{\text{Number of locations sampled}}{\text{Number of planned sample locations}} \times 100$$

An example formula for analytical completeness is:

$$\text{VOC Analytical Completeness} = \frac{\text{Number of Usable Data Points}}{\text{Expected Number of Usable Data Points}} \times 100$$

The ability to meet or exceed completeness objectives is dependent on the nature of samples submitted for analysis.

The following table lists the completeness goals for this program. If the completeness goal is not met because of controllable circumstances, then the samples will be recollected and reanalyzed, as necessary, to meet the completeness objective. If the completeness goal is not met because of uncontrollable circumstances, such as inaccessible sample points, matrix interferences, etc., then the deficiency will be evaluated.

Project Completeness Goals

Task	Subtask	Completeness Goal
Sampling	Sample Collection	95%
Analytical Measurements	All Laboratory Analyses	95% of collected analytes
		80% of each target analyte

Representativeness

Data representativeness for this project is accomplished by implementing approved sampling procedures and analytical methods that are appropriate for the intended data uses, and which are established within this QAPP.

Comparability

Comparability of data sets generated for this project will be obtained through the implementation of standard sampling and analysis procedures, by the use of traceable reference materials for laboratory standards, and by expressing the results in comparable concentration units.

Sensitivity/Selectivity

Sensitivity is the ability of the method or acceptable sensitivity instrument to detect the contaminant of concern and other target compounds at the level of interest. Quantitative measurement performance criteria need to be determined for acceptable sensitivity to ensure that the quantitation limits can be routinely achieved for each matrix, analytical parameter, and concentration level.

Quantitative measurement performance criteria need to be determined for acceptable sensitivity to ensure that the quantitation limits can be routinely achieved for each matrix, analytical parameter, and concentration level. The use of standards and instrument calibration will enable the instrument to identify and differentiate between various compounds/analytes of interest and interferences.

Assessment of Data Usability

Assessment of the data usability is an important component and will be performed as a preliminary step of the data interpretation phase.

In addition, data assessment is considered the final step in the data evaluation process and can be performed only on data of known and documented quality. As described in Worksheet 36, data generated for this project will undergo a formalized evaluation/validation process, following EPA Region 3 protocol. For this project, all data will be assessed for usability, regardless of the data evaluation/validation process implemented. As mentioned previously, data usability goes beyond validation in that it evaluates the achievement of the DQOs based on the comparison of the project DQIs and individual study-specific work plans, with the obtained results. The results of the data usability assessment, and particularly any changes to the DQOs necessitated by the data not meeting usability criteria, will be included in each final report.

Primarily, the assessment of the usability will follow procedures described in appropriate EPA guidance documents, particularly *Guidance for Data Useability in Risk Assessment* (Publication No. 9285.7-05FS, September 1992), and will be conducted according to the process outlined below.

Sampling and Analysis Activities Evaluation

The first step of the data usability evaluation will include a review of the sampling and analysis activities in comparison to project-specific DQIs and study-specific workplans. Specific limitations to the data, i.e., results that are qualified as estimated (J/UJ), or rejected, will be determined and documented in the database. The data acquisition and evaluation process consists of a series of procedures designed to maximize final data quality.

Achievement of DQIs

The second part of data usability pertains to the achievement of the program-specific DQIs. Each investigator will compare the performance achieved for each data quality criterion against the expected and planned performance. In general, this comparison will follow from the DQIs used to define each DQO. This comparison is the most critical component of the assessment process. Any deviation from planned performance will be documented and evaluated to determine whether corrective action is advisable. Potential corrective actions will range from resampling and/or reanalysis of data, to qualification or exclusion of the data for use in the data interpretation. In the event that corrective action is not possible, the limitations, if any, of the data with regard to achieving the DQOs will be noted.

In conjunction with the DQI achievement review, the investigators will need to make decisions for the use of qualified values, which are a consequence of the formalized evaluation/validation process. Data qualifiers will be applied to individual data results. Data usability decisions will be made based on the assessment of the usability of each of these results for the intended purpose. Evaluation will describe the uncertainty (bias, imprecision, etc.) of the qualified results. Cumulative QC exceedances from the DQIs may require technical judgment to determine the overall effect on the usability of the data. Decisions about usability of qualified data for use in risk assessment will be based on the EPA document mentioned, which allows for the use of estimated values. Finally, data users may choose to determine final data usability qualifiers as a result of this overall examination and decision process.

Achievement of DQOs

The third step in the data usability process concerns achievement of the DQOs. Once the data set has been assessed to be of known quality, data limitations have been documented, and overall result applicability/usability for its intended purpose has been determined, the final data assessment can be initiated by considering the answers to the following questions:

- Are the data adequate to determine the extent to which hazardous substances have migrated or to what extent they were expected to migrate from potential hazardous substance source areas?
- Do the data collected adequately characterize the nature and extent of potential hazardous substance source areas at the site?
- Are the data statistically adequate to evaluate on a per chemical and per media basis?
- Do the data collected allow assessment of hydrogeologic factors, which may influence contaminant migration/distribution?
- Is the sample set sufficient to develop site-specific removal and disposal treatment methodologies?
- Have sufficient data been collected to evaluate how factors including physical characteristics of the site and climate and water table fluctuations affect contaminant fate and transport?
- Have sufficient data been collected to determine the toxicity, environmental fate, and other significant characteristics of each hazardous substance present?
- Is the data set sufficient to evaluate the potential extent and risk of future releases of hazardous substances, which may remain as residual contamination at the source facility?

The study principal investigators, in conjunction with the project team, will need to formulate solutions if data gaps are found as a result of problems, biases, trends, etc., in the analytical data, or if conditions exist that were not anticipated in the development of the DQOs. It is particularly important that each data usability evaluation specifically address any limitations on the use of the data that may result from a failure to achieve the stipulated DQO.

If the project scope changes, the DQOs will be expanded. The DQOs will address the specific action limits and measurable performance criteria, in order to make appropriate decisions on the analytical data.

ATTACHMENT A—ANALYTICAL STANDARD OPERATING PROCEDURES

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Title: Metals by ICP-OES (SW-846 Method 6010B)

Approval Signatures:

William S. Cicero
Laboratory Director

Jessica A. Holzschuh
Department Manager

Kirstin L. McCracken
Quality Assurance Manager

Bryce E. Stearns
Technical Director

Dan Helfrich
Health & Safety Coordinator

Approval Date: March 5, 2010

Facility Distribution No. Electronic **Distributed To: Facility Intranet**

The controlled copy of this SOP is the PDF copy of the SOP that is posted to the laboratory's SOP Directory. Printed copies of this SOP or electronic copies of this SOP distributed outside the facility are considered uncontrolled.

1.0 Scope and Application

This SOP describes the laboratory procedure used to determine trace elements and metals in solution using Inductively Coupled Plasma-Atomic Emission Spectrometry.

1.1 Analytes, Matrix(s), and Reporting Limits

This procedure may be used for a variety of matrices including: non-potable water, soil, sediment, sludge, tissue and air.

Table 1, Section 18.0 lists the elements for which this SOP is applicable along with the laboratory established reporting limit (RL).

2.0 Summary of Method

Prior to analysis samples are digested using an appropriate preparation method following laboratory SOPs BR-ME-009 (SW-846 3010), BR-ME-010 (SW-846 3005) or BR-ME-011 (SW-846 3050).

The digested samples are introduced to the ICP-AES, which measures characteristic emission spectra by optical spectrometry. An aliquot of sample is nebulized and the resulting aerosol is transported to a plasma torch. Element-specific emission spectra are produced by radio-frequency inductively coupled plasma. The spectra are dispersed by a spectrometric grating and the intensities of the emission lines are monitored by photosensitive devices. Background correction is performed with the background measured adjacent to analyte lines on samples during analysis. The sample is analyzed by multiple integrations (2) and the average integration is converted to a concentration from a calibration curve.

This procedure is based on the following reference method:

- SW-846 Method 6010B, Inductively Coupled Plasma-Atomic Emission Spectrometry, Revision 2, December 1996.

If the laboratory's procedure is modified from the reference method, a list of modifications will be provided in Section 16.0.

3.0 Definitions

- Total Recoverable Metals: The concentration of metals in an unfiltered sample following treatment with hot dilute mineral acid. (SW-846 Method 3005).

- Dissolved Metals: The concentration of metals determined in a sample after the sample is filtered through a 0.45 µm filter. (SW-846 Method 3005).

- Total Metals: The concentration of metals determined in a sample following digestion by Methods 3010 or 3050.

A list of general laboratory terms and definitions are provided in Appendix A.

4.0 Interferences

Spectral interferences are caused by background emission from continuous or recombination phenomena, stray light from the line emission of high concentration elements, overlap of a spectral line from another element, or unresolved overlap of molecular band spectra. These effects are compensated by using computer correction of the raw data by monitoring and measurement of the interfering element and/or background correction adjacent to the analyte line.

Physical interferences are effects associated with sample nebulization and transport processes. Changes in viscosity and surface tension can cause significant inaccuracies especially in samples that contain high dissolved solids and/or acid concentrations. The use of a peristalitic pump or sample dilution should minimize these interferences.

Chemical interferences such as molecular compound formation, ionization effects and solute vaporization effects are highly dependent on matrix type and specific analyte elements. These interferences are not typical with ICP-AES analysis but if observed, can be minimized by matrix matching, buffering the sample and careful selection of instrument operating conditions.

Memory interferences result when analytes in a previous sample contribute to the signals measured in a new sample.

5.0 Safety

Employees must abide by the policies and procedures in the Corporate Safety Manual, Radiation Safety Manual and this document.

This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.1 Specific Safety Concerns or Requirements

The ICP plasma emits strong UV light and is harmful to vision. All analysts must avoid looking directly at the plasma.

5.2 Primary Materials Used

Table 2, Section 18.0 lists those materials used in this procedure that have a serious or significant hazard rating along with the exposure limits and primary hazards associated with that material as identified in the MSDS. **NOTE: This list does not include all materials used in the method.** A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the MSDS for each material before using it for the first time or when there are major changes to the MSDS.

6.0 Equipment and Supplies

Catalog numbers listed in this SOP are subject to change at the discretion of the vendor. Analysts are cautioned to be sure equipment used meets the specification of this SOP.

6.1 Miscellaneous

- Volumetric Pipettes: Size 0.10-1.00 mL & 1.00-5.00 mL, Finpipette or equivalent.
- Volumetric Flasks, Class A: Size 50, 100, 500, and 1000 mL.

6.2 Analytical System

- Inductively Coupled Argon Plasma Optical Emission Spectrometer (ICP-OES), Thermo Electron Corporation, ICAP Duo 6500 or equivalent.

7.0 Reagents and Standards

7.1 Reagents

Hydrochloric Acid (HCl), Concentrated: Reagent Grade, J.T. Baker or equivalent

Nitric Acid (HNO_3), Concentrated: Reagent Grade, J.T. Baker or equivalent

7.2 Standards

Purchase stock standard solutions from commercial vendors and store according to the manufacturer's recommendation. From these, prepare intermediate and working standard solutions as needed and unless otherwise noted, assign an expiration date of 6 months from date of preparation unless the parent standard expires sooner, in which case, use the earliest expiration date is used. The recommended formulations for standards used in this procedure along with the recommended source materials, expiration dates and storage conditions are provided in Appendix A.

8.0 Sample Collection, Preservation, Shipment and Storage

The laboratory does not perform sample collection so these procedures are not included in this SOP. Sampling requirements may be found in the published reference method.

Listed below are minimum sample size, preservation and holding time requirements:

Matrix	Sample Container	Minimum Sample Size	Preservation	Holding Time	Reference
Solid	Glass or plastic	5 grams	NA	180 days from collection	SW-846 6010B
Aqueous	Glass or plastic	500 mL	pH<2 with Nitric Acid	180 days from collection	SW-846 6010B

NOTE: Samples for measurement of dissolved metals should be filtered immediately after sample collection.

Unless otherwise specified by client or regulatory program, samples and digestates are retained for a minimum of 30 days after provision of the project report and then disposed of in accordance with applicable regulations.

9.0 Quality Control

9.1 Sample QC

The laboratory prepares the following quality control samples with each batch of samples.

QC Item	Frequency	Acceptance Criteria
Method Blank (MB)	1 in 20 or fewer samples	See Table 3
Laboratory Control Sample (LCS)	1 in 20 or fewer samples	See Table 3
Matrix Spike (MS)	1 in 20 or fewer samples	See Table 3
Matrix Spike Duplicate (MSD)	Per client request	See Table 3
Sample Duplicate (DP)	1 in 20 or fewer samples	See Table 3
Post Digestion Spike (A)	Performed with every MS	See Table 3

9.2 Instrument QC

The following instrument QC is performed:

QC Item	Frequency	Acceptance Criteria
Initial Calibration (ICAL)	Initially; when ICV or CCV fail	See Table 3
Second Source Calibration Verification (ICV)	Once, after each ICAL	See Table 3
Initial Calibration Blank (ICB)	Once, following ICV	See Table 3
Interference Check Standards (ICSA/ICSAB)	Once, following ICB	See Table 3
Low Level Standard (CRI)	Once, following ICSA/ICSAB	See Table 3
Continuing Calibration Verification (CCV)	At the beginning of each sequence, following the ICSA/ICSAB, every 10 samples, end of sequence	See Table 3
Continuing Calibration Blank (CCB)	At the beginning of each sequence, following the ICSA/ICSAB, every 10 samples, end of sequence, following CCV	See Table 3

10.0 Procedure

10.1 Instrument Operating Conditions

Set up the instrument with the proper operating conditions using the instructions provided by the instrument manufacturer. Operating manuals for each instrument are located in the metals laboratory.

Perform plasma optimization per the manufacturer's instructions when a new instrument is set up or when there is a significant change in operating conditions. The optimization is performed to provide a maximum signal to background ratio for some of the least sensitive elements in the analytical array.

Establish and verify the interelement spectral interference correction routine (IECs) used during sample analysis. To determine the IECs analyze a single element standard for each element at 3 successive concentrations and document the presence of a positive or negative value of any other element whose absolute value exceeds the RL (interfering element). Calculate a "K" factor for each element by dividing the concentration found by the concentration of the interfering element. Take the average of the three "K" values for each interfering element and enter this value (IEC) into the software system. Verify the IECs quarterly.

Establish the upper limit of the linear dynamic range (LDR) for each wavelength used by determining the signal responses from a minimum of 2 different concentration standards across the range. One of the standards should be near the upper limit. The %R should be within ± 10% of the known value. Establish new dynamic ranges when there is a significant change in instrument response and check the range every 3 months.

Profile the instrument by running an ICV standard. Visually inspect the peaks for proper peak alignment for each element. If adjustments to the peaks are necessary follow the steps to perform an Auto-peak adjustment in the iTEVA software. This will fine-tune the peak positions for optimum conditions. Profile the instrument again after the Auto-peak adjustment to ensure peak alignment is good.

10.2 Instrument Calibration

10.2.1 Initial Calibration (ICAL)

Calibrate the instrument with each analytical sequence using a a blank and one calibration standard for each element.

Prepare the calibration blank and standards using the formulations provided in Appendix A.

Analyze the standards following the procedure that begins in Section 10.4.

10.2.2 Second Source Calibration Verification (ICV)

Immediately after calibration verify the accuracy of the calibration with a second source standard (ICV). Prepare the ICV using the formulation provided in Appendix A and analyze the ICV following the procedure that begins in Section 10.4 The percent recovery of the ICV must be within 90-100% (%D ± 10%). If criteria are not met, correct the problem and rerun the ICV. If the reanalysis fails, correct problem and repeat initial calibration.

10.2.3 Continuing Calibration Verification (CCV)

Analyze a CCV every 10 samples and at the end of the analytical sequence or every 2 hours whichever is more frequent.

The percent recovery of the CCV must be within 90-100% (%D ± 10%). If criteria are not met, correct the problem and rerun the ICV. If the reanalysis fails, correct problem and repeat initial calibration.

10.2.4 Calibration Blanks (ICB/CCB)

Analyze a calibration blank at the beginning of the run (ICB) after each CCV (CCB). The result of the calibration blanks should be less than the RL. If it is not correct the problem and reprep and reanalyze the blank and all samples bracketed by the blank.

10.2.5 Interference Check Standards (ICSA/ICSAB)

The ICS consists of two solutions (ICSA/ICSAB) that are analyzed consecutively starting with the ICSA. The ICSA solution includes the interferents, and the ICSAB includes the analytes mixed with the interferents.

Analyze ICS solutions at the beginning and end of each analytical sequence immediately after each CCV/CCB at a minimum frequency of once per 20 samples per analytical run.

The result of the ICSA should be within ±2 times the RL of the analyte's true value or ±20% of the analyte's true value in the ICSA, whichever is greater assuming the true value is zero unless otherwise stated. For analytes with an RL less than 5000 ug/L, the ICSA results should be reported from the undiluted sample analysis.

The results of the ICSAB solution should be within ±2 times the RL or ±20% of the analyte's true value, whichever is greater. If the results are not within control limits, the analysis is stopped and the problem is investigated and corrected. The instrument is recalibrated and all samples analyzed since the last compliant ICSA/ICSAB are reanalyzed.

10.2.6 Low Level Standard (CRI)

To verify linearity near the RL, analyze a CRI at the beginning of each analytical after the ICSA/ICSAB. The CRI shall be run for every wavelength used for analysis.

10.2.7 Internal Standard (IS)

For the ICP-OES yttirium and indium are used as internal standards. Indium is associated with lead and thallium only. Check the response of the internal standard (IS) in every field and QC sample. The raw average should not vary by ± 30% from the raw average result of the ICB. If the IS response is outside this range, dilute 1:2 and reanalyze the sample. If the IS is still outside of range report the original result and narrative note the IS failure.

Troubleshooting:

Check the following items in case of calibration failures:

- Change the peristaltic pump tubing and replace the transition tubing pieces if the tubing appears cloudy or discolored.
- Recheck the profile to determine if maintenance performed was sufficient to correct the problem.
- Remake standards if solutions are running low.
- Replace the peristaltic pump tubing.

10.3 Standard and Sample Preparation

Transfer ~25 mL of each prepared standard (CAL #7, 4, 8, ICV, CCV, ICSA, ICSAB, CRI) into individual, labeled autosampler tubes. Use 25 mL of mixed acid solution (5%HCl / 2%HNO3) for each calibration blank.

Transfer approximately 8 mL of each digestate to individual autosampler tubes. Prepare a serial dilution and post digestion spike using aliquots of the digestate of the parent sample used for the matrix spike.

- To prepare the serial dilution, transfer 1.4 mL of parent sample to an autosampler tube and add 5.6 mL of the mixed acid solution (5%HCl / 2%HNO3).

- To prepare the post digestion spike, transfer 7.92 mL of parent sample to an autosampler tube and spike with 0.08 mL of the matrix spike solution.

10.4 Sample Analysis

Allow the instrument to become thermally stable prior to analysis. Create a new autosampler template on the instrument PC and enter the sample IDs in the order of analysis. Place the samples, serial dilution, post-digestion spike, calibration blanks, mixed calibration standards, and performance check standards in the position on the autosampler rack that corresponds to their assigned position in the autosampler template.

An example analytical sequence that includes initial calibration (ICAL) is provided below.

Injection Number	Lab Description
1	Calibration Blank
2	Calibration Standard #7
3	Calibration Standard #8
4	Calibration Standard #4
5	ICV
6	ICB
7	ICSA
8	ICSAB
9	CRI
10	CCV
11	CCB
12-21	10 Samples*
22	CCV
23	CCB
24-33	10 Samples*
34-35	Repeat until ending with CCV/CCB

*The number of samples between each CCB/CCV (10) includes the method blank, laboratory control sample, matrix spike, sample duplicate, serial dilution and the post digestion spike.

Place the autosampler rack in the autosampler tray and initiate the software macro to begin analysis. The ICP-AES software is configured to acquire a minimum of two replicate exposures for all analyses and to use the average result of multiple exposures for standardization. The data processing software calculates results and adjusts for appropriate factors such as dilution and dry weight. Equations used are provided in the next section.

11.0 Calculations / Data Reduction

The sample is quantified by multiple integrations (2) and the average integration is converted to a concentration (ppb) from a calibration curve. S

11.1 Calculations

See Appendix C.

11.2 Data Reduction

11.2.1 Primary Review

Review project documents such as the environmental test request (ETR) analytical worksheets, Project Plan (PP), Project Memo or any other document/process used to communicate project requirements to ensure those project requirements were met. If project requirements were not met, immediately notify the project manager (PM) to determine an appropriate course of action.

Review the instrument QC against the acceptance criteria given in Section 10.0 and summarized in Table 2. If the results do not fall within acceptance criteria, perform the recommended corrective action.

Upload the data files from the data processing system to the laboratory information management system (LIMS). Enter batch information and standards and reagents into the LIMS batch. Review the data in LIMS and set results to primary, secondary, acceptable or rejected as appropriate. Initiate a nonconformance memor for QC outside established acceptance criteria then set samples in batch to 1st level review.

11.2.2 Secondary Review

Review project documents such as the Project Plan (PP), Project Memo or any other document/process used to communicate project requirements to ensure those project requirements were met. If project requirements were not met, immediately notify the project manager (PM) to determine an appropriate course of action.

Check the batch editor and worksheet to verify the batch is complete and any outages are documented with an NCM along with the results of any corrective actions taken. Spot check results and when complete, set the status of the batch to second level review.

Run the QC Checker, investigate and correct any problems found. Run and review the deliverable. Fix any problems found then set the method chain to lab complete.

11.2.3 Data Reporting

Data reporting and creation of the data deliverable is performed by the LIMS using the formatters set by the project manager during project initiation.

The following sections describe the default reporting scheme for this method:

Analytical results above the reporting limit (RL) are reported as the value found. Analytical results less than the RL are reported as non-detect to the adjusted RL. The RL is adjusted for sample dilution/concentration. The unadjusted RL for each target analyte is provided in Section 1.

Electronic and hardcopy data are maintained as described in laboratory SOP BR-QA-014 Laboratory Records.

12.0 <u>Method Performance</u>

12.1 Method Detection Limit Study (MDL)

Perform a method detection limit (MDL) study at initial method set-up following the procedures specified in laboratory SOP BR-QA-005.

12.2 Demonstration of Capabilities (DOC)

Perform a method demonstration of capability at initial set-up and when time there is a significant change in instrumentation or procedure.

Each analyst that performs the analytical procedure must complete an initial demonstration of capability (IDOC) prior to independent analysis of client samples. Each analyst must demonstrate on-going proficiency (ODOC) annually thereafter. DOC procedures are further described in the laboratory's quality system manual (QAM) and in the laboratory SOP for employee training.

12.3 Interelement Corrections

Interelement correction factors are determined quarterly by the analysis of a single element standard for each element at an environmentally representative concentration. For each of those analyses the presence of a positive or negative value whose absolute value for any other element exceeds the CRQL is documented. A "K" factor is determined by dividing the concentration observed of a given element by the concentration of the interfering element and is entered into the software system. Following this, the ICSA solution is analyzed and the process is repeated for any elements not present in the solution that exhibit a positive or negative value. When the procedure is complete, all "K" values are considered final if the ICSA analysis meets the acceptance criteria for the ICSA analysis.

12.4 Linear Range Analysis

Linear range analysis is determined quarterly by the analysis of a multi-component or single element standard for each element. The highest concentration recovered within 5% of its true value determines the linear range for the instrument.

12.5 Training Requirements

Any employee that performs any portion of the procedure described in this SOP must have documentation in their employee training file that they have read this version of this SOP.

Instrument analysts, prior to independent analysis of client samples, must also have documentation of demonstration of initial proficiency (IDOC) and annual on-going proficiency (ODOC) in their employee training files.

13.0 Pollution Control

It is TestAmerica's policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, ordering chemicals based on quantity needed, preparation of reagents based on anticipated usage and reagent stability).

14.0 Waste Management

Waste management practices are conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes are disposed of in an accepted manner. Waste description rules and land disposal restrictions are followed. Waste disposal procedures are incorporated by reference to laboratory SOP BR-LP-001.

15.0 References / Cross-References

- SW-846 Method 6010B, Inductively Coupled Plasma-Atomic Emission Spectrometry, Revision 2, December 1996.
- Laboratory SOP LM-MP-3005 Acid Digestion of Waters for Total Recoverable or Dissolved Metals
- Laboratory SOP LM-MP-3010A Acid Digestion of Waters for Total Metals
- Laboratory SOP LM-MP-3050B Acid Digestion of Soils, Sediments & Sludge for Total Metals
- Laboratory SOP BR-QA-005, Procedures for the Determination of Limits of Detection (LOD), Limits of Quantitation (LOQ) and Reporting Limits (RL).
- Laboratory SOP BR-QA-011 Employee Training
- Laboratory SOP BR-LP-011 Hazardous Waste
- Laboratory SOP BR-QA-014 Laboratory Records
- Laboratory SOP BR-QA-006 Procedures & Documentation Requirements for Manual Integration
- Laboratory Quality Assurance Manual (QAM)

16.0 Method Modifications

Modification Number	Method Reference	Modification
1	NA	The laboratory monitors the internal standard behavior throughout the analysis. Check the response of the internal standard (IS) in every field and QC sample. The raw average should not vary by ± 30% from the raw average result of the ICB. If the IS response is outside this range, dilute 1:2 and reanalyze the sample. If the IS is still outside of range report the original result and narrative note the IS failure.

17.0 Attachments

- Table 1: Target Compound List and Reporting Limit
- Table 1A: Accuracy and Precision Limits

- Table 2: Primary Materials Used
- Table 3: QC Summary & Recommended Corrective Action
- Appendix B: Standard Preparation Tables
- Appendix C: Equations

18.0 Revision History

BR-ME-005, Revision 10:

Table 1: Routine Target Analyte List & Reporting Limit (RL)

Element	CAS No.	Reporting Limit		Wavelength
		Water (ug/L)	Soil (mg/Kg)	Thermo ICAP ICP7
Aluminum	7429-90-5	200	20	308.215
Antimony	7440-36-0	60	6	206.838
Arsenic	7440-38-2	10	1.0	189.042
Barium	7440-39-3	200	20	493.409
Beryllium	7440-41-7	5	0.5	313.042
Cadmium	7440-43-9	5	0.5	226.502
Calcium	7440-70-2	5000	500	317.933
Chromium	7440-47-3	10	1	267.716
Cobalt	7440-48-4	50	5	228.616
Copper	7440-50-8	25	2.5	324.753
Iron	7439-89-6	200	20	271.441
Lead	7439-92-1	10	1.0	220.353
Magnesium	7439-95-4	5000	500	279.078
Manganese	7439-96-5	15	1.5	257.610
Nickel	7440-02-0	40	4	202.030
Potassium	7440-09-7	5000	500	766.491
Selenium	7782-49-2	35	3.5	196.026
Silver	7440-22-4	10	1	328.068
Sodium	7440-23-5	5000	500	330.232
Thallium	7440-28-0	25	2.5	190.864
Vanadium	7440-62-2	50	5	292.402
Zinc	7440-66-6	20	2	206.200
Boron	7440-42-8	100	10	246.678
Molybdenum	7439-98-7	10	1	202.030
Tin	7440-31-5	20	2	189.989
Silicon	7440-21-3	100	10	--
Titanium	7440-32-6	20	2	334.941
Strontium	7440-24-6	20	2	421.552
Phosphorous	7723-14-0	250	25	178.287

Table 2: Primary Materials Used

Material (1)	Hazards	Exposure Limit (2)	Signs and symptoms of exposure
Nitric Acid	Corrosive Oxidizer Poison	2 ppm-TWA 4 ppm-STEL	Nitric acid is extremely hazardous; it is corrosive, reactive, an oxidizer, and a poison. Inhalation of vapors can cause breathing difficulties and lead to pneumonia and pulmonary edema, which may be fatal. Other symptoms may include coughing, choking, and irritation of the nose, throat, and respiratory tract. Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and stain skin a yellow or yellow-brown color. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Hydrochloric Acid	Corrosive Poison	5 ppm-Ceiling	Inhalation of vapors can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory failure, and death. Can cause redness, pain, and severe skin burns. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
1 – Always add acid to water to prevent violent reactions.			
2 – Exposure limit refers to the OSHA regulatory exposure limit.			

Table 3: QC Summary, Frequency, Acceptance Criteria and Recommended Corrective Action

QC Item	Frequency	Acceptance Criteria	Recommended Corrective Action[1]
ICAL	Daily	NA	NA
ICV	After each initial calibration, prior to sample analysis.	±10% of expected value	Correct problem and verify second source standard. If that fails, repeat initial calibration.
ICB	Beginning of analytical sequence after ICV	No analytes ≥ RL	Correct problem and reanalyze.
CCV	At beginning of analytical sequence, after every 10 samples and at the end of the analytical sequence.	±10% of expected value %RSD between replicate integrations <5%.	Correct problem; reanalyze CCV. If that fails, repeat calibration and reanalyze all samples since last successful calibration.
CCB	Beginning of sample run, after every 10 samples and at end of the sequence (i.e. after each CCV).	No analytes ≥ RL	Correct problem and reanalyze the calibration blank and previous 10 samples.
ICSA ICSAB	At the beginning of the analytical run.	±20% of expected value	Stop analysis, locate and correct problem, reanalyze ICS and all associated QC and samples.
CRI (Low Level Standard)	Daily, after ICSA and ICSAB		Examine project DQO's. If necessary, reanalyze.
MB	One per digestion batch.	No analytes ≥RL	Correct problem, redigest and reanalyze MB and associated samples.
LCS	One per digestion batch of 20 or fewer samples	%R= 80-120	Correct problem, redigest and reanalyze LCS, MB and associated samples for failed analytes if sufficient sample volume is available.
MS	One per digestion batch of 20 or fewer samples	%R= 80-120	Examine project DQO's with Project Manager. Evaluate data to determine if outage is related to analytical error or matrix effect.
DP	One per digestion batch of 20 or fewer samples	RPD ≤ 20	Examine project DQO's with Project Manager. Evaluate data to determine source of difference between results.
Serial Dilution	Each digestion batch	5X dilution within ±10% of original sample result	Perform Post Digestion Spike. Flag data.
Post Digestion Spike	Each digestion batch	%R within 75-125	Flag data or run samples by MSA.

[1]The recommended corrective action may include some or all of the items listed in this column. The corrective action taken may be dependent on project data quality objectives and/or analyst judgment but must be sufficient to ensure that results will be valid. If corrective action is not taken or is not successful, data must be flagged with appropriate qualifiers.

Appendix A: Terms and Definitions

Acceptance Criteria: specified limits placed on characteristics of an item, process or service defined in requirement documents.

Accuracy: the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator.

Analyte: The specific chemicals or components for which a sample is analyzed. (EPA Risk Assessment Guide for Superfund, OSHA Glossary).

Batch: environmental samples that are prepared and/or analyzed together with the same process, using the same lot(s) of reagents. A preparation/digestion batch is composed of one to 20 environmental samples of similar matrix, meeting the above criteria. An analytical batch is composed of prepared environmental samples (extracts, digestates and concentrates), which are analyzed together as a group.

Calibration: a set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material and the corresponding values realized by the standards.

Calibration Curve: the graphical relationship between the known values or a series of calibration standards and their instrument response.

Calibration Standard: A substance or reference used to calibrate an instrument.

Continuing Calibration Verification (CCV): a single or multi-parameter calibration standard used to verify the stability of the method over time. Usually from the same source as the calibration curve.

Corrective Action: the action taken to eliminate the cause of an existing nonconformity, defect or other undesirable occurrence in order to prevent recurrence.

Data Qualifier: a letter designation or symbol appended to an analytical result used to convey information to the data user. (Laboratory)

Demonstration of Capability (DOC): procedure to establish the ability to generate acceptable accuracy and precision.

Holding Time: the maximum time that a sample may be held before preparation and/or analysis as promulgated by regulation or as specified in a test method.

Initial Calibration: Analysis of analytical standards for a series of different specified concentrations used to define the quantitative response, linearity and dynamic range of the instrument to target analytes.

Intermediate Standard: a solution made from one or more stock standards at a concentration between the stock and working standard. Intermediate standards may be certified stock standard solutions purchased from a vendor and are also known as secondary standards.

Laboratory Control Sample (LCS): a blank matrix spiked with a known amount of analyte(s) processed simultaneously with and under the same conditions as samples through all steps of the procedure.

Matrix Spike (MS): a field sample to which a known amount of target analyte(s) is added.

Matrix Spike Duplicate (MSD): a second replicate matrix spike

Method Blank (MB): a blank matrix processed simultaneously with and under the same conditions as samples through all steps of the procedure. Also known as the preparation blank (PB).

Method Detection Limit (MDL): the minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific measurement system. The MDL is a statistical estimation at a specified confidence interval of the concentration at which relative uncertainty is ±100%. The MDL represents a range where qualitative detection occurs. Quantitative results are not produced in this range.

Non-conformance: an indication, judgment, or state of not having met the requirements of the relevant specification, contract or regulation.

Precision: the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves.

Preservation: refrigeration and/or reagents added at the time of sample collection to maintain the chemical, physical, and/or biological integrity of the sample.

Quality Control Sample (QC): a sample used to assess the performance of all or a portion of the measurement system.

Reporting Limit (RL): the level to which data is reported for a specific test method and/or sample.

Stock Standard: a solution made with one or more neat standards usually with a high concentration. Also known as a primary standard. Stock standards may be certified solutions purchased from a vendor.

Appendix B: Standard Preparation Tables

The standard formulations contained in this Appendix are recommended and are subject to change. If the concentration of the stock standard is different than those noted in this table, adjust the standard preparation formulation accordingly. Unless otherwise specified, all standards are prepared in a solutions that consists of 5% Hydrochloric Acid and 2% Nitric Acid and primary source standards are purchased from SPEX and second source standards are purchased from Inorganic Ventures. Unless otherwise specified for a standard solution, assign an expiration date of 6 months from date of preparation unless the parent standard expires sooner in which case use the earliest expiration date. See laboratory SOP BR-QA-002 *Standard Preparation* for further guidance.

Calibration Standard #7

Element	Stock Standard	Volume Used	Final Volume	Final Concentration
Aluminum (Al)	500 ppm	200 mL of X-AQU-4	2000 mL	50000 ug/L
Calcium (Ca)	500 ppm			50000 ug/L
Iron (Fe)	500 ppm			50000 ug/L
Magnesium (Mg)	500 ppm			50000 ug/L
Sodium (Na)	500 ppm			50000 ug/L
Potassium (K)	500 ppm			50000 ug/L

Calibration Standard #8

Element	Stock Standard	Volume Used	Final Volume	Final Concentration
Arsenic (As)	1000 ppm	1.0 mL	2000 mL	500 ug/L
Antimony (Sb)	1000 ppm	1.0 mL		500 ug/L
Lead (Pb)	1000 ppm	2.0 mL		1000 ug/L
Selenium (Se)	1000 ppm	1.0 mL		500 ug/L
Strontium (Sr)	1000 ppm	2.0 mL		1000 ug/L
Thallium (Tl)	1000 ppm	1.0 mL		500 ug/L
Tin (Sn)	1000 ppm	2.0 mL		1000 ug/L
Titanium (Ti)	1000 ppm	2.0 mL		1000 ug/L

Calibration Standard #4

Element	Stock Standard	Volume Used	Final Volume	Final Concentration
Silver (Ag)	1000 ppm	1.0 mL	2000	500 ug/L
Phosphorus (P)	1000 ppm	2.0 mL		1000 ug/L
Silicon (Si)	1000 ppm	10 mL		5000 ug/L
Aluminum (Al)	100 ppm	20 mL of X-AQU-5		1000 ug/L
Antimony	100 ppm			1000 ug/L
Barium	100 ppm			1000 ug/L
Berylium (Be)	50 ppm			500 ug/L
Boron (B)	100 ppm			1000 ug/L
Cadmium (Cd)	50 ppm			500 ug/L
Chromium (Cr)	100 ppm			1000 ug/L
Cobalt (Co)	100 ppm			1000 ug/L
Copper (Cu)	100 ppm			1000 ug/L
Iron (Fe)	100 ppm			1000 ug/L
Lead (Pb)	100 ppm			1000 ug/L
Magnesium (Mg)	100 ppm			1000 ug/L
Manganese (Mn)	100 ppm			1000 ug/L
Molybdenum (Mo)	100 ppm			1000 ug/L

Nickel (Ni)	100 ppm			1000 ug/L
Potassium (K)	100 ppm			1000 ug/L
Sodium (Na)	100 ppm			1000 ug/L
Strontium (Sr)	50 ppm			500 ug/L
Titanium (Ti)	100 ppm			1000 ug/L
Vanadium (V)	100 ppm			1000 ug/L
Zinc (Zn)	100 ppm			1000 ug/L

CRI Intermediate Solution #1

Element	Stock Standard	Volume Used	Final Volume	Final Concentration
Antimony (Sb)	1000 ppm	6.0 mL	100 mL	60000 ug/L
Arsenic (As)	1000 ppm	1.0 mL		10000 ug/L
Berylium (Be)	1000 ppm	0.5 mL		5000 ug/L
Cadmium (Cd)	1000 ppm	0.5 mL		5000 ug/L
Chromium (Cr)	1000 ppm	1.0 mL		10000 ug/L
Cobalt (Co)	1000 ppm	5.0 mL		50000 ug/L
Copper (Cu)	1000 ppm	2.5 mL		25000 ug/L
Lead (Pb)	1000 ppm	1.0 mL		10000 ug/L
Mangenese (Mn)	1000 ppm	1.5 mL		15000 ug/L
Nickel (Ni)	1000 ppm	4.0 mL		40000 ug/L
Selenium (Se)	1000 ppm	3.5 mL		35000 ug/L
Silver (Ag)	1000 ppm	1.0 mL		10000 ug/L
Thallium (Tl)	1000 ppm	2.5 mL		25000 ug/L
Vanadium (V)	1000 ppm	5.0 mL		50000 ug/L

CRI Intermediate Solution #2

Element	Stock Standard	Volume Used	Final Volume	Final Concentration
Aluminum (Al)	10000 ppm	0.2 mL	100 mL	20000 ug/L
Barium (Ba)	1000 ppm	2.0 mL		200000 ug/L
Calcium (Ca)	10000 ppm	5.0 mL		500000 ug/L
Iron (Fe)	10000 ppm	0.2 mL		20000 ug/L
Potassium (K)	10000 ppm	5.0 mL		500000 ug/L
Magnesium (Mg)	10000 ppm	5.0 mL		500000 ug/L
Sodium (Na)	10000 ppm	5.0 mL		500000 ug/L
Boron (B)	1000 ppm	1.0 mL		10000 ug/L
Molybdenum (Mo)	1000 ppm	0.1 mL		1000 ug/L
Phosphorus (P)	1000 ppm	2.5 mL		25000 ug/L
Silicon (Si)	1000 ppm	1.0 mL		10000 ug/L
Strontium (Sr)	1000 ppm	0.2 mL		2000 ug/L
Tin (Sn)	1000 ppm	0.2 mL		2000 ug/L
Titanium (Ti)	1000 ppm	0.2 mL		2000 ug/L

CRI Intermediate Solution #3

Element	Stock Standard	Volume Used	Final Volume	Final Concentration
Zinc (Zn)	1000 ppm	2.0 mL	100 mL	20000 ug/L

CRI Working Standard Solution

Element	Stock Standard	Volume Used	Final Volume	Final Concentration

Antimony (Sb)	60000 ug/L	1.0 mL of CRI #1	100 mL	60 ug/L
Arsenic (As)	10000 ug/L			10 ug/L
Berylium (Be)	5000 ug/L			5 ug/L
Cadmium (Cd)	5000 ug/L			5 ug/L
Chromium (Cr)	10000 ug/L			10 ug/L
Cobalt (Co)	50000 ug/L			50 ug/L
Copper (Cu)	25000 ug/L			25 ug/L
Lead (Pb)	10000 ug/L			10 ug/L
Mangenese (Mn)	15000 ug/L			15 ug/L
Nickel (Ni)	40000 ug/L			40 ug/L
Selenium (Se)	35000 ug/L			35 ug/L
Silver (Ag)	10000 ug/L			10 ug/L
Thallium (Tl)	25000 ug/L			25 ug/L
Vanadium (V)	50000 ug/L			50 ug/L
Aluminum (Al)	20000 ug/L	10 mL of CRI #2		200 ug/L
Barium (Ba)	20000 ug/L			200 ug/L
Calcium (Ca)	500000 ug/L			5000 ug/L
Iron (Fe)	20000 ug/L			200 ug/L
Potassium (K)	500000 ug/L			5000 ug/L
Magnesium (Mg)	500000 ug/L			5000 ug/L
Sodium (Na)	500000 ug/L			5000 ug/L
Boron (B)	10000 ug/L			100 ug/L
Molybdenum (Mo)	1000 ug/L			10 ug/L
Phosphorus (P)	25000 ug/L			250 ug/L
Silicon (Si)	10000 ug/L			100 ug/L
Strontium (Sr)	2000 ug/L			20 ug/L
Tin (Sn)	2000 ug/L			20 ug/L
Titanium (Ti)	2000 ug/L			20 ug/L
Zinc (Zn)	20000 ug/L	1.0 mL of CRI #3		20 ug/L

ICSA Working Standard Solution

Element	Stock Standard	Volume Used	Final Volume	Final Concentration
Aluminum (AL)	10000 ppm	100 mL	2000 mL	500000 ug/L
Calcium (Ca)	10000 ppm	100 mL		500000 ug/L
Iron (Fe)	10000 ppm	40 mL		200000 ug/L
Magnesium (Mg)	10000 ppm	100 mL		500000 ug/L

ICSAB Working Standard Solution

Element	Stock Standard	Volume Used	Final Volume	Final Concentration
Silver (Ag)	1000 ppm	0.40 mL	2000 mL	200 ug/L
Antimony (Sb)	1000 ppm	1.2 mL		600 ug/L
Zinc (Zn)	1000 ppm	2.0 mL		1000 ug/L
Cadmium (Cd)	1000 ppm	2.0 mL		1000 ug/L
Nickel (Ni)	1000 ppm	2.0 mL		1000 ug/L
Arsenic (As)	1000 ppm	0.20 mL		100 ug/L
Boron (B)	1000 ppm	3.0 mL		1500 ug/L

Tin (Sn)	1000 ppm	3.0 mL		1500 ug/L
Iron (Fe)	10000 ppm	40 mL		200000 ug/L
Calcium (Ca)	10000 ppm	100 mL		500000 ug/L
Magnesium (Mg)	10000 ppm	100 mL		500000 ug/L
Aluminum (Al)	10000 ppm	100 mL		500000 ug/L
Molybdenum (Mo)	1000 ppm	2.0 mL		1000 ug/L
Silicon (Si)	1000 ppm	2.0 mL		1000 ug/L
Selenium (Se)	1000 ppm	0.10 mL		50 ug/L
Thallium (Tl)	1000 ppm	0.20 mL		100 ug/L
Barium (Ba)	1000 ppm	1.0 mL		500 ug/L
Berylium (Be)	1000 ppm	1.0 mL		500 ug/L
Cobalt (Co)	1000 ppm	1.0 mL		500 ug/L
Chromium (Cr)	1000 ppm	1.0 mL		500 ug/L
Copper (Cu)	1000 ppm	1.0 mL		500 ug/L
Manganese (Mn)	1000 ppm	1.0 mL		500 ug/L
Lead (Pb)	1000 ppm	0.10 mL		50 ug/L
Vanadium (V)	1000 ppm	1.0 mL		500 ug/L
Phosphorus (P)	1000 ppm	1.0 mL		500 ug/L
Titanium (Ti)	1000 ppm	1.0 mL		500 ug/L
Strontium (Sr)	1000 ppm	0.50 mL		250 ug/L

Initial Calibration Verification (ICV)

Element	Stock Standard	Volume Used	Final Volume	Final Concentration
Aluminum (Al)*	100 ppm	20 mL of AT-2	2000 mL	1000 ppb
Lead (Pb)	100 ppm			1000 ppb
Barium (Ba)	50 ppm			500 ppb
Berylium (Be)	50 ppm			500 ppb
Boron (B)	50 ppm			500 ppb
Cadmium (Cd)	50 ppm			500 ppb
Chromium (Cr)	50 ppm			500 ppb
Cobalt (Co)	50 ppm			500 ppb
Iron (Fe)*	50 ppm			500 ppb
Manganese (Mn)	50 ppm			500 ppb
Nickel (Ni)	50 ppm			500 ppb
Silver (Ag)	50 ppm			500 ppb
Strontium (Sr)	50 ppm			500 ppb
Vanadium (V)	50 ppm			500 ppb
Zinc (Zn)	50 ppm			500 ppb
Aluminum (Al)*	500 ppm	100 mL of AT-3		25000 ppb
Calcium (Ca)	500 ppm			25000 ppb
Iron (Fe)*	500 ppm			25000 ppb
Magnesium (Mg)	500 ppm			25000 ppb
Potasium (K)	500 ppm			25000 ppb
Sodium (Na)	500 ppm			25000 ppb
Arsenic (As)	1000 ppm	0.50 mL		250 ppb
Antimony (Sb)	1000 ppm	0.50 mL		250 ppb

Molybdenum (Mo)	1000 ppm	1.0 mL		500 ppb
Phosphorous (P)	1000 ppm	1.0 mL		500 ppb
Selenium (Se)	1000 ppm	0.50 mL		250 ppb
Silicon (Si)	1000 ppm	0.50 mL		250 ppb
Tin (Sn)	1000 ppm	0.50 mL		250 ppb
Thallium (Tl)	1000 ppm	0.50 mL		250 ppb
Titanium (Ti)	1000 ppm	1.0 mL		500 ppb

Elements present in multiple intermediate solutions

CCV Working Standard Solution

Element	Stock Standard	Volume Used	Final Volume	Final Concentration
Aluminum (Al)*	50000 ppb	600 mL of STD 7	1000 mL	30000 ug/L
Calcium (Ca)	50000 ppb			30000 ug/L
Iron (Fe)*	50000 ppb			30000 ug/L
Magnesium (Mg)*	50000 ppb			30000 ug/L
Sodium (Na)*	50000 ppb			30000 ug/L
Potassium (K)*	50000 ppb			30000 ug/L
Arsenic (As)	500 ppb	200 mL of STD 8		100 ug/L
Antimony (Sb)*	500 ppb			100 ug/L
Lead (Pb)*	1000 ppb			200 ug/L
Selenium (Se)	500 ppb			100 ug/L
Strontium (Sr)*	1000 ppb			200 ug/L
Thallium (Tl)	500 ppb			100 ug/L
Tin (Sn)	1000 ppb			200 ug/L
Titanium (Ti)*	1000 ppb			200 ug/L
Aluminum (Al)*	1000 ppb	200 mL of STD 4		200 ug/L
Antimony (Sb)*	1000 ppb			200 ug/L
Barium (Ba)	1000 ppb			200 ug/L
Berylium (Be)	500 ppb			100 ug/L
Boron (B)*	1000 ppb			200 ug/L
Cadmium (Cd)	500 ppb			100 ug/L
Chromium (Cr)	1000 ppb			200 ug/L
Cobalt (Co)	1000 ppb			200 ug/L
Copper (Cu)	1000 ppb			200 ug/L
Iron (Fe)*	1000 ppb			200 ug/L
Lead (Pb)*	1000 ppb			200 ug/L
Magnesium (Mg)*	1000 ppb			200 ug/L
Manganese (Mn)	1000 ppb			200 ug/L
Molybdenum (Mo)	1000 ppb			200 ug/L
Nickel (Ni)	1000 ppb			200 ug/L
Phosphorous (P)	1000 ppb			200 ug/L
Potassium (K)*	1000 ppb			200 ug/L
Silicon(Si)	5000 ppb			1000 ug/L
Silver (Ag)	500 ppb			100 ug/L
Sodium (Na)*	1000 ppb			200 ug/L
Strontium (Sr)*	500 ppb			100 ug/L
Titanium (Ti)*	1000 ppb			200 ug/L
Vanadium (V)	1000 ppb			200 ug/L
Zinc (Zn)	1000 ppb			200 ug/L
Boron (B)*	1000 ppm	0.50 mL		500 ug/L

*Elements present in multiple intermediate solutions.

Appendix C: Equations

Water Sample Concentration

$$C_{(ug/L)} = \frac{\mu g}{L_{dig}} \times \frac{V_{dig}}{V_{samp}}$$

Where:
$\mu g/L_{dig}$ ICP result including dilution factors
V_{dig} Digestate Volume (mL)
V_{samp} Sample Volume (mL)

Soil/Sediment Sample Concentration

$$C_{(mg/Kg)} = \frac{\mu g}{L_{dig}} \times \frac{V_{dig}}{g_{samp}} \times \frac{100}{\%\,\text{solids}}$$

Where:
$\mu g/L_{dig}$ = ICP result including all dilution factors
V_{dig} = final digestate volume in Liters
g_{samp} = sample weight in grams

Percent Recovery (%R) LCS and CCVs

$$\%R = \frac{SR}{SA} \times 100\%$$

Where:
SR= Sample Result
SA=Concentration of Spike Added

Percent Recovery (%R) MS

$$\%R = \frac{SSR - SR}{SA} \times 100\%$$

Where:
SSR=Matrix Spike Result
SR=Sample Result
SA=Concentration of Spike Added

Relative Percent Difference (RPD)

$$RPD = \frac{|D_1 - D_2|}{\frac{D_1 + D_2}{2}} \times 100$$

Where:
D_1 = Sample result
D_2 = Duplicate Result

Title: Mercury by CVAA (SW-846 7470A)

Approvals (Signature/Date):

William S. Cicero
Laboratory Director

Jessica Holzschuh
Department Manager

Kirstin L. McCracken
Quality Assurance Manager

Bryce E. Stearns
Technical Director

Dan Helfrich
Health & Safety Coordinator

Approval Date: August 5, 2009

Facility Distribution No. Electronic **Distributed To: Facility Intranet**

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1.0 Scope and Application

This SOP describes the laboratory procedure for determining of mercury using cold vapor technique with atomic absorption (AA).

1.1 Analytes, Matrix(s), and Reporting Limits

This procedure may be used for a variety of matrices including: water and waste.

The routine reporting limit is 0.2 ug/L.

2.0 Summary of Method

An aliquot of sample is acid digested with potassium permanganate and potassium persulfate for two hours in a water bath maintained at a temperature of 95°C. After digestion, hydroxylamine hydrochloride is added to reduce excess permanganate. The digestate is placed on a closed-system mercury autoanalyzer and stannous chloride is added to each sample. The elemental mercury released is measured spectrophotometrically at a wavelength of 253.7 nm. Absorbance (peak height) is measured as a function of mercury concentration and sample results are calculated from the response of the sample absorbance applied against the calibration curve.

This procedure is based on SW-846 Method 7470A "Mercury in Liquid Waste (Manual Cold-Vapor Technique), Revision 1, September 1994.
Method modifications are listed in Section 16.0

3.0 Definitions

A list of terms and definitions are provided in Appendix A.

4.0 Interferences

Potassium permanganate is added to eliminate possible interference from sulfide. Concentrations as high as 20 mg/L of sulfide as sodium sulfide do not interfere with the recovery of added inorganic mercury from reagent water.

Copper has also been reported to interfere; however, copper concentrations as high as 10 mg/L had no effect on recovery of mercury from spiked samples.

5.0 Safety

Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual (CW-E-M-001) and this document. This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.1 Specific Safety Concerns or Requirements

Samples that contain high concentrations of carbonates or organic material or samples that are at elevated pH can react violently when acids are added.

5.2 Primary Materials Used

Table 1 lists those materials used in this procedure, which have a serious or significant hazard rating. **Note: This list does not include all materials used in the method. The table contains a summary of the primary hazards listed in the MSDS for each of the materials listed in the table.** A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the MSDS for each material before using it for the first time or when there are major changes to the MSDS.

6.0 Equipment and Supplies

Catalog numbers listed in this SOP are subject to change at the discretion of the vendor. Analysts are cautioned to be sure equipment used meets the specification of this SOP.

6.1 Miscellaneous

- Block Digester: Environmental Express or equivalent: able to maintain digestates at a temperature of 95°C.
- Polyethylene Digestion Vessels with Volumetric Indicators.
- Volumetric Pipettes: Calibrated daily.
- Top Loading Balance: capable of measuring to 0.01 g.

6.2 Analytical System

- Leeman Labs Hydra AA.

7.0 Reagents and Standards

7.1 Reagents

- Reagent Water
- Nitric Acid (HNO_3): Concentrated, Reagent Grade: J.T. Baker or equivalent.
- Sulfuric Acid (H_2SO_4): Concentrated, Reagent Grade, J.T. Baker or equivalent.
- Hydrochloric Acid (HCl): Concentrated, Reagent Grade, J.T. Baker or equivalent.
- Stannous Chloride: Reagent Grade: J.T. Baker or equivalent.
- Potassium Permanganate ($KMNO_4$): Reagent Grade, J.T. Baker or equivalent.
- Potassium Persulfate ($K_2S_2O_8$): Reagent Grade, J.T. Baker or equivalent.

HCl Solution (10% v/v): Add 100 mL of concentrated HCl to a 1 L volumetric flask containing ~800 mL of reagent water. Bring final volume of solution up to 1 L with reagent water. Assign an expiration date of 1 year from opened date and store this solution at ambient temperature.

HNO_3 (50% v/v): Add 10 L of concentrated HNO_3 to 20 L carboy containing 10 L of reagent water. Assign an expiration date of 1 year from opened date and store this solution at ambient temperature.

Stannous Chloride Solution: Add 100 g of $SnCl_2{}^{\circ}H_2O$ to 1 L of 10% hydrochloric acid. Assign an expiration date of 6 months from date prepared and store this solution at ambient temperature.

Hydroxylamine Hydrochloride Solution: Dissolve 240 g of Hydroxylamine Hydrochloride in 2 L of reagent water. Assign an expiration date of 6 months from date prepared and store this solution at ambient temperature.

Potassium Permanganate Solution ($KMNO_4$) (5% w/v): Dissolve 100g of $KMNO_4$ in 2 L of reagent water. Assign an expiration date of of 6 months from date prepared and store this solution at ambient temperature.

Potassium Persulfate Solution ($K_2S_2O_8$) (5% w/v): Dissolve 100 g of $K_2S_2O_8$ in 2 L of reagent water. Assign an expiration date of 6 months from date prepared and store this solution at ambient temperature.

7.2 Standards

- Hg Stock Standard Solution (1000 mg/L): Purchase from Spex or equivalent.

Mercury Intermediate Standard (10,000 ug/L): Add 1 mL of 1000 mg/L Hg Stock Standard Solution and 0.15 mL of concentrated HNO_3 to a 100 mL volumetric flask that contains approximately 80 mL reagent water. Adjust to volume with reagent water. Assign an expiration date of six months from the date made, or the manufacturers date, whichever is sooner.

Mercury Working Standard (100 ug/L): Add 1.0 mL of the Hg Intermediate Standard Solution and 0.15 mL of concentrated HNO_3 to a 100 mL volumetric flask that contains approximately 80 mL reagent water. Adjust to volume with reagent water. Use this standard to prepare the calibration standards (ICAL & CCV). Prepare this standard each day of use.

- ICV Stock Standard Solution (1000 mg/L): Purchase from Inorganic Ventures or equivalent so long as the manufacturer is different than the primary source standard.

ICV Intermediate Standard Solution (10,000 ug/L): Add 1 mL of the 1000 mg/L ICV Stock Standard Solution and 0.15 mL of concentrated HNO_3 to a 100 mL volumetric flask that contains approximately 80 mL reagent water. Adjust to volume with reagent water. Assign an expiration date of six months from the date made, or the manufacturer's expiration date, whichever is sooner.

ICV Working Standard Solution (30 ug/L): Add 1.5 mL of the ICV Intermediate Standard Solution and 0.75 mL of concentrated HNO_3 into a 500 mL volumetric flask that contains approximately 300 mL reagent water. Adjust to volume with reagent water. Assign an expiration date of six months from the date made, or the manufacturer's expiration date, whichever is sooner.

8.0 Sample Collection, Preservation, Shipment and Storage

The laboratory does not perform sample collection so these procedures are not included in this SOP. Sampling requirements may be found in the published reference method.

Listed below are minimum sample size, preservation and holding time requirements:

Matrix	Sample Container	Minimum Sample Size	Preservation	Holding Time	Reference
Water	Glass or Polyethylene	500 mL	pH<2 with Nitric Acid	28 days from collection	SW-846 7470A

Unless otherwise specified by client or regulatory program, after analysis, samples and extracts are retained for a minimum of 30 days after provision of the project report and then disposed of in accordance with applicable regulations.

9.0 Quality Control

9.1 Sample QC

The laboratory prepares the following quality control samples with each batch of samples:

QC Item	Frequency	Acceptance Criteria
Method Blank (MB)	1 in 20 or fewer samples	See Table 2
Laboratory Control Sample (LCS)	1 in 20 or fewer samples	See Table 2
Matrix Spike (MS)	1 in 20 or fewer samples	See Table 2
Sample Duplicate (SD)	1 in 20 or fewer samples	See Table 2

9.2 Instrument QC

The following instrument QC is performed:

QC Item	Frequency	Acceptance Criteria
Initial Calibration (ICAL)	Initially; when ICV or CCV fail	See Section 10.0
Second Source Calibration Verification (ICV)	Once, after each ICAL	See Section 10.0
Continuing Calibration Verification (CCV)	Daily, every 10 samples, end of sequence	See Section 10.0

10.0 Procedure

10.1 Instrument Operating Conditions

Turn on the instrument lamp, gas and pump. Allow 15 minutes for the instrument to warm up. Fill the rinse bath with 10% hydrochloric acid solution. Check all tubing connections and reset the calibration curve. Check the stannous chloride reductant reservoir and fill as necessary. Check and record the 0.2ug/L standard intensity. This value must be >2500. When applicable, record sample intensity and reference intensities and verify against previous day. Perform maintenance to increase intensities if needed.

On the PC connected to the instrument, select the autosampler template and enter the sample IDs in the order of analysis. Place the calibration standards, calibration blanks, performance check standards, and samples in the position on the autosampler rack that corresponds to their assigned position in the autosampler template. Place the autosampler rack in the autosampler tray and initiate the software macro to begin analysis.

10.2 Instrument Calibration

10.2.1 Initial Calibration (ICAL)

The mercury autoanalyzers are calibrated with five calibration standards and a blank at the beginning of each analytical sequence using the instrument operating conditions established by the manufacturer of the instrument. Operating instructions for the instrument are described in the instrument manual(s) located in the laboratory.

The calibration standards are prepared daily by making successive dilutions of the working standard (100 ug/L). The final concentration of the prepared calibration standards is given in the standard formulation tables in Appendix B.

The calibration standards are digested and analyzed following the procedures given in Section 10.3. After analysis, the data system prepares a standard curve by plotting the instrument response of the calibration standards against the true value concentration and using linear regression calculates the correlation coefficient. The correlation coefficient must be greater than or equal to 0.995.

10.2.2 Second Source Calibration Verification (ICV)

Immediately after the instrument is calibrated, the accuracy of calibration is verified with analysis of the ICV standard. The ICV standard solution is prepared, digested and analyzed with the samples following the procedures given in Section 10.3. The percent recovery of the ICV must be within 90-110%. If this criterion is not met the analysis is stopped the instrument is recalibrated and a new analytical sequence is initiated.

10.2.3 Continuing Calibration Verification (CCV)

To ensure the accuracy of the calibration during the analysis run, a CCV standard is analyzed at the beginning and end of each analytical run, every 10 samples or every 2 hours, whichever is more frequent. The concentration of the CCV standard should be at or near the mid point of the calibration curve and must be different than the concentration of the ICV. The CCV standard is prepared, digested and analyzed with the samples following the procedure given in Section 10.3. The percent recovery of the CCV must be within 80-120%. If this criterion is not met the analysis is stopped, the problem is corrected, the instrument is recalibrated and verified and all samples analyzed since the last compliant CCV are reanalyzed.

10.2.4 Initial and Continuing Calibration Blanks (ICB/CCB)

Calibration blanks are analyzed at each wavelength after every ICV and CCV, at a frequency of every 10 samples or every 2 hours, whichever is more frequent. The blanks are also analyzed at the beginning of the run and after the last sample (after the last CCV). The ICB/CCB are prepared, digested and analyzed with the samples following the procedure given in Section 10.3. The absolute value of the ICB/CCB must be less than the CRQL. If it is not, the analysis is stopped, the problem is corrected, the instrument is recalibrated and verified and all samples analyzed since the last compliant ICB/CCB are reanalyzed.

10.2.5 Low Level Standard (CRI)

At a client’s request, to verify linearity near the RL, a low level standard may be analyzed at the beginning of each analytical run following the ICB. The CRI standard is the same (0.2 ug/L) solution used as the second level of the calibration curve. The CRI is prepared, digested and analyzed with the samples following the procedure given in Section 10.3.

10.2.6 Calibration Acceptance Summary Table

Calibration Item	Calibration Type	Frequency	Criteria
ICAL	Linear Regression	Prior to each analytical sequence	≥0.995
ICV	Initial calibration verification	Once per analytical sequence immediately following ICAL.	90-110%
ICB	Initial calibration blank	Once per analytical sequence immediately following ICV.	<RL
CCV	Continuing calibration verification	At the beginning of each run, every 10 samples or every 2 hours, whichever is more frequent, and at the end of the analytical sequence.	80-120%
CCB	Continuing calibration blank	At the beginning of each run, every 10 samples or every 2 hours, whichever is more frequent, and at the end of the analytical sequence, always following a CCV.	<RL
CRI	RL Check standard	Per client request. Inset at the beginning of each run following the ICB.	Client Specified

Troubleshooting:

Check the following items in case of calibration failures:

- ICAL Failure – Perform instrument maintenance, change pump tubing, adjust the lamp, clean the sipper tip, replace the drying tube, clean or replace the optical cell. Re-pour curve standards and restart calibration.
- CCV/CRI Failure – Perform instrument maintenance, change pump tubing, adjust the lamp, clean the sipper tip, replace the drying tube, clean or replace the optical cell. Re-pour CCV or CRI standards and restart calibration and analytical sequence.

10.3 Sample Preparation

Transfer a 50 mL aliquot of sample to a labeled polyethylene digestion vessel. Use 50 mL of reagent water for the method blank, LCS and each calibration blank. Add 0.5 mL of the Hg working standard solution (100 ug/L) to the LCS and the matrix spike.

To prepare the ICV, transfer 5 mL of the ICV working standard solution (30 ug/L) to a labeled polyethylene digestion vessel and add 45 mL of reagent water.

For each CCV, transfer 2.5 mL of the Hg working standard solution (100 ug/L) to a labeled polyethylene digestion vessel and add 47.5 mL of reagent water.

If analysis of a low-level standard is requested, transfer 0.1 mL of the Hg working standard solution (100ug/L) to a labeled polyethylene digestion vessel and adjust the volume to 50 mL with reagent water.

Add 2.5 mL of concentrated sulfuric acid and 1.25 mL of concentrated nitric acid to each digestion bottle, mixing after each addition. Add 7.5 mL of potassium permanganate solution to each digestion vessel, mix and allow the vessels to stand for 15 minutes. During this time the solution should turn and remain the color purple. If after 15 minutes, the solution does not remain purple, add more potassium permanganate (~2.5 mL aliquots) and ensure that equal amounts of potassium permanganate are added to the standards and blanks.

Add 4 mL of potassium persulfate to each vessel and heat for two hours in a block digester maintained at 95°C. Cool and add 3 mL of hydroxylamine hydrochloride to each vessel to reduce the excess permanganate. If additional potassium permanganate was added prior to digestion, additional aliquots of hydroxylamine hydrochloride will be needed. Transfer each digestate to individual autoanalyzer tubes.

10.4 Sample Analysis

Load the autoanalyzer tubes onto the instrument. An example analytical sequence that includes initial calibration (ICAL) is provided below.

Injection Number	Lab Description
1	Calibration Blank
2	0.2 ug/L Calibration Standard
3	0.5 ug/L Calibration Standard
4	1.0 ug/L Calibration Standard
5	5.0 ug/L Calibration Standard
6	10.0 ug/L Calibration Standard
7	ICV
8	ICB
9	CRI (if client requested)
10	CCV
11	CCB
12-21	10 Samples*
22	CCV
23	CCB
24-33	10 Samples*
34	CCV
35	CCB
	Repeat until ending with CCV/CCB

**The number of samples between each CCB/CCV (10) includes the method blank, laboratory control sample, matrix spikes, and sample duplicates.*

11.0 <u>Calculations / Data Reduction</u>

11.1 Quantitative Identification

During analysis, the data processing system constructs a calibration curve by plotting the absorbence of standards versus units of mercury and sample concentrations are determined from the calibration curve. For each sample one replicate is acquired and the data system presents the sample result in concentration (ppb).

11.2 Calculations

See Appendix C.

11.3 Data Review

11.3.1 Primary Review

Review project documents such as the environmental test request (ETR) analytical worksheets, Project Plan (PP), Project Memo or any other document/process used to communicate project requirements to ensure those project requirements were met. If project requirements were not met, immediately notify the project manager (PM) to determine an appropriate course of action.

Review the instrument QC against the acceptance criteria given in Section 10.0 and summarized in Table 2. If the results do not fall within acceptance criteria, perform the recommended corrective action. If corrective action is not taken, document the situation with a nonconformance report (NCR) and provide technical justification for the decision to proceed with analysis in the NCR. If corrective action is not successful, provide explanation as appropriate in the NCR.

Review the method blank against the acceptance criteria given in Table 2. If criteria are not met, investigate the source of contamination, eliminate the problem and re-prepare and reanalyze the MB along with associated samples if the concentration of the MB is above the RL (½ RL for DoD projects) and is greater than 1/10 the concentration measured in any sample. If the concentration of the MB is less than 1/10 the concentration measured in any sample, corrective action is not required unless otherwise specified on a project basis.

In the absence of project-specific control limits, use the in-house control limits for the evaluation of the LCS, MS/MSD and sample duplicate (SD). If results are outside control limits initiate a nonconformance report (NCR) or correct the problem and re-prepare and reanalyze the LCS along with associated samples. If corrective action is not taken provide technical justification for the decision to proceed with analysis in the NCR.

Dilute and reanalyze samples whose results exceed the calibration range. The diluted analysis should result in a determination within the upper half of the calibration curve.

If a sample was analyzed immediately following a high concentration sample, review the results of the sample for any sign of carry over. If carry over is suspected, reanalyze the sample.

11.3.2 Secondary Data Review

Review project documents such as the environmental test request (ETR) analytical worksheets, Project Plan (PP), Project Memo or any other document/process used to communicate project requirements to ensure those project requirements were met. If project requirements were not met, immediately notify the project manager (PM) to determine an appropriate course of action.

Verify that the performance criteria for the QC items listed in Table 2 were met. If the results do not fall within the established limits verify the recommended corrective actions were performed. If corrective action was not taken or is unsuccessful, ensure the situation is documented with a nonconformance report (NCR) and ensure data is qualified accordingly. Report the nonconformance in the narrative note program.

11.4 Data Reporting

Report analytical results above the reporting limit (RL) as the value found. Adjust the RL for sample dilution/concentration. If reporting of estimated values is specified for the project, report analytical results between the MDL as the value found qualified with a "B" data flag to indicate the value is estimated. Report analytical results less than the RL and the MDL as MDL "U". Due to limitations with the laboratory's data processing software, the laboratory does not have the capability to report non-detect results to the laboratory's reporting limit.

When multiple dilutions are performed, the laboratory routinely reports the result from the appropriate diluted run (i.e. no target analyte above calibration range and the result for the analyte for which the dilution was performed is in the upper half of the calibration range). Undiluted and lesser dilutions are not routinely provided unless specifically requested by the client. For DoD work, the DoD QSM requires that the undiluted analysis or most concentrated dilution be reported along with the appropriate dilution (i.e. report multiple dilutions).

Review project documents such as the environmental test request (ETR) analytical worksheets, Project Plan (PP), Project Memo or any other document/process used to communicate project requirements to ensure those project requirements were met. If project requirements were not met, immediately notify the project manager (PM) to determine an appropriate course of action.

Generate the data report in the deliverable format specified by the laboratory PM and release the report to report management.

Retain, manage and archive electronic and hardcopy data as specified in laboratory SOP BR-QA-014 Laboratory Records.

12.0 <u>Method Performance</u>

12.1 Method Detection Limit Study (MDL)

Perform a method detection limit (MDL) study at initial method set-up following the procedures specified in laboratory SOP BR-QA-005 *Determination of LOQs, LODs, and MDLs*. An MDL study is performed annually after initial method set-up.

12.2 Demonstration of Capabilities (DOC)

Perform a method demonstration of capability at initial set-up and when time there is a significant change in instrumentation or procedure.

Each analyst that performs the analytical procedure must complete an initial demonstration of capability (IDOC) prior to independent analysis of client samples. Each analyst must demonstrate on-going proficiency (ODOC) annually thereafter. DOC procedures are further described in the laboratory's quality system manual (QAM) and in laboratory SOP BR-QA-011 *Employee Training and Analyst Demonstration of Proficiency*.

12.3 Instrument Detection Limit

Determine the instrument detection limits (IDL) for each individual analyte line. Refer to laboratory SOP BR-ME-017 for additional guidance on the procedures for IDL studies. Determine IDLs once every 3 months.

12.4 Training Requirements

Any employee that performs any portion of the procedure described in this SOP must have documentation in their employee training file that they have read this version of this SOP.

Instrument analysts, prior to independent analysis of client samples, must also have documentation of demonstration of initial proficiency (IDOC) and annual on-going proficiency (ODOC) in their employee training files.

13.0 Pollution Control

It is TestAmerica's policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, ordering chemicals based on quantity needed, preparation of reagents based on anticipated usage and reagent stability).

14.0 Waste Management

Waste management practices are conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes are disposed of in an accepted manner. Waste description rules and land disposal restrictions are followed. Waste disposal procedures are incorporated by reference to laboratory SOP BR-LP-001.

15.0 References / Cross-References

- SW-846 Method 7470A "Mercury in Liquid Waste (Manual Cold-Vapor Technique)", Revision 1, September 1994.
- Laboratory SOP BR-QA-005, Procedures for the Determination of Limits of Detection (LOD), Limits of Quantitation (LOQ) and Reporting Limits (RL).
- Laboratory SOP BR-QA-011 *Employee Training*
- Laboratory SOP BR-LP-011 *Hazardous Waste*
- Laboratory SOP BR-QA-014 *Laboratory Records*
- Laboratory Quality Assurance Manual (QAM)

16.0 Method Modifications

None

17.0 Attachments

- Table 1: Primary Materials Used
- Table 2: QC Summary & Recommended Corrective Action
- Appendix A: Terms and Definitions
- Appendix B: Standard Preparation Tables
- Appendix C: Equations

18.0 Revision History

- The expiration date of the 100 ug/L working standard was changed from 6 months to daily.
- Updated to reflect a sample volume of 50 mL instead of 100 mL.

Table 1: Primary Materials Used

Material (1)	Hazards	Exposure Limit (2)	Signs and symptoms of exposure
Mercury (1,000 PPM in Reagent)	Oxidizer Corrosive Poison	0.1 Mg/M3 Ceiling (Mercury Compounds)	Extremely toxic. Causes irritation to the respiratory tract. Causes irritation. Symptoms include redness and pain. May cause burns. May cause sensitization. Can be absorbed through the skin with symptoms to parallel ingestion. May affect the central nervous system. Causes irritation and burns to eyes. Symptoms include redness, pain, and blurred vision; may cause serious and permanent eye damage.
Sulfuric Acid	Corrosive Oxidizer Dehydrator Poison	1 Mg/M3-TWA	Inhalation produces damaging effects on the mucous membranes and upper respiratory tract. Symptoms may include irritation of the nose and throat, and labored breathing. Symptoms of redness, pain, and severe burn can occur. Contact can cause blurred vision, redness, pain and severe tissue burns. Can cause blindness.
Nitric Acid	Corrosive Oxidizer Poison	2 ppm-TWA 4 ppm-STEL	Nitric acid is extremely hazardous; it is corrosive, reactive, an oxidizer, and a poison. Inhalation of vapors can cause breathing difficulties and lead to pneumonia and pulmonary edema, which may be fatal. Other symptoms may include coughing, choking, and irritation of the nose, throat, and respiratory tract. Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and stain skin a yellow or yellow-brown color. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Potassium Permanganate	Oxidizer	5 Mg/M3 for Mn Compounds	Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath. Dry crystals and concentrated solutions are caustic causing redness, pain, severe burns, brown stains in the contact area and possible hardening of outer skin layer. Diluted solutions are only mildly irritating to the skin. Eye contact with crystals (dusts) and concentrated solutions causes severe irritation, redness, and blurred vision and can cause severe damage, possibly permanent.
Hydrochloric Acid	Corrosive Poison	5 PPM-Ceiling	Inhalation of vapors can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory failure, and death. Can cause redness, pain, and severe skin burns. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Potassium Persulfate	Oxidizer	None	Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath. Causes irritation to skin and eyes. Symptoms include redness, itching, and pain. May cause dermatitis, burns, and moderate skin necrosis.
1 – Always add acid to water to prevent violent reactions.			
2 – Exposure limit refers to the OSHA regulatory exposure limit.			

Table 2: QC Summary, Frequency, Acceptance Criteria and Recommended Corrective Action for Routine and DoD v3.0

QC Item	Frequency	Acceptance Criteria	Recommended Corrective Action[1]
ICAL	Daily prior to sample analysis	Linear Regression: r ≥ 0.995	Correct problem, repeat calibration.
ICV	After each calibration, prior to sample analysis.	(% R) 90-110	Correct problem and verify second source standard. If that fails, repeat initial calibration.
ICB	Beginning of analytical sequence after ICV	Routine: No analytes ≥ RL DoD: > 2X MDL	Correct problem and reanalyze.
CCV	Beginning of sequence, after every 10 samples and at the end of the analytical sequence	±20% of expected value	Correct problem, reanalyze CCV. If that fails, repeat calibration and reanalyze all samples since last successful calibration.
CCB	After every 10 samples and at end of the sequence (i.e. after each CCV)	Routine: No analytes ≥ RL DoD: > 2X MDL	Correct problem and reanalyze the calibration blank and previous 10 samples.
MB	One per digestion batch of 20 or less samples	Routine: No analytes ≥ RL DoD: ½ ≥RL	Correct problem, redigest and reanalyze MB and associated samples.
LCS	One per digestion batch of 20 or less samples	%R (85-115)	Correct problem, redigest and reanalyze LCS, MB and associated samples for failed analytes if sufficient sample volume is available.
MS	One per batch of twenty samples or less	%R (85-115)	Examine project DQO's with Project Manager. Evaluate data to determine if outage is related to analytical error or matrix effect.
DP	One per batch of twenty samples or less	RPD < 20	Examine project DQO's with Project Manager. Evaluate data to determine source of difference between results.

[1]The recommended corrective action may include some or all of the items listed in this column. The corrective action taken may be dependent on project data quality objectives and/or analyst judgment but must be sufficient to ensure that results will be valid. If corrective action is not taken or is not successful, data must be flagged with appropriate qualifiers.

Table 2A: QC Summary, Frequency, Acceptance Criteria and Recommended Corrective Action for DoD v4.1

QC Item	Frequency	Acceptance Criteria	Recommended Corrective Action[1]
ICAL	Daily prior to sample analysis	Linear Regression: r ≥ 0.995	Correct problem, repeat calibration.
ICV	After each calibration, prior to sample analysis.	(%R) 90-110	Correct problem and verify second source standard. If that fails, repeat initial calibration.
ICB	Beginning of analytical sequence after ICV	No analytes > LOD	Correct problem and reanalyze.
CCV	Beginning of sequence, after every 10 samples and at the end of the analytical sequence	±20% of expected value	Correct problem, reanalyze CCV. If that fails, repeat calibration and reanalyze all samples since last successful calibration.
CCB	After every 10 samples and at end of the sequence (i.e. after each CCV)	No analytes > LOD	Correct problem and reanalyze the calibration blank and previous 10 samples.
MB	One per digestion batch of 20 or less samples	No analytes detected > ½ RL (common lab contaminants > RL) **and** >1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Correct problem, redigest and reanalyze MB and associated samples.
LCS	One per digestion batch of 20 or less samples	(%R) 80-120	Correct problem, redigest and reanalyze LCS, MB and associated samples for failed analytes if sufficient sample volume is available.
MS	One per batch of twenty samples or less	(%R) 80-120	Examine project DQO's with Project Manager. Evaluate data to determine if outage is related to analytical error or matrix effect.
DP	One per batch of twenty samples or less	RPD < 20	Examine project DQO's with Project Manager. Evaluate data to determine source of difference between results.

[1]The recommended corrective action may include some or all of the items listed in this column. The corrective action taken may be dependent on project data quality objectives and/or analyst judgment but must be sufficient to ensure that results will be valid. If corrective action is not taken or is not successful, data must be flagged with appropriate qualifiers.

Appendix A: Terms and Definitions

Acceptance Criteria: specified limits placed on characteristics of an item, process or service defined in requirement documents.

Accuracy: the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator.

Analyte: The specific chemicals or components for which a sample is analyzed. (EPA Risk Assessment Guide for Superfund, OSHA Glossary).

Batch: environmental samples that are prepared and/or analyzed together with the same process, using the same lot(s) of reagents. A preparation/digestion batch is composed of one to 20 environmental samples of similar matrix, meeting the above criteria. An analytical batch is composed of prepared environmental samples (extracts, digestates and concentrates), which are analyzed together as a group.

Calibration: a set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material and the corresponding values realized by the standards.

Calibration Curve: the graphical relationship between the known values or a series of calibration standards and their instrument response.

Calibration Standard: A substance or reference used to calibrate an instrument.

Continuing Calibration Verification (CCV): a single or multi-parameter calibration standard used to verify the stability of the method over time. Usually from the same source as the calibration curve.

Corrective Action: the action taken to eliminate the cause of an existing nonconformity, defect or other undesirable occurrence in order to prevent recurrence.

Data Qualifier: a letter designation or symbol appended to an analytical result used to convey information to the data user. (Laboratory)

The qualifiers that are routinely used for this test method are:

U: Analyte analyzed for but not detected at a concentration above the detection limit.
B: Estimated Value

Demonstration of Capability (DOC): procedure to establish the ability to generate acceptable accuracy and precision.

Holding Time: the maximum time that a sample may be held before preparation and/or analysis as promulgated by regulation or as specified in a test method.

Initial Calibration: Analysis of analytical standards for a series of different specified concentrations used to define the quantitative response, linearity and dynamic range of the instrument to target analytes.

Intermediate Standard: a solution made from one or more stock standards at a concentration between the stock and working standard. Intermediate standards may be certified stock standard solutions purchased from a vendor and are also known as secondary standards.

Laboratory Control Sample (LCS): a blank matrix spiked with a known amount of analyte(s) processed simultaneously with and under the same conditions as samples through all steps of the procedure.

Matrix Spike (MS): a field sample to which a known amount of target analyte(s) is added.

Matrix Spike Duplicate (MSD): a second replicate matrix spike

Method Blank (MB): a blank matrix processed simultaneously with and under the same conditions as samples through all steps of the procedure. Also known as the preparation blank (PB).

Method Detection Limit (MDL): the minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific measurement system. The MDL is a statistical estimation at a specified confidence interval of the concentration at which relative uncertainty is ±100%. The MDL represents a range where qualitative detection occurs. Quantitative results are not produced in this range.

Non-conformance: an indication, judgment, or state of not having met the requirements of the relevant specification, contract or regulation.

Precision: the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves.

Preservation: refrigeration and/or reagents added at the time of sample collection to maintain the chemical, physical, and/or biological integrity of the sample.

Quality Control Sample (QC): a sample used to assess the performance of all or a portion of the measurement system.

Reporting Limit (RL): the level to which data is reported for a specific test method and/or sample.

Stock Standard: a solution made with one or more neat standards usually with a high concentration. Also known as a primary standard. Stock standards may be certified solutions purchased from a vendor.

Appendix B: Standard Preparation Tables

The standard formulations contained in this Appendix are recommended and are subject to change. If the concentration of the stock standard is different than those noted in this table, adjust the standard preparation formulation accordingly. Unless otherwise specified, prepare the standard solutions in hexane using Class A volumetric glassware and Hamilton syringes. Unless otherwise specified for a standard solution, assign an expiration date of 6 months from date of preparation unless the parent standard expires sooner in which case use the earliest expiration date. See laboratory SOP BR-QA-002 *Standard Preparation* for further guidance.

Intermediate Calibration Standards (10,000 ug/L)

Parent Standard	Vendor	Component	Stock Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
Mercury	SPEX	Mercury	1000	1.0	100	10000

Add the mercury standard and 0.15 mL of concentrated HNO_3 to a 100 mL volumetric flask that contains approximately 80 mL of reagent water. Adjust to final volume with reagent water.

Working Calibration Standards (100 ug/L)

Parent Standard	Vendor	Component	Parent Standard Concentration (ug/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
Intermediate Calibration	Laboratory Prepared	Mercury	10000	10.0	1000	100

Add the mercury standard and 1.5 mL of concentrated HNO_3 to a 1000 mL volumetric flask that contains approximately 800 mL of reagent water. Adjust to final volume with reagent water.

Intermediate ICV Standard (10,000 ug/L)

Parent Standard	Vendor	Component	Stock Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
Mercury	Inorganic Ventures	Mercury	1000	1.0	100	10000

Add the mercury standard and 0.15 mL of concentrated HNO_3 to a 100 mL volumetric flask that contains approximately 80 mL of reagent water. Adjust to final volume with reagent water.

Working ICV Standard (30 ug/L)

Parent Standard	Vendor	Component	Parent Standard Concentration (ug/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
Intermediate ICV	Laboratory Prepared	Mercury	10000	1.5	500	30

Add the mercury standard and 0.75 mL of concentrated HNO_3 to a 500 mL volumetric flask that contains approximately 300 mL of reagent water. Adjust to final volume with reagent water.

Mercury Calibration Standards: CAL Levels 1- 6

Parent Standard	Calibration Standard	Parent Standard Concentration (ug/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration* (ug/L)
Reagent Water	Blank	0	50	50	0
Intermediate Calibration	Level 1	100	0.1	50	0.2
Intermediate Calibration	Level 2	100	0.25	50	0.5
Intermediate Calibration	Level 3	100	0.5	50	1
Intermediate Calibration	Level 4	100	2.5	50	5
Intermediate Calibration	Level 5	100	5.0	50	10

**The final concentration is achieved after digestion.*

Appendix C: Equations

Percent Recovery (%R)

$$\%R = \frac{C_s}{C_n} \times 100\%$$

Where:
C_s = Concentration of the Spiked Field or QC Sample
C_n = Nominal Concentration of Spike Added

Percent Recovery (%R) for MS

$$\%R \text{ for MS} = \frac{C_s - C_u}{C_n} \times 100\%$$

Where:
C_s = Concentration of the Spiked Sample
C_u = Concentration of the Unspiked Sample
C_n = Nominal Concentration of Spike Added

Relative Percent Difference (%RPD)

$$\%RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100\%$$

Where:
C_1 = Measured Concentration of First Sample
C_2 = Measured Concentration of Second Sample

Water Sample Concentration

$$C_{(ug/L)} = \frac{\mu g}{L_{dig}} * \frac{V_{dig}}{V_{samp}}$$

Where:
$\mu g/L_{dig}$ = Instrument result adjusted for dilution factors
V_{dig} = Final digestate volume
V_{samp} = Sample volume

Title: Mercury by CVAA (SW-846 7471A)

Approval Signatures:

William S. Cicero
Laboratory Director

Jessica A. Holzschuh
Department Manager

Kirstin L. McCracken
Quality Assurance Manager

Bryce E. Stearns
Technical Director

Dan Helfrich
Health & Safety Coordinator

Approval Date: March 5, 2010

Facility Distribution No. Electronic **Distributed To: Facility Intranet**

The controlled copy of this SOP is the PDF copy of the SOP that is posted to the laboratory's SOP Directory. Printed copies of this SOP or electronic copies of this SOP distributed outside the facility are considered uncontrolled.

1.0 Scope and Application

This SOP describes the laboratory procedure for determining of total mercury using cold vapor technique with atomic absorption (AA).

1.1 Analytes, Matrix(s), and Reporting Limits

This procedure may be used for a variety of matrices including: soils, sediments, bottom deposits, and sludge-type materials.

The routine RL for solid samples is 0.033 mg/Kg based on a sample digestion weight of 0.3 grams and a final volume of 50 mL.

2.0 Summary of Method

A portion of solid sample is acid digested for 2 minutes at a temperature of 95°C then digested with potassium permanganate and potassium persulfate for 30 minutes at a temperature of 95°C. Hydroxylamine hydrochloride is added to each digestate in order to reduce excess permanganate. The digestate is placed on a closed-system mercury autoanalyzer and stannous chloride is added to each sample. The elemental mercury released is measured spectrophotometrically at a wavelength of 253.7 nm. The concentration is calculated from the response of the sample absorbance applied against the calibration curve.

This procedure is based on the following reference method:

- SW-846 Method 7471A, Revision 1, September 1994.

If the laboratory's procedure is modified from the reference method, a list of such modifications will be provided in Section 16.0

3.0 Definitions

A list of terms and definitions are provided in Appendix A.

4.0 Interferences

Potassium permanganate is added to the samples to eliminate possible interference from sulfide. Copper has also been noted as an interferent but per reference method SW-846 7471A concentrations as high as 10mg/Kg had no effect on recovery of mercury from spiked samples.

Samples high in chlorides may require additional permanganate because during the oxidation step, chlorides are converted to free chlorine, which also absorbs radiation of 253nm. Care must be taken to ensure free chlorine is not present and this is accomplished by the addition of hydroxylamine hydrochloride and stannous chloride.

5.0 Safety

Employees must abide by the policies and procedures in the Corporate Safety Manual, Radiation Safety Manual and this document.

This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.1 Specific Safety Concerns or Requirements

Samples that contain high concentrations of carbonates or organic material or samples that are at elevated pH can react violently when acids are added.

5.2 Primary Materials Used

Table 1 lists those materials used in this procedure that have a serious or significant hazard rating along with the exposure limits and primary hazards associated with that material as identified in the MSDS. **NOTE: This list does not include all materials used in the method.** A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the MSDS for each material before using it for the first time or when there are major changes to the MSDS.

6.0 Equipment and Supplies

Catalog numbers listed in this SOP are subject to change at the discretion of the vendor. Analysts are cautioned to be sure equipment used meets the specification of this SOP.

6.1 Miscellaneous

- Block Digester: Environmental Express or equivalent: able to maintain digestates at a temperature of 95°C.
- Polyethylene Digestion Vessels with Volumetric Indicators.
- Volumetric Pipettes: Calibrated daily.
- Top Loading Balance: capable of measuring to 0.01 grams.

6.2 Analytical System

- Leeman Labs Hydra AA.

7.0 Reagents and Standards

7.1 Reagents

- Reagent Water
- Aqua Regia: Prepare by carefully adding 3 volumes of concentrated hydrochloric acid to one volume of concentrated nitric acid.
- Nitric Acid (HNO_3): concentrated, reagent grade: J.T. Baker or equivalent.
- Hydrochloric Acid (HCl): concentrated, reagent grade: J.T. Baker or equivalent.
- Stannous Chloride: reagent grade: J.T. Baker or equivalent.
- Potassium Permanganate ($KMNO_4$): reagent grade: J.T. Baker or equivalent.

HCl Solution (10% v/v): Add 100 mL of concentrated HCl to a 1 L volumetric flask containing ~800 mL of reagent water. Bring final volume of solution up to 1 L with reagent water. Assign an expiration date of 1 year from opened date and store this solution at ambient temperature.

Stannous Chloride Solution: Add 100 g of $SnCl_2{}^{\circ}H_2O$ to 1 L of 10% hydrochloric acid. Assign an expiration date of 6 months from date prepared and store this solution at ambient temperature.

Hydroxylamine Hydrochloride Solution: Dissolve 240 g of Hydroxylamine Hydrochloride in 2 L of reagent water. Assign an expiration date of 6 months from date prepared and store this solution at ambient temperature.

Potassium Permanganate Solution ($KMNO_4$) (5% w/v): Dissolve 100g of $KMNO_4$ in 2 L of reagent water. Assign an expiration date of 6 months from date prepared and store this solution at ambient temperature.

7.2 Standards

- Hg Stock Standard Solution (1000 mg/L): Purchase from Spex or equivalent.

Mercury Intermediate Standard (10,000 ug/L): Add 1 mL of 1000 mg/L Hg Stock Standard Solution and 0.15 mL of concentrated HNO_3 to a 100 mL volumetric flask that contains approximately 80 mL reagent water. Adjust to volume with reagent water. Assign an expiration date of six months from the date made, or the manufacturers date, whichever is sooner.

Mercury Working Standard (100 ug/L): Add 1.0 mL of the Hg Intermediate Standard Solution and 0.15 mL of concentrated HNO_3 to a 100 mL volumetric flask that contains approximately 80 mL reagent water. Adjust to volume with reagent water. Use this standard to prepare the calibration standards (ICAL & CCV). Prepare this standard each day of use.

- ICV Stock Standard Solution (1000 mg/L): Purchase from Inorganic Ventures or equivalent so long as the manufacturer is different than the primary source standard.

ICV Intermediate Standard Solution (10,000 ug/L): Add 1 mL of the 1000 mg/L ICV Stock Standard Solution and 0.15 mL of concentrated HNO_3 to a 100 mL volumetric flask that contains approximately 80 mL reagent water. Adjust to volume with reagent water. Assign an expiration date of six months from the date made, or the manufacturers date, whichever is sooner.

ICV Working Standard Solution (30 ug/L): Add 1.5 mL of the ICV Intermediate Standard Solution and 0.75 mL of concentrated HNO_3 into a 500 mL volumetric flask that contains approximately 300 mL reagent water. Adjust to volume with reagent water. Assign an expiration date of six months from the date made, or the manufacturers date, whichever is sooner.

8.0 Sample Collection, Preservation, Shipment and Storage

The laboratory does not perform sample collection so these procedures are not included in this SOP. Sampling requirements may be found in the published reference method.

Listed below are minimum sample size, preservation and holding time requirements:

Matrix	Sample Container	Minimum Sample Size	Preservation	Holding Time	Reference
Solid	glass or polyethylene	100 mL	$4^oC \pm 2$	28 days from collection	SW-846 7471A

Unless otherwise specified by client or regulatory program, after analysis, samples and extracts are retained for a minimum of 30 days after provision of the project report and then disposed of in accordance with applicable regulations.

9.0 Quality Control

9.1 Sample QC

The laboratory prepares the following quality control samples with each batch of samples:

QC Item	Frequency	Acceptance Criteria
Method Blank (MB)	1 in 20 or fewer samples	See Table 2
Laboratory Control Sample (LCS)	1 in 20 or fewer samples	See Table 2
Matrix Spike(s) MS	1 in 20 or fewer samples	See Table 2
Sample Duplicate (SD)	1 in 20 or fewer samples	See Table 2

9.2 Instrument QC

The following instrument QC is performed:

QC Item	Frequency	Acceptance Criteria
Initial Calibration (ICAL)	Initially; when ICV or CCV fail	See Section 10.0
Second Source Calibration Verification (ICV)	Once, after each ICAL	See Section 10.0
Continuing Calibration Verification (CCV)	Daily, every 10 samples, end of sequence	See Section 10.0

10.0 Procedure

10.1 Instrument Operating Conditions

Turn on the instrument lamp, gas and pump. Allow 15 minutes for the instrument to warm up. Fill the rinse bath with 10% hydrochloric acid solution. Check all tubing connections and reset the calibration curve. Check the stannous chloride reductant reservoir and fill as necessary. Check and record the 0.2ug/L standard intensity. This value must be >2500. When applicable, record sample intensity and reference intensities and verify against previous day. Perform maintenance to increase intensities if needed.

On the PC connected to the instrument, select the autosampler template and enter the sample IDs in the order of analysis. Place the samples, calibration blanks, calibration standards, and performance check standards in the position on the autosampler rack that corresponds to their assigned position in the autosampler template. Place the autosampler rack in the autosampler tray and initiate the software macro to begin analysis.

10.2 Determination of MDLs and IDLs

Determine the sensitivity (MDL), instrument detection limits (IDL), linear dynamic range and interference effects for each individual analyte line. Refer to laboratory SOP BR-QA-005 for additional guidance on the procedures for MDL and laboratory SOP BR-ME-017 for additional guidance on the procedures for IDL studies. Determine MDLs annually and IDLs every 3 months.

10.3 Instrument Calibration

10.3.1 Initial Calibration (ICAL)

The mercury autoanalyzers are calibrated with five calibration standards and a blank at the beginning of each analytical sequence using the instrument operating conditions established by the manufacturer of the instrument. Operating instructions for the instrument are described in the instrument manual(s) located in the laboratory.

The calibration standards are prepared daily by making successive dilutions of the working standard (100ug/L). The final concentration of the prepared calibration standards is given in the standard formulation tables in appendix A.

The calibration standards are digested and analyzed following the procedures given in Section 10.3. After analysis, the data system prepares a standard curve by plotting the instrument response of the calibration standards against the true value concentration and using linear regression calculates the correlation coefficient. The correlation coefficient must be greater than or equal to 0.995.

10.3.2 Second Source Calibration Verification (ICV)

Immediately after the instrument is calibrated, the accuracy of calibration is verified with analysis of the ICV standard. The ICV standard solution is prepared, digested and analyzed with the samples following the procedures given in Section 10.3. The percent recovery of the ICV must be within 90-110%. If this criterion is not met the analysis is stopped the instrument is recalibrated and a new analytical sequence is initiated.

10.3.3 Continuing Calibration Verification (CCV)

To ensure the accuracy of the calibration during the analysis run, a CCV standard is analyzed at the beginning and end of each analytical run, every 10 samples or every 2 hours, whichever is more frequent. The concentration of the CCV standard should be at or near the mid point of the calibration curve and must be different than the concentration of the ICV. The CCV standard is prepared, digested and analyzed with the samples following the procedure given in Section 10.3. The percent recovery of the CCV must be within 80-120%. If this criterion is not met the analysis is stopped, the problem is corrected, the instrument is recalibrated and verified and all samples analyzed since the last compliant CCV are reanalyzed.

10.3.4 Initial and Continuing Calibration Blanks (ICB/CCB)

Calibration blanks are analyzed at each wavelength after every ICV and CCV, at a frequency of every 10 samples or every 2 hours, whichever is more frequent. The blanks are also analyzed at the beginning of the run and after the last sample (after the last CCV). The ICB/CCB are prepared, digested and analyzed with the samples following the procedure given in Section 10.3. The absolute value of the ICB/CCB must be less than the CRQL. If it is not, the analysis is stopped, the problem is corrected, the instrument is recalibrated and verified and all samples analyzed since the last compliant ICB/CCB are reanalyzed.

10.3.5 Low Level Standard (CRI)

At a client's request, to verify linearity near the RL, a low level standard may be analyzed at the beginning of each analytical run following the ICB. The CRI standard is the same (0.2ug/L) solution used as the second level of the calibration curve. The CRI is prepared, digested and analyzed with the samples following the procedure given in Section 10.3.

10.3.6 Calibration Acceptance Summary Table

Calibration Item	Calibration Type	Frequency	Criteria
ICAL	Linear Regression	Prior to each analytical sequence	0.995 or better.
ICV	Initial calibration verification	Once per analytical sequence immediately following ICAL.	90-110%
ICB	Initial calibration blank	Once per analytical sequence immediately following ICV.	<RL
CCV	Continuing calibration verification	At the beginning of each run, every 10 samples or every 2 hours, whichever is more frequent, and at the end of the analytical sequence.	80-120%
CCB	Continuing calibration blank	At the beginning of each run, every 10 samples or every 2 hours, whichever is more frequent, and at the end of the analytical sequence, always following a CCV.	<RL
CRI	RL Check standard	Per client request. Inset at the beginning of each run following the ICB.	Client specified.

Troubleshooting:

Check the following items in case of calibration failures:

- ICAL Failure – Perform instrument maintenance, change pump tubing, adjust the lamp, clean the sipper tip, replace the drying tube, clean or replace the optical cell. Re-pour curve standards and restart calibration.
- CCV/CRI Failure – Perform instrument maintenance, change pump tubing, adjust the lamp, clean the sipper tip, replace the drying tube, clean or replace the optical cell. Re-pour CCV or CRI standards and restart calibration and analytical sequence.

10.4 Sample Preparation

Weigh 0.3 g of sample into a polyethylene digestion vessel. Add 5 mL of reagent water. Weigh 0.3 g of Teflon chips and use reagent water for the method blank and the laboratory control sample (LCS). Use reagent water for each calibration blank. Add 0.50 mL of the Hg working standard solution (100 ug/L) to the LCS and the matrix spike.

To prepare the ICV, transfer 5 mL of the ICV working standard solution (30 ug/L) to a labeled polyethylene digestion vessel and add 45 mL of reagent water.

For each CCV, transfer 2.5 mL of the Hg working standard solution (100 ug/L) to a labeled polyethylene digestion vessel and add 47.5 mL of reagent water.

If analysis of a low-level standard is requested, transfer 0.1 mL of the Hg working standard solution (100ug/L) to a labeled polyethylene digestion vessel and adjust the volume to 50 mL with reagent water.

To each sample, standard, and blank add 2.5 mL of aqua regia. Heat for 2 minutes in a digestion block at 95°C. Allow the samples to cool then add 20 mL of reagent water, 7.5 mL of potassium permanganate, and swirl to mix. Return to the block for 30 minutes. Cool and, when ready to analyze, add 3 mL of hydroxylamine hydrochloride to reduce the excess permanganate. Swirl each vessel to ensure that any soluble residue dissolves back into solution. If the color of any sample is still purple, add hydroxylamine hydrochloride in 3 mL increments until the purple color disappears. Add 25 mL of reagent water to each vessel and transfer the digestate to individual autoanalyzer tubes for analysis.

10.5 Sample Analysis

Load the autoanalyzer tubes onto the instrument. An example analytical sequence that includes initial calibration (ICAL) is provided below.

Injection Number	Lab Description
1	Calibration Blank
2	0.2 Calibration Standard
3	0.5 Calibration Standard
4	1.0 Calibration Standard
5	5.0 Calibration Standard
6	10.0 Calibration Standard
7	ICV
8	ICB
9	CRI (if client requested)
10	CCV
11	CCB
12-21	10 Samples*
22	CCV
23	CCB
24-33	10 Samples*
34	CCV
35	CCB
	Repeat until ending with CCV/CCB

**The number of samples between each CCB/CCV (10) includes the method blank, laboratory control sample, matrix spikes, and sample duplicates.*

11.0 <u>Calculations / Data Reduction</u>

11.1 Quantitative Identification

During analysis, the data processing system constructs a calibration curve by plotting the absorbance of standards versus units of mercury and sample concentrations are determined from the calibration curve. For each sample one replicate is acquired and the data system presents the sample result in concentration (ppb).

11.2 Calculations

See Appendix C.

11.3 Data Review

11.3.1 Primary Review

Review project documents such as the environmental test request (ETR) analytical worksheets, Project Plan (PP), Project Memo or any other document/process used to communicate project requirements to ensure those project requirements were met. If project requirements were not met, immediately notify the project manager (PM) to determine an appropriate course of action.

Review the instrument QC against the acceptance criteria given in Section 10.0 and summarized in Table 2. If the results do not fall within acceptance criteria, perform the recommended corrective action.

Upload the data files from the data processing system to the laboratory information management system (LIMS). Enter batch information and standards and reagents into the LIMS batch. Review the data in LIMS and set results to primary, secondary, acceptable or rejected as appropriate. Initiate a nonconformance memo for QC outside established acceptance criteria then set samples in batch to 1st level review.

11.3.2 Secondary Review

Review project documents such as the Project Plan (PP), Project Memo or any other document/process used to communicate project requirements to ensure those project requirements were met. If project requirements were not met, immediately notify the project manager (PM) to determine an appropriate course of action.

Check the batch editor and worksheet to verify the batch is complete and any outages are documented with an NCM along with the results of any corrective actions taken. Spot check results and when complete, set the status of the batch to second level review.

Run the QC Checker, investigate and correct any problems found. Run and review the deliverable. Fix any problems found then set the method chain to lab complete.

11.3.3 Data Reporting

Data reporting and creation of the data deliverable is performed by the LIMS using the formatters set by the project manager during project initiation.

Electronic and hardcopy data are maintained as described in laboratory SOP BR-QA-014 Laboratory Records.

12.0 Method Performance

12.1 Method Detection Limit Study (MDL)

Perform a method detection limit (MDL) study at initial method set-up following the procedures specified in laboratory SOP BR-QA-005. An MDL study is performed annually after initial method set-up.

12.2 Demonstration of Capabilities (DOC)

Perform a method demonstration of capability at initial set-up and when time there is a significant change in instrumentation or procedure.

Each analyst that performs the analytical procedure must complete an initial demonstration of capability (IDOC) prior to independent analysis of client samples. Each analyst must demonstrate on-going proficiency (ODOC) annually thereafter. DOC procedures are further described in the laboratory's quality system manual (QAM) and in the laboratory SOP for employee training.

12.3 Training Requirements

Any employee that performs any portion of the procedure described in this SOP must have documentation in their employee training file that they have read this version of this SOP.

Instrument analysts, prior to independent analysis of client samples, must also have documentation of demonstration of initial proficiency (IDOC) and annual on-going proficiency (ODOC) in their employee training files.

13.0 Pollution Control

It is TestAmerica's policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, ordering chemicals based on quantity needed, preparation of reagents based on anticipated usage and reagent stability).

14.0 Waste Management

Waste management practices are conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes are disposed of in an accepted manner. Waste description rules and land disposal restrictions are followed. Waste disposal procedures are incorporated by reference to laboratory SOP BR-LP-001.

15.0 References / Cross-References

- Method 7471A Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique), Revision 1, September 1994. Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986.
- Laboratory SOP BR-QA-005, Procedures for the Determination of Limits of Detection (LOD), Limits of Quantitation (LOQ) and Reporting Limits (RL).
- Laboratory SOP BR-QA-011 Employee Training
- Laboratory SOP BR-LP-011 Hazardous Waste
- Laboratory SOP BR-QA-014 Laboratory Records

- Laboratory Quality Assurance Manual (QAM)

16.0 Method Modifications

None

17.0 Attachments

- Table 1: Primary Materials Used
- Table 2: QC Summary & Recommended Corrective Action
- Appendix A: Terms and Definitions
- Appendix B: Standard Preparation Tables
- Appendix C: Equations

18.0 Revision History

BR-ME-004, Revision 12:

- Title Page: Updated approval signatures
- Section 11.0: Updated procedure to be consistent with TALS process.
- All Sections: Removed references to DoD and DoD criteria. DoD protocol is specified in a controlled document separate from laboratory SOPs.

Table 1: Primary Materials Used

Material[1]	Hazards	Exposure Limit[2]	Signs and symptoms of exposure
Mercury (1,000 PPM in Reagent)	Oxidizer Corrosive Poison	0.1 Mg/M3 Ceiling (Mercury Compounds)	Extremely toxic. Causes irritation to the respiratory tract. Causes irritation. Symptoms include redness and pain. May cause burns. May cause sensitization. Can be absorbed through the skin with symptoms to parallel ingestion. May affect the central nervous system. Causes irritation and burns to eyes. Symptoms include redness, pain, and blurred vision; may cause serious and permanent eye damage.
Sulfuric Acid	Corrosive Oxidizer Dehydrator Poison	1 Mg/M3-TWA	Inhalation produces damaging effects on the mucous membranes and upper respiratory tract. Symptoms may include irritation of the nose and throat, and labored breathing. Symptoms of redness, pain, and severe burn can occur. Contact can cause blurred vision, redness, pain and severe tissue burns. Can cause blindness.
Nitric Acid	Corrosive Oxidizer Poison	2 ppm-TWA 4 ppm-STEL	Nitric acid is extremely hazardous; it is corrosive, reactive, an oxidizer, and a poison. Inhalation of vapors can cause breathing difficulties and lead to pneumonia and pulmonary edema, which may be fatal. Other symptoms may include coughing, choking, and irritation of the nose, throat, and respiratory tract. Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and stain skin a yellow or yellow-brown color. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Hydrochloric Acid	Corrosive Poison	5 PPM-Ceiling	Inhalation of vapors can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory failure, and death. Can cause redness, pain, and severe skin burns. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Potassium Permanganate	Oxidizer	5 Mg/M3 for Mn Compounds	Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath. Dry crystals and concentrated solutions are caustic causing redness, pain, severe burns, brown stains in the contact area and possible hardening of outer skin layer. Diluted solutions are only mildly irritating to the skin. Eye contact with crystals (dusts) and concentrated solutions causes severe irritation, redness, and blurred vision and can cause severe damage, possibly permanent.
Potassium Persulfate	Oxidizer	None	Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath. Causes irritation to skin and eyes. Symptoms include redness, itching, and pain. May cause dermatitis, burns, and moderate skin necrosis.

[1] Always add acid to water to prevent violent reactions.
[2] Exposure limit refers to the OSHA regulatory exposure limit.

Table 2: QC Summary, Frequency, Acceptance Criteria and Recommended Corrective Action

QC Item	Frequency	Acceptance Criteria	Recommended Corrective Action[1]
ICAL	Daily prior to sample analysis	Linear Regression: r $\geq$ 0.995	Correct problem, repeat calibration.
ICV	After each calibration, prior to sample analysis.	(% R) 90-110	Correct problem and verify second source standard. If that fails, repeat initial calibration.
ICB	Beginning of analytical sequence after ICV	Routine: No analytes $\geq$ RL	Correct problem and reanalyze.
CCV	Beginning of sequence, after every 10 samples and at the end of the analytical sequence	±20% of expected value	Correct problem, reanalyze CCV. If that fails, repeat calibration and reanalyze all samples since last successful calibration.
CCB	After every 10 samples and at end of the sequence (i.e. after each IPC)	Routine: No analytes $\geq$ RL	Correct problem and reanalyze the calibration blank and previous 10 samples.
MB	One per digestion batch of 20 or less samples	Routine: No analytes $\geq$ RL	Correct problem, redigest and reanalyze MB and associated samples.
LCS	One per digestion batch of 20 or less samples	%R (85-115)	Correct problem, redigest and reanalyze LCS, MB and associated samples for failed analytes if sufficient sample volume is available.
MS	One per batch of twenty samples or less	%R (85-115)	Examine project DQO's with Project Manager. Evaluate data to determine if outage is related to analytical error or matrix effect.
DP	One per batch of twenty samples or less	RPD $\leq$ 20	Examine project DQO's with Project Manager. Evaluate data to determine source of difference between results

[1]The recommended corrective action may include some or all of the items listed in this column. The corrective action taken may be dependent on project data quality objectives and/or analyst judgment but must be sufficient to ensure that results will be valid. If corrective action is not taken or is not successful, data must be flagged with appropriate qualifiers.

Table 2: QC Summary, Frequency, Acceptance Criteria and Recommended Corrective Action for Routine and DoD v3.0

QC Item	Frequency	Acceptance Criteria	Recommended Corrective Action[1]
ICAL	Daily prior to sample analysis	Linear Regression: r ≥ 0.995	Correct problem, repeat calibration.
ICV	After each calibration, prior to sample analysis.	(%R) 90-110	Correct problem and verify second source standard. If that fails, repeat initial calibration.
ICB	Beginning of analytical sequence after ICV	No analytes > LOD	Correct problem and reanalyze.
CCV	Beginning of sequence, after every 10 samples and at the end of the analytical sequence	±20% of expected value	Correct problem, reanalyze CCV. If that fails, repeat calibration and reanalyze all samples since last successful calibration.
CCB	After every 10 samples and at end of the sequence (i.e. after each CCV)	No analytes > LOD	Correct problem and reanalyze the calibration blank and previous 10 samples.
MB	One per digestion batch of 20 or less samples	No analytes detected > ½ RL (common lab contaminants > RL) **and** >1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Correct problem, redigest and reanalyze MB and associated samples.
LCS	One per digestion batch of 20 or less samples	(%R) 80-120	Correct problem, redigest and reanalyze LCS, MB and associated samples for failed analytes if sufficient sample volume is available.
MS	One per batch of twenty samples or less	(%R) 80-120	Examine project DQO's with Project Manager. Evaluate data to determine if outage is related to analytical error or matrix effect.
DP	One per batch of twenty samples or less	RPD < 20	Examine project DQO's with Project Manager. Evaluate data to determine source of difference between results.

[1] *The recommended corrective action may include some or all of the items listed in this column. The corrective action taken may be dependent on project data quality objectives and/or analyst judgment but must be sufficient to ensure that results will be valid. If corrective action is not taken or is not successful, data must be flagged with appropriate qualifiers.*

Appendix A: Terms and Definitions

Acceptance Criteria: specified limits placed on characteristics of an item, process or service defined in requirement documents.

Accuracy: the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator.

Analyte: The specific chemicals or components for which a sample is analyzed. (EPA Risk Assessment Guide for Superfund, OSHA Glossary).

Batch: environmental samples that are prepared and/or analyzed together with the same process, using the same lot(s) of reagents. A preparation/digestion batch is composed of one to 20 environmental samples of similar matrix, meeting the above criteria. An analytical batch is composed of prepared environmental samples (extracts, digestates and concentrates), which are analyzed together as a group.

Calibration: a set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material and the corresponding values realized by the standards.

Calibration Curve: the graphical relationship between the known values or a series of calibration standards and their instrument response.

Calibration Standard: A substance or reference used to calibrate an instrument.

Continuing Calibration Verification (CCV): a single or multi-parameter calibration standard used to verify the stability of the method over time. Usually from the same source as the calibration curve.

Corrective Action: the action taken to eliminate the cause of an existing nonconformity, defect or other undesirable occurrence in order to prevent recurrence.

Data Qualifier: a letter designation or symbol appended to an analytical result used to convey information to the data user. (Laboratory)

Demonstration of Capability (DOC): procedure to establish the ability to generate acceptable accuracy and precision.

Holding Time: the maximum time that a sample may be held before preparation and/or analysis as promulgated by regulation or as specified in a test method.

Initial Calibration: Analysis of analytical standards for a series of different specified concentrations used to define the quantitative response, linearity and dynamic range of the instrument to target analytes.

Intermediate Standard: a solution made from one or more stock standards at a concentration between the stock and working standard. Intermediate standards may be certified stock standard solutions purchased from a vendor and are also known as secondary standards.

Laboratory Control Sample (LCS): a blank matrix spiked with a known amount of analyte(s) processed simultaneously with and under the same conditions as samples through all steps of the procedure.

Matrix Spike (MS): a field sample to which a known amount of target analyte(s) is added.

Matrix Spike Duplicate (MSD): a second replicate matrix spike

Method Blank (MB): a blank matrix processed simultaneously with and under the same conditions as samples through all steps of the procedure. Also known as the preparation blank (PB).

Method Detection Limit (MDL): the minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific measurement system. The MDL is a statistical estimation at a specified confidence interval of the concentration at which relative uncertainty is ±100%. The MDL represents a range where qualitative detection occurs. Quantitative results are not produced in this range.

Non-conformance: an indication, judgment, or state of not having met the requirements of the relevant specification, contract or regulation.

Precision: the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves.

Preservation: refrigeration and/or reagents added at the time of sample collection to maintain the chemical, physical, and/or biological integrity of the sample.

Quality Control Sample (QC): a sample used to assess the performance of all or a portion of the measurement system.

Reporting Limit (RL): the level to which data is reported for a specific test method and/or sample.

Stock Standard: a solution made with one or more neat standards usually with a high concentration. Also known as a primary standard. Stock standards may be certified solutions purchased from a vendor.

Appendix B: Standard Preparation Tables

The standard formulations contained in this Appendix are recommended and are subject to change. If the concentration of the stock standard is different than those noted in this table, adjust the standard preparation formulation accordingly. Unless otherwise specified, prepare the standard solutions in hexane using Class A volumetric glassware and Hamilton syringes. Unless otherwise specified for a standard solution, assign an expiration date of 6 months from date of preparation unless the parent standard expires sooner in which case use the earliest expiration date. See laboratory SOP BR-QA-002 *Standard Preparation* for further guidance.

Intermediate Calibration Standards (10,000 ug/L)

Parent Standard	Vendor	Stock Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
Mercury	SPEX	1000	1.0	100	10000

Add the mercury standard and 0.15 mL of concentrated HNO_3 to a 100 mL volumetric flask that contains approximately 80 mL of reagent water. Adjust to final volume with reagent water.

Working Calibration Standards (100 ug/L)

Parent Standard	Vendor	Parent Standard Concentration (ug/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
Intermediate Calibration	Laboratory Prepared	10000	10.0	1000	100

Add the mercury standard and 1.5 mL of concentrated HNO_3 to a 1000 mL volumetric flask that contains approximately 800 mL of reagent water. Adjust to final volume with reagent water.

Intermediate ICV Standard (10,000 ug/L)

Parent Standard	Vendor	Stock Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
Mercury	Inorganic Ventures	1000	1.0	100	10000

Add the mercury standard and 0.15 mL of concentrated HNO_3 to a 100 mL volumetric flask that contains approximately 80 mL of reagent water. Adjust to final volume with reagent water.

Working ICV Standard (30 ug/L)

Parent Standard	Vendor	Parent Standard Concentration (ug/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
Intermediate ICV	Laboratory Prepared	10000	1.5	500	30

Add the mercury standard and 0.75 mL of concentrated HNO_3 to a 500 mL volumetric flask that contains approximately 300 mL of reagent water. Adjust to final volume with reagent water.

Mercury Calibration Standard(s): CAL Levels 1- 6

Parent Standard	Calibration Standard	Parent Standard Concentration (ug/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration* (ug/L)
Reagent Water	Blank	0	50	50	0
Intermediate Calibration	Level 1	100	0.1	50	0.2
Intermediate Calibration	Level 2	100	0.25	50	0.5
Intermediate Calibration	Level 3	100	0.5	50	1
Intermediate Calibration	Level 4	100	2.5	50	5
Intermediate Calibration	Level 5	100	5.0	50	10

**The final concentration is achieved after digestion.*

Appendix C: Equations

Percent Recovery (%R)

$$\%R = \frac{C_s}{C_n} \times 100\%$$

Where:
C_s = Concentration of the Spiked Field or QC Sample
C_n = Nominal Concentration of Spike Added

Percent Recovery (%R) for MS

$$\%R \text{ for MS} = \frac{C_s - C_u}{C_n} \times 100\%$$

Where:
C_s = Concentration of the Spiked Sample
C_u = Concentration of the Unspiked Sample
C_n = Nominal Concentration of Spike Added

Relative Percent Difference (%RPD)

$$\%RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100\%$$

Where:
C_1 = Measured Concentration of First Sample
C_2 = Measured Concentration of Second Sample

Solid Sample Concentration

$$C_{(mg/Kg\ drywt.)} = \frac{\mu g}{L_{dig}} * \frac{V_{dig}}{g_{samp}} * \frac{100}{\%\ \ solids}$$

Where:
$\mu g/L_{dig}$ = Instrument result adjusted for dilution factors
V_{dig} = Final digestate volume in liters
g_{samp} = Sample weight in grams
% Solids = Percent solids to nearest 0.1%

Title: Nitroaromatics, Nitramines, and Nitrate Esters by HPLC (SW-846 8330B)

Approval Signatures:

William S. Cicero
Laboratory Director

Jon Zygmuntowicz
Department Manager

Kirstin L. McCracken
Quality Assurance Manager

Dan Helfrich
EH&S Coordinator

Approval Date: August 25, 2009

Facility Distribution No. Electronic **Distributed To: Facility Intranet**

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SOP Change in Progress Attachment (CIPA)

SOP Number	SOP Title	SOP Revision	SOP Effective Date	CIPA Effective Date
BR-LC-003	Nitroaromatics, Nitramines and Nitrate Esters by HPLC (SW-846 8330B)	15	08/25/09	09/22/09

The following revisions were made to this standard operating procedure (SOP). These changes are effective as of the CIPA Effective Date. Changes to this document will be incorporated into the document with the next revision. This document change is authorized and issued by the laboratory's QA Department.

- Page 4 of 25: Remove strikethrough text

~~Primary Column (C-18)~~ Buffer Solution (10 mM $NH_4H_2PO_4$): Add 2.3 g of $NH_4H_2PO_4$ to a 2L volumetric flask add DI water to volume and mix to dissolve. Filter the solution through a 0.22 um cellulose ester filter collecting the filtrate in a 2L glass vacuum flask. Prepare weekly and store the solution at ambient temperature.

~~Secondary Column (Phenyl hexyl) Buffer Solution (100 mM NH4H2PO4): Add 23 g of NH4H2PO4 to a 2L volumetric flask add DI water to volume and mix to dissolve. Filter the solution through a 0.22 um cellulose ester filter collecting the filtrate in a 2L glass vacuum flask. Prepare weekly and store the solution at ambient temperature.~~

- Page 7 of 25:

The percent recovery of each analyte must be within $\pm$ ~~20~~ 30% of the expected value. If this criterion is not met, correct the problem and reanalyze the ICV. If the reanalysis fails, remake the calibration standards and/or perform instrument maintenance and recalibrate. The acceptance criteria must be met on both columns.

Page 11 and 12 of 25: Change the header for Section 15.0 from Method Modifications to References / Cross References and change the header for Section 16.0 from References / Cross References to Method Modifications.

- Page 13 of 25: Change RLs in Table 1 as noted below:

Table 1: Routine Compound List & Limit of Quantitation (LOQ)

Analyte	CAS	LOQ Water (ug/L)	LOQ Soil (ug/Kg)	LOQ LL Soil (ug/Kg)
1,3,5-Trinitrobenzene	99-35-4	0.2	100	11
1,3-Dinitrobenzene	99-65-0	0.2	100	11
2,4,6-Trinitrotoluene	118-96-7	0.2	100	11
2,4-Diamino-6-nitrotoluene	6629-29-4	0.2	100	11
2,4-Dinitrotoluene	121-14-2	0.2	100	11
2,6-Diamino-4-nitrotoluene	59229-75-3	0.2	100	11

2,6-Dinitotoluene	606-20-2	0.2	100	11
2-Amino-4,6-dinitrotoluene	35572-78-2	0.2	100	11
2-Nitrotoluene	88-72-2	0.2	100	11
3-Nitrotoluene	99-08-1	0.2	100	11
4-Amino-2,6-dinitrotoluene	19406-51-0	0.2	100	11
4-Nitrotoluene	99-99-0	0.2	100	11
HMX	2691-41-0	0.2	100	11
Nitrobenzene	98-95-3	0.2	100	11
Nitroglycerin	55-63-0	~~1.0~~ 4.0	~~500~~ 2000	~~53~~ 220
PETN	78-11-5	~~1.0~~ 10	~~500~~ 5000	~~11~~ 550
Picric Acid	88-89-1	0.2	100	11
RDX	121-82-4	0.2	100	11
Tetryl	479-45-8	0.2	100	11

HMX is also known as octrahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
RDX is also known as hexahydro-1,3,5-trinitro-1,3,5-triazine
Picric Acid is also known as 2,4,6-Trinitrophenol
Tetryl is also known as 2,4,6-Trinitorphenyl-methylnitramine

- Page 15 of 25: Add DoD QSM 4.1 Requirements to Table 3 for ICAL and ICV

Table 3

QC Check	Minimum Frequency	Acceptance Criteria	Recommended Corrective Action
5-Point Calibration (ICAL)	Before sample analysis, when CCVs indicate calibration is no longer valid; after major instrument maintenance	• CF = RSD ≤ 20% • Linear Regression: r ≥ 0.99 • DoD QSM 4.1: Linear Regression: r ≥ 0.995	Correct problem and repeat initial calibration.
Second Source Standard Verification (ICV)	After each calibration	• %R ± 30% of true value • DoD QSM 4.1: %R ± 20% of true value	Correct problem and verify second source standard. If that fails repeat calibration. NOTE: SW-846 Method 8330B allows continuation of analysis for analytes that fail criteria so long as these results are considered estimated.
Continuing Calibration Verification (CCV)	Beginning of each analytical sequence, every twenty samples and at the end of each analytical sequence. NOTE: SW-846 Method 8330B recommends a CCV frequency of every 10 samples;	CF within ± 20% of mean CF of ICAL.	Re-analyze once, if still outside criteria perform corrective action, sequence can be re-started if two successive CCVs meet criteria otherwise repeat ICAL. The following exceptions apply: If the CCV is exceeded high and the associated samples are non-detects, the non-detects may be reported; if the CCV is exceeded low, sample results may be reported if the results exceed the maximum regulatory level.
Method Blank	One per extraction batch of 20 or fewer samples	Routine: < RL for all target analytes DoD QSM 4.1: ½ RL for all target analytes	Reprocess MB and associated samples if the target analyte or any common laboratory contaminant in the MB is greater than 1/10 the amount detected in any sample or 1/10

QC Check	Minimum Frequency	Acceptance Criteria	Recommended Corrective Action
			the regulatory limit, whichever is greater – otherwise data may be reported with appropriate data qualifiers. If insufficient sample to reprocess, report data with appropriate data qualifiers.
Laboratory Control Sample	One per extraction batch of 20 or fewer samples	%R within control limits. See Table 4 DoD QSM 4.1: Use DoD limits to evaluate for corrective action and report in-house limits – See DoD QSM 4.1 Protocol Summary	Reprep and reanalyze samples for failed analytes. If reanalysis is not possible due to insufficient sample volume, report data with appropriate data qualifiers.
Matrix Spike / Matrix Spike Duplicate	One ste per extraction batch when sufficient sample volume is provided or as requested per client	%R within control limits. See Table 4 DoD QSM 4.1: Use DoD limits to evaluate for corrective action and report in-house limits= See DoD QSM 4.1 Protocol Summary	Evaluate to determine if there is a matrix effect or analytical error. If analytical error, reanalyze or reprocess as appropriate.
Sample Duplicate	Per Client Request	RPD within control limits. See Table 4	Evaluate data to determine source for error. If analytical error is suspected, reanalyze or reprocess as appropriate.
Confirmation Analysis	When target analytes are detected on the primary column above the RL.	RPD between the results from the primary and confirmation column ≤ 40	Qualify data.
Soil Grind Blank	One composite sample per grind batch – See SOP for Grind & MIS.	Routine: < RL for all target analytes DoD QSM 4.1: ½ RL for all target analytes	Qualify data
Soil Sample Triplicate	One sample per grind batch – See SOP for Grind & MIS.	%RSD for results above RL ≤20	Qualify data

1.0 Scope and Application

This SOP describes the laboratory procedure used for the analysis of explosive and propellant residues by high performance liquid chromatography (HPLC).

1.1 Analytes, Matrix(s), and Reporting Limits

This procedure may be used for a variety of matrices including: water, soil, and sediment.

The list of target compounds that may be determined from this procedure is provided in Section 18.0, Table 1 along with the associated reporting limits(RL).

NOTE: The reporting limits provided in Table 1 for low level soil are derived from an extraction procedure that was developed by the laboratory (SOP BR-EX-021). This extraction procedure is considered project specific and is not applicable to project work that requires NELAC accreditation.

2.0 Summary of Method

Water Samples: Water samples are extracted following the procedures in laboratory SOPs BR-EX-010.

Soil Samples: Soil samples are extracted following the procedures given in laboratory SOPs BR-EX-010 or BR-EX-021. Prior to extraction, if required for the project, samples are dried, ground and subsampled following the procedure given in laboratory SOP BR-GT-021.

Sample extracts are analyzed by an HPLC equipped with a UV detector monitoring 254nm. Second column confirmation is performed for all target analytes positively identified on the primary column. Photo Diode Array (PDA) confirmation is performed per client request.

This SOP is based on the following reference method:

- SW-846 Method 8330B Nitroaromatics, Nitramines, and Nitrate Esters by High Performance Liquid Chromatography (HPLC) Revision 2, October 2006.

If the laboratory's SOP is modified from the reference method, a list of method modifications along with technical justification may be found in Section 15.0. Modifications to this SOP may be applied on a project specific basis to meet project data quality objectives. Project specific modifications are documented in the project record.

3.0 Definitions

A list of terms and definitions are provided in Appendix A.

4.0 Interferences

- Solvents, reagents, glassware, and other sample processing hardware may yield artifacts and/or interferences to sample analysis. All these materials must be demonstrated to be free from interferences with analysis of method blanks.

- 2,4-DNT and 2,6-DNT elute at similar retention times on the Kromasil C-18 column. An isomer of one compound at high concentrations may mask the response of the other compound. The presence of one or both of the compounds may be confirmed on the secondary column (Phenyl Hexyl). The analyst may report the results from these compounds from the secondary column at their discretion. If the concentration of one isomer is so great on the Phenyl hexyl column that it prevents the identification of the other, both compounds must be reported as an isomeric mixture.

- Tetryl decomposes rapidly in methanol/water solution and in heat. Water samples expected to contain Tetryl should be diluted with acetonitrile prior to filtration and acidified to pH <3. These samples should not be exposed to temperature variations above ambient temperature.

- Matrix interferences may be caused by contaminants co-extracted from the sample. The extent of these interferences will vary depending on the nature and diversity of the samples.

5.0 Safety

Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual (CW-E-M-001) and this document. This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.1 Specific Safety Concerns or Requirements

The HPLC has areas of high voltage. Depending on the type of work involved, the instrument should be turned off or disconnected from its source of power prior to extensive maintenance.

5.2 Primary Materials Used

Table 2, Section 18.0 lists those materials used in this procedure that have a serious or significant hazard rating along with the exposure limits and primary hazards associated with that material as identified in the MSDS. **NOTE: This list does not include all materials used in the method.** A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the MSDS for each material before using it for the first time or when there are major changes to the MSDS.

6.0 Equipment and Supplies

Catalog numbers listed in this SOP are subject to change at the discretion of the vendor. Analysts are cautioned to be sure equipment used meets the specification of this SOP.

6.1 Miscellaneous

- Autosampler Vials: 1 mL shell vials with 300 µL polyspring inserts and snap caps or equivalent.

- Volumetric Syringes, Class “A” (25µl, 100µl, and 500µl), Hamilton or equivalent.

- Cellulose ester filter 0.22 um, Millipore Cat. No. GSWP04700 or equivalent.

6.2 Analytical System

- HPLC Pump: Capable of a flow rate between 0.5 and 10.0 mL/min. Waters 600 or equivalent; Dionex HPG P680 with Dionex Column Heater TCC-100.

- HPLC Autosampler: Capable of injections up to 250 µL. Waters 717 or equivalent.

- UV Detector: Capable of monitoring absorbance at 254 nm with low signal to noise ratio. Spectra Physics Model: Spectra 100 or equivalent.
- Primary Column: Kromasil C-18 HPLC column, 250 x 4.6 mm, 5 um, Ultra-C18, 250 x 4.6mm, 5um (Restek) or equivalent.
- Secondary Column: Luna Phenyl Hexyl, 150 x 4.6 mm, 3 um (Phenomenex) or equivalent.
- Computer Hardware/Software: GC Acquisition Platform - VAX 4505 (GVAX) Multichrom V2.11. Data Processing - Hewlett-Packard 9000-series computers, an HP 9000 K200 (Chemsvr5)/ HP-UX 10.20 and Target V3.5 or higher.

7.0 Reagents and Standards

7.1 Reagents

- Acetonitrile, Ultra-Resi Analyzed. JT Baker or equivalent.
- Methanol, Ultra-Resi Analyzed. JT Baker or equivalent.
- Deionized Water. Laboratory nanopure water system.
- Ammonium Phosphate Monobasic ($NH_4H_2PO_4$), ACS grade or higher. Fisher Scientific or equivalent. Use the reagent to prepare the following buffer solutions:

  Primary Column (C-18) Buffer Solution (10 mM $NH_4H_2PO_4$): Add 2.3 g of $NH_4H_2PO_4$ to a 2L volumetric flask add DI water to volume and mix to dissolve. Filter the solution through a 0.22 um cellulose ester filter collecting the filtrate in a 2L glass vacuum flask. Prepare weekly and store the solution at ambient temperature.

  Secondary Column (Phenyl hexyl) Buffer Solution (100 mM $NH_4H_2PO_4$): Add 23 g of $NH_4H_2PO_4$ to a 2L volumetric flask add DI water to volume and mix to dissolve. Filter the solution through a 0.22 um cellulose ester filter collecting the filtrate in a 2L glass vacuum flask. Prepare weekly and store the solution at ambient temperature.

7.2 Standards

Purchase stock standard solutions from commercial vendors and from these prepare calibration and working standards by diluting a known volume of stock standard in an appropriate solvent to the final volume needed to achieve the desired concentration. The recommended formulation for each standard used in this procedure is provided in Appendix B along with the recommended source materials, expiration dates and storage conditions.

8.0 Sample Collection, Preservation, Shipment and Storage

The laboratory does not perform sample collection so these procedures are not included in this SOP, sampling requirements may be found in the published reference method.

Listed below are minimum sample size, preservation and holding time requirements:

Matrix	Sample Container	Minimum Sample Size	Preservation	Holding Time[1]	Reference

Water	glass	1 L	<4°C	7 days	Method 8330B
Soil	glass/bag	1Kg	<4°C[2]	14 days	Method 8330B
Extract	amber vial	NA	<4°C	Analytical: 40 days	Method 8330B

[1] Extraction holding time is calculated from date of collection. Analytical holding time is determined from date of extraction.
[2] Holding time applies until the drying process for the sample begins.

Unless otherwise specified by client or regulatory program, after analysis, samples and extracts are retained for a minimum of 30 days after provision of the project report and then disposed of in accordance with applicable regulations.

9.0 Quality Control

9.1 Sample QC

The laboratory prepares the following sample QC:

QC Item	Frequency	Acceptance Criteria
Method Blank (MB)	1 per extraction batch	See Table 3
Laboratory Control Sample (LCS)	1 per extraction batch	See Table 3
Matrix Spike(s) (MS/MSD)	1 pair per extraction batch	See Table 3
Sample Duplicate (SD)	Client Request	See Table 3
Soil Grind Blank	As associated with samples	See Table 3
Soil Sample Triplicate	As associated with samples	See Table 3

9.2 Instrument QC

The following instrument QC is performed:

QC Item	Frequency	Acceptance Criteria
Initial Calibration (ICAL)	Initially, when CCV fails and after major instrument maintenance	See Table 3
Low Calibration Standard (DOD Only)	Immediately after each ICAL	See Table 3
Second Source Verification (ICV)	Immediately after ICAL DoD: After the analysis of the low cal standard	See Table 3
Continuing Calibration Verification (CCV)	Beginning and end of each sequence and after every 10 field samples.	See Table 3

10.0 Procedure

10.1 Instrument Operating Conditions

Primary Column:	Kromasil C-18, UV Detector 254nm
Injection Volume:	200 uL
Mobile Phase:	Gradient
Flow Rate:	Initial: 80/20% water/methanol at 1.10 mL/min, hold 1 minute Change to 40/60% in 9 minutes, hold 7 minutes. Change to 15/85% in 4 minutes. Change to 1.25 mL/min in 1 minute, hold 3 minutes. Change to 1.50 mL/min and 80/20% in 1 minute

	Change to 1.25 mL/min in 2 minutes, hold 5 minutes.
	Change to 1.10 mL/Min in 1.33 minutes.
Secondary Column:	Phenyl Hexyl Column, UV Detector 254nm
Injection Volume:	125 uL
Mobile Phase:	Gradient – Binary Pumping
Flow Rate:	Initial 80/20/0% buffer/Methanol/DI at 1.1 mL/min, hold 4 min.
	Change to 40/60/0% and 0.8 mL/min in 9 minutes, hold 12 minutes.
	Change to 30/70/0% and 1.2 mL/min in 2.5 minutes.
	Change to 0/70/30% and 1.2 mL/min.
	Change to 0/90/10% and 1.2 mL/min. in 2.5 minutes.
	Change to 0/90/10% and 1.4 mL/min. in 1.0 minutes.
	Change to 0/20/80 and 1.2 mL/min. in 4 minutes, hold 4 minutes.
	Change to Initial conditions.

10.2 Retention Time Window Establishment

Generate RT windows when a new LC column is installed by analyzing three standards over a 72-hour period and calculating the mean RT and Standard Deviation (SD). Calculate the RT window as mean RT $\pm$ 3SD of the three standards. If, in the professional judgment of the analyst, this procedure results in an RT window that is too tight and would favor false negatives, the analyst may opt to use an alternate method to determine the RT windows as follows: calculate the RT window using $\pm$ 0.10 minutes from the mean RT in each initial calibration with the following exceptions:

- Phenyl Hexyl column: The RT for samples with higher concentrations of picric acid tend to elute earlier thus retention time window is expanded to $\pm$0.20 minutes and is calculated using the midpoint RT from the calibration curve.

10.3 Instrument Calibration

10.3.1 Initial Calibration (ICAL)

Perform initial calibration with a minimum of five calibration standards before any sample analysis (initial method set-up), whenever a new column is installed, when significant instrument maintenance has been performed, and when the CCV does not meet acceptance criteria. Significant instrument maintenance includes installing a new column, or changing the proportioning valve.

Prepare the working calibration standards using the recommended formulations given in Appendix B ensuring the lowest calibration standard for each analyte is equal to or below the established RL. Unless otherwise specified on a project basis, use calibration levels 2 to 7 to establish the calibration curve for each analyte.

Prime the instrument by analyzing an instrument blank (IBLK) consisting of 50%Acetonitrile/Deionized (DI) Water then sequentially analyze the standards using the procedure that begins in Section 10.6. Inject each calibration standard onto the system using the column-specific injection volume (See Section 10.1) and acquire the data.

The data system generates a curve of concentration vs. peak area for each analyte and calculates the correlation coefficient with 1/X weighting. The calibration must have a correlation coefficient (r) $\geq$ 0.99 on both columns for acquisition of samples to continue. For DoD work, the correlation coefficient must be $\geq$ 0.995. If criteria are not met, correct the problem and repeat calibration. Further analysis may not proceed without valid calibration. An example linear regression equation is provided in laboratory guidance document FQA019.

10.3.2 Second Source Calibration Verification (ICV)

Immediately after each calibration and prior to the analysis of any other QC or field samples, verify the accuracy of the initial calibration by analyzing a second source ICV.

Prepare the ICV using the formulation provided in Appendix B. Inject the ICV standard onto the instrument in the same manner as performed for the initial calibration standards.

The percent recovery of each analyte must be within $\pm$ 20% of the expected value. If this criterion is not met, correct the problem and reanalyze the ICV. If the reanalysis fails, remake the calibration standards and/or perform instrument maintenance and recalibrate. The acceptance criteria must be met on both columns.

10.3.3 Continuing Calibration Verification (CCV)

Analyze a CCV prepared at a concentration at or below mid-calibration range each day (CAL Level 5) before sample analysis, after every ten field samples and at the end of each analytical batch to monitor instrument drift. NOTE: The reference method requires a CCV every twenty field samples but recommends a frequency of every 10 field samples. The laboratory may increase the number of samples between CCV from 10 up to 20 at the analyst's discretion.

Analyze the CCV standards at the proper frequency in the analytical sequence and acquire the data.

The data system calculates the percent difference or drift for both columns for each analyte from the expected value of from the calibration curve. The percent difference or drift must be within ±20% for each analyte and the RT for each analyte must be must be within the window established in 10.2. Acceptance criteria must be met on both columns in order to proceed with analysis.

If the CCV fails, it may be repeated once. If it still fails, corrective action must be taken. The sequence may be continued only if two immediate, consecutive CCVs at different concentrations are within acceptance criteria. If the two CCVs do not meet the criteria, recalibration is required prior to running samples. Samples must be bracketed by passing CCVs, and samples before and after CCV failure must be reanalyzed, unless the CCV is high and there are no detects in the associated samples.

10.4 Troubleshooting:

Check the following items in case of calibration failures:

- Retention time drift: evaluate the drift pattern. If the RT drift is slowly increasing or decreasing in the same direction over a period of 10-20 injections, then slowly drifts back in the opposite direction, it is likely due to room temp cycling. If the RT drift continues in the same direction and doesn't revert back, then the system pressure must be evaluated to determine whether the increased backpressure is due to the in-line filter or guard column. One or both items may need to be replaced as corrective action.

- CCV low: evaluate injection or pre-injection problems. The bottom of the low volume poly-spring inserts can crack and leak, leading to low results.

- CCV high: evaluate the seal on the low volume poly-spring inserts within the 1-mL shell vial to determine if the solution concentrated prior to injection.

10.5 Sample Preparation

Remove the sample extract from refrigerated storage and warm to room temperature.

Transfer an approximate 750 uL aliquot of extract to a labeled autosampler vial and cap. Place the vial in the autosampler using the analytical sequence specified in the next section.

10.6 Sample Analysis

Place the field and QC samples in a sequence that begins with the calibration standards followed by the analysis of QC samples, field samples and continuing calibration verification standards (CCVs).

An example analytical sequence that includes initial calibration (ICAL) is provided below.

Injection Number	Lab Description
1	Instrument Blank
2	Calibration Level 1
3	Calibration Level 2
4	Calibration Level 3
5	Calibration Level 4
6	Calibration Level 5
7	Calibration Level 6
8	Calibration Level 7
9	ICV
10	Instrument Blank
11	10 Field samples
12	8330 CCV
13	10 Field samples
14	8330 CCV

Enter the sample ID's into the data acquisition program in the order the samples were placed in the autosampler and initiate the analytical sequence. If the client has requested photodiode array (PDA) enter the run sequence into the PDA software.

Cleaning blanks (CBLK) consisting of 50/50 (v/v) acetonitrile/deionized (DI) water may inserted into the analytical sequence after analysis of high concentration samples at the discretion of the analyst.

11.0 <u>Calculations / Data Reduction</u>

Qualitative Identification

The data processing system identifies the target analytes by comparing the retention time of the peaks to the retention times of the initial calibration standards. Tentative identification occurs when a peak is within the retention time window above the reporting limit (RL) or if required by program or project, the limit of detection (LOD). All positive identifications on the primary column must be confirmed on the secondary column.

Quantitative Identification

The data system calculates the corrected concentration for each target analyte on each column from the calibration curve using the equations given in Appendix C.

11.1 Calculations

See Appendix C.

11.2 Data Review

11.2.1 Primary Review

Confirm qualitative and quantitative identification criteria using the criteria provided in Section 11.1 and Section 11.2. If the data system did not properly integrate a peak, perform and document manual integration in accordance with laboratory SOP *BR-QA-006 Manual Integration.*

Review QC against the acceptance criteria given in Section 10.0 and in Table 3. If the results are not within acceptance criteria, perform the recommended corrective action. If corrective action is not taken or is unsuccessful, document the situation with a nonconformance report (NCR) and qualify data.

Unless otherwise specified for the project, use the in-house control limits specified in Table 3 for the evaluation of the LCS, MS/MSD and sample duplicate (SD). If results are outside control limits evaluate for marginal exceedance (See Appendix D) or perform the recommended corrective action. If corrective action is not taken or is unsuccessful document the situation with a nonconformance report (NCR) and qualify data.

Dilute and reanalyze samples whose results exceed the calibration range. The diluted analysis should be targeted to produce a result in a result within the upper half of the calibration curve.

If a sample was analyzed immediately following a high concentration sample, review the results of the sample for any sign of carry over. If carry over is suspected, reanalyze the sample.

Review project documents such as the environmental test request (ETR) analytical worksheets, Project Plan (PP), Project Memo or any other document/process used to communicate project requirements to ensure those project requirements were met. If project requirements were not met, immediately notify the project manager (PM) to determine an appropriate course of action.

11.2.2 Secondary Data Review

Verify that the acceptance criteria were met. If the results do not fall within the established limits verify the recommended corrective actions were performed. If corrective action was not taken or is unsuccessful, ensure the situation is documented with a nonconformance report (NCR) and ensure data is qualified accordingly.

If manual integrations were performed:

- Review each manual integration to verify that the integration is consistent and compliant with the requirements specified in laboratory SOP BR-QA-005. If a problem is found, immediately consult with the primary analyst or notify the Technical Director or QA Manager. Check that each manual integration is included in the manual integration summary and that each instance has an associated manual integration code. Also, check to ensure that a “before and after” report is present for each manual integration of reported analyte.

11.3 Data Reporting

This section describes the routine reporting protocol of the laboratory. Unless otherwise specified for a project, results are reported using the requirements specified in this section. Program specific reporting schemes, such as DoD QSM protocol, apply when specified for the project. Refer to the Project Plan for those reporting requirements.

Analytical results are reported from the primary column (Kromasil C18).

Report analytical results above the limit of quantitation (LOQ) as the value found. The LOQ is the minimum concentration of an analyte that can be quantitatively determined with acceptable precision and bias. For purpose of clarification, the LOQ may also be referred to as the in-house reporting limit (RL). The LOQ must be equal to or above the concentration of the low calibration standard and within the range of calibration.

Report analytical results less than the LOQ to the adjusted LOQ with a “U” data qualifier. Adjust the LOQ for sample dilution/concentration and percent moisture. The unadjusted LOQ for each target analyte is provided in Table 1. If project specific reporting limits (RL) are requested, use the project RL in lieu of the LOQ for reporting purposes. If the project specific RL is less than the laboratory established LOQ, all non-detect analytical results reported to the project RL must be qualified “UJ” and any analyte detected above the project specific RL but less than the LOQ must be qualified with a “J” flag. Report results above the LOQ and the project specific RL as the value found.

Due to limitations with the laboratory’s data processing software, the laboratory does not routinely report estimated values less than the limit of quantitation (LOQ). However, the laboratory will report estimated values per client request. When estimated value reporting is requested, report analytical results as follows:

- Evaluate analytical results to the established limit of detection (LOD) for each analyte. The LOD is the minimum level at which the presence of an analyte can be reliably concluded. For purposes of clarification, the laboratory uses the phrase “verified MDL” interchangeably with the term LOD. Report any analyte that meets qualitative identification detected above the LOD but less than the LOQ as the value found flagged with a “J” data qualifier.

If the sample was analyzed at multiple dilutions, report the result from the appropriate dilution (i.e. no target analyte above calibration range and the result for the analyte for which the dilution was performed is in the upper half of the calibration range). Provide results for the undiluted or more concentrated analyses when requested for each project.

Review project documents such as the environmental test request (ETR) analytical worksheets, Project Plan (PP), Project Memo or any other document/process used to communicate project requirements to ensure those project requirements were met. If project requirements were not met, immediately notify the project manager (PM) to determine an appropriate course of action.

Retain, manage and archive electronic and hardcopy data as specified in laboratory SOP BR-QA-014 Laboratory Records.

12.0 Method Performance

12.1 Method Detection Limits (MDL) / Limits of Detection (LOD) and Limit of Quantitation (LOQ) / Reporting Limits (RL)

Establish and verify the detection limit, the LOD, and LOQ at initial method-set up following the procedures in laboratory SOP BR-QA-005.

12.2 Demonstration of Capabilities (DOC)

Perform a method demonstration of capability at initial set-up and when there is a significant change in instrumentation or procedure.

Each analyst that performs the analytical procedure must complete an initial demonstration of capability (IDOC) prior to independent analysis of client samples. Each analyst must demonstrate on-going proficiency (ODOC) annually thereafter. DOC procedures are further described in the laboratory's quality system manual (QAM) and in the laboratory SOP for employee training.

12.3 Training Requirements

Any employee that performs any portion of the procedure described in this SOP must have documentation in their employee training file that they have read this version of this SOP.

Instrument analysts must also have documentation of initial demonstration of initial proficiency (IDOC) for the test method prior to independent work. On-going proficiency (ODOC) must be demonstrated annually thereafter.

13.0 Pollution Control

It is Test America's policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, ordering chemicals based on quantity needed, preparation of reagents based on anticipated usage and reagent stability). Employees must abide by the policies in Section 13 of the Corporate Safety Manual for "Waste Management and Pollution Prevention."

14.0 Waste Management

Waste management practices are conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes are disposed of in an accepted manner. Waste description rules and land disposal restrictions are followed. Waste disposal procedures are incorporated by reference to BR-EH-001. The following waste streams are produced when this method is carried out.

- Vials containing sample extracts: Satellite Container: 4 L glass bottle.
- Solvent Waste: Satellite Container: 5 Gallon carboy.

15.0 Method Modifications

- Laboratory SOP BR-QA-005, Procedures for the Determination of Limits of Detection (LOD), Limits of Quantitation (LOQ) and Reporting Limits (RL).
- Laboratory SOP BR-QA-011 Employee Training
- Laboratory SOP BR-LP-011 Hazardous Waste
- Laboratory SOP BR-QA-014 Laboratory Records
- Laboratory SOP BR-QA-006 Procedures & Documentation Requirements for Manual Integration
- Laboratory Quality Assurance Manual (QAM)
- Department of Defense Quality System Manual (DoD QSM), Version 4.1.

16.0 References / Cross-References

Modification Number	Method Reference	Modification & Technical Justification
1	Section 6.1.1	The laboratory monitors all target analytes at a single wavelength. The method recommends use of 210nm for PETN and nitroglycerin presumably in order to achieve greater sensitivity. Laboratory experience has shown that sufficient sensitivity is achieved for these target analytes at 254nm.
2	Section 11.3	The use of an ammonium phosphate buffer in conjunction with reagent water is employed as the aqueous component of our eluent to promote the chromatography of picric acid. While picric acid is not a target compound associated with Method 8330B, it is a primary component of our analytical offering. The addition of the buffer does not affect the chromatography of any of the target compounds associated with Method 8330B, as they are not readily ionizable. The addition of the buffer to the analysis for the purpose of improving the retention of picric acid was based on guidance provided within an article published by ERDC-CRREL (US Army's Engineer Research and Development Center-Cold Regions Research and Environmental Laboratory (SR95-20).
3	Section 11.3 8330B	A solvent gradient is employed instead of the recommended isocratic conditions for the C-18 column. This change reduces the potential of highly retained peaks which may interfere with subsequent analyses by flushing them from the column after all target compounds have eluted. It also provides the resolution of 2,6-Diamino-4-nitrotoluene and 2,4-Diamino-6-nitrotoluene from HMX, which are additional compounds provided within our analytical offering.

17.0 Attachments

- Table 1: Routine Compound List and LOQ
- Table 1A: Non-Routine Compound List and LOQ
- Table 2: Primary Materials Used
- Table 3:QC Summary & Recommended Corrective Action
- Table 4: Control Limits
- Appendix A: Terms and Definitions
- Appendix B: Standard Preparation Tables
- Appendix C: Equations

18.0 Revision History

- BR-LC-003, Rev 15:

All sections of this SOP were updated. This version should be considered a complete re-write from previous versions.

Table 1: Routine Compound List & Limit of Quantitation (LOQ)

Analyte	CAS	LOQ Water (ug/L)	LOQ Soil (ug/Kg)	LOQ LL Soil (ug/Kg)
1,3,5-Trinitrobenzene	99-35-4	0.2	100	11
1,3-Dinitrobenzene	99-65-0	0.2	100	11
2,4,6-Trinitrotoluene	118-96-7	0.2	100	11
2,4-Diamino-6-nitrotoluene	6629-29-4	0.2	100	11
2,4-Dinitrotoluene	121-14-2	0.2	100	11
2,6-Diamino-4-nitrotoluene	59229-75-3	0.2	100	11
2,6-Dinitotoluene	606-20-2	0.2	100	11
2-Amino-4,6-dinitrotoluene	35572-78-2	0.2	100	11
2-Nitrotoluene	88-72-2	0.2	100	11
3-Nitrotoluene	99-08-1	0.2	100	11
4-Amino-2,6-dinitrotoluene	19406-51-0	0.2	100	11
4-Nitrotoluene	99-99-0	0.2	100	11
HMX	2691-41-0	0.2	100	11
Nitrobenzene	98-95-3	0.2	100	11
Nitroglycerin	55-63-0	1.0	500	53
PETN	78-11-5	1.0	500	11
Picric Acid	88-89-1	0.2	100	11
RDX	121-82-4	0.2	100	11
Tetryl	479-45-8	0.2	100	11

HMX is also known as octrahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
RDX is also known as hexahydro-1,3,5-trinitro-1,3,5-triazine
Picric Acid is also known as 2,4,6-Trinitrophenol
Tetryl is also known as 2,4,6-Trinitorphenyl-methylnitramine

NOTE: The LOQ values for soils represent those that can be achieved in a blank matrix with zero percent moisture. Actual LOQ values will vary with sample matrix, co-extracted interferences and percent moisture in sample. The Soil LOQ is applicable to 10 g sample extraction weight; the LOQ for LL Soil is applicable to a 15 g sample extraction weight using the “wrist-action” extraction technique.

Table 1A: Non-Routine Compounds

Analyte	CAS	LOQ Water (ug/L)	LOQ Soil (ug/Kg)	LOQ LL Soil (ug/Kg)
DNX		0.2	100	11
MNX		0.2	100	11
TNX	13980-04-6	0.2	100	11

TNX is known as hexahdyro-1,3,5-trinitroso-1,3,5-triazine
DNX is known as hexahydro-1,3-dinitroso-5-nitro-1,3,5-triazine
MNX is known as hexahydro-1-nitroso-3,5-dinitro-1,3,5-triazine

NOTE: The laboratory does not routinely calibrate or maintain MDL, DOC or in-house control limits for the compounds listed in Table 1A. Analytical service and QC requirements for non-routine compounds must be determined on a project specific basis prior to shipment of the samples to the laboratory. The LOQ values for soils represent those that can be achieved in a blank matrix with zero percent moisture. Actual LOQ values will vary with sample matrix, co-extracted interferences and percent moisture in sample. The Soil LOQ is applicable to 10 g sample extraction weight; the LOQ for LL Soil is applicable to a 15 g sample extraction weight using the “wrist-action” extraction technique.

Table 2: Primary Materials Used

Material[1]	Hazards	Exposure Limit[2]	Signs and Symptoms of Exposure
Acetonitrile	Flammable Poison	40 ppm-TWA	Early symptoms may include nose and throat irritation, flushing of the face, and chest tightness. Prolonged exposure to high levels of vapors may cause formation of cyanide anions in the body.
Methanol	Flammable Poison Irritant	200 ppm-TWA	A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Symptoms of overexposure may include headache, drowsiness and dizziness. Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure. Irritant to the eyes.

[1] Always add acid to water to prevent violent reactions.
[2] Exposure limit refers to the OSHA regulatory exposure limit.

Table 3: QC Summary, Acceptance Criteria and Recommended Corrective Action (SW-846 8330B)

QC Check	Minimum Frequency	Acceptance Criteria	Recommended Corrective Action
5-Point Calibration (ICAL)	Before sample analysis, when CCVs indicate calibration is no longer valid; after major instrument maintenance	• CF = RSD $\leq$ 20% • Linear Regression: r $\geq$ 0.99	Correct problem and repeat initial calibration.
Second Source Standard Verification (ICV)	After each calibration	%R ± 30% of true value	Correct problem and verify second source standard. If that fails repeat calibration. NOTE: SW-846 Method 8330B allows continuation of analysis for analytes that fail criteria so long as these results are considered estimated.
Continuing Calibration Verification (CCV)	Beginning of each analytical sequence, every twenty samples and at the end of each analytical sequence. NOTE: SW-846 Method 8330B recommends a CCV frequency of every 10 samples;	CF within ± 20% of mean CF of ICAL.	Re-analyze once, if still outside criteria perform corrective action, sequence can be re-started if two successive CCVs meet criteria otherwise repeat ICAL. The following exceptions apply: If the CCV is exceeded high and the associated samples are non-detects, the non-detects may be reported; if the CCV is exceeded low, sample results may be reported if the results exceed the maximum regulatory level.
Method Blank	One per extraction batch of 20 or fewer samples	Routine: < RL for all target analytes DoD QSM 4.1: ½ RL for all target analytes	Reprocess MB and associated samples if the target analyte or any common laboratory contaminant in the MB is greater than 1/10 the amount detected in any sample or 1/10 the regulatory limit, whichever is greater – otherwise data may be reported with appropriate data qualifiers. If insufficient sample to reprocess, report data with appropriate data qualifiers.
Laboratory Control Sample	One per extraction batch of 20 or fewer samples	%R within control limits. See Table 4	Reprep and reanalyze samples for failed analytes. If reanalysis is not possible due to insufficient sample volume, report data with appropriate data qualifiers.
Matrix Spike / Matrix Spike Duplicate	One ste per extraction batch when sufficient sample volume is provided or as requested per client	%R within control limits. See Table 4	Evaluate to determine if there is a matrix effect or analytical error. If analytical error, reanalyze or reprocess as appropriate.
Sample Duplicate	Per Client Request	RPD within control limits. See Table 4	Evaluate data to determine source for error. If analytical error is suspected, reanalyze or reprocess as appropriate.
Confirmation Analysis	When target analytes are detected on the primary column above the RL.	RPD between the results from the primary and confirmation column ≤ 40	Qualify data.
Soil Grind Blank	One composite sample per grind batch – See SOP for Grind & MIS.	Routine: < RL for all target analytes DoD QSM 4.1: ½ RL for all target analytes	Qualify data
Soil Sample Triplicate	One sample per grind batch – See SOP for Grind & MIS.	%RSD for results above RL ≤20	Qualify data

Table 4: In-House Control Limits

Analyte	In-House Limits[1] (%R)			Precision (RPD)
	Water	Soil	LL Soil	(≤)
1,3,5-Trinitrobenzene	65-110	75-125	85-115	20
1,3-Dinitrobenzene	70-115	80-125	80-110	20
2,4,6-Trinitrotoluene	70-115	55-140	70-105	20
2,4-Diamino-6-nitrotoluene	60-105	50-150	50-90	20
2,4-Dinitrotoluene	70-115	80-125	80-110	20
2,6-Diamino-4-nitrotoluene	65-110	50-150	50-90	20
2,6-Dinitotoluene	70-115	80-120	80-115	20
2-Amino-4,6-dinitrotoluene	70-115	80-125	75-115	20
2-Nitrotoluene	70-115	80-125	70-100	20
3-Nitrotoluene	70-115	75-120	70-105	20
4-Amino-2,6-dinitrotoluene	70-115	80-125	80-115	20
4-Nitrotoluene	70-115	75-125	75-105	20
HMX	70-115	75-125	80-120	20
Nitrobenzene	70-115	75-125	75-105	20
Nitroglycerin	70-115	50-150	80-110	20
PETN	60-105	50-150	70-110	20
Picric Acid	65-110	10-150	50-110	20
RDX	70-115	70-135	85-115	20
Tetryl	65-110	10-150	75-105	20
Surrogate: 1,2-Dinitrobenzene	70-115	80-125	85-115	NA

[1] *The limits in this table are those used as of the effective date of this SOP.*

Appendix A: Terms and Definitions

Acceptance Criteria: specified limits placed on characteristics of an item, process or service defined in requirement documents.

Accuracy: the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator.

Analyte: The specific chemicals or components for which a sample is analyzed. (EPA Risk Assessment Guide for Superfund, OSHA Glossary).

Batch: environmental samples that are prepared and/or analyzed together with the same process, using the same lot(s) of reagents. A preparation/digestion batch is composed of one to 20 environmental samples of similar matrix, meeting the above criteria. An analytical batch is composed of prepared environmental samples (extracts, digestates and concentrates), which are analyzed together as a group.

Calibration: a set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material and the corresponding values realized by the standards.

Calibration Curve: the graphical relationship between the known values or a series of calibration standards and their instrument response.

Calibration Standard: A substance or reference used to calibrate an instrument.

Continuing Calibration Verification (CCV): a single or multi-parameter calibration standard used to verify the stability of the method over time. Usually from the same source as the calibration curve.

Corrective Action: the action taken to eliminate the cause of an existing nonconformity, defect or other undesirable occurrence in order to prevent recurrence.

Data Qualifier: a letter designation or symbol appended to an analytical result used to convey information to the data user. (Laboratory)

The qualifiers that are routinely used for this test method are:

U: Compound analyzed for but not detected at a concentration above the reporting limit.
J: Estimated Value
P: There is greater than 40% difference for detected concentrations between two GC columns
C: Positive result whose identification has been confirmed by GC/MS
B: Compound is found in the sample and the associated method blank.
E: Compound whose concentration exceeds the upper limit of the calibration range.
D: Concentration identified from a dilution analysis.
X,Y,Z: Laboratory defined flags that may be used alone or combined as needed. If used, provide a description of the flag in the project narrative.

Demonstration of Capability (DOC): procedure to establish the ability to generate acceptable accuracy and precision.

Holding Time: the maximum time that a sample may be held before preparation and/or analysis as promulgated by regulation or as specified in a test method.

Initial Calibration: Analysis of analytical standards for a series of different specified concentrations used to define the quantitative response, linearity and dynamic range of the instrument to target analytes.

Intermediate Standard: a solution made from one or more stock standards at a concentration between the stock and working standard. Intermediate standards may be certified stock standard solutions purchased from a vendor and are also known as secondary standards.

Laboratory Control Sample (LCS): a blank matrix spiked with a known amount of analyte(s) processed simultaneously with and under the same conditions as samples through all steps of the procedure.

Matrix Spike (MS): a field sample to which a known amount of target analyte(s) is added.

Matrix Spike Duplicate (MSD): a second replicate matrix spike

Method Blank (MB): a blank matrix processed simultaneously with and under the same conditions as samples through all steps of the procedure. Also known as the preparation blank (PB).

Method Detection Limit (MDL): the minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific measurement system. The MDL is a statistical estimation at a specified confidence interval of the concentration at which relative uncertainty is ±100%. The MDL represents a range where qualitative detection occurs. Quantitative results are only produced in this range and qualified with the proper data reporting flag when a project requires this type of data reporting.

Non-conformance: an indication, judgment, or state of not having met the requirements of the relevant specification, contract or regulation.

Precision: the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves.

Preservation: refrigeration and/or reagents added at the time of sample collection to maintain the chemical, physical, and/or biological integrity of the sample.

Quality Control Sample (QC): a sample used to assess the performance of all or a portion of the measurement system.

Reporting Limit (RL): the level to which data is reported for a specific test method and/or sample.

Stock Standard: a solution made with one or more neat standards usually with a high concentration. Also known as a primary standard. Stock standards may be certified solutions purchased from a vendor.

Surrogate: a substance with properties that mimic the analyte of interest but that are unlikely to be found in environmental samples.

Appendix B: Standard Preparation Tables

The standard formulations contained in this Appendix are recommended and are subject to change. If the concentration of the stock standard is different than those noted in this table, adjust the standard preparation formulation accordingly. Unless otherwise specified, prepare the standard solutions in acetonitrile using Class A volumetric glassware and Hamilton syringes. Unless otherwise specified for a standard solution, assign an expiration date of 6 months from date of preparation unless the parent standard expires sooner in which case use the earliest expiration date. See laboratory SOP BR-QA-002 *Standard Preparation* for further guidance.

Stock Standard Solutions

8330 Matrix Spike solution 40PPM

Parent Standard	Vendor	Component	Stock Standard Concentration (ug/mL)	Volume Added (uL)	Final Volume (mL)	Final Concentration (mg/L)
Combined Stock Solution	Ultra Scientific # NAIM-833E1	HMX	1000	1000	25	40
		RDX				
		1,3,5-Tinitrobenzene				
		1,3-Dinitrobenzene				
		Nitrobenzene				
		Tetryl				
		2,4,6- Trinitrotoluene				
		4-Amino-2, 6-dinitrotoluene				
		2-Amino-4, 6-dinitrotoluene				
		2,6-Dinitrotoluene				
		2,4-Dintrotoluene				
		2-Nitrotoluene				
		4-Nitrotoluene				
		3-Nitrotoluene				

Solvent: Acetonitrile

Matrix SUPP Spike 40/800PPM

Parent Standard	Vendor	Component	Stock Standard Concentration (ug/mL)	Volume Added (uL)	Final Volume (mL)	Final Concentration (mg/L)
2,6-Diaminio-4-nitrotoluene	Accustandard M-8330-ADD-13-10X	2,6-Diaminio-4-nitrotoluene	1000	200	5.0	40/800
2,4-Diamino-6-nitrotoluene	Accustandard M-8330-ADD-12-10X	2,4-Diamino-6-nitrotoluene	1000	200		
Picric Acid	Restek 31499	Picric Acid	1000	200		
Custom Explosive Solution	Accustandard S-3599-0.5X-5mL	Nitroglycerin/PETN	5000	800		

Solvent: Acetonitrile

Extraction Surrogate Spike 40PPM

Parent Standard	Vendor	Component	Stock Standard Concentration (ug/mL)	Volume Added (uL)	Final Volume (mL)	Final Concentration (mg/L)
1,2 Dinitrobenzene	Accustandard M-8330-SS	1,2 Dinitrobenzene	1000	1000	25	40

Solvent: Acetonitrile

8330 MMRSTD7 Calibration Solution 1000/20000ppb

Parent Standard	Vendor	Component	Stock Standard Concentration (ug/mL)	Volume Added (uL)	Final Volume (mL)	Final Concentration (mg/L)
8330 Matrix Spike	TA-Burlington	HMX	1000	1000	40.0	1.0
		RDX				
		1,3,5-Tinitrobenzene				
		1,3-Dinitrobenzene				
		Nitrobenzene				
		Tetryl				
		2,4,6- Trinitrotoluene				
		4-Amino-2, 6-dinitrotoluene				
		2-Amino-4, 6-dinitrotoluene				
		2,6-Dinitrotoluene				
		2,4-Dintrotoluene				
		2-Nitrotoluene				
		4-Nitrotoluene				
		3-Nitrotoluene				
Supplemental Matrix Spike	TA-Burlington	2,6-Diaminio-4-nitrotoluene	40	1000	40.0	1.0/20
		2,4-Diamino-6-nitrotoluene	40			
		Picric Acid	40			
		Nitroglycerin	800			
		PETN	800			
1,2-Dinitrobenzene	TA-Burlington	1,2-Dinitrobenzene	40	1000	40.0	1.0

Solvent: 50/50 Acetonitrile/Water

Routine Calibration Standards (MMRSTD6 - MMRSTD1)

Stock Standard	C stock ug/L	V stock (uL)	V std (mL)	C std (ug/L)	Calibration Level
MMRSTD 7	1000/20000	5000	10.0	500/1000	MMRSTD6
MMRSTD 7	1000/20000	8000	40.0	200/5000	MMRSTD5
MMRSTD 7	1000/20000	500	10.0	50/1000	MMRSTD4
MMRSTD 7	1000/20000	50	2.0	25/500	MMRSTD3
MMRSTD 7	1000/20000	20	2.0	10/200	MMRSTD2
MMRSTD 7	1000/20000	5.0	2.0	2.5/50	MMRSTD1

Solvent: 50/50 Acetonitrile/Water

SUPP ICV Stock Solution 2.0/40PPM

Parent Standard	Vendor	Component	Stock Standard Concentration (ug/mL)	Volume Added (uL)	Final Volume (mL)	Final Concentration (mg/L)
Matrix Supplemental Spike	TA-Burlington	2,6-Diaminio-4-nitrotoluene	200	50	5	2.0/40
	TA-Burlington	2,4-Diamino-6-nitrotoluene	200	50		
	AccuStandard M-8330-ADD-3-10X	Picric Acid	1000	10		
	Cerilliant T-002	Nitroglycerin	1000	200		
	Cerilliant P-037	PETN	1000	200		

Solvent: 50/50 Acetonitrile/Water

MMRICV Calibration Solution 200/4000PPB

Parent Standard	Vendor	Component	Stock Standard Concentration (ug/mL)	Volume Added (uL)	Final Volume (mL)	Final Concentration (mg/L)
Method 8330 Stock Standard	Cerilliant ERE-021	HMX	200	4	4	0.2
		RDX				
		1,3,5-Tinitrobenzene				
		1,3-Dinitrobenzene				
		Nitrobenzene				
		Tetryl				
		2,4,6- Trinitrotoluene				
		4-Amino-2, 6-dinitrotoluene				
		2-Amino-4, 6-dinitrotoluene				
		2,6-Dinitrotoluene				
		2,4-Dintrotoluene				
		2-Nitrotoluene				
		4-Nitrotoluene				
		3-Nitrotoluene				
SUPP ICV Stock	TA-Burlington	2,6-Diaminio-4-nitrotoluene	2	400	4	0.2/4.0
		2,4-Diamino-6-nitrotoluene	2			
		Picric Acid	2			
		Nitroglycerin	40			
		PETN	40			
1,2-Dinitrobenzene	TA-Burlington	1,2-Dinitrobenzene	40	20	4	0.2

Solvent: 50/50 Acetonitrile/Water

3,5-Dinitroaniline Matrix Spike Solution

Parent Standard	Vendor	Component	Stock Standard Concentration	Volume Added (uL)	Final Volume (mL)	Final Concentration (mg/L)
3,5-DNA	Accustandard M-3330-ADD-4-10X	3,5-Dinitroaniline	1000	0.2	5.0	40

Solvent: Acetonitrile

3,5-Dinitroaniline Calibration Solution (DNASTD7)

Parent Standard	Vendor	Component	Stock Standard Concentration	Volume Added (uL)	Final Volume (mL)	Final Concentration (mg/L)
3,5-DNA	Accustandard M-3330-ADD-4-10X	3,5-Dinitroaniline	40	1.0	40	1.0
Surrogate Spike	TA-Burlington	1,2 -Dinitrobenzene	40	1.0	40	1.0

Solvent: 50/50 Acetonitrile/Water

Routine Calibration Standard (DNASTD6-DNASTD2)

Stock Standard	C stock ug/L	V stock (uL)	V std (mL)	C std (ug/L)	Calibration Level
DNASTD7	1000	2000	4.0	500	DNASTD6
DNASTD7	1000	2000	10.0	200	DNASTD5
DNASTD7	1000	200	4.0	50	DNASTD4
DNASTD7	1000	50	2.0	25	DNASTD3
DNASTD7	1000	20	2.0	10	DNASTD2

Solvent: 50/50 Acetonitrile/Water

3,5-Dinitroaniline ICV Stock

Parent Standard	Vendor	Component	Stock Standard Concentration	Volume Added (uL)	Final Volume (mL)	Final Concentration (mg/L)
3,5-DNA	Restek 31661	3,5-Dinitroaniline	1000	0.2	5.0	40

Solvent: Acetonitrile

3,5-Dinitroaniline ICV Standard

Parent Standard	Vendor	Component	Stock Standard Concentration	Volume Added (uL)	Final Volume (mL)	Final Concentration (mg/L)
3,5-DNA ICV Stock	TA-Burlington	3,5-Dinitroaniline	40	0.02	4.0	0.2
Surrogate Spike	TA-Burlington	1,2 -Dinitrobenzene	40	0.02	4.0	0.2

Solvent: 50/50 Acetonitrile/Water

TNX/MNX/DNX Stock Solutions (ADDSTD)

Parent Standard	Vendor	Component	Stock Standard Concentration	Volume Added (mg)	Final Volume (mL)	Final Concentration (mg/L)
TNX	SRI International	TNX	neat	1.01	1.01	1000
DNX	Cerilliant	DNX	neat	0.52	0.52	1000
MNX	SRI International	MNX	neat	0.47	0.47	1000

Solvent: Acetonitrile

TNX/DNX/MNX Matrix Spiking Solution-40PPM

Parent Standard	Vendor	Component	Stock Standard Concentration (ug/mL)	Volume Added (uL)	Final Volume (mL)	Final Concentration (mg/L)
TNX Stock	TA-Burlington	TNX	1000	200	5.0	40
DNX Stock	TA-Burlington	DNX	1000	200		
MNX Stock	TA-Burlington	MNX	1000	200		

Solvent: Acetonitrile

TNX/MNX/DNX Calibration Standard (ADDSTD7)

Parent Standard	Vendor	Component	Stock Standard Concentration (mg/L)	Volume Added (uL))	Final Volume (mL)	Final Concentration (mg/L)
TNX/MNX/DNX Matrix Spike Solution	TA-Burlington	TNX/DNX/MNX	40	250	10	1.0
Surrogate Spike	TA-Burlington	1,2 -Dinitrobenzene	40	250	10	1.0

Solvent: 50/50 Acetonitrile Water

Routine Calibration Standard (ADDSTD6 - ADDSTD2)

Stock Standard	C stock ug/L	V stock (uL)	V std (mL)	C std (ug/L)	Calibration Level
ADDSTD7	1000	2000	4.0	500	ADDSTD6
ADDSTD7	1000	2000	10.0	200	ADDSTD5
ADDSTD7	1000	200	4.0	50	ADDSTD4
ADDSTD7	1000	50	2.0	25	ADDSTD3
ADDSTD7	1000	20	2.0	10	ADDSTD2

Solvent: 50/50 Acetonitrile Water

TNX/MNX/DNX ICV Stock Solution (ADDICV)

Parent Standard	Vendor	Component	Stock Standard Concentration	Volume Added (mg)	Final Volume (mL)	Final Concentration (mg/L)
TNX/DNX/ MNX Mixture	SRI International	TNX/DNX/MNX	Neat (TNX-11.5%/ DNX-52.6%/MNX-35.9%	0.50	5.00	11.5/52.6/35.9 TNX/DNX/MNX

Solvent: Acetonitrile

TNX/MNX/DNX ICV

Parent Standard	Vendor	Component	Stock Standard Concentration (mg/L)	Volume Added (uL))	Final Volume (mL)	Final Concentration (ug/L)
TNX/MNX/DNX ICV Stock	TA-Burlington	TNX/DNX/MNX	11.5/52.6/35.9	20	4	57.5/263/179.5
Surrogate Spike	TA-Burlington	1,2 -Dinitrobenzene	40	20	4	200

Solvent: 50/50 Acetonitrile Water

Appendix C: Equations

$$\textbf{Calibration Factor } (\mathbf{CF_x}) = \frac{\text{Peak area or height}_{(x)}}{\text{Standard concentration}_{(ug/L)}}$$

$$\textbf{Mean Calibration Factor } (\overline{CF}) = \frac{\sum_{i=1}^{n} CF_i}{n}$$

where: n = number of calibration levels

$$\textbf{Standard Deviation of the Calibration Factor (SD)} = \sqrt{\frac{\sum_{i=1}^{n}\left(CF_i - \overline{CF}\right)^2}{n-1}}$$

where: n = number of calibration levels

Percent Relative Standard Deviation (RSD) of the Calibration Factor =

$$\frac{SD}{\overline{CF}} \times 100\%$$

$$\textbf{Percent Difference (\%D)} = \frac{CF_v - \overline{CF}}{\overline{CF}} \times 100\%$$

where: CF_v = Calibration Factor from the Continuing Calibration Verification (CCV)

$$\textbf{Percent Drift} = \frac{\text{Calculated Concentration} - \text{Theoretical Concentration}}{\text{Theoretical Concentration}} \times 100\%$$

$$\textbf{Percent Recovery (\%R)} = \frac{C_s}{C_n} \times 100\%$$

where: C_s = Concentration of the Spiked Field or QC Sample
C_n = Nominal Concentration of Spike Added

$$\textbf{Percent Recovery (\%R) for MS/MSD} = \frac{C_s - C_u}{C_n} \times 100\%$$

where: C_s = Concentration of the Spiked Sample
C_u = Concentration of the Unspiked Sample
C_n = Nominal Concentration of Spike Added

Relative Percent Difference (%RPD) = $\frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100\%$

where: C_1 = Measured Concentration of First Sample
C_2 = Measured Concentration of Second Sample

Sample Concentration

Extract

$C_{extract}$ (ug/L) = $\frac{\text{Peak Area (or Height)}}{\overline{\text{CF}}}$

Note: The concentrations of the 3-5 peaks chosen for quantificaton is calculated and the average is then taken for final calculation.

Solid

$$C_{sample}(\text{ug/Kg}) = C_{extract}(\text{ug/L}) \times \frac{\text{extract volume (L)}}{\text{sample weight (Kg)}} \times \frac{100}{\%\ \text{solids}} \times DF$$

Test Methods in Application for Accreditation as of 09/17/09

Parameter	Test Method	Matrix
Perchlorate	SW-846 6850	Water / Soil
Perchlorate	EPA 331.0	Water
Nitroaromatics/Nitramines	SW-846 8330B	Water / Soil
pH	SW-846 9040A / 9045	Water / Soil
Total Organic Carbon	SW-846 9060	Water
Total Organic Carbon	Lloyd Kahn Method	Soil
Cyanide, Total	SW-846 9012A/B	Water / Soil
Sulfide	SW-846 9030/9034	Water / Soil
Mercury	SW-846 7470A / 7471A	Water / Soil
Metals (ICP-AES)	SW-846 6010B	Water / Soil
Metals (ICP-MS)	SW-846 6020	Water / Soil
PCBs	SW-846 8082	Water / Soil
Pesticides (Organochlorine)	SW-846 8081A	Water / Soil
Herbicides	SW-846 8151A	Water / Soil
Semivolatile Organic Compounds	SW-846 8270C	Water / Soil
Volatile Organic Compounds	SW-846 8260B	Water / Soil
Volatile Organic Compounds	EPA TO15	Air
Diesel Range Organics	SW-846 8015B (Modified)	Water / Soil
Organic Extraction Methods	SW-846 3510C, 3550B and 3540C	Water / Soil
Extract Cleanup Methods	SW-846 3620B, 3630C, 3660B, 3665A and 3640A	Solvent
Inorganic Digestion Methods	SW-846 3005A, 3010A and 3050B	Water / Soil

The above list of test methods includes those methods for which the laboratory has applied for DoD ELAP accreditation. TestAmerica Burlington is not currently accredited for any of these methods under the DoD ELAP Accreditation Program.

LABORATORY INSTRUCTIONS: The remaining sections of this document describe specific procedures that the laboratory must follow for DoD QSM project work for each laboratory section. These procedures are intended to supplement or super cede procedures in laboratory SOPs. For example, when a PM specifies DoD Protocol for a job, requirements in this program requirement summary (PRS) super cede the SOP unless otherwise specified for the project. DoD program specific requirements or reporting result will not be included in laboratory SOPs, these requirements are provided in this document and will supplement existing laboratory SOPs.

PROJECT MANAGEMENT

- Test Methods: If client is requesting a method for which the laboratory is not accredited, check with the QA Manager (QAM) or QA Assistant (QAA) to determine if accreditation or DoD approval is required.

- Target Analyte Lists: Establish with the client the “target analytes” for each method for each project. “Target analytes” are those that are subject to necessary QC evaluation, criteria and corrective action and may be inclusive of the entire analytes list reported for the project or a subset of analytes reported in the project.

- LOQ Precision & Bias: Communicate to the client the laboratory’s basis for reporting bias and precision at the LOQ. The TestAmerica (TA) DoD QAM Work Group plans to develop guidance for your use on this topic.

- Subcontracting: Any DoD project work that falls under this program must be subcontracted to a DoD ELAP approved lab and the subcontract lab must be approved by DoD project personnel. Retain a copy of the DoD ELAP Accreditation from the subcontract lab along with DoD approval of the subcontractor in the project record.

- Log-In: Specify “DoD QSM 4.1 Protocol” in the comment section of the log-in or Project Plan. Unless otherwise specified, the laboratory will follow the protocol in this document. If project requirements differ, attach the project specific requirements to a Project Plan and specify “DoD-Project Specific Protocol” in the comment section of the log-in. When lab is on TALS, use the DoD Program to build the project. Attach a copy of the established “target analyte” with the Project Plan.

- Reporting Specification: DoD QSM 4.1 has a specific scheme for the reporting of analytical results which cannot be handled by the laboratory until the laboratory in on TALS. Part of this reporting scheme requires the reporting of estimated values which can be handled at present time so specify estimated value reporting for all test methods.

- Case Narrative: Include the Manual Integration Summary for each method with the case narrative. Describe QA/QC exceptions and any variances taken by the laboratory to the requirements specified in the QSM or the requirements specified in the project quality assurance plan (QAPP). Inclusion of reference to the project QAPP in the narrative is recommended. If variances to the QSM were negotiated prior to project start-up, include a discussion of these variances and/or attach a record of authorization of the variance from the customer.

- Measurement Uncertainty: If project requires laboratory to provide measurement uncertainty, the laboratory estimates measurement uncertainty using statistically derived LCS control limits based on historical LCS recovery data to estimate the minimum laboratory contribution to measurement uncertainty at a 99% confidence level.

- QA Review: QA Review is required on 10% of project reports.

SAMPLE MANAGEMENT

- Follow established SOPs.

SAMPLE PREPARATION (ORGANIC EXTRACTIONS & INORGANIC METALS / WET CHEM)

- Follow established SOP for each test method.

- LCS: Full-List Spike required. Ensure spike list matches target analyte list provided by PM.

- Waters: Add spike and surrogate solutions to the sample container prior to transfer of the sample into the separatory funnel or liquid-liquid extractor.

- Start/End Time: Ensure the start and end time is recorded for each preparation batch.

- Drying Oven: Check and record the temperature of drying ovens before and after use.

SAMPLE ANALYSIS (All Sections)

- Follow established SOP for each test method except perform the QC checks at the minimum frequency specified in the DoD “F” tables and apply the DoD acceptance criteria, and corrective actions. NOTE: The “F” tables include some specifications for flagging such non-routine use of the “J” flag and use of a “Q” flag that cannot be supported with the existing laboratory system. For flagging, follow routine laboratory procedures. If the “F” Tables do not list the test method that you are using, use the routine and QC procedures specified in the laboratory SOP.

- Control Limits: Use DoD Acceptance Criteria (Appendix G) to evaluate for corrective actions; report in-house control limits in data report.

- Dual Column Analysis / Confirmation of Positive Results: All positive results must be confirmed. The calibration and QC criteria are the same for the primary and secondary column. If the RPD between columns exceeds 40%, the data must be flagged. The laboratory’s data processing system applies a “P” flag to denote this situation instead of the “J” flag required by QSM 4.1. Due to limitations with the laboratory’s data processing and reporting software, the laboratory will continue to apply the “P” flag until such time as the laboratory’s new reporting software (TestAmerica LIMS (TALS)) is installed in the laboratory. The time-frame for installation of TALS is first quarter of 2010.

Major Changes in “F” Tables from prior version of QSM:

- Calibration and QC requirements are based on SW-846 Update IV methods. The acceptance criteria are more challenging than previous versions of SW-846 and the QSM. Even though the laboratory has not transitioned to Update IV methods, the requirements in “F” tables are to be followed.

- Dual Column Methods: Laboratory must designate a primary column and report all results from the primary column regardless of which column yields a higher/lower value. The result may be reported from the secondary column only when there is a documented scientifically valid reason to do so.

- ICV/CCV criteria in “F” tables may be more stringent than the criteria in the published reference method. Lab must use the limits in the “F” tables for decisions regarding corrective actions.

- GC/MS 8260 & 8270: RSD criteria must be met for all target analytes in addition to SPCC and CCC compounds.

GENERAL ANALYTICAL / QUALITY SYSTEM REQUIREMENTS

All references to the term "MDL" have been removed from QSM 4.1. The new terms are:

Detection Limit (DL)
Limit of Detection (LOD)
Limit of Quantitation (LOQ)
Reporting Limit (RL)

LOD and LOQ must be verified quarterly and DL must be determined for surrogates. A draft SOP that describes procedures for establishment and verification of the DL, LOD, and LOQ has been developed and a copy will be made available for reference to each section.

ATTACHMENT B—LABORATORY QUALITY ASSURANCE MANUAL

Cover Page:

Quality Assurance Manual

TestAmerica Burlington
30 Community Drive, Suite 11
South Burlington, VT 05403
Phone: (802) 660-1990
Fax: (802) 660-1919

www.testamericainc.com

Facility Distribution No. Electronic **Distributed To: Facility Server**

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Title Page:

Quality Assurance Manual

Name and Address of Facility & Organizational Unit Covered:

TestAmerica
Burlington Laboratory
30 Community Drive, Suite 11
South Burlington, VT 05403
Phone: (802) 660-1990
Fax: (802) 660-1919

Responsible Individuals:

Laboratory Director – William S. Cicero 30 Community Drive, Suite 11 South Burlington, VT 05403 (802) 660-1990	4/29/10 Date
Quality Assurance Manager - Kirstin L. McCracken 30 Community Drive, Suite 11 South Burlington, VT 05403 (802) 660-1990	05/06/10 Date
Technical Director - Bryce E. Stearns 30 Community Drive, Suite 11 South Burlington, VT 05403 (802) 660-1990	5/6/10 Date
General Manager- Rusty Vicinie Pittsburgh Laboratory 301 Alpha Drive, RIDC Park Pittsburgh, PA 15238 (412) 963-7058	4/28/10 Date

SECTION 2

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REFERENCED CORPORATE SOPs AND POLICIES

SOP / Policy Reference	Title
CA-Q-S-001	Solvent and Acid Lot Testing and Approval
CA-Q-S-002	Acceptable Manual Integration Practices
CA-Q-S-004	Method Compliance & Data Authenticity Audits
CA-Q-S-006	Detection Limits
CA-Q-S-008	Management Systems Review
CW-Q-S-001	Corporate Document Control and Archiving
CW-Q-S-002	Writing a Standard Operating Procedure (SOPs)
CA-L-S-001	Internal Investigation of Potential Data Discrepancies and Determination for Data Recall
CA-L-S-002	Subcontracting Procedures
CA-L-P-001	Ethics Policy
CA-L-P-002	Contract Compliance Policy
CW-F-P-002	Authorization Matrix
CW-F-P-004	Procurement and Contracts Policy
CA-C-S-001	Work Sharing Process
CA-T-P-001	Qualified Products List
CW-F-S-007	Controlled Purchases Policy
CW-F-S-018	Vendor Selection
CA-Q-M-002	Corporate Quality Management Plan
CW-E-M-001	Corporate Environmental Health & Safety Manual

REFERENCED LABORATORY SOPs

SOP Reference	Title
BR-QA-003	Document Control & Updating (However Named, Sec. 3.4.1)
BR-QA-004	Complaint Resolution (However Named, Sec .10.1)
BR-QA-011	Lab Training (However Named, Sec. 17.3)
See Corporate SOP	Writing SOPs (However Named, Sec. 19.2)
BR-QA-011	DOCs (However Named, Sec. 19.4.2)
BR-QA-005	MDLs (However Named, Sec. 19.7)
BR-QA-006	MI (However Named, Sec. 19.14.1)
BR-QA-020	Subsampling (However Named, 22.5)
BR-SM-001	Sample Receipt / Login, etc… (However Named, Sec. 23.2.1.3)

SECTION 3. INTRODUCTION (NELAC 5.1 - 5.3)

3.1 INTRODUCTION AND COMPLIANCE REFERENCES

TestAmerica Burlington's Quality Assurance Manual (QAM) is a document prepared to define the overall policies, organization objectives and functional responsibilities for achieving TestAmerica's data quality goals. The laboratory maintains a local perspective in its scope of services and client relations and maintains a national perspective in terms of quality.

The QAM has been prepared to assure compliance with the 2003 National Environmental Laboratory Accreditation Conference (NELAC) standards and ISO/IEC Guide 17025 2005. In addition, the policies and procedures outlined in this manual are compliant with TestAmerica's Corporate Quality Management Plan (CQMP) and the various accreditation and certification programs listed in Appendix 3. The CQMP provides a summary of TestAmerica's quality and data integrity system. It contains requirements and general guidelines under which all TestAmerica facilities shall conduct their operations.

The QAM has been prepared to be consistent with the requirements of the following documents:

- EPA 600/4-88/039, *Methods for the Determination of Organic Compounds in Drinking Water,* EPA, Revised July 1991.
- EPA 600/R-95/131, *Methods for the Determination of Organic Compounds in Drinking Water,* Supplement III, EPA, August 1995.
- EPA 600/4-79-019, *Handbook for Analytical Quality Control in Water and Wastewater Laboratories,* EPA, March 1979.
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IIIB, November 2004, Final Update IV, January 2008.*
- *U.S. Department of Defense, Quality Systems Manual for Environmental Laboratories, Version 4.1, April 2009.*
- U.S. Department of Defense, *Quality Systems Manual for Environmental Laboratories*, Final Version 3, January 2006.
- Federal Register, 40 CFR Parts 136, 141, 172, 173, 178, 179 and 261.
- *Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.*
- APHA, *Standard Methods for the Examination of Water and Wastewater,* 18th Edition, 19th, 20th and 21st Edition.
- Nuclear Regulatory Commission (NRC) Quality Assurance Requirements.
- Marine Protection, Research, and Sanctuaries Act (MPRSA).
- Toxic Substances Control Act (TSCA).

3.2 TERMS AND DEFINITIONS

A Quality Assurance Program is a company-wide system designed to ensure that data produced by the laboratory conforms to the standards set by state and/or federal regulations.

The program functions at the management level through company goals and management policies, and at the analytical level through Standard Operating Procedures (SOPs) and quality control. The TestAmerica program is designed to minimize systematic error, encourage constructive, documented problem solving, and provide a framework for continuous improvement within the organization.

Refer to Appendix 2 for the Glossary/Acronyms.

3.3 SCOPE / FIELDS OF TESTING

The laboratory analyzes a broad range of environmental and industrial samples every month. Sample matrices vary among solids and sediments, drinking water, non-potable water, waste, tissue, air and saline/estuarine samples. Specialty capabilities include air toxics testing, geotechnical testing, and tissue preparation and analysis. The Quality Assurance Program contains specific procedures and methods to test samples of differing matrices for chemical and physical parameters. The Program also contains guidelines on maintaining documentation of analytical process, reviewing results, servicing clients and tracking samples through the laboratory. The technical and service requirements of all requests to provide analyses are thoroughly evaluated before commitments are made to accept the work. Measurements are made using published reference methods or methods developed and validated by the laboratory.

The methods covered by this manual include the most frequently requested methodologies needed to provide analytical services in the United States and its territories. The specific list of test methods used by the laboratory can be found on the company's website or may be obtained from any laboratory Project Manager (PM). The approach of this manual is to define the minimum level of quality assurance and quality control necessary to meet requirements. All methods performed by the laboratory shall meet these criteria as appropriate. In some instances, quality assurance project plans (QAPPs), project specific data quality objectives (DQOs) or local regulations may require criteria other than those contained in this manual. In these cases, the laboratory will abide by the requested criteria following review and acceptance of the requirements by the Laboratory Director and the Quality Assurance (QA) Manager. In some cases, QAPPs and DQOs may specify less stringent requirements. The Laboratory Director and the QA Manager must determine if it is in the lab's best interest to follow the less stringent requirements.

3.4 MANAGEMENT OF THE MANUAL

3.4.1 Review Process

This manual is reviewed annually by senior laboratory management to assure that it reflects current practices and meets the requirements of the laboratory's clients and regulators as well as the Corporate Quality Management Plan (CQMP). Occasionally, the manual may need changes in order to meet new or changing regulations and operations. The QA Manager will review the changes in the normal course of business and incorporate changes into revised sections of the document. All updates will be reviewed by the senior laboratory management staff. The laboratory updates and approves such changes according to our SOP for Document Control, laboratory SOP No. BR-QA-003.

SECTION 4. ORGANIZATION AND MANAGEMENT (NELAC 5.4.1)

4.1 OVERVIEW

TestAmerica Burlington is a local operating unit of TestAmerica Laboratories, Inc.. The organizational structure, responsibilities and authorities of the corporate staff of TestAmerica Laboratories, Inc. are presented in the CQMP. The laboratory has day-to-day independent operational authority overseen by corporate officers (e.g., President, Chief Operating Officer, Corporate Quality Assurance, etc.). The laboratory operational and support staff work under the direction of the Laboratory Director. The organizational structure for both Corporate & TestAmerica Burlington is presented in Figure 4-1.

4.2 ROLES AND RESPONSIBILITIES

In order for the Quality Assurance Program to function properly, all members of the staff must clearly understand and meet their individual responsibilities as they relate to the quality program. The following descriptions briefly define each role in its relationship to the Quality Assurance Program.

4.2.1 Quality Assurance Program

The responsibility for quality lies with every employee of the laboratory. All employees have access to the QAM, are trained to this manual, and are responsible for upholding the standards therein. Each person carries out his/her daily tasks in a manner consistent with the goals and in accordance with the procedures in this manual and the laboratory's SOPs. Role descriptions for Corporate personnel are defined in the CQMP. This manual is specific to the operations of TestAmerica's Burlington laboratory.

4.2.2 Laboratory Director

The Laboratory Director (LD) has responsibility and authority for the overall quality, safety, financial, technical, human resource and service performance of the laboratory. The LD oversees the daily operations of the laboratory and provides the resources necessary to implement and maintain an effective and comprehensive Quality Assurance and Data Integrity Program. The LD responsibilities include supervision of staff, setting goals and objectives for both the business and the employees and achieving the financial, business, technical and quality objectives of the laboratory. The LD ensures timely compliance with audits and corrective actions, and is responsible for maintaining a working environment that encourages open, constructive problem solving for continuous improvement.

4.2.3 Quality Assurance Manager

The QA Manager (QM) is responsible for ensuring the laboratory's quality system and quality assurance manual meet the requirements given in the company's Corporate Quality Management Plan (CQMP). The QAM implements, maintains and improves the quality system. The QAM provides quality system and ethics training to all new personnel ensuring all personnel understand their contributions to the quality system and the QAM evaluates the effectiveness of the training program. The QAM performs and oversees internal systems, data, and special audits and performs other surveillance activities to monitor for trends and opportunities for continuous improvement. The QAM oversees the maintenance of QA records, certifications and accreditations. The QAM is responsible for ensuring communication regarding the effectiveness of the quality system takes place at all levels within the laboratory. The QAM has the final authority to accept or reject data and to stop work in progress in the event the practice compromises the validity or integrity of analytical data. The QAM has an indirect reporting relationship to an assigned Quality Director, is independent of laboratory operations and has responsibility and authority to ensure the continuous implementation of the quality system based on ISO 17025 including:

- Ensuring Communication & monitoring standards of performance to ensure that systems are in place to produce the level of quality as defined in this document.
- Notifying laboratory management of deficiencies in the quality system and ensuring corrective action is taken. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs are temporarily suspended following the procedures outlined in Section 12.
- Evaluation of the thoroughness and effectiveness of training.
- Compliance with ISO 17025.

4.2.4 Technical Director (TD)

The Technical Director is responsible for compliance with the ISO 17025 Standard. The Technical Director solves day to day technical issues, provides technical training and guidance to laboratory staff, project managers, and clients, investigates technical issues identified by QA, and directs evaluation of new methods.

4.2.5 Customer Service Manager (CSM)

The Customer Service Manager is responsible for supervision of the project management staff. The CSM compiles and interprets the receipts forecast and tracks and maintains information for various revenue reports. The CSM is responsible for the evaluation and preparation of bids and proposals for new business opportunities and overseeing the project management bid activity for existing client base.

4.2.6 Project Manager (PM)

The Project Manager(s) is responsible for direct communication with the client, coordination of laboratory services, work scheduling and dissemination of project requirements to the laboratory operation. The PM writes project narratives, performs tertiary data review, investigates and resolves technical and service related issues that arise during the course of the project.

4.2.7 Department Manager/Supervisor/Coordinator

The Department Manager has responsibilities for a defined portion of the laboratory that include work scheduling, development, execution and supervision of analytical procedures including SOP review and revision, secondary data review, staff training, goal setting and monitoring lab activities to achieve the quality objectives set forth in the LQM and standard operating procedures. A department supervisor or coordinator may be designated by the Department Manager to perform some of these job responsibilities. Department Supervisors or Coordinators report to the Department Manager.

4.2.8 Chemist/Analyst

Chemists and analysts responsible for analysis of samples and generation of analytical data in accordance with the requirements set forth in the CQMP, this document, company policy and procedure, test method and process standard operating procedures, and project specifications.

4.2.9 Sample Custodian

The Sample Custodian(s) is responsible for the receipt and handling of samples within the laboratory. Responsibilities include adherence to the laboratory sample acceptance policy, initiation of internal chain of custody, when needed, sample log-in and tracking, sample security and storage, and sample disposal.

4.2.10 IT Staff

The IT Staff are responsible for the design and maintenance of the laboratory's computer hardware and software. Responsibilities include preparation and maintenance of the Information Systems Quality Manual (ISQM), implementation and validation of new data systems, network administration, hardware and software maintenance, review, creation of electronic data deliverables (EDD) and the provision of technical support to all laboratory staff.

4.2.11 Environmental Health & Safety Coordinator

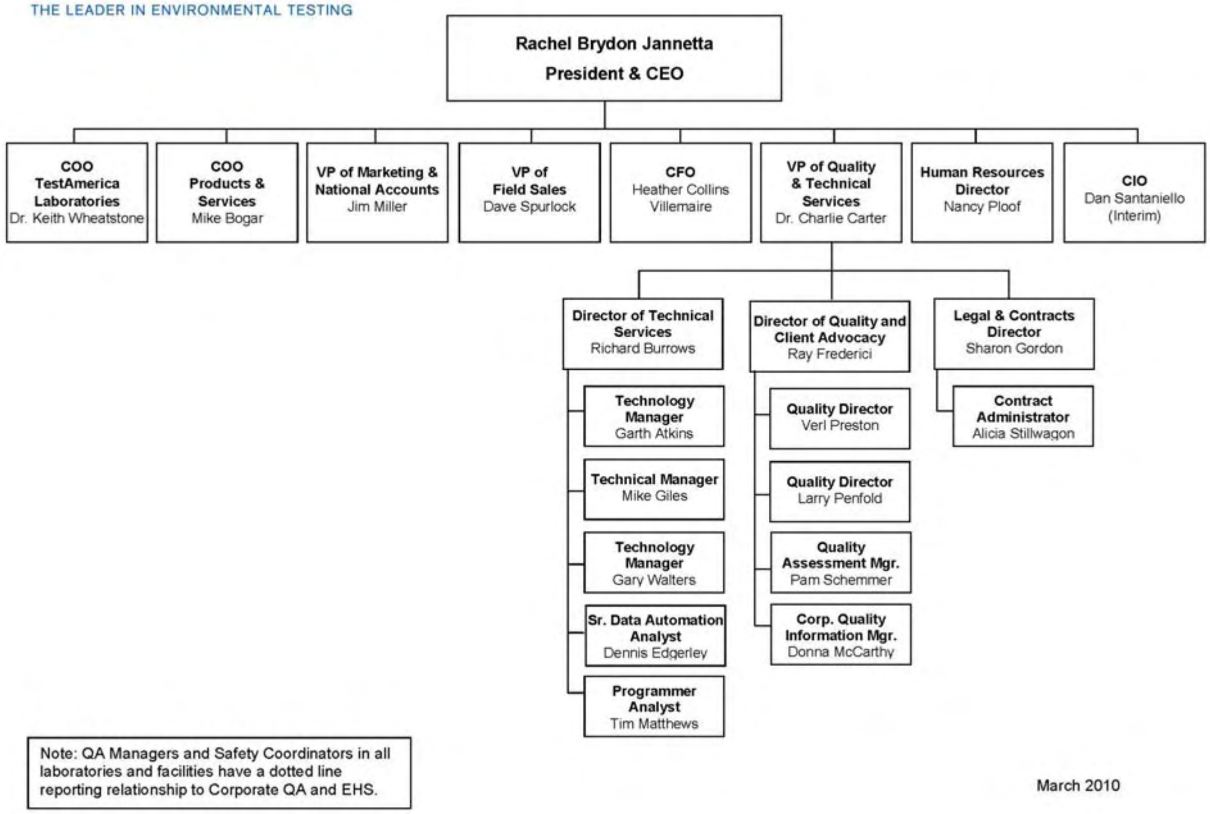
The Employee Health and Safety Coordinator is responsible for administering the EH&S program in order to provide a safe, healthy working environment for all employees. The EH&S Coordinator responsibilities include the monitoring of all work areas to detect unsafe conditions, acts, and potential hazards, enforcement of environmental, health, and safety policies and procedures and ensuring regulatory compliance with local, state, and federal laws. The EH& S Coordinator provides safety and health recommendations to laboratory management in conjunction with the facility safety committee, develops the facility Integrated Contingency Plan and coordinates the facility's Emergency Response Team.

4.3 DEPUTIES

The following table defines who assumes the responsibilities of key personnel in their absence:

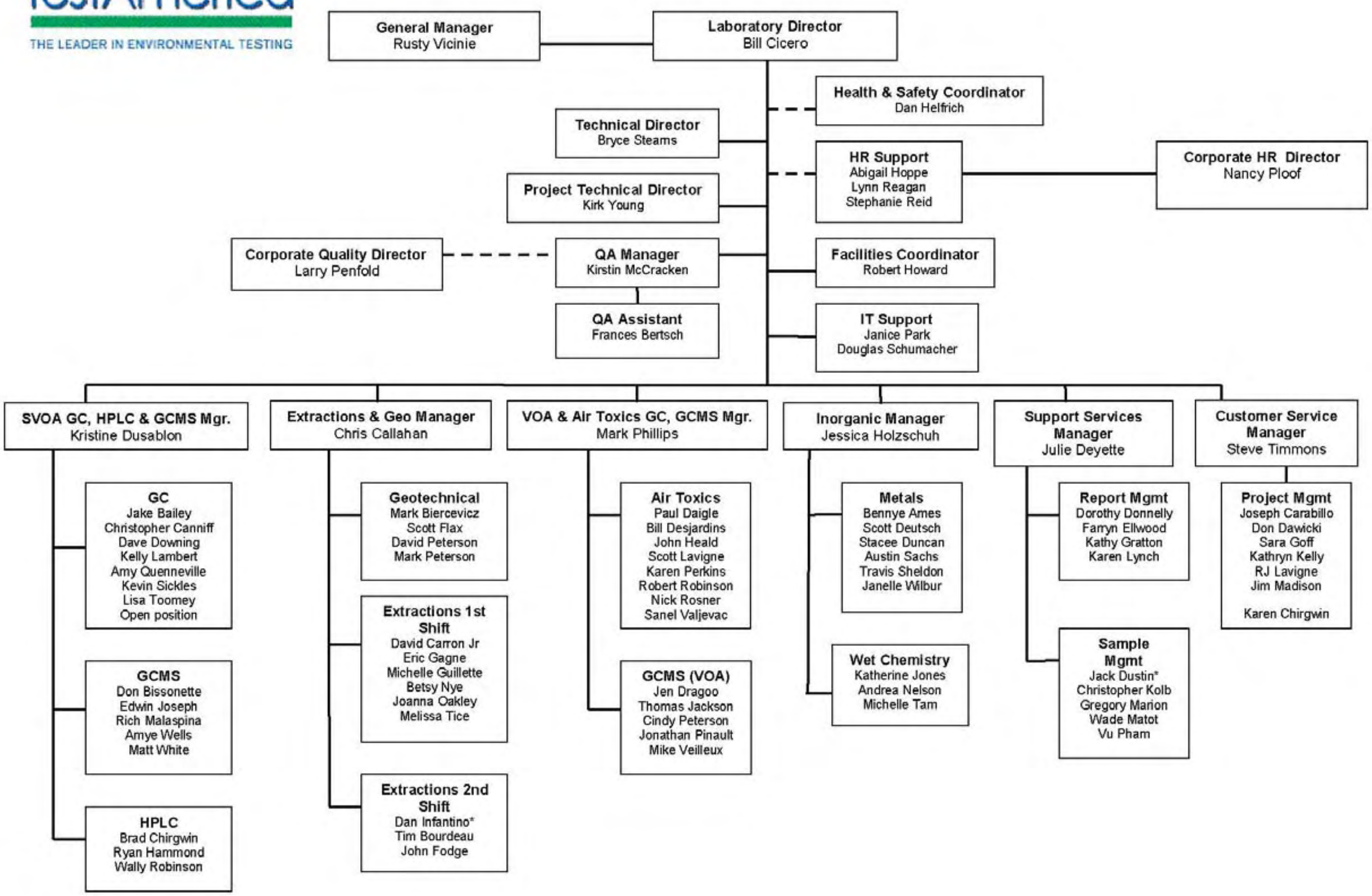
Key Personnel	Deputy
William S. Cicero Laboratory Director	Bryce E. Stearns, Technical Director Kirstin L. McCracken, QA Manager Steve Timmons, Customer Service Manger
Kirstin L. McCracken QA Manager	William S. Cicero, Laboratory Director Bryce E. Stearns, Technical Director Frances S. Bertsch, QA Assistant
Bryce E. Stearns Technical Director	William S. Cicero, Laboratory Director Kirstin L. McCracken, QA Manager
Dan E. Helfrich EHS Coordinator	William S. Cicero, Laboratory Director

Figure 4-1. Corporate and Laboratory Organization Charts



Burlington Laboratory Organization

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING



03/17/2010 * Denotes Supervisor

SECTION 5. QUALITY SYSTEM (NELAC 5.4.2)

5.1 QUALITY POLICY STATEMENT

It is TestAmerica's Policy to:

- Provide data of known quality to its clients by adhering to approved methodologies, regulatory requirements and the QA/QC protocols.

- Effectively manage all aspects of the laboratory and business operations by the highest ethical standards.

- Continually improve systems and provide support to quality improvement efforts in laboratory, administrative and managerial activities. TestAmerica recognizes that the implementation of a quality assurance program requires management's commitment and support as well as the involvement of the entire staff.

- Provide clients with the highest level of professionalism and the best service practices in the industry.

- To comply with the ISO/IEC 17025:2005 International Standard and to continually improve the effectiveness of the management system.

Every staff member at the laboratory plays an integral part in quality assurance and is held responsible and accountable for the quality of their work. It is, therefore, required that all laboratory personnel are trained and agree to comply with applicable procedures and requirements established by this document.

5.2 ETHICS AND DATA INTEGRITY

TestAmerica is committed to ensuring the integrity of its data and meeting the quality needs of its clients. The elements of TestAmerica's Ethics and Data Integrity Program include:

- An Ethics Policy (Corporate Policy No. CA-L-P-001) and Employee Ethics Statements.
- Ethics and Compliance Officers (ECOs).
- A Training Program.
- Self-governance through disciplinary action for violations.
- A Confidential mechanism for anonymously reporting alleged misconduct and a means for conducting internal investigations of all alleged misconduct. (Corporate SOP No. CA-L-S-001.)
- Procedures and guidance for recalling data if necessary (Corporate SOP No. CA-L-S-001).
- Effective external and internal monitoring system that includes procedures for internal audits (Section 15).
- Produce results, which are accurate and include QA/QC information that meets client pre-defined Data Quality Objectives (DQOs).
- Present services in a confidential, honest and forthright manner.

- Provide employees with guidelines and an understanding of the Ethical and Quality Standards of our Industry.
- Operate our facilities in a manner that protects the environment and the health and safety of employees and the public.
- Obey all pertinent federal, state and local laws and regulations and encourage other members of our industry to do the same.
- Educate clients as to the extent and kinds of services available.
- Assert competency only for work for which adequate personnel and equipment are available and for which adequate preparation has been made.
- Promote the status of environmental laboratories, their employees, and the value of services rendered by them.

5.3 QUALITY SYSTEM DOCUMENTATION

The laboratory's Quality System is communicated through a variety of documents.

- Quality Assurance Manual – Each laboratory has a lab specific quality assurance manual.
- Corporate SOPs and Policies - Corporate SOPs and Policies are developed for use by all relevant laboratories. They are incorporated into the laboratory's normal SOP distribution, training and tracking system. Corporate SOPs may be general or technical.
- Work Instructions - A subset of procedural steps, tasks or forms associated with an operation of a management system (e.g., checklists, preformatted bench sheets, forms).
- Laboratory SOPs – General and Technical
- Corporate Quality Policy Memorandums
- Laboratory QA/QC Policy Memorandums

5.3.1 Order of Precedence

In the event of a conflict or discrepancy between policies, the order of precedence is as follows:

- Corporate Quality Policy Memorandum
- Corporate Quality Management Plan (CQMP)
- Corporate SOPs and Policies
- Laboratory QA/QC Policy Memorandum
- Laboratory Quality Assurance Manual (QAM)
- Laboratory SOPs and Policies
- Other (Work Instructions (WI), memos, flow charts, etc.)

Note: The laboratory's has the responsibility and authority to operate in compliance with regulatory requirements of the jurisdiction in which the work is performed. Where the CQMP conflicts with those regulatory requirements, the regulatory requirements of the jurisdiction shall hold primacy. The laboratory's quality assurance manual shall take precedence over the CQMP in those cases.

5.4 QA/QC OBJECTIVES FOR THE MEASUREMENT OF DATA

Quality Assurance (QA) and Quality Control (QC) are activities undertaken to achieve the goal of producing data that accurately characterize the sites or materials that have been sampled. Quality Assurance is generally understood to be more comprehensive than Quality Control. Quality Assurance can be defined as the integrated system of activities that ensures that a product or service meets defined standards.

Quality Control is generally understood to be limited to the analyses of samples and to be synonymous with the term *"analytical quality control"*. QC refers to the routine application of statistically based procedures to evaluate and control the accuracy of results from analytical measurements. The QC program includes procedures for estimating and controlling precision and bias and for determining reporting limits.

Request for Proposals (RFPs) and Quality Assurance Project Plans (QAPP) provide a mechanism for the client and the laboratory to discuss the data quality objectives in order to ensure that analytical services closely correspond to client needs. The client is responsible for developing the QAPP. In order to ensure the ability of the laboratory to meet the Data Quality Objectives (DQOs) specified in the QAPP, clients are advised to allow time for the laboratory to review the QAPP before being finalized. Additionally, the laboratory will provide support to the client for developing the sections of the QAPP that concern laboratory activities.

Historically, laboratories have described their QC objectives in terms of precision, accuracy, representativeness, comparability, completeness, selectivity and sensitivity (PARCCSS).

5.4.1 Precision

The laboratory objective for precision is to meet the performance for precision demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Precision is defined as the degree of reproducibility of measurements under a given set of analytical conditions (exclusive of field sampling variability). Precision is documented on the basis of replicate analysis, usually duplicate or matrix spike (MS) duplicate samples.

5.4.2 Accuracy

The laboratory objective for accuracy is to meet the performance for accuracy demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Accuracy is defined as the degree of bias in a measurement system. Accuracy may be documented through the use of laboratory control samples (LCS) and/or MS. A statement of accuracy is expressed as an interval of acceptance recovery about the mean recovery.

5.4.3 Representativeness

The laboratory objective for representativeness is to provide data which is representative of the sampled medium. Representativeness is defined as the degree to which data represent a characteristic of a population or set of samples and is a measurement of both analytical and field sampling precision. The representativeness of the analytical data is a function of the procedures used in procuring and processing the samples. The representativeness can be documented by the relative percent difference between separately procured, but otherwise identical samples or sample aliquots.

The representativeness of the data from the sampling sites depends on both the sampling procedures and the analytical procedures. The laboratory may provide guidance to the client regarding proper sampling and handling methods in order to assure the integrity of the samples.

5.4.4 Comparability

The comparability objective is to provide analytical data for which the accuracy, precision, representativeness and reporting limit statistics are similar to these quality indicators generated by other laboratories for similar samples, and data generated by the laboratory over time.

The comparability objective is documented by inter-laboratory studies carried out by regulatory agencies or carried out for specific projects or contracts, by comparison of periodically generated statements of accuracy, precision and reporting limits with those of other laboratories.

5.4.5 Completeness

The completeness objective for data is as specified by a particular project expressed as the ratio of the valid data to the total data over the course of the project. Data will be considered valid if they are adequate for their intended use. Data usability will be defined in a QAPP, project scope or regulatory requirement. Data validation is the process for reviewing data to determine its usability and completeness. If the completeness objective is not met, actions will be taken internally and with the data user to improve performance. This may take the form of an audit to evaluate the methodology and procedures as possible sources for the difficulty or may result in a recommendation to use a different method.

5.4.6 Selectivity

Selectivity is defined as: The capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. Target analytes are separated from non-target constituents and subsequently identified/detected through one or more of the following, depending on the analytical method: extractions (separation), digestions (separation), interelement corrections (separation), use of matrix modifiers (separation), specific retention times (separation and identification), confirmations with different columns or detectors (separation and identification), specific wavelengths (identification), specific mass spectra (identification), specific electrodes (separation and identification), etc..

5.4.7 Sensitivity

Sensitivity refers to the amount of analyte necessary to produce a detector response that can be reliably detected (Method Detection Limit or Limit of Detection) or quantified (Reporting Limit).

5.5 CRITERIA FOR QUALITY INDICATORS

The laboratory maintains the LIMS database that summarizes the precision and accuracy acceptability limits for performed analyses. The database includes an effective date, is updated each time new limits are generated and are managed by the laboratory's QA department. Unless otherwise noted, limits within these tables are laboratory generated. Some acceptability limits are derived from US EPA methods when they are required. Where US EPA method limits are not required, the laboratory has developed limits from evaluation of data from similar matrices. Criteria for development of control limits is contained in laboratory SOP BR-QA-013.

5.6 STATISTICAL QUALITY CONTROL

If a method defines the QC limits, the method limits are used. In the absence of method specific or project specific limits, the laboratory routinely utilizes statistically-derived limits to evaluate method performance and determine when corrective action is appropriate. These limits are maintained by the QA Manager or her designee in the Laboratory Information Management System (LIMS).

Statistical limits for spikes and surrogates are generated from recent data in the LIMS database following the guidelines described in Section 24.

Current QC limits are entered and maintained in the LIMS database. As sample results and the related QC are entered into LIMS, the sample QC values are compared with the limits in LIMS to determine if they are within the acceptable range. The analyst then evaluates if the sample needs to be rerun or re-extracted/rerun or if a comment should be added to the report explaining the reason for the QC outlier.

5.6.1 QC Charts

Trend analysis is performed to determine if adjustments need to be made or for corrective actions to methods. These procedures are provided in laboratory SOP BR-QA-013.

5.7 QUALITY SYSTEM METRICS

In addition to the QC parameters discussed above, the entire Quality System is evaluated on a monthly basis through the use of specific metrics (refer to Section 16). These metrics are used to drive continuous improvement in the laboratory's Quality System.

SECTION 6. DOCUMENT CONTROL (NELAC 5.4.3)

6.1 OVERVIEW

The QA Department is responsible for the control of documents used in the laboratory to ensure that approved, up-to-date documents are in circulation and out-of-date (obsolete) documents are archived or destroyed. The following documents, at a minimum, must be controlled:

- Laboratory Quality Assurance Manual
- Laboratory Standard Operating Procedures (SOP)
- Laboratory Policies
- Work Instructions and Forms
- Corporate Policies and Procedures distributed outside the intranet

Corporate Quality posts Corporate Manuals, SOPs, Policies, Work Instructions, White Papers and Training Materials on the company intranet site. These Corporate documents are only considered controlled when they are read on the intranet site. Printed copies are considered uncontrolled unless the laboratory physically distributes them as controlled documents. A detailed description of the procedure for issuing, authorizing, controlling, distributing, and archiving Corporate documents is found in Corporate SOP No. CW-Q-S-001, Corporate Document Control and Archiving. The laboratory's internal document control procedure is defined in SOP BR-QA-003.

The laboratory QA Department also maintains access to various references and document sources integral to the operation of the laboratory. This includes reference methods and regulations. Instrument manuals (hard or electronic copies) are also maintained by the laboratory.

The laboratory maintains records for raw analytical data and supporting records such as audit reports and responses, logbooks, standard logs, training files, MDL studies, Proficiency Testing (PT) studies, certifications and related correspondence, and corrective action reports. Raw analytical data consists of bound logbooks, instrument printouts, any other notes, magnetic media, electronic data and final reports.

6.2 DOCUMENT APPROVAL AND ISSUE

The pertinent elements of a document control system for each document include a unique document title and number, the number of pages of the item, the effective date, revision number and the laboratory's name. The QA personnel are responsible for the maintenance of this system.

Controlled documents are authorized by the QA Department. In order to develop a new document, a manager submits an electronic draft to the QA Department. Upon approval, QA personnel add the identifying version information to the document and retain the official document on file. The official document is provided to all applicable operational units (may include electronic access). Controlled documents are identified as such and records of their distribution are kept by the QA Department. Document control may be achieved by either electronic or hardcopy distribution.

The QA Department maintains a list of the official versions of controlled documents.

Quality System Policies and Procedures will be reviewed annually and revised as appropriate. Changes to documents occur when a procedural change warrants.

6.3 PROCEDURES FOR DOCUMENT CONTROL POLICY

For changes to the QA Manual, refer to SOP No. BR-QA-003. A controlled copy of the QA Manual is issued under controlled distribution to the controlled distribution directory located on a network server. Uncontrolled copies must not be used within the laboratory. Previous revisions of the Quality Manual are stored by the QA department.

For changes to SOPs, refer to SOP No. CW-Q-S-002, Writing a Standard Operating Procedure SOP.

Forms, worksheets, work instructions and information are organized by department and are maintained by QA. The procedure for the care of these documents is in SOP BR-QA-003.

6.4 OBSOLETE DOCUMENTS

All invalid or obsolete documents are removed, or otherwise prevented from unintended use. The laboratory has specific procedures as described above to accomplish this. In general, obsolete documents are collected from employees according to distribution lists and are marked obsolete on the cover or destroyed. At least one copy of the obsolete document is archived according to SOP BR-QA-003.

SECTION 7. SERVICE TO THE CLIENT (NELAC 5.4.7)

7.1 OVERVIEW

The laboratory has established procedures for the review of work requests and contracts, oral or written. The procedures include evaluation of the laboratory's capability and resources to meet the contract's requirements within the requested time period. All requirements, including the methods to be used, must be adequately defined, documented and understood. For many environmental sampling and analysis programs, testing design is site or program specific and does not necessarily "fit" into a standard laboratory service or product. It is the laboratory's intent to provide both standard and customized environmental laboratory services to our clients.

A thorough review of technical and QC requirements contained in contracts is performed to ensure project success. The appropriateness of requested methods, and the lab's capability to perform them must be established. Projects, proposals and contracts are reviewed for adequately defined requirements and the laboratory's capability to meet those requirements. Alternate test methods that are capable of meeting the clients' requirements may be proposed by the lab. A review of the lab's capability to analyze non-routine analytes is also part of this review process.

All projects, proposals and contracts are reviewed for the client's requirements in terms of compound lists, test methodology requested, sensitivity (detection and reporting levels), accuracy, and precision requirements (% Recovery and RPD). The reviewer ensures that the laboratory's test methods are suitable to achieve these regulatory and client requirements and that the laboratory holds the appropriate certifications and approvals to perform the work. The laboratory and any potential subcontract laboratories must be certified, as required, for all proposed tests.

The laboratory must determine if it has the necessary physical, personnel and information resources to meet the contract, and if the personnel have the expertise needed to perform the testing requested. Each proposal is checked for its impact on the capacity of the laboratory's equipment and personnel. As part of the review, the proposed turnaround time will be checked for feasibility.

Electronic or hard copy deliverable requirements are evaluated against the laboratory's capacity for production of the documentation.

If the laboratory cannot provide all services but intends to subcontract such services, whether to another TestAmerica facility or to an outside firm, this will be documented and discussed with the client prior to contract approval. (Refer to Section 8 for Subcontracting Procedures.)

The laboratory informs the client of the results of the review if it indicates any potential conflict, deficiency, lack of accreditation, or inability of the lab to complete the work satisfactorily. Any discrepancy between the client's requirements and the laboratory's capability to meet those requirements is resolved in writing before acceptance of the contract. It is necessary that the contract be acceptable to both the laboratory and the client. Amendments initiated by the client and/or TestAmerica, are documented in writing.

All contracts, QAPPs, Sampling and Analysis Plans (SAPs), contract amendments, and documented communications become part of the project record.

The same contract review process used for the initial review is repeated when there are amendments to the original contract by the client, and the participating personnel are informed of the changes.

7.2 REVIEW SEQUENCE AND KEY PERSONNEL

Appropriate personnel review the work request at each stage of evaluation.

For routine projects a review by the Project Manager (PM) is considered adequate. The PM confirms that the laboratory has any required certifications, that it can meet the clients' data quality and reporting requirements and that the lab has the capacity to meet the clients turn around needs. It is recommended that, where there is a sales person assigned to the account, an attempt should be made to contact that sales person to inform them of the incoming samples.

For new, complex or large projects, the proposed contract is given to the National Account Director, who will decide which network laboratory will receive the work based on the scope of work and other requirements, including certification, testing methodology, and available capacity to perform the work. The contract review process is outlined in TestAmerica's Corporate SOP No. CA-L-P-002**,** Contract Compliance Policy.

This review encompasses all facets of the operation. The scope of work is distributed to the appropriate personnel, as needed based on scope of contract, to evaluate all of the requirements shown above. Appropriate personnel include but are not limited to:

- Legal & Contracts Director
- General Manager
- Laboratory Director
- Laboratory Customer Service Manager
- Laboratory Project Manager
- Laboratory QA Manager and Technical Director
- Laboratory Department Managers

In the event that one of the above personnel is not available to review the contract, his or her back-up will fulfill the review requirements.

The local account representative submits the final proposal to the client.

The Legal & Contracts Director maintains copies of all signed contracts and a copy is kept locally in the project file.

7.3 DOCUMENTATION

Appropriate records are maintained for every contract or work request. All stages of the contract review process are documented and include records of any significant changes. Records of review are retained by the Project Manager.

Records are maintained of pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract.

7.3.1 Project-Specific Quality Planning

Communication of contract specific technical and QC criteria is an essential activity in ensuring the success of site specific testing programs. To achieve this goal, the laboratory assigns a PM to each client. It is the PM's responsibility to ensure that project-specific technical and QC requirements are effectively evaluated and communicated to the laboratory personnel before and during the project.

Prior to work on a new project, the dissemination of project information and/or project opening meetings may occur to discuss schedules and unique aspects of the project. Items to be discussed may include the project technical profile, turnaround times, holding times, methods, analyte lists, reporting limits, deliverables, sample hazards, or other special requirements. The PM introduces new projects to the laboratory staff through project kick-off meetings or during production meetings. These meetings provide direction to the laboratory staff in order to maximize production and client satisfaction, while maintaining quality. In addition, project notes may be associated with each sample batch as a reminder upon sample receipt and analytical processing.

During the project, any change that may occur within an active project is agreed upon between the client/regulatory agency and the PM/laboratory. These changes (e.g., use of a non-standard method or modification of a method) and approvals must be documented prior to implementation. Documentation pertains to any document, e.g., letter, e-mail, variance, contract addendum, which has been signed by both parties.

Such changes are also communicated to the laboratory by the PM and documentation of the modification is made in the case narrative of the data report(s).

The laboratory strongly encourages client visits to the laboratory and for formal/informal information sharing session with employees in order to effectively communicate ongoing client needs as well as project specific details for customized testing programs.

7.4 SPECIAL SERVICES

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. It is the laboratory's goal to meet all client requirements in addition to statutory and regulatory requirements. The laboratory has procedures to ensure confidentiality to clients (Section 15 and 25).

Note: ISO 17025/NELAC 2003 states that a laboratory "shall afford clients or their representatives cooperation to clarify the client's request". This topic is discussed in Section 7.

The laboratory's standard procedures for reporting data are described in Section 25. Special services are also available and provided upon request. These services include:

- Reasonable access for our clients or their representatives to the relevant areas of the laboratory for the witnessing of tests performed for the client.
- Assist client-specified third party data validators as specified in the client's contract.
- Supplemental information pertaining to the analysis of their samples. Note: An additional charge may apply for additional data/information that was not requested prior to the time of sample analysis or previously agreed upon.

7.5 CLIENT COMMUNICATION

Project managers are the primary communication link to the clients. They shall inform their clients of any delays in project completion as well as any non-conformances in either sample receipt or sample analysis. Project management will maintain ongoing client communication throughout the entire client project.

The Technical Director, QA Staff or Department Managers are available to discuss any technical questions or concerns that the client may have.

7.6 REPORTING

The laboratory works with our clients to produce any special communication reports required by the contract.

7.7 CLIENT SURVEYS

The laboratory assesses both positive and negative client feedback. The results are used to improve overall laboratory quality and client service. TestAmerica's Sales and Marketing teams periodically develops lab and client specific surveys to assess client satisfaction.

SECTION 8. SUBCONTRACTING OF TESTS (NELAC 5.4.5)

8.1 OVERVIEW

For the purpose of this quality manual, the phrase subcontract laboratory refers to a laboratory external to the TestAmerica laboratories. The phrase “work sharing” refers to internal transfers of samples between the TestAmerica laboratories. The term outsourcing refers to the act of subcontracting tests.

When contracting with our clients, the laboratory makes commitments regarding the services to be performed and the data quality for the results to be generated. When the need arises to outsource testing for our clients because project scope, changes in laboratory capabilities, capacity or unforeseen circumstances, we must be assured that the subcontractors or work sharing laboratories understand the requirements and will meet the same commitments we have made to the client. Refer to TestAmerica’s Corporate SOP’s on Subcontracting Procedures (CA-L-S-002) and the Work Sharing Process (CA-C-S-001).

When outsourcing analytical services, the laboratory will assure, to the extent necessary, that the subcontract or work sharing laboratory maintains a program consistent with the requirements of this document, the requirements specified in NELAC/ISO 17025 and/or the client’s Quality Assurance Project Plan (QAPP) and any relevant program requirements, such as compliance to DoD QSM 4.1. All QC guidelines specific to the client’s analytical program are transmitted to the subcontractor and agreed upon before sending the samples to the subcontract facility. Additionally, work requiring accreditation will be placed with an appropriately accredited laboratory. The laboratory performing the subcontracted work will be identified in the final report, as will non-NELAC accredited work where required.

Project Managers (PMs), Customer Service Managers (CSM), or Regional Account Executives (RAE) for the Export Lab are responsible for obtaining client approval prior to outsourcing any samples. The laboratory will advise the client of a subcontract or work sharing arrangement in writing and when possible approval from the client shall be retained in the project folder.

Note: In addition to the client, some regulating agencies, such as the Department of Defense US Army Corps of Engineers and the USDA, require notification prior to placing such work.

8.2 QUALIFYING AND MONITORING SUBCONTRACTORS

Whenever a PM or Regional Account Executive (RAE) or Customer Service Manager becomes aware of a client requirement or laboratory need where samples must be outsourced to another laboratory, the other laboratory(s) shall be selected based on the following:

- The first priority is to attempt to place the work in a qualified TestAmerica laboratory;
- Firms specified by the client for the task (Documentation that a subcontractor was designated by the client must be maintained with the project file. This documentation can be as simple as placing a copy of an e-mail from the client in the project folder);
- Firms listed as pre-qualified and currently under a subcontract with TestAmerica: A listing of all approved subcontracting laboratories and supporting documentation is available on the TestAmerica intranet site. Verify necessary accreditation, where applicable, (e.g., on the subcontractors NELAC, A2LA accreditation or State Certification).

- Firms identified in accordance with the company's Small Business Subcontracting program as small, women-owned, veteran-owned and/or minority-owned businesses;
- NELAC or A2LA accredited laboratories.
- In addition, the firm must hold the appropriate certification to perform the work required.

All TestAmerica laboratories are pre-qualified for work sharing provided they hold the appropriate accreditations, can adhere to the project/program requirements, and the client approved sending samples to that laboratory. The client must provide acknowledgement that the samples can be sent to that facility (an e-mail is sufficient documentation or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented). The originating laboratory is responsible for communicating all technical, quality, and deliverable requirements as well as other contract needs. (Corporate SOP No. CA-C-S-001, Work Sharing Process).

When the potential sub-contract laboratory has not been previously approved, Account Executives or PMs may nominate a laboratory as a subcontractor based on need. The decision to nominate a laboratory must be approved by the Laboratory Director. The Laboratory Director requests that the QA Manager begin the process of approving the subcontract laboratory as outlined in Corporate SOP No. CA-L-S-002, Subcontracting Procedures. The client must provide acknowledgement that the samples can be sent to that facility (an e-mail is sufficient documentation or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented).

8.2.1 Once the appropriate accreditation and legal information is received by the laboratory, it is evaluated for acceptability (where applicable) and forwarded to Corporate Contracts for formal contracting with the laboratory. They will add the lab to the approved list on the intranet site along with the associate documentation and notify the finance group for JD Edwards.

8.2.2 The client will assume responsibility for the quality of the data generated from the use of a subcontractor they have requested the lab to use. The qualified subcontractors on the intranet site are known to meet minimal standards. TestAmerica does not certify laboratories. The subcontractor is on our approved list and can only be recommended to the extent that we would use them.

8.2.3 The status and performance of qualified subcontractors will be monitored periodically by the Corporate Contracts and/or Quality Departments. Any problems identified will be brought to the attention of TestAmerica's Corporate Finance or Corporate Quality personnel.

- Complaints shall be investigated. Documentation of the complaint, investigation and corrective action will be maintained in the subcontractor's file on the intranet site. Complaints are posted using the Vendor Performance Report.
- Information shall be updated on the intranet when new information is received from the subcontracted laboratories.
- Subcontractors in good standing will be retained on the intranet listing. The QA Manager will notify all TestAmerica laboratories, Corporate Quality and Corporate Contracts if any laboratory requires removal from the intranet site. This notification will be posted on the

intranet site and e-mailed to all Lab Directors/Managers, QA Managers and Sales Personnel.

8.3 OVERSIGHT AND REPORTING

The PM must request that the selected subcontractor be presented with a subcontract, if one is not already executed between the laboratory and the subcontractor. The subcontract must include terms which flow down the requirements of our clients, either in the subcontract itself or through the mechanism of work orders relating to individual projects. A standard subcontract and the Lab Subcontractor Vendor Package (posted on the intranet) can be used to accomplish this, and the Legal & Contracts Director can tailor the document or assist with negotiations, if needed. The PM responsible for the project must advise and obtain client consent to the subcontract as appropriate, and provide the scope of work to ensure that the proper requirements are made a part of the subcontract and are made known to the subcontractor.

Prior to sending samples to the subcontracted laboratory, the PM confirms their certification status to determine if it's current and scope-inclusive. The information is documented on a Subcontracted Sample Form (Figure 8-1) and the form is retained in the project folder. For TestAmerica laboratories, certifications can be viewed on the company's TotalAccess Database.

The Sample Control department is responsible for ensuring compliance with QA requirements and applicable shipping regulations when shipping samples to a subcontracted laboratory.

All subcontracted samples must be accompanied by a Chain of Custody (COC). A copy of the original COC sent by the client must be included with all samples subbed within TestAmerica.

Through communication with the subcontracted laboratory, the PM monitors the status of the subcontracted analyses, facilitates successful execution of the work, and ensures the timeliness and completeness of the analytical report.

Non-NELAC accredited work must be identified in the subcontractor's report as appropriate. If NELAC accreditation is not required, the report does not need to include this information.

Reports submitted from subcontractor laboratories are not altered and are included in their original form in the final project report. This clearly identifies the data as being produced by a subcontractor facility. If subcontract laboratory data is incorporated into the laboratories EDD (i.e., imported), the report must explicitly indicate which lab produced the data for which methods and samples.

Note: The results submitted by a TestAmerica work sharing laboratory may be transferred electronically and the results reported by the TestAmerica work sharing lab are identified on the final report. The report must explicitly indicate which lab produced the data for which methods and samples. The final report must include a copy of the completed COC for all work sharing reports.

8.4 CONTINGENCY PLANNING

The Laboratory Director may waive the full qualification of a subcontractor process temporarily to meet emergency needs. In the event this provision is utilized, the QA Manager will be required to verify certifications. The comprehensive approval process must then be initiated within 30 calendar days of subcontracting.

Figure 8-1.

Example - Subcontracted Sample Form

Date/Time: ____

Subcontracted Laboratory Information:

- Subcontractor's Name: ____
- Subcontractor Point of Contact: ____
- Subcontractor's Address: ____
- Subcontractor's Phone: ____
- Analyte/Method: ____
- Certified for State of Origin: ____
- NELAC Certified: Yes________________No_________________
- USDA Permit (__Domestic __ Foreign) Yes________________No_________________
- A2LA (or ISO 17025) Certified: Yes________________No_________________
- CLP-like Required: (Full doc required) Yes________________No_________________
- Requested Sample Due Date: (Must be put on COC) ____

Project Manager: ____

Laboratory Sample # Range: ____
(Only of Subcontracted Samples)

Laboratory Project Number (Billing Control #): ____

All subcontracted samples are to be sent via bonded carrier and Priority Overnight. Please attach tracking number below and maintain these records in the project files.

PM Signature____**Date**____________________________

SECTION 9. PURCHASING SERVICES AND SUPPLIES (NELAC 5.4.6)

9.1 OVERVIEW

Evaluation and selection of suppliers and vendors is performed, in part, on the basis of the quality of their products, their ability to meet the demand for their products on a continuous and short term basis, the overall quality of their services, their past history, and competitive pricing. This is achieved through evaluation of objective evidence of quality furnished by the supplier, which can include certificates of analysis, recommendations, and proof of historical compliance with similar programs for other clients. To ensure that quality critical consumables and equipment conform to specified requirements, which may affect quality, all purchases from specific vendors are approved by a member of the supervisory or management staff. Capital expenditures are made in accordance with TestAmerica's Corporate Controlled Purchases Procedure, SOP No. CW-F-S-007.

Contracts will be signed in accordance with TestAmerica's Corporate Authorization Matrix Policy, Policy No. CW-F-P-002. Request for Proposals (RFP's) will be issued where more information is required from the potential vendors than just price. Process details are available in TestAmerica's Corporate Procurement and Contracts Policy (Policy No. CW-F-P-004). RFP's allow TestAmerica to determine if a vendor is capable of meeting requirements such as supplying all of the TestAmerica facilities, meeting required quality standards and adhering to necessary ethical and environmental standards. The RFP process also allows potential vendors to outline any additional capabilities they may offer.

9.2 GLASSWARE

Glassware used for volumetric measurements must be Class A or verified for accuracy according to laboratory procedure. Pyrex (or equivalent) glass should be used where possible. For safety purposes, thick-wall glassware should be used where available.

9.3 REAGENTS, STANDARDS & SUPPLIES

Purchasing guidelines for equipment and reagents must meet the requirements of the specific method and testing procedures for which they are being purchased. Solvents and acids are pre-tested in accordance with TestAmerica's Corporate SOP on Solvent & Acid Lot Testing & Approval, SOP No. CA-Q-S-001.

9.3.1 Purchasing

Chemical reagents, solvents, glassware, and general supplies are ordered as needed to maintain sufficient quantities on hand. Materials used in the analytical process must be of a known quality. The wide variety of materials and reagents available makes it advisable to specify recommendations for the name, brand, and grade of materials to be used in any determination. This information is contained in the method SOP. The laboratory maintains an on-site consignment system for frequently used items. Analysts may check items out of the on-site consignment system as needed or place orders through the purchasing system. Orders placed through the purchasing system are approved by designated personnel.

9.3.2 Receiving

It is the responsibility of each department manager to receive the shipment. All orders are checked on receipt to ensure the material received matches material ordered and to ensure that the purchase meets the quality level specified. Material Safety Data Sheets (MSDSs) are available online through the Company's intranet website. Anyone may review these for relevant information on the safe handling and emergency precautions of on-site chemicals.

9.3.3 Specifications

All methods in use in the laboratory specify the grade of reagent that must be used in the procedure. If the quality of the reagent is not specified, it may be assumed that it is not significant in that procedure and, therefore, any grade reagent may be used. It is the responsibility of the analyst to check the procedure carefully for the suitability of grade of reagent.

Chemicals must not be used past the manufacturer's expiration date and must not be used past the expiration time noted in a method SOP. If expiration dates are not provided, the laboratory may contact the manufacturer to determine an expiration date.

The laboratory assumes a five year expiration date on inorganic dry chemicals unless noted otherwise by the manufacturer or by the reference source method. Chemicals should not be used past the manufacturer's or SOPs expiration date unless 'verified' (refer to item 3 listed below).

- An expiration date can not be extended if the dry chemical is discolored or appears otherwise physically degraded, the dry chemical must be discarded.
- Expiration dates can be extended if the dry chemical is found to be satisfactory based on acceptable performance of quality control samples (Continuing Calibration Verification (CCV), Blanks, Laboratory Control Sample (LCS), etc.).
- If the dry chemical is used for the preparation of standards, the expiration dates can be extended 6 months if the dry chemical is compared to an unexpired independent source in performing the method and the performance of the dry chemical is found to be satisfactory. The comparison must show that the dry chemical meets CCV limits. The comparison studies are maintained in the relevant laboratory section where the chemical is used.

Wherever possible, standards must be traceable to national or international standards of measurement or to national or international reference materials. Records to that effect are available to the user.

Compressed gases in use are checked for pressure and secure positioning daily. The minimum total pressure must be 500 psig for Argon/Methane and Hydrogen an all cylinders directly connected to instruments. The minimum total pressure must be 120 psig for Helium, 100 psig for liquid Argon and 30 psig for Nitrogen. If pressure exceeds the minimum pressure the tank must be replaced. The quality of the gases must meet method or manufacturer specification or be of a grade that does not cause any analytical interference.

Water used in the preparation of standards or reagents must have a specific conductivity of less than 1- umho/cm at 25°C. The specific conductivity is checked and recorded daily. If the water's specific conductivity is greater than the specified limit, the Facility Manager and appropriate Department Managers/Supervisors must be notified immediately in order to notify all departments, decide on cessation (based on intended use) of activities, and make arrangements for correction.

The laboratory may purchase reagent grade (or other similar quality) water for use in the laboratory. This water must be certified "clean" by the supplier for all target analytes or otherwise verified by the laboratory prior to use. This verification is documented.

Standard lots are verified before first time use if the laboratory switches manufacturers or has historically had a problem with the type of standard.

Purchased VOA vials must be certified clean and the certificates must be maintained. If uncertified VOA vials are purchased, all lots must be verified clean prior to use. This verification must be maintained.

Records of manufacturer's certification and traceability statements are maintained in the LIMS. These records include date of receipt, lot number (when applicable), and expiration date (when applicable).

9.3.4 Storage

Reagent and chemical storage is important from the aspects of both integrity and safety. Light-sensitive reagents may be stored in brown-glass containers. Storage conditions are per the Corporate Environmental Health & Safety Manual (Corp. Doc. No. CW-E-M-001) and method SOPs or manufacturer instructions.

9.4 PURCHASE OF EQUIPMENT/INSTRUMENTS/SOFTWARE

When a new piece of equipment is needed, either for additional capacity or for replacing inoperable equipment, the analyst or supervisor makes a supply request to the Laboratory Director. If they agree with the request, the procedures outlined in TestAmerica's Corporate Policy No. CA-T-P-001, Qualified Products List, are followed. A decision is made as to which piece of equipment can best satisfy the requirements.

Upon receipt of a new or used piece of equipment, an identification name is assigned and added to the equipment list. IT must also be notified so that they can synchronize the instrument for back-ups. Its capability is assessed to determine if it is adequate or not for the specific application. For instruments, a calibration curve is generated, followed by MDLs, Demonstration of Capabilities (DOCs), and other relevant criteria (refer to Section 19). For software, its operation must be deemed reliable and evidence of instrument verification must be retained by the IT Department. Software certificates supplied by the vendors are filed with the IT Department. The manufacturer's operation manual is retained at the bench.

9.5 SERVICES

Service to analytical instruments (except analytical balances) is performed on an as needed basis. Routine preventative maintenance is discussed in Section 20. The need for service is determined by analysts and/or Department Managers. The service providers that perform the services are approved by the Department Managers or the Technical Director.

9.6 SUPPLIERS

TestAmerica selects vendors through a competitive proposal / bid process, strategic business alliances or negotiated vendor partnerships (contracts). This process is defined in the Corporate Finance documents on Vendor Selection (SOP No. CW-F-S-018) and Procurement & Contracts Policy (Policy No. CW-F-P-004). The level of control used in the selection process is dependent on the anticipated spending amount and the potential impact on TestAmerica business. Vendors that provide test and measuring equipment, solvents, standards, certified containers, instrument related service contracts or subcontract laboratory services shall be subject to more rigorous controls than vendors that provide off-the-shelf items of defined quality that meet the end use requirements. The JD Edwards purchasing system includes all suppliers/vendors that have been approved for use.

Evaluation of suppliers is accomplished by ensuring the supplier ships the product or material ordered and that the material is of the appropriate quality. This is documented by signing off on packing slips or other supply receipt documents. The purchasing documents contain the data that adequately describe the services and supplies ordered.

Any issues of vendor performance are to be reported immediately by the laboratory staff to the Corporate Purchasing Group by completing a Vendor Performance Report.

The Corporate Purchasing Group will work through the appropriate channels to gather the information required to clearly identify the problem and will contact the vendor to report the problem and to make any necessary arrangements for exchange, return authorization, credit, etc.

As deemed appropriate, the Vendor Performance Reports will be summarized and reviewed to determine corrective action necessary, or service improvements required by vendors

The laboratory has access to a listing of all approved suppliers of critical consumables, supplies and services. This information is provided through the JD Edwards purchasing system.

9.6.1 New Vendor Procedure

TestAmerica employees who wish to request the addition of a new vendor must complete a J.D. Edwards Vendor Add Request Form.

New vendors are evaluated based upon criteria appropriate to the products or services provided as well as their ability to provide those products and services at a competitive cost. Vendors are also evaluated to determine if there are ethical reasons or potential conflicts of interest with TestAmerica employees that would make it prohibitive to do business with them as well as their financial stability. The QA Department and/or the Technology Director are consulted with vendor and product selection that have an impact on quality.

SECTION 10. COMPLAINTS (NELAC 5.4.8)

10.1 OVERVIEW

The laboratory considers an effective client complaint handling processes to be of significant business and strategic value. Listening to and documenting client concerns captures 'client knowledge' that enables our operations to continually improve processes and client satisfaction. An effective client complaint handling process also provides assurance to the data user that the laboratory will stand behind its data, service obligations and products.

A client complaint is any expression of dissatisfaction with any aspect of our business services (e.g., communications, responsiveness, data, reports, invoicing and other functions) expressed by any party, whether received verbally or in written form. Client inquiries, complaints or noted discrepancies are documented, communicated to management, and addressed promptly and thoroughly.

The laboratory has procedures for addressing both external and internal complaints with the goal of providing satisfactory resolution to complaints in a timely and professional manner.

The nature of the complaint is identified, documented and investigated, and an appropriate action is determined and taken. In cases where a client complaint indicates that an established policy or procedure was not followed, the QA Department must evaluate whether a special audit must be conducted to assist in resolving the issue. A written confirmation or letter to the client, outlining the issue and response taken is recommended as part of the overall action taken.

The process of complaint resolution and documentation utilizes the procedures outlined in Section 12 (Corrective Actions) and is documented following SOP BR-QA-004.

10.2 EXTERNAL COMPLAINTS

An employee that receives a complaint initiates the complaint resolution process by first documenting the complaint according to laboratory SOP BR-QA-004.

Complaints fall into two categories: correctable and non-correctable. An example of a correctable complaint would be one where a report re-issue would resolve the complaint. An example of a non-correctable complaint would be one where a client complains that their data was repeatedly late. Non-correctable complaints should be reviewed for preventive action measures to reduce the likelihood of future occurrence and mitigation of client impact.

The general steps in the complaint handling process are:

- Receiving and Documenting Complaints
- Complaint Investigation and Service Recovery
- Process Improvement

The laboratory shall inform the initiator of the complaint of the results of the investigation and the corrective action taken, if any.

10.3 INTERNAL COMPLAINTS

Internal complaints include, but are not limited to: errors and non-conformances, training issues, internal audit findings, and deviations from methods. Corrective actions may be initiated by any staff member who observes a nonconformance and shall follow the procedures outlined in Section 12. In addition, Corporate Management, Sales and Marketing and IT may initiate a complaint by contacting the laboratory or through the corrective action system described in Section 12.

10.4 MANAGEMENT REVIEW

The number and nature of client complaints is reported by the QA Manager to the laboratory and QA Director in the QA Monthly report. Monitoring and addressing the overall level and nature of client complaints and the effectiveness of the solutions is part of the Annual Management Review (Section 16).

SECTION 11. CONTROL OF NON-CONFORMING WORK (NELAC 5.4.9)

11.1 OVERVIEW

When data discrepancies are discovered or deviations and departures from laboratory SOPs, policies and/or client requests have occurred, corrective action is taken immediately. First, the laboratory evaluates the significance of the nonconforming work. Then, a corrective action plan is initiated based on the outcome of the evaluation. If it is determined that the nonconforming work is an isolated incident, the plan could be as simple as adding a qualifier to the final results and/or making a notation in the case narrative. If it is determined that the nonconforming work is a systematic or improper practices issue, the corrective action plan could include a more in depth investigation and a possible suspension of an analytical method. In all cases, the actions taken are documented using the laboratory's corrective action system (refer to Section 12).

Due to the frequently unique nature of environmental samples, sometimes departures from documented policies and procedures are needed. When an analyst encounters such a situation, the problem is presented to the department manager (DM) for resolution. The DM may elect to discuss it with the Technical Director or have a representative contact the client to decide on a logical course of action. Once an approach is agreed upon, the analyst documents the approach in the analytical record and the PM includes a discussion of the departure in the case narrative.

Project Management may encounter situations where a client may request that a special procedure be applied to a sample that is not standard lab practice. Based on a technical evaluation, the lab may accept or opt to reject the request based on technical or ethical merit. Project specific procedures must be documented by the PM in the project record.

11.2 RESPONSIBILITIES AND AUTHORITIES

TestAmerica's Corporate SOP entitled *Internal Investigation of Potential Data Discrepancies and Determination for Data Recall* (SOP No. CA-L-S-001), outlines the general procedures for the reporting and investigation of data discrepancies and alleged incidents of misconduct or violations of TestAmerica's data integrity policies as well as the policies and procedures related to the determination of the potential need to recall data.

Under certain circumstances, the Laboratory Director, the Technical Director, QA Manager or Department Manager may authorize departures from documented procedures or policies. The departures may be a result of procedural changes due to the nature of the sample; a one-time procedure for a client; QC failures with insufficient sample to reanalyze, etc.. In most cases, the client will be informed of the departure prior to the reporting of the data. Any departures must be well documented using the laboratory's corrective action procedures. This information may also be documented in logbooks and/or data review checklists as appropriate. Any impacted data must be referenced in a case narrative and/or flagged with an appropriate data qualifier.

Any misrepresentation or possible misrepresentation of analytical data discovered by any laboratory staff member must be reported to facility Senior Management within 24-hours. The Senior Management staff is comprised of the Laboratory Director, the QA Manager, and the Department Managers. The reporting of issues involving alleged violations of the company's Data Integrity or Manual Integration procedures <u>must</u> be conveyed to an Ethics and Compliance

Officer (ECO), Director of Quality & Client Advocacy and the laboratory's Quality Director within 24 hours of discovery.

Whether an inaccurate result was reported due to calculation or quantitation errors, data entry errors, improper practices, or failure to follow SOPs, the data must be evaluated to determine the possible effect.

The Laboratory Director, QA Manager, ECOs, Corporate Quality, the COO, General Managers and the Quality Directors have the authority and responsibility to halt work, withhold final reports, or suspend an analysis for due cause as well as authorize the resumption of work.

11.3 EVALUATION OF SIGNIFICANCE AND ACTIONS TAKEN

For each nonconforming issue reported, an evaluation of its significance and the level of management involvement needed is made. This includes reviewing its impact on the final data, whether or not it is an isolated or systematic issue, and how it relates to any special client requirements.

TestAmerica's Corporate Data Investigation & Recall Procedure (SOP No. CA-L-S-001) distinguishes between situations when it would be appropriate for laboratory management to make the decision on the need for client notification (written or verbal) and data recall (report revision) and when the decision must be made with the assistance of the ECO's and Corporate Management. Laboratory level decisions are documented and approved using the laboratory's standard nonconformance/corrective action reporting in lieu of the data recall determination form contained in TestAmerica's Corporate SOP No. CA-L-S-001.

11.4 PREVENTION OF NONCONFORMING WORK

If it is determined that the nonconforming work could recur, further corrective actions must be made following the laboratory's corrective action system. On a monthly basis, the QA Department evaluates non-conformances to determine if any nonconforming work has been repeated multiple times. If so, the laboratory's corrective action process may be followed.

11.5 METHOD SUSPENSION/RESTRICTION (STOP WORK PROCEDURES)

In some cases, it may be necessary to suspend/restrict the use of a method or target compound which constitutes significant risk and/or liability to the laboratory. Suspension/restriction procedures can be initiated by any of the persons noted in Section 11.2, Paragraph 5.

Prior to suspension/restriction, confidentiality will be respected, and the problem with the required corrective and preventive action will be stated in writing and presented to the Laboratory Director.

The Laboratory Director shall arrange for the appropriate personnel to meet with the QA Manager as needed. This meeting shall be held to confirm that there is a problem, that suspension/restriction of the method is required and will be concluded with a discussion of the steps necessary to bring the method/target or test fully back on line. In some cases, that may not be necessary if all appropriate personnel have already agreed there is a problem and there is agreement on the steps needed to bring the method, target or test fully back on line.

The QA Manager will also initiate a corrective action report as described in Section 12 if one has not already been started. A copy of any meeting notes and agreed upon steps should be faxed or e-mailed by the laboratory to the appropriate General Manager and member of Corporate QA. This fax/e-mail acts as notification of the incident.

After suspension/restriction, the lab will hold all reports to clients pending review. No faxing, mailing or distributing through electronic means may occur. The report must not be posted for viewing on the internet. It is the responsibility of the Laboratory Director to hold all reporting and to notify all relevant laboratory personnel regarding the suspension/restriction (e.g., Project Management, Log-in, etc…). Clients will NOT generally be notified at this time. Analysis may proceed in some instances depending on the non-conformance issue.

Within 72 hours, the QA Manager will determine if compliance is now met and reports can be released, OR determine the plan of action to bring work into compliance, and release work. A team, with all principals involved (Laboratory Director, Technical Director, QA Manager, Department Manager) can devise a start-up plan to cover all steps from client notification through compliance and release of reports. Project Management, and the Directors of Client Services and Sales and Marketing must be notified if clients must be notified or if the suspension/restriction affects the laboratory's ability to accept work. The QA Manager must approve start-up or elimination of any restrictions after all corrective action is complete. This approval is given by final signature on the completed corrective action report.

SECTION 12. CORRECTIVE ACTION (NELAC 5.4.10)

12.1 OVERVIEW

A major component of TestAmerica's Quality Assurance (QA) Program is the problem investigation and feedback mechanism designed to keep the laboratory staff informed on quality related issues and to provide insight to problem resolution. When nonconforming work or departures from policies and procedures in the quality system or technical operations are identified, the corrective action procedure provides a systematic approach to assess the issues, restore the laboratory's system integrity, and prevent reoccurrence. Corrective actions are documented using Corrective Action Reports (CAR) (refer to Figure 12-1).

12.2 GENERAL

Problems within the quality system or within analytical operations may be discovered in a variety of ways, such as QC sample failures, internal or external audits, proficiency testing (PT) performance, client complaints, staff observation, etc..

The purpose of a corrective action system is to:

- Identify non-conformance events and assign responsibility(s) for investigating.
- Resolve non-conformance events and assign responsibility for any required corrective action.
- Identify Systematic Problems before they become serious.
- Identify and track client complaints and provide resolution.

12.2.1 Non-Conformance Memo (NCM) – may be used to document the following types of corrective actions:

- Deviations from an established procedure or SOP
- QC outside of limits (non-matrix related)
- Isolated reporting / calculation errors
- Client Complaints
- Discrepancies in materials / goods received vs. manufacturer packing slips.

12.2.2 **Corrective Action Report (CAR)** – may be used to document the following types of corrective actions:

- Questionable trends that are found in the monthly review of nonconformance
- Issues found while reviewing NCRs that warrant further investigation.
- Internal and external audit findings
- Failed or unacceptable PT results.
- Corrective actions that cross multiple departments in the laboratory.
- Systematic reporting / calculation errors

12.3 CLOSED LOOP CORRECTIVE ACTION PROCESS

Any employee in the company can initiate a corrective action. There are four main components to a closed-loop corrective action process once an issue has been identified: Cause Analysis, Selection and Implementation of Corrective Actions (both short and long term), Monitoring of the Corrective Actions, and Follow-up.

12.3.1 Cause Analysis

- Upon discovery of a non-conformance event, the event must be defined and documented. An CAR must be initiated, someone is assigned to investigate the issue and the event is investigated for cause. Table 12-1 provides some general guidelines on determining responsibility for assessment.
- The cause analysis step is the key to the process as a long term corrective action cannot be determined until the cause is determined.
- If the cause is not readily obvious, the Laboratory Director, QA Manager or Technical Director is consulted.

12.3.2 Selection and Implementation of Corrective Actions

- Where corrective action is needed, the laboratory shall identify potential corrective actions. The action(s) most likely to eliminate the problem and prevent recurrence are selected and implemented. Responsibility for implementation is assigned.
- Corrective actions shall be to a degree appropriate to the magnitude of the problem identified through the cause analysis.
- Whatever corrective action is determined to be appropriate, the laboratory shall document and implement the changes. The NCR or CAR is used for this documentation.

12.3.3 Root Cause Analysis

Root Cause Analysis is a class of problem solving (investigative) methods aimed at identifying the basic or causal factor(s) that underlie variation in performance or the occurrence of a significant failure. The root cause may be buried under seemingly innocuous events, many steps preceding the perceived failure. At first glance, the immediate response is typically directed at a symptom and not the cause. Typically, root cause analysis would be best with three or more incidents to triangulate a weakness.

Systematically analyze and document the Root Causes of the more significant problems that are reported. Identify, track, and implement the corrective actions required to reduce the likelihood of recurrence of significant incidents. Trend the Root Cause data from these incidents to identify Root Causes that, when corrected, can lead to dramatic improvements in performance by eliminating entire classes of problems.

Identify the one event associated with problem and ask why this event occurred. Brainstorm the root causes of failures by asking why events occurred or conditions existed; and then why the cause occurred 5 consecutive times until you get to the root cause. For each of these sub events or causes, ask why it occurred. Repeat the process for the other events associated with the incident.

Root cause analysis does not mean the investigation is over. Look at technique, or other systems outside the normal indicators. Often creative thinking will find root causes that ordinarily would be missed, and continue to plague the laboratory or operation.

12.3.4 Monitoring of the Corrective Actions

- The Department Manager and QA Manager are responsible to ensure that the corrective action taken was effective.
- Ineffective actions are documented and re-evaluated until acceptable resolution is achieved. Department Managers are accountable to the Laboratory Director to ensure final acceptable resolution is achieved and documented appropriately.
- Each CAR is entered into a spreadsheet for tracking purposes. The spreadsheet is subsequently used to ensure CAR are closed and actions taken effective.
- The QA Manager reviews corrective actions for trends. Highlights are included in the QA monthly report (refer to Section 16). If a significant trend develops that adversely affects quality, an audit of the area is performed and corrective action implemented.
- Any out-of-control situations that are not addressed acceptably at the laboratory level may be reported to the Corporate Quality Director by the QA Manager, indicating the nature of the out-of-control situation and problems encountered in solving the situation.

12.3.5 Follow-up Audits

- Follow-up audits may be initiated by the QA Manager and shall be performed as soon as possible when the identification of a nonconformance casts doubt on the laboratory's compliance with its own policies and procedures, or on its compliance with state or federal requirements.
- These audits often follow the implementation of the corrective actions to verify effectiveness. An additional audit would only be necessary when a critical issue or risk to business is discovered.

(Also refer to Section ~~15.2.4~~15.1.4, Special Audits.)

12.4 TECHNICAL CORRECTIVE ACTIONS

In addition to providing acceptance criteria and specific protocols for technical corrective actions in the method SOPs, the laboratory has general procedures to be followed to determine when departures from the documented policies and procedures and quality control have occurred (refer to Section 11). The documentation of these procedures is through the use of an NCR or project memo.

Table 12-1 includes examples of general technical corrective actions. For specific criteria and corrective actions, refer to the analytical methods or specific method SOPs.

Table 12-1 provides some general guidelines for identifying the individual(s) responsible for assessing each QC type and initiating corrective action. The table also provides general guidance on how a data set should be treated if associated QC measurements are unacceptable. Specific procedures are included in Method SOPs, Work Instructions, QAM

Sections 19 and 20. All corrective actions are reviewed monthly, at a minimum, by the QA Manager and highlights are included in the QA monthly report.

To the extent possible, samples shall be reported only if all quality control measures are acceptable. If the deficiency does not impair the usability of the results, data will be reported with an appropriate data qualifier and/or the deficiency will be noted in the case narrative. Where sample results may be impaired, the Project Manager is notified and appropriate corrective action (e.g., reanalysis) is taken and documented**.**

12.5 BASIC CORRECTIONS

When mistakes occur in records, each mistake shall be crossed-out, [not obliterated (e.g. no white-out)], and the correct value entered alongside. All such corrections shall be initialed (or signed) and dated by the person making the correction. In the case of records stored electronically, the original "uncorrected" file must be maintained intact and a second "corrected" file is created.

This same process applies to adding additional information to a record. All additions made later than the initial must also be initialed (or signed) and dated.

When corrections are due to reasons other than obvious transcription errors, the reason for the corrections (or additions) shall also be documented.

Figure 12-1.
Example - Corrective Action Report

CORRECTIVE ACTION REPORT (CAR)		Tracking Number:	
Initiated By:		Assigned To:	
Initiation Date:		CC:	
Due Date:			
Section 1: Describe Problem & Attach Supporting Documentation As Needed			
Corrective Action Prompted By:			
Recurring NCR	Internal Audit	External Audit	Complaint / Other
Section 2: Root Cause Analysis			
Section 3: Describe Actions Required to Correct & Prevent Problem			
Section 4: QA Review and Close Out			
Action Taken Was:	Acceptable	Not Acceptable	Other
Comments:			
Close Out Date:		Closed By:	
Section 5: Follow Up (From Close-Out Date)			
Time Frame:	Performed By:	Date:	Is action taken preventing recurrence?
1 Month			
3 Month			
6 Month			
Comments:			

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Table 12-1.

Example – General Corrective Action Procedures

QC Activity ***(Individual Responsible for Initiation/Assessment)***	**Acceptance Criteria**	**Recommended Corrective Action**
Initial Instrument Blank *(Primary Analyst, Secondary Data Review Analyst)*	- See details in Method SOP	- Prepare another blank. - If same response, determine cause of contamination: reagents, environment, instrument equipment failure, etc.
Initial Calibration Standards *(Primary Analyst, Secondary Data Review Analyst)*	- See details in Method SOP	- Reanalyze standards. - If still unacceptable, remake standards and recalibrate instrument.
Independent Calibration Verification (Second Source) *(Primary Analyst, Secondary Data Review Analyst)*	- % Recovery within limits documented in SOP.	- Remake and reanalyze standard. - If still unacceptable, then remake calibration standards or use new primary standards and recalibrate instrument.
Continuing Calibration Standards *(Primary Analyst, Secondary Data Review Analyst)*	- See details in Method SOP	- Reanalyze standard. - If still unacceptable, then recalibrate and rerun affected samples.
Matrix Spike / Matrix Spike Duplicate (MS/MSD) *(Primary Analyst, Secondary Data Review Analyst)*	- % Recovery within limits documented in SOP.	- If the acceptance criteria for duplicates or matrix spikes are not met because of matrix interferences, the acceptance of the analytical batch is determined by the validity of the LCS. - If the LCS is within acceptable limits the batch is acceptable. - The results of the duplicates, matrix spikes and the LCS are reported with the data set.
Laboratory Control Sample (LCS) *(Primary Analyst, Secondary Data Review Analyst)*	- % Recovery within limits documented in SOP.	- Batch must be re-prepared and re-analyzed. **Note:** If there is insufficient sample or the holding time cannot be met, contact client and report with flags.
Surrogates *(Primary Analyst, Secondary Data Review Analyst)*	- % Recovery within limits documented in SOP.	- Individual sample must be repeated. Place comment in LIMS.

QC Activity ***(Individual Responsible for Initiation/Assessment)***	Acceptance Criteria	Recommended Corrective Action
Method Blank (MB) *(Primary Analyst, Secondary Data Review Analyst)*	< Reporting Limit or as specified by regulatory program, such as DoD.	- Reanalyze blank. - If still positive, determine source of contamination. If necessary, reprocess (i.e. digest or extract) entire sample batch. Report blank results.
Proficiency Testing (PT) Samples *(Primary Analyst, Secondary Data Review Analyst, Department Manager)*	- Criteria supplied by PT Supplier.	- Any failures or warnings must be investigated for cause. Failures may result in the need to repeat a PT sample to show the problem is corrected.
Internal / External Audits *(QA Manager, Department Manager, Laboratory Director)*	- Defined in Quality System documentation such as SOPs, QAM, etc.	- Non-conformances must be investigated through CAR system and necessary corrections must be made.
Reporting / Calculation Errors *(Depends on issue – possible individuals include: Analysts, Data Reviewers, Project Managers, Department Manager/ Supervisor, QA Manager, Corporate QA, Corporate Management)*	- SOP CA-L-S-001, Internal Investigation of Potential Data Discrepancies and Determination for Data Recall.	- Corrective action is determined by type of error. Follow the procedures in SOP CA-L-S-001.
Client Complaints *(Project Managers, Lab Director, QA Manager)*	- SOP BR-QA-004	- Corrective action is determined by the type of complaint. For example, a complaint regarding an incorrect address on a report will result in the report being corrected and then follow-up must be performed on the reasons the address was incorrect (e.g., database needs to be updated).
QA Monthly Report (Refer to Section 17 for an example) *(QA Manager, Lab Director)*	- QAM, SOPs.	- Corrective action is determined by the type of issue. For example, CARs for the month are reviewed and possible trends are investigated.
Health and Safety Violation *(Safety Officer, Lab Director, Department Manager)*	- Environmental Health and Safety (EHS) Manual.	- Non-conformance is investigated and corrected through CAR system.

SECTION 13. PREVENTIVE ACTION (NELAC 5.4.11)

13.1 OVERVIEW

The laboratory's preventive action programs improve, or eliminate potential causes of nonconforming product and/or nonconformance to the quality system. This preventive action process is a proactive continuous process improvement activity that can be initiated through feedback from clients, employees, business providers, and affiliates. The QA Department has the overall responsibility to ensure that the preventive action process is in place, and that relevant information on actions is submitted for management review.

Dedicating resources to an effective preventive action system emphasizes the laboratory's commitment to its Quality Program. It is beneficial to identify and address negative trends before they develop into complaints, problems and corrective actions. Additionally, customer service and satisfaction can be improved through continuous improvements to laboratory systems.

Opportunities for improvement may be discovered during management reviews, the QA Metrics Report, internal or external audits, proficiency testing performance, client complaints, staff observation, etc..

The monthly QA Metrics Report shows performance indicators in all areas of the quality system. These areas include revised reports, corrective actions, audit findings, internal auditing and data authenticity audits, client complaints, PT samples, holding time violations, SOPs, ethics training, etc. These metrics are used to help evaluate quality system performance on an ongoing basis and provide a tool for identifying areas for improvement.

The laboratory's corrective action process is integral to implementation of preventive actions. A critical piece of the corrective action process is the implementation of actions to prevent further occurrence of a non-compliance event. Historical review of corrective action provides a valuable mechanism for identifying preventive action opportunities.

13.1.1 The following elements are part of a preventive action system:

- <u>Identification</u> of an opportunity for preventive action.
- <u>Process</u> for the preventive action.
- <u>Define the measurements</u> of the effectiveness of the process once undertaken.
- <u>Execution</u> of the preventive action.
- <u>Evaluation</u> of the plan using the defined measurements.
- <u>Verification</u> of the effectiveness of the preventive action.
- <u>Close-Out</u> by documenting any permanent changes to the Quality System as a result of the Preventive Action. Documentation of Preventive Action is incorporated into the monthly QA reports, corrective action process and management review.

13.1.2 Any Preventive Actions undertaken or attempted shall be taken into account during the Annual Management Review (Section 16). A highly detailed recap is not required; a simple recount of success and failure within the preventive action program will provide management a measure for evaluation.

13.2 MANAGEMENT OF CHANGE

The Management of Change process is designed to manage significant events and changes that occur within the laboratory such as the addition of new equipment or personnel. Procedures for minimization of potential risks inherent with a new event or change are described in various laboratory standard operating procedures.

SECTION 14. CONTROL OF RECORDS (NELAC 5.4.12)

The laboratory maintains a record system appropriate to its needs and that complies with applicable standards or regulations as required. The system produces unequivocal, accurate records that document all laboratory activities. The laboratory retains all original observations, calculations and derived data, calibration records and a copy of the analytical report for a minimum of five years after it has been issued.

14.1 OVERVIEW

The laboratory has established procedures for identification, collection, indexing, access, filing, storage, maintenance and disposal of quality and technical records. A record index is listed in Table 14-1. Quality records are maintained by the QA department. Records are of two types; either electronic or hard copy paper formats depending on whether the record is computer or hand generated (some records may be in both formats). Technical records are retained by QA, Department Managers, electronically or by report management depending on the record type.

Table 14-1. Record Index[1]

	Record Types [1]**:**	**Retention Time:**
Technical Records	- Raw Data - Logbooks[2] - Standards - Certificates - Analytical Records - Lab Reports	5 Years from analytical report issue*
Official Documents	- Quality Assurance Manual (QAM) - Work Instructions - Policies - SOPs - Policy Memorandums - Manuals	5 Years from document retirement date*
QA Records	- Internal & External Audits/Responses - Certifications - Corrective/Preventive Actions - Management Reviews - Method & Software Validation / Verification Data - Data Investigation	5 Years from archival* **Data Investigation:** 5 years or the life of the affected raw data storage whichever is greater (beyond 5 years if ongoing project or pending investigation)
Project Records	- Sample Receipt & COC Documentation - Contracts and Amendments - Correspondence - QAPP -SAP - Telephone Logbooks - Lab Reports	5 Years from analytical report issue*
Administrative Records	Finance and Accounting	10 years
	EH&S Manual, Permits, Disposal Records	7 years

	Record Types [1]:	**Retention Time:**
	Employee Handbook	Indefinitely
	Personnel files, Employee Signature & Initials, Administrative Training Records (e.g., Ethics)	7 Years (HR Personnel Files must be maintained indefinitely)
	Administrative Policies Technical Training Records	7 years

[1] Record Types encompass hardcopy and electronic records.
[2] Examples of Logbook types: Maintenance, Instrument Run, Preparation (standard and samples), Standard and Reagent Receipt, Archiving, Balance Calibration, Temperature (hardcopy or electronic records).
* Exceptions listed in Table 14-2.

14.1.1 All records are stored and retained in such a way that they are secure and readily retrievable at the laboratory facility or an offsite location that provides a suitable environment to prevent damage or deterioration and to prevent loss**.** All records shall be protected against fire, theft, loss, environmental deterioration, and vermin. In the case of electronic records, electronic or magnetic sources, storage media are protected from deterioration caused by magnetic fields and/or electronic deterioration.

Access to the data is limited to laboratory and company employees**.** Records archived off-site are stored in a secure location where a record is maintained of any entry into the storage facility. Whether on-site or off-site storage is used access logs are maintained. Records are maintained for a minimum of five years unless otherwise specified by a client or regulatory requirement.

For raw data and project records, record retention shall be calculated from the date the project report is issued. For other records, such as Controlled Documents, QA, or Administrative Records, the retention time is calculated from the date the record is formally retired. Records related to the programs listed in Table 14-2 have lengthier retention requirements and are subject to the requirements in Section 14.1.3.

14.1.2 Programs with Longer Retention Requirements

Some regulatory programs have longer record retention requirements than the standard record retention time. These are detailed in Table 14-2 with their retention requirements. In these cases, the longer retention requirement is enacted. If special instructions exist such that client data cannot be destroyed prior to notification of the client, the container or box containing that data is marked as to who to contact for authorization prior to destroying the data.

Table 14-2. Example: Special Record Retention Requirements

Program	[1]Retention Requirement
Drinking Water – All States	10 years (project records)
Drinking Water Lead and Copper Rule	12 years (project records)
Commonwealth of MA – All environmental data 310 CMR 42.14	10 years
FIFRA – 40 CFR Part 160	Retain for life of research or marketing permit for pesticides regulated by EPA
Housing and Urban Development (HUD) Environmental Lead Testing	10 years
Alaska	10 years
Louisiana – All	10 years
Michigan Department of Environmental Quality – all environmental data	10 years
Navy Facilities Engineering Service Center (NFESC)	10 years
NY Potable Water NYCRR Part 55-2	10 years
Ohio VAP	10 years and State contacted prior to disposal
TSCA - 40 CFR Part 792	10 years after publication of final test rule or negotiated test agreement

[1]Note: Extended retention requirements must be noted with the archive documents or addressed in facility-specific records retention procedures.

14.1.3 The laboratory has procedures to protect and back-up records stored electronically and to prevent unauthorized access to or amendment of these records. All analytical data is maintained as hard copy or in a secure readable electronic format. For analytical reports that are maintained as copies in PDF format, refer to Section 19.14.1 for more information.

14.1.4 The record keeping system allows for historical reconstruction of all laboratory activities that produced the analytical data, as well as rapid recovery of historical data. The history of the sample from when the laboratory took possession of the samples must be readily understood through the documentation. This shall include inter-laboratory transfers of samples and/or extracts.

- The records include the identity of personnel involved in sampling, sample receipt, preparation, or testing. All analytical work contains the initials (at least) of the personnel involved. The chain of custody should indicate the name of the sampler. If any sampling notes are provided with a work order, they are kept with this package.

- All information relating to the laboratory facilities equipment, analytical test methods, and related laboratory activities, such as sample receipt, sample preparation, or data verification are documented.

- The record keeping system facilitates the retrieval of all working files and archived records for inspection and verification purposes. These procedures are described in laboratory SOP BR-QA-014. Instrument data is stored sequentially by instrument. A given day's analyses are maintained in the order of the analysis. Run logs are maintained for each instrument or method; a copy of each day's run long or instrument sequence is stored with the data to aid in re-constructing an analytical sequence. Where an analysis is performed without an instrument, bound logbooks or electronic bench sheets are used to record and file data. Standard and reagent information is entered into the LIMS for each method as required.

- Changes to hardcopy records shall follow the procedures outlined in Section 12 and 19. Changes to electronic records in LIMS or instrument data are recorded in audit trails.

- The reason for a signature or initials on a document is clearly indicated in the records such as "sampled by," "prepared by," "reviewed by", or "analyzed by".

- All generated data except those that are generated by automated data collection systems, are recorded directly, promptly and legibly in permanent dark ink.

- Hard copy data may be scanned into PDF format for record storage as long as the scanning process can be verified in order to ensure that no data is lost and the data files and storage media must be tested to verify the laboratory's ability to retrieve the information prior to the destruction of the hard copy that was scanned. The procedure for this verification can be found in SOP BR-QA-014.

- Also refer to Section 19.14.1 'Computer and Electronic Data Related Requirements'**.**

14.2 TECHNICAL AND ANALYTICAL RECORDS

14.2.1 The laboratory retains records of original observations, derived data and sufficient information to establish an audit trail, calibration records, staff records and a copy of each analytical report issued, for a minimum of five years unless otherwise specified by a client or regulatory requirement. The records for each analysis shall contain sufficient information to enable the analysis to be repeated under conditions as close as possible to the original. The records shall include the identity of laboratory personnel responsible for the sampling, performance of each analysis and reviewing results.

14.2.2 Observations, data and calculations are recorded real-time and are identifiable to the specific task.

14.2.3 Changes to hardcopy records shall follow the procedures outlined in Section 12 and 19. Changes to electronic records in LIMS or instrument data are recorded in audit trails.

The essential information to be associated with analysis, such as strip charts, tabular printouts, computer data files, analytical notebooks, and run logs, include:

- laboratory sample ID code**;**
- Date of analysis; Time of Analysis is also required if the holding time is seventy-two (72) hours or less, or when time critical steps are included in the analysis (e.g., drying times, incubations, etc.); instrumental analyses have the date and time of analysis recorded as part of their general operations.
- Instrumentation identification and instrument operating conditions/parameters.
- analysis type**;**
- all manual calculations and manual integrations**;**
- analyst's or operator's initials/signature**;**
- sample preparation
- test results**;**
- standard and reagent origin, receipt, preparation, and use**;**
- calibration criteria, frequency and acceptance criteria**;**
- data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions**;**
- quality control protocols and assessment**;**
- electronic data security, software documentation and verification, software and hardware audits, backups, and records of any changes to automated data entries; and
- Method performance criteria including expected quality control requirements.

14.3 LABORATORY SUPPORT ACTIVITIES

In addition to documenting all the above-mentioned activities, the following are retained QA records and project records (previous discussions in this section relate where and how these data are stored):

- all original raw data, whether hard copy or electronic, for calibrations, samples and quality control measures, including analysts' work sheets and data output records (chromatograms, strip charts, and other instrument response readout records)**;**
- a written description or reference to the specific test method used which includes a description of the specific computational steps used to translate parametric observations into a reportable analytical value**;**
- copies of final reports**;**
- archived SOPs**;**
- correspondence relating to laboratory activities for a specific project**;**
- all corrective action reports, audits and audit responses**;**
- proficiency test results and raw data; and

- results of data review, verification, and crosschecking procedures

14.3.1 Sample Handling Records

Records of all procedures to which a sample is subjected while in the possession of the laboratory are maintained. These include but are not limited to records pertaining to:

- sample preservation including appropriateness of sample container and compliance with holding time requirement;
- sample identification, receipt, acceptance or rejection and login;
- sample storage and tracking including shipping receipts, sample transmittal / COC forms; and
- procedures for the receipt and retention of samples, including all provisions necessary to protect the integrity of samples.

14.4 ADMINISTRATIVE RECORDS

The laboratory also maintains the administrative records in either electronic or hard copy form. Refer to Table 14-1.

14.5 RECORDS MANAGEMENT, STORAGE AND DISPOSAL

All records (including those pertaining to test equipment), certificates and reports are safely stored, held secure and in confidence to the client. Certification related records are available upon request.

All information necessary for the historical reconstruction of data is maintained by the laboratory. Records that are stored only on electronic media must be supported by the hardware and software necessary for their retrieval.

Records that are stored or generated by computers or personal computers have hard copy, write-protected backup copies, or an electronic audit trail controlling access.

The laboratory has a record management system (a.k.a., document control) for control of laboratory notebooks, instrument logbooks, standards logbooks, and records for data reduction, validation, storage and reporting. These procedures are described in laboratory SOPs BR-QA-003 and BR-QA-014.

14.5.1 Transfer of Ownership

In the event that the laboratory transfers ownership or goes out of business, the laboratory shall ensure that the records are maintained or transferred according to client's instructions. Upon ownership transfer, record retention requirements shall be addressed in the ownership transfer agreement and the responsibility for maintaining archives is clearly established. In addition, in cases of bankruptcy, appropriate regulatory and state legal requirements concerning laboratory records must be followed. In the event of the closure of the laboratory, all records will revert to the control of the corporate headquarters. Should the entire company cease to exist, as much notice as possible will be given to clients and the accrediting bodies who have worked with the laboratory during the previous 5 years of such action.

14.5.2 Records Disposal

Records are removed from the archive and destroyed after 5 years unless otherwise specified by a client or regulatory requirement. On a project specific or program basis, clients may need to be notified prior to record destruction. Records are destroyed in a manner that ensures their confidentiality such as shredding, mutilation or incineration. (Refer to Tables 14-1 and 14-2).

Electronic copies of records must be destroyed by erasure or physically damaging off-line storage media so no records can be read.

If a third party records management company is hired to dispose of records, a “Certificate of Destruction” is required.

SECTION 15. AUDITS (NELAC 5.4.13)

15.1 INTERNAL AUDITS

Internal audits are performed to verify that laboratory operations comply with the requirements of the lab's quality system and with the external quality programs under which the laboratory operates. Audits are planned and organized by the QA staff. Personnel conducting the audits should be independent of the area being evaluated. Auditors will have sufficient authority, access to work areas, and organizational freedom necessary to observe all activities affecting quality and to report the assessments to laboratory management and when requested to corporate management.

Audits are conducted and documented as described in the TestAmerica Corporate SOP on performing Internal Audits, SOP No. CA-Q-S-004. The types and frequency of routine internal audits are shown in Table 15-1. Special or ad hoc assessments may be conducted as needed under the direction of the QA staff.

Table 15-1. Types of Internal Audits and Frequency

Description	Performed by	Frequency
Quality Systems	QA Department or Designee	All areas of the laboratory annually
QA Technical Audits - Evaluate raw data versus final reports - Analyst integrity - Data authenticity	QA Department or Designee	All methods within a 2-year period, with at least 15% of methods every quarter
SOP Method Compliance	Technical Director	- All SOPs within a 2-year period - All new analysts or new analyst/methods within 3 months of IDOC
Special	QA Department or Designee	Surveillance or spot checks performed as needed
Performance Testing	Analysts with QA oversight	Two successful per year for each NELAC field of testing or as dictated by regulatory requirements

15.1.1 Annual Quality Systems Audit

An annual quality systems audit is required to ensure compliance to analytical methods and SOPs, the laboratory's Data Integrity and Ethics Policies, NELAC quality systems, client and state requirements, and the effectiveness of the internal controls of the analytical process, including but not limited to data review, quality controls, preventive action and corrective action. The completeness of earlier corrective actions is assessed. The audit is divided into modules for each operating or support area of the lab, and each module is comprehensive for a given area. The area audits may be done on a rotating schedule throughout the year to ensure adequate coverage of all areas. This schedule may change as situations in the laboratory warrant.

15.1.2 QA Technical Audits

QA technical audits are based on client projects, associated sample delivery groups, and the methods performed. Reported results are compared to raw data to verify the authenticity of results. The validity of calibrations and QC results are compared to data qualifiers, footnotes, and case narratives. Documentation is assessed by examining run logs and records of manual integrations. Manual calculations are checked. Where possible, MintMiner is used to identify unusual manipulations of the data deserving closer scrutiny. QA technical audits will include all methods within a two-year period.

15.1.3 SOP Method Compliance

Compliance of all SOPs with the source methods and compliance of the operational groups with the SOPs will be assessed by the Technical Director at least every two years. The work of each newly hired analyst is assessed within 3 months of working independently, (e.g., completion of method IDOC). In addition, as analysts add methods to their capabilities, (new IDOC) reviews of the analyst work products will be performed within 3 months of completing the documented training.

15.1.4 Special Audits

Special audits are conducted on an as needed basis, generally as a follow up to specific issues such as client complaints, corrective actions, PT results, data audits, system audits, validation comments, regulatory audits or suspected ethical improprieties. Special audits are focused on a specific issue, and report format, distribution, and timeframes are designed to address the nature of the issue.

15.1.5 Performance Testing

The laboratory participates in performance audits conducted through the analysis of PT samples provided by a third party. The laboratory generally participates in the following types of PT studies: Air, Potable Water, Non-Potable Water and Soil.

It is TestAmerica's policy that PT samples be treated as typical samples in the production process. Furthermore, where PT samples present special or unique problems, in the regular production process they may need to be treated differently, as would any special or unique request submitted by any client. The QA Manager must be consulted and in agreement with any decisions made to treat a PT sample differently due to some special circumstance.

Written responses to unacceptable PT results are required. In some cases it may be necessary for blind QC samples to be submitted to the laboratory to show a return to control.

15.2 EXTERNAL AUDITS

External audits are performed when certifying agencies or clients conduct on-site inspections or submit performance testing samples for analysis. It is TestAmerica's policy to cooperate fully with regulatory authorities and clients. The laboratory makes every effort to provide the auditors with access to personnel, documentation, and assistance. Laboratory supervisors are responsible for providing corrective actions to the QA Manager who coordinates the response for any deficiencies discovered during an external audit. Audit responses are due in the time allotted by the client or agency performing the audit. When requested, a copy of the audit report and the labs corrective action plan will be forwarded to Corporate Quality.

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. The client may only view data and systems related directly to the client's work. All efforts are made to keep other client information confidential.

15.2.1 Confidential Business Information (CBI) Considerations

During on-site audits, auditors may come into possession of information claimed as business confidential. A business confidentiality claim is defined as "a claim or allegation that business information is entitled to confidential treatment for reasons of business confidentiality or a request for a determination that such information is entitled to such treatment." When information is claimed as business confidential, the laboratory must place on (or attach to) the information at the time it is submitted to the auditor, a cover sheet, stamped or typed legend or other suitable form of notice, employing language such as "trade secret", "proprietary" or "company confidential". Confidential portions of documents otherwise non-confidential must be clearly identified. CBI may be purged of references to client identity by the responsible laboratory official at the time of removal from the laboratory. However, sample identifiers may not be obscured from the information. Additional information regarding CBI can be found in within the 2003 NELAC standards.

15.3 AUDIT FINDINGS

Audit findings are documented using the corrective action process and tracked using a spreadsheet. The laboratory's corrective action responses for both types of audits may include action plans that could not be completed within a predefined timeframe. In these instances, a completion date must set and agreed to by operations management and the QA Manager.

Developing and implementing corrective actions to findings is the responsibility of the Department Manager where the finding originated. Findings that are not corrected by specified due dates are reported monthly to management in the QA monthly report. When requested, a copy of the audit report and the labs corrective action plan will be forwarded to Corporate Quality.

If any audit finding casts doubt on the effectiveness of the operations or on the correctness or validity of the laboratory's test results, the laboratory shall take timely corrective action, and shall notify clients in writing if the investigations show that the laboratory results have been affected. Once corrective action is implemented, a follow-up audit is scheduled to ensure that the problem has been corrected.

Clients must be notified promptly in writing, of any event such as the identification of defective measuring or test equipment that casts doubt on the validity of results given in any test report or amendment to a test report. The investigation must begin within 24-hours of discovery of the problem and all efforts are made to notify the client within two weeks after the completion of the investigation.

SECTION 16. MANAGEMENT REVIEWS (NELAC 5.4.14)

16.1 QUALITY ASSURANCE REPORT

A comprehensive QA Report shall be prepared each month by the laboratory's QA Department and forwarded to the Laboratory Director and their Quality Director as well as the General Manager. All aspects of the QA system are reviewed to evaluate the suitability of policies and procedures. During the course of the year, the Laboratory Director, General Manager or Corporate QA may request that additional information be added to the report.

On a monthly basis, Corporate QA compiles information from all the monthly laboratory reports. The Corporate Quality Directors prepare a report that includes a compilation of all metrics and notable information and concerns regarding the QA programs within the laboratories. The report also includes a listing of new regulations that may potentially impact the laboratories. This report is presented to the Senior Management Team and General Managers.

16.2 ANNUAL MANAGEMENT REVIEW

The senior lab management team conducts a review annually of its quality systems and LIMS to ensure its continuing suitability and effectiveness in meeting client and regulatory requirements and to introduce any necessary changes or improvements. It will also provide a platform for defining quality goals & objectives. Corporate Operations and Corporate QA personnel may be included in this meeting at the discretion of the Laboratory Director. The LIMS review consists of examining any audits, complaints or concerns that have been raised through the year that are related to the LIMS. The laboratory will summarize any critical findings that can not be solved by the lab and report them to Corporate IT.

This management systems review (Corporate SOP No. CA-Q-S-008 & Work Instruction No. CA-Q-WI-020) uses information generated during the preceding year to assess the "big picture" by ensuring that routine actions taken and reviewed on a monthly basis are not components of larger systematic concerns. The monthly review should keep the quality systems current and effective, therefore, the annual review is a formal senior management process to review specific existing documentation. Significant issues from the following documentation are compiled or summarized by the QA Manager prior to the review meeting:

- Matters arising from the previous annual review.
- Prior Monthly QA Reports issues.
- Laboratory QA Metrics.
- Review of report reissue requests.
- Review of client feedback and complaints.
- Issues arising from any prior management or staff meetings.
- Minutes from prior senior lab management meetings. Issues that may be raised from these meetings include:
    - Adequacy of staff, equipment and facility resources.
    - Adequacy of policies and procedures.
    - Future plans for resources and testing capability and capacity.

- The annual internal double blind PT program sample performance (if performed),
- Compliance to the Ethics Policy and Data Integrity Plan. Including any evidence/incidents of inappropriate actions or vulnerabilities related to data Integrity.

A report is generated by the QA Manager and management. The report is distributed to the appropriate General Manager and the Quality Director. The report includes, but is not limited to:

- The date of the review and the names and titles of participants.
- A reference to the existing data quality related documents and topics that were reviewed.
- Quality system or operational changes or improvements that will be made as a result of the review [e.g., an implementation schedule including assigned responsibilities for the changes (Action Table)].

Changes to the quality systems requiring update to the laboratory QA Manual shall be included in the next revision of the QA Manual.

16.3 POTENTIAL INTEGRITY RELATED MANAGERIAL REVIEWS

Potential integrity issues (data or business related) must be handled and reviewed in a confidential manner until such time as a follow-up evaluation, full investigation, or other appropriate actions have been completed and issues clarified. TestAmerica's Corporate Data Investigation/Recall SOP shall be followed (SOP No. CA-L-S-001). All investigations that result in finding of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients.

TestAmerica's COO, VP of Client & Technical Services, General Managers and Quality Directors receive a monthly report from the Director of Quality & Client Advocacy summarizing any current data integrity or data recall investigations. The General Manager's are also made aware of progress on these issues for their specific labs.

SECTION 17. PERSONNEL (NELAC 5.5.2)

17.1 OVERVIEW

The laboratory's management believes that its highly qualified and professional staff is the single most important aspect in assuring a high level of data quality and service. The staff consists of professionals and support personnel as outlined in the organization chart in Figure 4-1.

All personnel must demonstrate competence in the areas where they have responsibility. Any staff that is undergoing training shall have appropriate supervision until they have demonstrated their ability to perform their job function on their own. Staff shall be qualified for their tasks based on appropriate education, training, experience and/or demonstrated skills as required.

The laboratory employs sufficient personnel with the necessary education, training, technical knowledge and experience for their assigned responsibilities.

All personnel are responsible for complying with all QA/QC requirements that pertain to the laboratory and their area of responsibility. Each staff member must have a combination of experience and education to adequately demonstrate a specific knowledge of their particular area of responsibility. Technical staff must also have a general knowledge of lab operations, test methods, QA/QC procedures and records management.

Laboratory management is responsible for formulating goals for lab staff with respect to education, training and skills and ensuring that the laboratory has a policy and procedures for identifying training needs and providing training of personnel. The training shall be relevant to the present and anticipated responsibilities of the lab staff.

The laboratory only uses personnel that are employed by or under contract to, the laboratory. Contracted personnel, when used, must meet competency standards of the laboratory and work in accordance to the laboratory's quality system.

17.2 EDUCATION AND EXPERIENCE REQUIREMENTS FOR TECHNICAL PERSONNEL

The laboratory makes every effort to hire analytical staffs that possess a college degree (AA, BA, BS) in an applied science with some chemistry in the curriculum. Exceptions can be made based upon the individual's experience and ability to learn. Selection of qualified candidates for laboratory employment begins with documentation of minimum education, training, and experience prerequisites needed to perform the prescribed task. Minimum education and training requirements for TestAmerica employees are outlined in job descriptions and are generally summarized for analytical staff in the table below.

The laboratory maintains job descriptions for all personnel who manage, perform or verify work affecting the quality of the environmental testing the laboratory performs. Job Descriptions are located on the TestAmerica intranet site's Human Resources web-page.

Experience and specialized training are occasionally accepted in lieu of a college degree (basic lab skills such as using a balance, colony counting, aseptic or quantitation techniques, etc., are also considered).

As a general rule for analytical staff:

Specialty	Education	Experience
Extractions, Digestions, some electrode methods (pH, DO, Redox, etc.), or Titrimetric and Gravimetric Analyses	H.S. Diploma	On the job training (OJT)
GFAA, CVAA, FLAA, Single component or short list Chromatography (e.g., Fuels, BTEX-GC, IC	A college degree in an applied science or 2 years of college and at least 1 year of college chemistry	Or 2 years prior analytical experience is required
ICP, ICPMS, Long List or complex chromatography (e.g., Pesticides, PCB, Herbicides, HPLC, etc.), GCMS	A college degree in an applied science or 2 years of college chemistry	or 5 years of prior analytical experience
Spectra Interpretation	A college degree in an applied science or 2 years of college chemistry	And 2 years relevant experience Or 5 years of prior analytical experience
Technical Directors **General**	Bachelors Degree in an applied science or engineering with 24 semester hours in chemistry An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years experience in environmental analysis of representative analytes for which they will oversee
Technical Director – **Wet Chem** only (no advanced instrumentation)	Associates degree in an applied science or engineering or 2 years of college with 16 semester hours in chemistry	And 2 years relevant experience
Technical Director - Microbiology	Bachelors degree in applied science with at least 16 semester hours in general microbiology and biology An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years of relevant experience

When an analyst does not meet these requirements, they can perform a task under the direct supervision of a qualified analyst, peer reviewer or Department Manager, and are considered an analyst in training. The person supervising an analyst in training is accountable for the quality of the analytical data and must review and approve data and associated corrective actions.

17.3 TRAINING

The laboratory is committed to furthering the professional and technical development of employees at all levels.

Orientation to the laboratory's policies and procedures, in-house method training, and employee attendance at outside training courses and conferences all contribute toward employee proficiency. Below are examples of various areas of required employee training:

Required Training	Time Frame	Employee Type
Environmental Health & Safety	Prior to lab work	All
Ethics – New Hires	1 week of hire	All
Ethics – Comprehensive	90 days of hire	All
Data Integrity	30 days of hire	Technical and PMs
Quality Assurance	90 days of hire	All
Ethics – Comprehensive Refresher	Annually	All
Initial Demonstration of Capability (DOC)	Prior to unsupervised method performance	Technical

The laboratory maintains records of relevant authorization/competence, education, professional qualifications, training, skills and experience of technical personnel (including contracted personnel) as well as the date that approval/authorization was given. These records are kept on file at the laboratory. Also refer to "Demonstration of Capability" in Section 19.

The training of technical staff is kept up to date by:

- Each employee must have documentation in their training file that they have read, understood and agreed to follow the most recent version of the laboratory QA Manual and SOPs in their area of responsibility. This documentation is updated as SOPs are updated.
- Documentation from any training courses or workshops on specific equipment, analytical techniques or other relevant topics are maintained in their training file.
- Documentation of proficiency (refer to Section 19).
- An Ethics Agreement signed by each staff member (renewed each year) and evidence of annual ethics training.
- A Confidentiality Agreement signed by each staff member signed at the time of employment.
- Human Resources maintains documentation and attestation forms on employment status & records; benefit programs; timekeeping/payroll; and employee conduct (e.g., ethics). This information is maintained in the employee's secured personnel file.

Evidence of successful training could include such items as:

- Adequate documentation of training within operational areas, including one-on-one technical training for individual technologies, and particularly for people cross-trained.
- Analysts knowledge to refer to QA Manual for quality issues.
- Analysts following SOPs, i.e., practice matches SOPs.
- Analysts regularly communicate to supervisors and QA if SOPs need revision, rather than waiting for auditors to find problems.

Further details of the laboratory's training program are described in the Laboratory Training SOP BR-QA-011.

17.4 DATA INTEGRITY AND ETHICS TRAINING PROGRAM

Establishing and maintaining a high ethical standard is an important element of a Quality System. Ethics and data integrity training is integral to the success of TestAmerica and is provided for each employee at TestAmerica. It is a formal part of the initial employee orientation within 1 week of hire followed by technical data integrity training within 30 days, comprehensive training within 90 days, and an annual refresher for all employees. Senior management at each facility performs the ethics training for their staff.

In order to ensure that all personnel understand the importance TestAmerica places on maintaining high ethical standards at all times; TestAmerica has established a Corporate Ethics Policy (Policy No. CA-L-P-001) and an Ethics Statement. All initial and annual training is documented by signature on the signed Ethics Statement demonstrating that the employee has participated in the training and understands their obligations related to ethical behavior and data integrity.

Violations of this Ethics Policy will not be tolerated. Employees who violate this policy will be subject to disciplinary actions up to and including termination. Criminal violations may also be referred to the Government for prosecution. In addition, such actions could jeopardize TestAmerica's ability to do work on Government contracts, and for that reason, TestAmerica has a Zero Tolerance approach to such violations.

Employees are trained as to the legal and environmental repercussions that result from data misrepresentation. Key topics covered in the presentation include:

- Organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting.
- Ethics Policy
- How and when to report ethical/data integrity issues. Confidential reporting.
- Record keeping.
- Discussion regarding data integrity procedures.
- Specific examples of breaches of ethical behavior (e.g. peak shaving, altering data or computer clocks, improper macros, etc., accepting/offering kickbacks, illegal accounting practices, unfair competition/collusion)
- Internal monitoring. Investigations and data recalls.

- Consequences for infractions including potential for immediate termination, debarment, or criminal prosecution.
- Importance of proper written narration / data qualification by the analyst and project manager with respect to those cases where the data may still be usable but are in one sense or another partially deficient.

Additionally, a data integrity hotline (1-800-736-9407) is maintained by TestAmerica and administered by the Corporate Quality Department.

SECTION 18. ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS (NELAC 5.5.3)

18.1 OVERVIEW

The laboratory is a 22,000 sq ft^2 secure laboratory facility with controlled access and designed to accommodate an efficient workflow and to provide a safe and comfortable work environment for employees. All visitors sign in and are escorted by laboratory personnel. Access is controlled by various measures.

The laboratory is equipped with structural safety features. Each employee is familiar with the location, use, and capabilities of general and specialized safety features associated with their workplace. The laboratory provides and requires the use of protective equipment including safety glasses, protective clothing, gloves, etc., OSHA and other regulatory agency guidelines regarding required amounts of bench and fume hood space, lighting, ventilation (temperature and humidity controlled), access, and safety equipment are met or exceeded.

Traffic flow through sample preparation and analysis areas is minimized to reduce the likelihood of contamination. Adequate floor space and bench top area is provided to allow unencumbered sample preparation and analysis space. Sufficient space is also provided for storage of reagents and media, glassware, and portable equipment. Ample space is also provided for refrigerated sample storage before analysis and archival storage of samples after analysis. Laboratory HVAC and deionized water systems are designed to minimize potential trace contaminants.

The laboratory is separated into specific areas for sample receiving, sample preparation, volatile organic sample analysis, non-volatile organic sample analysis, inorganic sample analysis, and administrative functions.

18.2 ENVIRONMENT

Laboratory accommodation, test areas, energy sources, lighting are adequate to facilitate proper performance of tests. The facility is equipped with heating, ventilation, and air conditioning (HVAC) systems appropriate to the needs of environmental testing performed at this laboratory.

The environment in which these activities are undertaken does not invalidate the results or adversely affect the required accuracy of any measurements.

The laboratory provides for the effective monitoring, control and recording of environmental conditions that may affect the results of environmental tests as required by the relevant specifications, methods, and procedures.

When any of the method or regulatory required environmental conditions change to a point where they may adversely affect test results, analytical testing will be discontinued until the environmental conditions are returned to the required levels.

Environmental conditions of the facility housing the computer network and LIMS are regulated to protect against raw data loss.

18.3 WORK AREAS

There is effective separation between neighboring areas when the activities therein are incompatible with each other. Examples include:

- Volatile organic chemical handling areas, including sample preparation and waste disposal, and volatile organic chemical analysis areas.

Access to and use of all areas affecting the quality of analytical testing is defined and controlled by secure access to the laboratory building as described below in the Building Security section.

Adequate measures are taken to ensure good housekeeping in the laboratory and to ensure that any contamination does not adversely affect data quality. These measures include regular cleaning to control dirt and dust within the laboratory. Work areas are available to ensure an unencumbered work area. Work areas include:

- Access and entryways to the laboratory.
- Sample receipt areas.
- Sample storage areas.
- Chemical and waste storage areas.
- Data handling and storage areas.
- Sample processing areas.
- Sample analysis areas.

18.4 FLOOR PLAN

A floor plan can be found in Appendix 1.

18.5 BUILDING SECURITY

Electronic access cards are issued to each employee and building keys are distributed to authorized employees as necessary.

Visitors to the laboratory sign in and out in a visitor's logbook. A visitor is defined as any person who visits the laboratory who is not an employee of the laboratory. In addition to signing into the laboratory, the Environmental, Health and Safety Manual contains requirements for visitors and vendors. There are specific safety forms that must be reviewed and signed. Visitors (with the exception of company employees) are escorted by laboratory personnel at all times, or the location of the visitor is noted in the visitor's logbook.

SECTION 19. TEST METHODS AND METHOD VALIDATION (NELAC 5.5.4)

19.1 OVERVIEW

The laboratory uses methods that are appropriate to meet our clients' requirements and that are within the scope of the laboratory's capabilities. These include sampling, handling, transport, storage and preparation of samples, and, where appropriate, an estimation of the measurement of uncertainty as well as statistical techniques for analysis of environmental data.

Instructions are available in the laboratory for the operation of equipment as well as for the handling and preparation of samples. All instructions, Standard Operating Procedures (SOPs), reference methods and manuals relevant to the working of the laboratory are readily available to all staff. Deviations from published methods are documented (with justification) in the laboratory's approved SOPs. SOPs are submitted to clients for review at their request. Significant deviations from published methods require client approval and regulatory approval where applicable.

19.2 STANDARD OPERATING PROCEDURES (SOPS)

The laboratory maintains SOPs that accurately reflect all phases of the laboratory such as assessing data integrity, corrective actions, handling customer complaints as well as all analytical methods and sampling procedures. The method SOPs are derived from the most recently promulgated/approved, published methods and are specifically adapted to the laboratory facility. Modifications or clarifications to published methods are clearly noted in the SOPs. All SOPs are controlled in the laboratory.

- All SOPs contain a revision number, effective date, and appropriate approval signatures. Controlled copies are available to all staff.
- Procedures for writing an SOP are incorporated by reference to TestAmerica's Corporate SOP entitled 'Writing a Standard Operating Procedure', No. CW-Q-S-002.
- SOPs are reviewed at a minimum of every 2 years (annually for Drinking Water and DoD SOPs), and where necessary, revised to ensure continuing suitability and compliance with applicable requirements.

19.3 LABORATORY METHODS MANUAL

For each test method, the laboratory shall have available the published referenced method as well as the laboratory developed SOP.

Note: If more stringent standards or requirements are included in a mandated test method or regulation than those specified in this manual, the laboratory shall demonstrate that such requirements are met. If it is not clear which requirements are more stringent, the standard from the method or regulation is to be followed. Any exceptions or deviations from the referenced methods or regulations are noted in the specific analytical SOP.

The laboratory maintains an SOP Index for both technical and non-technical SOPs. Technical SOPs are maintained to describe a specific test method. Non-technical SOPs are maintained to describe functions and processes not related to a specific test method.

19.4 SELECTION OF METHODS

Since numerous methods and analytical techniques are available, continued communication between the client and laboratory is imperative to assure the correct methods are utilized. Once client methodology requirements are established, this and other pertinent information is summarized by the Project Manager. These mechanisms ensure that the proper analytical methods are applied when the samples arrive for log-in. For non-routine analytical services (e.g., special matrices, non-routine compound lists), the method of choice is selected based on client needs and available technology. The methods selected should be capable of measuring the specific parameter of interest, in the concentration range of interest, and with the required precision and accuracy.

19.4.1 Sources of Methods

Routine analytical services are performed using standard EPA-approved methodology. In some cases, modification of standard approved methods may be necessary to provide accurate analyses of particularly complex matrices. When the use of specific methods for sample analysis is mandated through project or regulatory requirements, only those methods shall be used.

When clients do not specify the method to be used or methods are not required, the methods used will be clearly validated and documented in an SOP and available to clients and/or the end user of the data.

The analytical methods used by the laboratory are those currently accepted and approved by the U. S. EPA and the state or territory from which the samples were collected. Reference methods include:

- *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, US EPA, January 1996.*
- *Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act, and Appendix A-C; 40 CFR Part 136, USEPA Office of Water. Revised as of July 1, 1995, Appendix A to Part 136 - Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater (EPA 600 Series)*
- *Methods for Chemical Analysis of Water and Wastes, EPA 600 (4-79-020), 1983.*
- *Methods for the Determination of Inorganic Substances in Environmental Samples, EPA-600/R-93/100, August 1993.*
- *Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91/010, June 1991. Supplement I: EPA-600/R-94/111, May 1994.*
- *Methods for the Determination of Organic Compounds in Drinking Water, EPA-600/4-88-039, December 1988, Revised, July 1991, Supplement I, EPA-600-4-90-020, July 1990, Supplement II, EPA-600/R-92-129, August 1992. Supplement III EPA/600/R-95/131 - August 1995 (EPA 500 Series) (EPA 500 Series methods)*
- *Technical Notes on Drinking Water Methods, EPA-600/R94-173, October 1994*
- *NIOSH Manual of Analytical Methods, 4th ed., August 1994.*
- *Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.*

- *Standard Methods for the Examination of Water and Wastewater, 18th/19th /20th/ on-line edition; Eaton, A.D. Clesceri, L.S. Greenberg, A.E. Eds; American Water Works Association, Water Pollution Control Federation, American Public Health Association: Washington, D.C.*
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008.*
- *Annual Book of ASTM Standards, American Society for Testing & Materials (ASTM), Philadelphia, PA.*
- *National Status and Trends Program, National Oceanographic and Atmospheric Administration, Volume I-IV, 1985-1994.*
- *Manual for the Certification of Laboratories Analyzing Drinking Water (EPA 815-R-05-004, January 2005).*
- *Code of Federal Regulations (CFR) 40, Parts 136, 141, 172, 173, 178, 179 and 261*

The laboratory reviews updated versions to all the aforementioned references for adaptation based upon capabilities, instrumentation, etc., and implements them as appropriate. As such, the laboratory strives to perform only the latest versions of each approved method as regulations allow or require.

Other reference procedures for non-routine analyses may include methods established by specific states (e.g., Underground Storage Tank methods), ASTM or equipment manufacturers. Sample type, source, and the governing regulatory agency requiring the analysis will determine the method utilized.

The laboratory shall inform the client when a method proposed by the client may be inappropriate or out of date. After the client has been informed, and they wish to proceed contrary to the laboratory's recommendation, it will be documented.

19.4.2 Demonstration of Capability

Before the laboratory may institute a new method and begin reporting results, the laboratory shall confirm that it can properly operate the method. In general, this demonstration does not test the performance of the method in real world samples, but in an applicable and available clean matrix sample. If the method is for the testing of analytes that are not conducive to spiking, demonstration of capability may be performed on quality control samples.

A demonstration of capability (DOC, Lab SOP BR-QA-011) is performed whenever there is a change in instrument type (e.g., new instrumentation), method or personnel.

The initial demonstration of capability must be thoroughly documented and approved by the Technical Director and QA Manager prior to independently analyzing client samples. All associated documentation must be retained in accordance with the laboratories archiving procedures.

The laboratory must have an approved SOP, demonstrate satisfactory performance, and conduct an MDL study (when applicable). There may be other requirements as stated within the published method or regulations (i.e., retention time window study).

Note: In some instances, a situation may arise where a client requests that an unusual analyte be reported using a method where this analyte is not normally reported. If the analyte is being reported for regulatory purposes, the method must meet all procedures outlined within this QA Manual (SOP, MDL, and Demonstration of Capability). If the client states that the information is not for regulatory purposes, the result may be reported as long as the following criteria are met:

- The instrument is calibrated for the analyte to be reported using the criteria for the method and ICV/CCV criteria are met (unless an ICV/CCV is not required by the method or criteria are per project DQOs).
- The laboratory's nominal or default reporting limit (RL) is equal to the quantitation limit (QL), must be at or above the lowest non-zero standard in the calibration curve and must be reliably determined. Project RLs are client specified reporting levels which may be higher than the QL. Results reported below the QL must be qualified as estimated values. Also see Section 19.6.1.3, Relationship of Limit of Detection (LOD) to Quantitation Limit (QL).
- The client request is documented and the lab informs the client of its procedure for working with unusual compounds. The final report must be footnoted: *Reporting Limit based on the low standard of the calibration curve.*

19.4.3 **Initial Demonstration of Capability (IDOC) Procedures**

19.4.3.1 The spiking standard used must be prepared independently from those used in instrument calibration.

19.4.3.2 The analyte(s) shall be diluted in a volume of clean matrix sufficient to prepare four aliquots at the concentration specified by a method or the laboratory SOP.

19.4.3.3 At least four aliquots shall be prepared (including any applicable clean-up procedures) and analyzed according to the test method (either concurrently or over a period of days).

19.4.3.4 Using all of the results, calculate the mean recovery in the appropriate reporting units and the standard deviations for each parameter of interest.

19.4.3.5 When it is not possible to determine the mean and standard deviations, such as for presence, absence and logarithmic values, the laboratory will assess performance against criteria described in the Method SOP.

19.4.3.6 Compare the information obtained above to the corresponding acceptance criteria for precision and accuracy in the test method (if applicable) or in laboratory generated acceptance criteria (LCS or interim criteria) if there is no mandatory criteria established. If any one of the parameters do not meet the acceptance criteria, the performance is unacceptable for that parameter.

19.4.3.7 When one or more of the tested parameters fail at least one of the acceptance criteria, the analyst must proceed according to either option listed below:

- Locate and correct the source of the problem and repeat the test for all parameters of interest beginning with 19.4.3.3 above.
- Beginning with 19.4.3.3 above, repeat the test for all parameters that failed to meet criteria. Repeated failure, however, will confirm a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds of interest beginning with 19.4.3.1 above.

Note: Results of successive LCS analyses can be used to fulfill the DOC requirement.

A certification statement (refer to Figure 19-1 as an example shall be used to document the completion of each initial demonstration of capability. A copy of the certification is archived in the analyst’s training folder.

Methods on line prior to the effective date of this Section shall be updated to the procedures outlined above as new analysts perform their demonstration of capability. A copy of the new record will replace that which was used for documentation in the past. At a minimum, the precision and accuracy of four mid-level laboratory control samples must have been compared to the laboratory’s quality control acceptance limits.

19.5 LABORATORY DEVELOPED METHODS AND NON-STANDARD METHODS

Any new method developed by the laboratory must be fully defined in an SOP and validated by qualified personnel with adequate resources to perform the method. Method specifications and the relation to client requirements must be clearly conveyed to the client if the method is a non-standard method (not a published or routinely accepted method). The client must also be in agreement to the use of the non-standard method.

19.6 VALIDATION OF METHODS

Validation is the confirmation by examination and the provision of objective evidence that the particular requirements for a specific intended use are fulfilled.

All non-standard methods, laboratory designed/developed methods, standard methods used outside of their scope, and major modifications to published methods must be validated to confirm they are fit for their intended use. The validation will be as extensive as necessary to meet the needs of the given application. The results are documented with the validation procedure used and contain a statement as to the fitness for use.

19.6.1 Method Validation and Verification Activities for All New Methods

While method validation can take various courses, the following activities can be required as part of method validation. Method validation records are designated QC records and are archived accordingly.

19.6.1.1 Determination of Method Selectivity

Method selectivity is the demonstrated ability to discriminate the analyte(s) of interest from other compounds in the specific matrix or matrices from other analytes or interference. In some cases to achieve the required selectivity for an analyte, a confirmation analysis is required as part of the method.

19.6.1.2 Determination of Method Sensitivity

Sensitivity can be both estimated and demonstrated. Whether a study is required to estimate sensitivity depends on the level of method development required when applying a particular measurement system to a specific set of samples. Where estimations and/or demonstrations of sensitivity are required by regulation or client agreement, such as the procedure in 40 CFR Part 136 Appendix B, under the Clean Water Act, these shall be followed.

19.6.1.3 Relationship of Limit of Detection (LOD) to the Quantitation Limit (QL)

An important characteristic of expression of sensitivity is the difference in the LOD and the QL. The LOD is the minimum level at which the presence of an analyte can be reliably concluded. The QL is the minimum concentration of analyte that can be quantitatively determined with acceptable precision and bias. For most instrumental measurement systems, there is a region where semi-quantitative data is generated around the LOD (both above and below the estimated MDL or LOD) and below the QL. In this region, detection of an analyte may be confirmed but quantification of the analyte is unreliable within the accuracy and precision guidelines of the measurement system. When an analyte is detected below the QL, and the presence of the analyte is confirmed by meeting the qualitative identification criteria for the analyte, the analyte can be reliably reported, but the amount of the analyte can only be estimated. If data is to be reported in this region, it must be done so with a qualification that denotes the semi-quantitative nature of the result.

19.6.1.4 Determination of Interferences

A determination that the method is free from interferences in a blank matrix is performed.

19.6.1.5 Determination of Range

Where appropriate to the method, the quantitation range is determined by comparison of the response of an analyte in a curve to established or targeted criteria. Generally the upper quantitation limit is defined by highest acceptable calibration concentration. The lower quantitation limit or QL cannot be lower than the lowest non-zero calibration level, and can be constrained by required levels of bias and precision.

19.6.1.6 Determination of Accuracy and Precision

Accuracy and precision studies are generally performed using replicate analyses, with a resulting percent recovery and measure of reproducibility (standard deviation, relative standard deviation) calculated and measured against a set of target criteria.

19.6.1.7 Documentation of Method

The method is formally documented in an SOP. If the method is a minor modification of a standard laboratory method that is already documented in an SOP, an SOP Attachment describing the specific differences in the new method is acceptable in place of a separate SOP.

19.6.1.8 Continued Demonstration of Method Performance

Continued demonstration of Method Performance is addressed in the SOP. Continued demonstration of method performance is generally accomplished by batch specific QC samples such as LCS, method blanks or PT samples.

19.7 METHOD DETECTION LIMITS (MDL)/ LIMITS OF DETECTION (LOD)

Method detection limits (MDL) are initially determined in accordance with 40 CFR Part 136, Appendix B or alternatively by other technically acceptable practices that have been accepted by regulators. MDL is also sometimes referred to as Limit of Detection (LOD). The MDL theoretically represents the concentration level for each analyte within a method at which the Analyst is 99% confident that the true value is not zero. The MDL is determined for each analyte initially during the method validation process and updated as required in the analytical methods, whenever there is a significant change in the procedure or equipment, or based on project specific requirements. Generally, the analyst prepares at least seven replicates of solution spiked at one to five times the estimated method detection limit (most often at the lowest standard in the calibration curve) into the applicable matrix with all the analytes of interest. Each of these aliquots is extracted (including any applicable clean-up procedures) and analyzed in the same manner as the samples. Where possible, the seven replicates should be analyzed over 2-4 days to provide a more realistic MDL.

Refer to the Corporate SOP No. CA-Q-S-006 or the laboratory's SOP BR-QA-005 for details on the laboratory's MDL process.

19.8 INSTRUMENT DETECTION LIMITS (IDL)

The IDL is sometimes used to assess the reasonableness of the MDLs or in some cases required by the analytical method or program requirements. IDLs are most used in metals analyses but may be useful in demonstration of instrument performance in other areas.

IDLs are calculated to determine an instrument's sensitivity independent of any preparation method. IDLs are calculated either using 7 replicate spike analyses, like MDL but without sample preparation, or by the analysis of 10 instrument blanks and calculating 3 x the absolute value of the standard deviation.

If IDL is > than the MDL, it may be used as the reported MDL.

19.9 VERIFICATION OF DETECTION AND REPORTING LIMITS

Once an MDL is established, it must be verified, on each instrument, by analyzing a quality control sample (prepared as a sample) at approximately 2-3 times the calculated MDL for single analyte analyses (e.g. most wet chemistry methods, Atomic Absorption, etc.) and 1-4 times the calculated MDL for multiple analyte methods (e.g. GC, GCMS, ICP, etc.). The analytes must be qualitatively identified. This verification does not apply to methods that are not readily spiked (e.g. pH, turbidity, etc.) or where the lab does not report to the MDL. If the MDL does not verify, then the lab will not report to the MDL, or redevelop their MDL or use the level where qualitative identification is established.

For DoD QSM work, once the detection limit is determined, it must be verified on each instrument used for the given method. TestAmerica defines the DoD QSM Detection Limit (DL) as being equal to the MDL. TestAmerica also defines the DoD QSM Limit of Detection (LOD) as being equal to the lowest concentration standard that successfully verifies the MDL, also referred to as the MDLV standard. MDL and MDLV standards are extracted/digested and analyzed through the entire analytical process. The MDL and MDLV determinations do not apply to methods that are not readily spiked (e.g. pH, turbidity, etc.) or where the lab does not report to the MDL. If the MDLV standard is not successful, then the laboratory will redevelop their MDL. Initial and quarterly verification is required for all methods listed in the laboratory's DoD ELAP Scope of Accreditation. Refer to the laboratory SOP BR-QA-005 Method Detection Limits (MDLs/DLs) for further details.

When the laboratory establishes a quantitation limit, it must be initially verified by the analysis of a low level standard or QC sample at 1-2 the reporting limit and annually thereafter. The annual requirement is waved for methods that have an annually verified MDL. The laboratory will comply with any regulatory requirements.

For DoD QSM work, The laboratory quantitation limit is equivalent to the DoD Limit of Quantitation (LOQ), which is at a concentration equal to or greater than the lowest non-zero calibration standard. The DoD QSM requires the laboratory to perform an initial characterization of the bias and precision at the LOQ and quarterly LOQ verifications thereafter. If the quarterly verification results are not consistent with three-standard deviation confidence limits established initially, then the bias and precision will be reevaluated and clients contacted for any on-going projects. For DoD projects, TestAmerica makes a distinction between the Reporting Limit (RL) and the LOQ. The RL is a level at or above the LOQ that is used for specific project reporting purposes, as agreed to between the laboratory and the client. The RL cannot be lower than the LOQ concentration, but may be higher.

19.10 RETENTION TIME WINDOWS

Most organic analyses and some inorganic analyses use chromatography techniques for qualitative and quantitative determinations. For every chromatography analysis or as specific in the reference method, each analyte will have a specific time of elution from the column to the detector. This is known as the analyte's retention time. The variance in the expected time of elution is defined as the retention time window. As the key to analyte identification in chromatography, retention time windows must be established on every column for every analyte used for that method. These records are kept with the files associated with an instrument for later quantitation of the analytes. Complete details are available in the laboratory SOPs.

19.11 EVALUATION OF SELECTIVITY

The laboratory evaluates selectivity by following the checks within the applicable analytical methods, which include mass spectral tuning, second column confirmation, ICP interelement interference checks, chromatography retention time windows, sample blanks, spectrochemical, atomic absorption or fluorescence profiles, co-precipitation evaluations and specific electrode response factors.

19.12 ESTIMATION OF UNCERTAINTY OF MEASUREMENT

19.12.1 Uncertainty is "a parameter associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand" (as defined by the International Vocabulary of Basic and General Terms in Metrology, ISO Geneva, 1993, ISBN 92-67-10175-1). Knowledge of the uncertainty of a measurement provides additional confidence in a result's validity. Its value accounts for all the factors which could possibly affect the result, such as adequacy of analyte definition, sampling, matrix effects and interferences, climatic conditions, variances in weights, volumes, and standards, analytical procedure, and random variation. Some national accreditation organizations require the use of an "expanded uncertainty": the range within which the value of the measurand is believed to lie within at least a 95% confidence level with the coverage factor k=2.

19.12.2 Uncertainty is not error. Error is a single value, the difference between the true result and the measured result. On environmental samples, the true result is never known. The measurement is the sum of the unknown true value and the unknown error. Unknown error is a combination of systematic error, or bias, and random error. Bias varies predictably, constantly, and independently from the number of measurements. Random error is unpredictable, assumed to be Gaussian in distribution, and reducible by increasing the number of measurements.

19.12.3 The minimum uncertainty associated with results generated by the laboratory can be determined by using the Laboratory Control Sample (LCS) accuracy range for a given analyte. The LCS limits are used to assess the performance of the measurement system since they take into consideration all of the laboratory variables associated with a given test over time (except for variability associated with the sampling and the variability due to matrix effects). The percent recovery of the LCS is compared either to the method-required LCS accuracy limits or to the statistical, historical, in-house LCS accuracy limits.

19.12.4 To calculate the uncertainty for the specific result reported, multiply the result by the decimal of the lower end of the LCS range percent value for the lower end of the uncertainty range, and multiply the result by the decimal of the upper end of the LCS range percent value for the upper end of the uncertainty range. These calculated values represent a 99%-certain range for the reported result. As an example, suppose that the result reported is 1.0 mg/l, and the LCS percent recovery range is 50 to 150%. The uncertainty range would be 0.5 to 1.5 mg/l, which could also be written as 1.0 +/- 0.5 mg/l.

19.12.5 In the case where a well recognized test method specifies limits to the values of major sources of uncertainty of measurement (e.g., 524.2, 525, etc.) and specifies the form of presentation of calculated results, no further discussion of uncertainty is required.

19.13 SAMPLE REANALYSIS GUIDELINES

Because there is a certain level of uncertainty with any analytical measurement, a sample reanalysis may result in either a higher or lower value from an initial sample analysis. There are also variables that may be present (e.g., sample homogeneity, analyte precipitation over time, etc.) that may affect the results of a reanalysis. Based on the above comments, the laboratory will reanalyze samples at a client's request with the following caveats. **Client specific Contractual Terms & Conditions for reanalysis protocols may supersede the following items.**

- Homogenous samples: If a reanalysis agrees with the original result to within the RPD limits for MS/MSD or Duplicate analyses, or within $\pm$ 1 reporting limit for samples $\leq$ 5x the reporting limit, the original analysis will be reported. At the client's request, both results may be reported on the same report but not on two separate reports.

- If the reanalysis does not agree (as defined above) with the original result, then the laboratory will investigate the discrepancy and reanalyze the sample a third time for confirmation if sufficient sample is available.

- Any potential charges related to reanalysis are discussed in the contract terms and conditions or discussed at the time of the request. The client will typically be charged for reanalysis unless it is determined that the lab was in error.

- Due to the potential for increased variability, reanalysis may not be applicable to Non-homogenous, Encore, and Sodium Bisulfate preserved samples. See the Area Supervisor or Laboratory Director if unsure.

19.14 CONTROL OF DATA

The laboratory has policies and procedures in place to ensure the authenticity, integrity, and accuracy of the analytical data generated by the laboratory.

19.14.1 Computer and Electronic Data Related Requirements

The three basic objectives of our computer security procedures and policies are shown below. The laboratory is currently running the TALS LIMS system which is a in-house developed LIMS system that has been highly customized to meet the needs of the laboratory. It is referred to as LIMS for the remainder of this section. The LIMS utilizes an SQL database which is an industry standard relational database platform. It is referred to as Database for the remainder of this section.

19.14.1.1 Maintain the Database Integrity: Assurance that data is reliable and accurate through data verification (review) procedures, password-protecting access, anti-virus protection, data change requirements, as well as an internal LIMS permissions procedure.

- LIMS Database Integrity is achieved through data input validation, internal user controls, and data change requirements.
- Spreadsheets and other software developed in-house must be verified with documentation through hand calculations prior to use.

19.14.1.2 Ensure Information Availability: Protection against loss of information or service is ensured through scheduled back-ups, stable file server network architecture, secure storage of media, line filter, Uninterruptible Power Supply (UPS), and maintaining older versions of software as revisions are implemented.

19.14.1.3 Maintain Confidentiality: Ensure data confidentiality through physical access controls when electronically transmitting data.

19.14.2 Data Reduction

The complexity of the data reduction depends on the analytical method and the number of discrete operations involved (e.g., extractions, dilutions, instrument readings and concentrations). The analyst calculates the final results from the raw data or uses appropriate computer programs to assist in the calculation of final reportable values.

Manual integration of peaks will be documented and reviewed and the raw data will be flagged in accordance with the TestAmerica Corporate SOP No. CA-Q-S-002, *Acceptable Manual Integration Practices* and laboratory SOP BR-QA-006.

Analytical results are reduced to appropriate concentration units specified by the analytical method, taking into account factors such as dilution, sample weight or volume, etc. Blank correction will be applied only when required by the method or per manufacturer's indication; otherwise, it should not be performed. Calculations are independently verified by appropriate laboratory staff. Calculations and data reduction steps for various methods are summarized in the respective analytical SOPs or program requirements.

19.14.2.1 All raw data must be retained. All criteria pertinent to the method must be recorded. The documentation is recorded at the time observations or calculations are made and must be signed or initialed/dated (month/day/year). It must be easily identifiable who performed which tasks if multiple people were involved.

19.14.2.2 In general, concentration results are reported in milligrams per liter (mg/l) or micrograms per liter (µg/l) for liquids and milligrams per kilogram (mg/kg) or micrograms per kilogram (µg/kg) for solids. For values greater than 10,000 mg/l, results can be reported in percent, i.e., 10,000 mg/l = 1**%.** Units are defined in each lab SOP.

19.14.2.3 In reporting, the analyst or the instrument output records the raw data result using values of known certainty plus one uncertain digit. If final calculations are performed external to LIMS, the results should be entered in LIMS with at least three significant figures. In general, results are reported to the LIMS formatter specified by the PM.

19.14.2.4 For those methods that do not have an instrument printout or an instrumental output compatible with the LIMS System, the raw results and dilution factors are entered directly into LIMS by the analyst, and the software calculates the final result for the analytical report. LIMS has a defined significant figure criterion for each analyte.

19.14.2.5 The laboratory strives to import data directly from instruments or calculation spreadsheets to ensure that the reported data are free from transcription and calculation errors. For those analyses with an instrumental output compatible with the LIMS, the raw results and dilution factors are transferred into LIMS electronically after reviewing the quantitation report, and removing unrequested or poor spectrally-matched compounds.

19.14.3 Logbook / Worksheet Use Guidelines

Logbooks and worksheets are filled out 'real time' and have enough information on them to trace the events of the applicable analysis/task. (e.g. calibrations, standards, analyst, sample ID, date, time on short holding time tests, temperatures when applicable, calculations are traceable, etc.)

- Corrections are made following the procedures outlined in Section 12.
- Logbooks are controlled by the QA department. A record is maintained of all logbooks in the lab.
- Unused portions of pages must be "Z"'d out, signed and dated.
- Worksheets are created with the approval of the QA Manager at the facility. The QA Manager controls all worksheets following the procedures in Section 6.

19.14.4 Review / Verification Procedures

Review procedures are out lined in several SOP BR-QA-019 to ensure that reported data are free from calculation and transcription errors, that QC parameters have been reviewed and evaluated before data is reported. The laboratory also has an SOP for manual integration, BR-

QA-005. The general review concepts are discussed below, more specific information can be found in the SOPs.

19.14.4.1 The data review process at the laboratory starts at the Sample Control level. Sample Control personnel review chain-of-custody forms and input the sample information and required analyses into a computer LIMS. The Sample Control Supervisor reviews the transaction of the chain-of-custody forms and the inputted information. The Project Managers perform final review of the chain-of-custody forms and inputted information.

19.14.4.2 The next level of data review occurs with the Analysts. As results are generated, analysts review their work to ensure that the results generated meet QC requirements and relevant EPA methodologies. The Analysts transfer the data into the LIMS and add data qualifiers if applicable. To ensure data compliance, a different analyst performs a second level of review. Second level review is accomplished by checking reported results against raw data and evaluating the results for accuracy. During the second level review, blank runs, QA/QC check results, initial and continuing calibration results, laboratory control samples, sample data, qualifiers and spike information are evaluated. Where calibration is not required on a daily basis, secondary review of the initial calibration results may be conducted at the time of calibration. Approximately 15% of all sample data from manual methods and from automated methods, all GC/MS spectra and all manual integrations are reviewed. Manual integrations are also electronically reviewed utilizing auditing software to help ensure compliance to ethics and manual integration policies. Issues that deem further review include the following:

- QC data are outside the specified control limits for accuracy and precision
- Reviewed sample data does not match with reported results
- Unusual detection limit changes are observed
- Samples having unusually high results
- Samples exceeding a known regulatory limit
- Raw data indicating some type of contamination or poor technique
- Inconsistent peak integration
- Transcription errors
- Results outside of calibration range

19.14.4.3 Unacceptable analytical results may require reanalysis of the samples. Any problems are brought to the attention of the Department Manager, Project Manager, QA Manager or Technical Director, as necessary. Corrective action is initiated whenever necessary.

19.14.4.4 The results are then entered or directly transferred into the computer database and a report is prepared for the client.

19.14.4.5 As a final review prior to the release of the report, the Project Manager reviews the report for completeness. This review and approval ensures that client requirements have been met and that the final report has been properly completed. The process includes, but is not limited to, verifying that chemical relationships are evaluated, COC is followed, cover letters/ narratives are present, flags are appropriate, and project specific requirements are met.

19.14.4.6 Any project that requires a data package is subject to a tertiary data review for transcription errors and acceptable quality control requirements. The Project Manager then signs the final report. The accounting personnel also check the report for any clerical or invoicing errors. When complete, the report is sent out to the client.

19.14.5 **Manual Integrations**

Computerized data systems provide the analyst with the ability to re-integrate raw instrument data in order to optimize the interpretation of the data. Though manual integration of data is an invaluable tool for resolving variations in instrument performance and some sample matrix problems, when used improperly, this technique would make unacceptable data appear to meet quality control acceptance limits. Improper re-integrations lead to legally indefensible data, a poor reputation, or possible laboratory decertification. Because guidelines for re-integration of data are not provided in the methods and most methods were written prior to widespread implementation of computerized data systems, the laboratory trains all analytical staff on proper manual integration techniques using TestAmerica's Corporate SOP (CA-Q-S-002) as the guideline for our internal SOP No. BR-QA-005 entitled Manual Integration.

19.14.5.1 The analyst must adjust baseline or the area of a peak in some situations, for example when two compounds are not adequately resolved or when a peak shoulder needs to be separated from the peak of interest. The analyst must use professional judgment and common sense to determine when manual integrating is required. Analysts are encouraged to ask for assistance from a senior analyst or manager when in doubt.

19.14.5.2 Analysts shall not increase or decrease peak areas to for the sole purpose of achieving acceptable QC recoveries that would have otherwise been unacceptable. The intentional recording or reporting of incorrect information (or the intentional omission of correct information) is against company principals and policy and is grounds for immediate termination.

19.14.5.3 Client samples, performance evaluation samples, and quality control samples are all treated equally when determining whether or not a peak area or baseline should be manually adjusted.

19.14.5.4 All manual integrations receive a second level review. Manual integrations must be indicated on an expanded scale "after" chromatograms such that the integration performed can be easily evaluated during data review. Expanded scale "before" chromatograms are also required for all manual integrations on QC parameters (calibrations, calibration verifications, laboratory control samples, internal standards, surrogates, etc.) unless the laboratory has another documented corporate approved procedure in place that can demonstrate an active process for detection and deterrence of improper integration practices.

Figure 19-1. Example - Demonstration of Capability Documentation

Demonstration of Capability
Certification Statement

Date: _______________ Page ____ of ________

Laboratory Name: TestAmerica Burlington
Laboratory Address: 30 Community Drive, Suite 11, South Burlington, VT 05403

Analyst Name: ____

Matrix: ____

Test Method: _________________ Prep Method: _________________

We, the undersigned, CERTIFY that:

The analyst identified above, using the cited test method(s), which is in use at this facility for the analyses of samples under the various*Program, have method the Demonstration of Capability.

The test method(s) was performed by the analyst identified on this certification.

A copy of the test method(s) and the laboratory-specific SOP are available for all personnel on-site.

The data associated with the demonstration of capability are true, accurate, complete and self-explanatory (1).

All raw data (including a copy of this certification form) necessary to reconstruct and validate these analyses have been retained at the facility and that the associated information is well organized and available for review by authorized assessors.

Bryce E. Stearns Technical Director	Signature	Date
Kirstin L. McCracken QA Manager	Signature	Date

This certification form must be completed each time a demonstration of capability study is completed.

(1) True: Consistent with Supporting Data
Accurate: Based on good laboratory practices consistent with sound scientific principles / practices.
Complete: Includes the results of supporting performance testing.
Self-Explanatory: Data properly labeled and stored so that the results are clear and require no additional explanation.

* Various – includes any regulatory program for which the laboratory performs work including but not limited to: NELAC accreditation program, Department of Defense, USEPA CLP, state and other federal programs.

FQA013:03.30.10:2
TestAmerica Burlington

SECTION 20. EQUIPMENT (AND CALIBRATIONS) (NELAC 5.5.5)

20.1 OVERVIEW

The laboratory purchases the most technically advanced analytical instrumentation for sample analyses. Instrumentation is purchased on the basis of accuracy, dependability, efficiency and sensitivity. Each laboratory is furnished with all items of sampling, preparation, analytical testing and measurement equipment necessary to correctly perform the tests for which the laboratory has capabilities. Each piece of equipment is capable of achieving the required accuracy and complies with specifications relevant to the method being performed. Before being placed into use, the equipment (including sampling equipment) is calibrated and checked to establish that it meets its intended specification. The calibration routines for analytical instruments establish the range of quantitation. Calibration procedures are specified in laboratory SOPs. A list of laboratory instrumentation is presented in Table 20-1.

Equipment is only operated by authorized and trained personnel. Manufacturers instructions for equipment use are readily accessible to all appropriate laboratory personnel.

20.2 PREVENTIVE MAINTENANCE

The laboratory follows a well-defined maintenance program to ensure proper equipment operation and to prevent the failure of laboratory equipment or instrumentation during use. This program of preventive maintenance helps to avoid delays due to instrument failure.

Routine preventive maintenance procedures and frequency, such as cleaning and replacements, should be performed according to the procedures outlined in the manufacturer's manual. Qualified personnel must also perform maintenance when there is evidence of degradation of peak resolution, a shift in the calibration curve, loss of sensitivity, or failure to continually meet one of the quality control criteria.

Table 20-2 lists examples of scheduled routine maintenance. It is the responsibility of each Department Manager to ensure that instrument maintenance logs are kept for all equipment in his/her department. Preventative maintenance procedures may be / are also outlined in analytical SOPs or instrument manuals.

Instrument maintenance logs are controlled and are used to document instrument problems, instrument repair and maintenance activities. Maintenance logs shall be kept for all major pieces of equipment. Instrument maintenance logs may also be used to specify instrument parameters.

- Documentation must include all major maintenance activities such as contracted preventive maintenance and service and in-house activities such as the replacement of electrical components, lamps, tubing, valves, columns, detectors, cleaning and adjustments.
- Each entry in the instrument log includes the Analyst's initials, the date, a detailed description of the problem (or maintenance needed/scheduled), a detailed explanation of the solution or maintenance performed, and a verification that the equipment is functioning properly (state what was used to determine a return to control. e.g. CCV run on *'date'* was acceptable, or instrument recalibrated on 'date' with acceptable verification, etc.) must also be documented in the instrument records.

- When maintenance or repair is performed by an outside agency, service receipts detailing the service performed can be affixed into the logbooks adjacent to pages describing the maintenance performed. This stapled in page must be signed across the page entered and the logbook so that it is clear that a page is missing if only half a signature is found in the logbook.

If an instrument requires repair (subjected to overloading or mishandling, gives suspect results, or otherwise has shown to be defective or outside of specified limits) it shall be taken out of operation and tagged as out-of-service or otherwise isolated until such a time as the repairs have been made and the instrument can be demonstrated as operational by calibration and/or verification or other test to demonstrate acceptable performance. The laboratory shall examine the effect of this defect on previous analyses.

In the event of equipment malfunction that cannot be resolved, service shall be obtained from the instrument vendor manufacturer, or qualified service technician, if such a service can be tendered. If on-site service is unavailable, arrangements shall be made to have the instrument shipped back to the manufacturer for repair. Back up instruments, which have been approved, for the analysis shall perform the analysis normally carried out by the malfunctioning instrument. If the back up is not available and the analysis cannot be carried out within the needed timeframe, the samples shall be subcontracted.

If an instrument is sent out for service or transferred to another facility, it must be recalibrated and verified (including new initial MDL study) prior to return to lab operations.

20.3 SUPPORT EQUIPMENT

This section applies to all devices that may not be the actual test instrument, but are necessary to support laboratory operations. These include but are not limited to: balances, ovens, refrigerators, freezers, incubators, water baths, field sampling devices, temperature measuring devices, thermal/pressure sample preparation devices and volumetric dispensing devices if quantitative results are dependent on their accuracy, as in standard preparation and dispensing or dilution into a specified volume. All raw data records associated with the support equipment are retained to document instrument performance.

20.3.1 Weights and Balances

The accuracy of the balances used in the laboratory is checked every working day, before use. All balances are placed on stable counter tops.

Each balance is checked prior to initial serviceable use with at least two certified ASTM type 1 weights spanning its range of use (weights that have been calibrated to ASTM type 1 weights may also be used for daily verification). ASTM type 1 weights used only for calibration of other weights (and no other purpose) are inspected for corrosion, damage or nicks at least annually and if no damage is observed, they are calibrated at least every 5 years by an outside calibration laboratory. Any weights (including ASTM Type 1) used for daily balance checks or other purposes are recalibrated/recertified annually to NIST standards (this may be done internally if laboratory maintains “calibration only” ASTM type 1 weights).
All balances are serviced annually by a qualified service representative, who supplies the laboratory with a certificate that identifies traceability of the calibration to the NIST standards.

All of this information is recorded in logs, and the recalibration/recertification certificates are kept on file.

20.3.2 pH, Conductivity, and Turbidity Meters

The pH meters used in the laboratory are accurate to $\pm$ 0.1 pH units, and have a scale readability of at least 0.05 pH units. The meters automatically compensate for the temperature, and are calibrated with at least two working range buffer solutions before each use.

Conductivity meters are also calibrated before each use with a known standard to demonstrate the meters do not exceed an error of 1% or one umhos/cm.

Turbidity meters are also calibrated before each use. All of this information is documented in logs.

Consult pH and Conductivity, and Turbidity SOPs for further information.

20.3.3 Thermometers

All thermometers are calibrated on an annual basis with a NIST-traceable thermometer. IR thermometers, digital probes and thermocouples are calibrated quarterly.

The NIST thermometer is recalibrated every five years (unless thermometer has been exposed to temperature extremes or apparent separation of internal liquid) by an approved outside service and the provided certificate of traceability is kept on file. The NIST thermometer(s) have increments of 1 degree (0.5 degree or less increments are required for drinking water microbiological laboratories), and have ranges applicable to method and certification requirements. The NIST traceable thermometer is used for no other purpose than to calibrate other thermometers.

All of this information is documented in logbooks. Monitoring method-specific temperatures, including incubators, heating blocks, water baths, and ovens, is documented in the analytical record. More information on this subject can be found in the laboratory SOP for the calibration of thermometers, BR-QA-012 and individual laboratory SOPs.

20.3.4 Refrigerators/Freezer Units, Waterbaths, Ovens and Incubators

The temperatures of all refrigerator units and freezers used for sample and standard storage are monitored each day.

Ovens, waterbaths and incubators are monitored on days of use.

All of this equipment has a unique identification number, and is assigned a unique thermometer for monitoring.

Sample storage refrigerator temperatures are kept between > 0ºC and $\leq$ 6 ºC.

Specific temperature settings/ranges for other refrigerators, ovens waterbaths, and incubators can be found in method specific SOPs.

All of this information is documented in Daily Temperature Logbooks and/or the analytical record.

20.3.5 Autopipettors, Dilutors, and Syringes

Mechanical volumetric dispensing devices including burettes (except Class A Glassware) are given unique identification numbers and the delivery volumes are verified gravimetrically, at a minimum, on a quarterly basis. Glass micro-syringes are considered the same as Class A glassware.

For those dispensers that are not used for analytical measurements, a label is / can be applied to the device stating that it is not calibrated. Any device not regularly verified can not be used for any quantitative measurements. Laboratory procedures for the verification of mechanical pipette are described in laboratory SOP BR-QA-008.

Micro-syringes are purchased from Hamilton Company. Each syringe is traceable to NIST. The laboratory keeps on file an “Accuracy and Precision Statement of Conformance” from Hamilton attesting established accuracy.

20.4 INSTRUMENT CALIBRATIONS

Calibration of analytical instrumentation is essential to the production of quality data. Strict calibration procedures are followed for each method. These procedures are designed to determine and document the method detection limits, the working range of the analytical instrumentation and any fluctuations that may occur from day to day.

Sufficient raw data records are retained to allow an outside party to reconstruct all facets of the initial calibration. Records contain, but are not limited to, the following: calibration date, method, instrument, analyst(s) initials or signatures, analysis date, analytes, concentration, response, type of calibration (Avg RF, curve, or other calculations that may be used to reduce instrument responses to concentration.)

Sample results must be quantitated from the initial calibration and may not be quantitated from any continuing instrument calibration verification unless otherwise required by regulation, method or program.

If the initial calibration results are outside of the acceptance criteria, corrective action is performed and any affected samples are reanalyzed if possible. If the reanalysis is not possible, any data associated with an unacceptable initial calibration will be reported with appropriate data qualifiers (refer to Section 12).

Note: Instruments are calibrated initially and as needed after that and at least annually.

20.4.1 CALIBRATION STANDARDS

Calibration standards are prepared using the procedures indicated in the Reagents and

Standards section of the determinative method SOP.

Standards for instrument calibration are obtained from a variety of sources. All standards are traceable to national or international standards of measurement, or to national or international standard reference materials.

The lowest concentration calibration standard that is analyzed during an initial calibration must be at or below the stated reporting limit for the method based on the final volume of extract (or sample).

The other concentrations define the working range of the instrument/method or correspond to the expected range of concentrations found in actual samples that are also within the working range of the instrument/method. Results of samples not bracketed by initial instrument calibration standards (within calibration range to 3 significant figures) must be reported as having less certainty, e.g., defined qualifiers or flags (additional information may be included in the case narrative). The exception to these rules is ICP methods or other methods where the referenced method does not specify two or more standards.

All initial calibrations are verified with a standard obtained from a second source and traceable to a national standard, when available (or vendor certified different lot if a second source is not available). For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst at a different time or a different preparation would be considered a second source. This verification occurs immediately after the calibration curve has been analyzed, and before the analysis of any samples.

20.4.1.1 Calibration Verification

The calibration relationship established during the initial calibration must be verified initially and at least daily as specified in the laboratory method SOPs in accordance with the referenced analytical methods and NELAC (2003) standard, Section 5.5.5.10. The process of calibration verification applies to both external standard and internal standard calibration techniques, as well as to linear and non-linear calibration models. Initial calibration is with a standard source secondary (second source standard) to the calibration standards, but continuing calibration verifications may use the same source standards as the calibration curve.

Note: The process of calibration verification referred to here is fundamentally different from the approach called "calibration" in some methods. As described in those methods, the calibration factors or response factors calculated during calibration are used to update the calibration factors or response factors used for sample quantitation. This approach, while employed in other EPA programs, amounts to a daily single-point calibration

All target analytes and surrogates, including those reported as non-detects, must be included in periodic calibration verifications for purposes of retention time confirmation and to demonstrate that calibration verification criteria are being met, i. e., RPD, per NELAC (2003) Standard, Section 5.5.5.10.

All samples must be bracketed by periodic analyses of standards that meet the QC acceptance criteria (e.g., calibration and retention time). The frequency is found in the determinative methods or SOPs.

Note: If an internal standard calibration is being used (basically GCMS) then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

Generally, the initial calibrations must be verified at the beginning of each 12-hour analytical shift during which samples are analyzed. (Some methods may specify more or less frequent verifications). The 12-hour analytical shift begins with the injection of the calibration verification standard (or the MS tuning standard in MS methods). The shift ends after the completion of the analysis of the last sample, QC, or standard that can be injected within 12 hours of the beginning of the shift.

A continuing instrument calibration verification (CCV) must be repeated at the beginning and, for methods that have quantitation by external calibration models, at the end of each analytical batch. Some methods have more frequent CCV requirements see specific SOPs. Most Inorganic methods require the CCV to be analyzed after ever 10 samples or injections, including matrix or batch QC samples.

Note: If an internal standard calibration is being used (basically GCMS) then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

20.4.1.2 Verification of Linear and Non-Linear Calibrations

Calibration verification for calibrations involves the calculation of the percent drift or the percent difference of the instrument response between the initial calibration and each subsequent analysis of the verification standard. (These calculations are available in the laboratory method SOPs. Verification standards are evaluated based on the % Difference from the average CF or RF of the initial calibration or based on % Drift or % Recovery if a linear or quadratic curve is used.

Regardless of whether a linear or non-linear calibration model is used, if initial verification criterion is not met, then no sample analyses may take place until the calibration has been verified or a new initial calibration is performed that meets the specifications listed in the method SOPs. If the calibration cannot be verified after the analysis of a single verification standard, then adjust the instrument operating conditions and/or perform instrument maintenance, and analyze another aliquot of the verification standard. If the calibration cannot be verified with the second standard, then a new initial calibration is performed.

- When the acceptance criteria for the calibration verification are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported. Otherwise, the samples affected by the unacceptable calibration verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted.

- When the acceptance criteria for the calibration verification are exceeded low, i.e., low bias, those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise, the samples affected by the unacceptable verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted. Alternatively, a reporting limit standard may be analyzed to demonstrate that the laboratory can still support non-detects at their reporting limit.

20.5 TENTATIVELY IDENTIFIED COMPOUNDS (TICS) – GC/MS ANALYSIS

For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by the purpose of the analyses being conducted. Data system library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other.

Note: If the TIC compound is not part of the client target analyte list but is calibrated by the laboratory and is both qualitatively and/or quantitatively identifiable, it should not be reported as a TIC. If the compound is reported on the same form as true TICs, it should be qualified and/or narrated that the reported compound is qualitatively and quantitatively (if verification in control) reported compared to a known standard that is in control (where applicable).

For example, the RCRA permit or waste delisting requirements may require the reporting of non-target analytes. Only after visual comparison of sample spectra with the nearest library searches may the analyst assign a tentative identification.

20.6 GC/MS TUNING

Prior to any GCMS analytical sequence, including calibration, the instrument parameters for the tune and subsequent sample analyses within that sequence must be set.

Prior to tuning/auto-tuning the mass spec, the parameters may be adjusted within the specifications set by the manufacturer or the analytical method. These generally don't need any adjustment but it may be required based on the current instrument performance. If the tune verification does not pass it may be necessary to clean the source or perform additional maintenance. Any maintenance is documented in the maintenance log.

Table 20-1. Instrumentation List

Instrument Type	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Automated Distillation Apparatus	Westco	Easy Dist	1090	2002	NEW
Automated Distillation Apparatus	Westco	Easy Dist	1091	2002	NEW
COD	HACH	UNKNOWN	11000022452	UNKNOWN	UNKNOWN
CVAA	Leeman (CV3)	HydraAA112-0064-1	2031	2003	NEW
CVAA	Leeman (CV4)	HydraAA112-0064-1	8015	2008	NEW
GC/ECD/ECD	Agilent (7424)	6890	US10332093	2003	NEW
GC/ECD/ECD	Hewlett-Packard (2620)	5890II	3203A41056	1998	UNKNOWN
GC/ECD/ECD	Agilent (3283)	6890II	US10202136	2008	NEW
GC/ECD/ECD	Hewlett-Packard (2618)	5890II	3203A41055	1987	UNKNOWN
GC/ECD/ECD	Hewlett-Packard (2624)	5890II	3203A41057	1998	UNKNOWN
GC/ECD/ECD	Agilent (7227)	6890II	CN10602095	2006	NEW

Instrument Type	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
GC/ECD/ECD	Agilent (0825)	6890II	US10202136	2002	NEW
GC/ECD/ECD	Agilent (5253)	6890N	CN10723008	2007	NEW
GC/ECD/ECD	Agilent (0911)	6890II	US10230082	2002	NEW
GC/ECD/ECD	Agilent (5005)	6890II	CN10615005	2009	USED
GC/FID/ECD	Hewlett-Packard (Screen)	5890	GC 2415A01109	UNKNOWN	UNKNOWN
GC/FID/FID	Hewlett-Packard (3328)	5890A	333A58806	2008	USED
GC/FID/FID	Hewlett-Packard (3012)	5890II	3235A45259	1984	UNKNOWN
GC/FID/FID/TCD	Varian (CP3800)	3800	S/N 10328	2003	NEW
GC/FID/TCD	Varian (VR3600)	3600	1467	1998	UNKNOWN
GC/FPD/FPD	Hewlett-Packard (2860)	5890	2950A27078	1990	UNKNOWN
GC/FPD/FPD	Hewlett-Packard (2622)	5890II	3203A41058	1987	UNKNOWN
GC/MS	Hewlett-Packard (N)	5890II / 5971	418803507	1998	NEW
GC/MS	Hewlett Packard (V)	5890 / 5971	3549A03239	1998	NEW
GC/MS	Agilent (B)	6890 / 5973	US30965342	2003	NEW
GC/MS	Agilent (C)	6890 / 5973	US41720738	UNKNOWN	NEW
GC/MS	Agilent (G)	6890 / 5973	US43110515	UNKNOWN	USED
GC/MS	Agilent (E)	6890 / 5973	US44621242	2005	NEW
GC/MS	Agilent (F)	6890 / 5973	US52420622	2005	NEW
GC/MS	Hewlett-Packard (L)	5890II / 5971	3188A03410	1998	NEW
GC/MS	Hewlett-Packard (M)	5890II / 5971	3188A03486	1998	NEW
GC/MS	Agilent (D)	6890N / 5973	US43120962	2004	NEW
GC/MS	Hewlett-Packard (P)	5890II / 5971	3188A03495	1992	USED
GC/MS	Hewlett-Packard (Q)	5890II / 5971	3188A03498	1992	NEW
GC/MS	Hewlett-Packard (R)	5890II / 5971	3188A03506	1992	NEW
GC/MS	Hewlett-Packard (U)	5890II / 5972	3549A03238	1997	NEW
GC/MS	Agilent (H)	6890 / 5973	US+0532425	2006	NEW
GC/MS	Agilent (Z)	6890 / 5973	US02440321	2000	NEW
GC/MS	Agilent (J)	6890 / 5973	US41720746	2009	USED
GPC	ABC	1000	9137SI	UNKNOWN	UNKNOWN
GPC	J2 Scientific (I)	Autoinject 110	02D-1030-2.1	2002	NEW
GPC	J2 Scientific (H)	Autoinject 110	02D-1031-2.1	2001	NEW
GPC	J2 Scientific (J)	AccuPrep	03G1076-3.0	2003	NEW
GPC	J2 Scientific (K)	Autoinject 110	02A-102.3-2.1	2007	USED
HPLC/UV	Dionex (1488)	P680	1680407	1991	UNKNOWN
HPLC/UV/PDA	Waters (1208)	600	600-4790RP	1988	NEW
Hydrogen Generator	Parker Hannafin	H2-800	h2-800081C	2006	NEW
Hydrogen Generator	Parker Hannafin	H2-800	h2-800099C	2006	NEW
IC	Dionex (LC2723)	ICS 2000-ICAS40	4100753	2005	UNKNOWN
ICP-MS	Thermo Elemental (2)	X7	X0288	2003	NEW
ICP-OES	Thermo Electron Corp (7)	iCAP 6000	ICP20063302	2006	NEW
LC/MS/MS	Waters (1111)	Acquity/Quattro micro	QAA929	2005	NEW
LC/MS/MS	Waters (3062)	616	MX5NM6829M	UNKNOWN	NEW

Instrument Type	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
pH Meter	Beckman	45	166928	1991	UNKNOWN
Soxtherm	Gerhardt (SOXA)	4012396	35172	UNKNOWN	UNKNOWN
Soxtherm	Gerhardt (SOXB)	4022047	35171	UNKNOWN	UNKNOWN
Soxtherm	Gerhardt (SOXC)	4022046	35169	UNKNOWN	UNKNOWN
Soxtherm	Gerhardt (SOXD)	4022045	35170	UNKNOWN	UNKNOWN
TKN Digestion System	Tecator	1015	UNKNOWN	1991	UNKNOWN
TOC	Carlo Erba	EA-1108	220465	1991	UNKNOWN
TOC	Costech	4010	231009973	2005	UNKNOWN
TOC	Shimadzu	TOC-5000A	37401209A	1997	UNKNOWN
Turbidimeter	HF Scientific	Micro 100	208463	2001	UNKNOWN
UV/VIS	Genesys	Spectronic 20	35GB029021	1999	UNKNOWN

Table 20-2. Schedule of Routine Maintenance

Instrument	Procedure	Frequency
Leeman Mercury Analyzer	Check Peristaltic Pump tubing Lubricate Autosampler rods Clean Autosampler Check and fill Rinse Vessel Check and fill Stannous Chloride Check Waste Vessel Empty Waste Vessel	As required Monthly Weekly As required As required Daily As required
ICP	Check Peristaltic Pump tubing Clean Torch Replace Torch Check and fill Rinse Vessel Check and fill IS Vessel Fill Standards Cup Check Waste Vessel Empty Waste Vessel Check and clean Cones Perform Auto Peak Adjustment	As required Daily As required As required As required Daily Daily As required As required As required
ICP MS	Check Peristaltic Pump tubing Clean Torch Check and fill Rinse Vessel Check and fill IS Vessel Fill standards cup Check Waste Vessel Empty Waste Vessel Check and clean Cones	As required As required As required As required Daily Daily As required As required
UV-Vis Spectrophotometer	Clean ambient flow cell Wavelength verification check Clean Cuvette with Cuvette Cleaning Solution	As required As required As required
Hewlett Packard GC/MS (VOA)	Clean Injection Port and Liner Change Septa Cut 2-3 inches from GC Column Fill Autosampler rinse vials Clean Purge and Trap mount and purge vessel Check Purge Flow	As required As required As required As required As required As required
Hewlett Packard GC/MS (SVOA)	Clean Injection Port and Liner Change Septa Replace or clip Guard Column Replace or clip Analytical Column Fill Autosampler rinse vials	Daily Daily Daily Daily Daily
Hewlett Packard GC/MS (Air)	Check GC / Entech Column Interface Check Nitrogen Tank Volume Check Nitrogen Valves Software and Valves Cut 2-3 inches from GC Column	As required As required As required As required
Gas Chromatograph	Replace Septa Clean and replace Injection Port Liner Replace or clip Guard Column Replace or clip Analytical Column Bake, Re-foil, Refurbish Detector	As required As required As required As required As required

Instrument	Procedure	Frequency
Zero Air Generator	Change pre-filter cartridge Replace catalyst module Check Indicator Beads in Moisture Filters Bake and Refill Mol Sieve Dry Rite Beads	Annually Indicator Light Blinks Daily As required
Hydrogen Generator	Fill Water Reservoir Replace Water in Water Reservoir Replace Ionic Bags in Water Reservoir	Daily Semi-Annually Semi-Annually
HPLC	Change Transfer Lines Replace Guard Column Replace Analytical Column Replace or clean Pump Head Check Valves Change Plunger Seals Change Suppressor Change Eluent Generator Cartridge and CR-ATC	As required As required As required As required As required As required As required
LC/MS/MS	Replace Guard Column Replace Analytical Column Replace or clean Pump Head Check Valves Change Plunger Seals Change In Line Filter Clean or Change Sample Cone Clean Source	As required As required As required As required As required As required As required
Balances	Class “1” traceable weight check Clean pan and check if level Field service	Daily, when used Daily Annually
Latchet	Change Tubing Replace Bulb	As required As required
Conductivity Meter	Calibrate	Daily
Turbidimeter	Calibrate Check light bulb	As required Daily, when used
Drying Ovens	Temperature monitoring Temperature adjustments	Daily As required
Refrigerators/ Freezers	Temperature monitoring Temperature adjustment Defrosting/cleaning	Daily As required As required
pH/Specific Ion Meter	Calibrate Clean electrode	Daily As required
Centrifuge	Check brushes and bearings	Every 6 months or as needed
Water baths	Temperature monitoring Water replaced	Daily, when used Monthly or as needed

SECTION 21. MEASUREMENT TRACEABILITY (NELAC 5.5.6)

21.1 OVERVIEW

Traceability of measurements shall be assured using a system of documentation, calibration, and analysis of reference standards. Laboratory equipment that are peripheral to analysis and whose calibration is not necessarily documented in a test method analysis or by analysis of a reference standard shall be subject to ongoing certifications of accuracy. At a minimum, these must include procedures for checking specifications of ancillary equipment: balances, thermometers, temperature, Deionized (DI) and Reverse Osmosis (RO) water systems, automatic pipettes and other volumetric measuring devices. (Refer to Section 20.3). With the exception of Class A Glassware (including glass microliter syringes that have a certificate of accuracy), quarterly accuracy checks are performed for all mechanical volumetric devices. Wherever possible, subsidiary or peripheral equipment is checked against standard equipment or standards that are traceable to national or international standards. Class A Glassware should be routinely inspected for chips, acid etching or deformity. If the Class A glassware is suspect, the accuracy of the glassware will be assessed prior to use.

21.2 NIST-TRACEABLE WEIGHTS AND THERMOMETERS

Reference standards of measurement shall be used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

For NIST-traceable weights the laboratory requires that all calibrations be conducted by a calibration laboratory accredited by A2LA, NVLAP (National Voluntary Laboratory Accreditation Program), APLAC (Asia-Pacific Laboratory Accreditation Cooperation), or EA (European Cooperation for Accreditation). A certificate and scope of accreditation is kept on file at the laboratory.

An external certified service engineer services laboratory balances on an annual basis. This service is documented on each balance with a signed and dated certification sticker. Balance calibrations are checked each day of use. All mercury thermometers are calibrated annually against a traceable reference thermometer. Temperature readings of ovens, refrigerators, and incubators are checked on each day of use.

21.3 REFERENCE STANDARDS / MATERIALS

Reference standards/materials, where commercially available, are traceable to certified reference materials. Commercially prepared standard materials are purchased from vendors accredited by A2LA or NVLAP with an accompanying Certificate of Analysis that documents the standard purity. If a standard cannot be purchased from a vendor that supplies a Certificate of Analysis, the purity of the standard is documented by analysis. The receipt of all reference standards must be documented. Reference standards are labeled with a unique Standard Identification Number and expiration date. All documentation received with the reference standard is retained as a QC record and references the Standard Identification Number.

All reference, primary and working standards/materials, whether commercially purchased or laboratory prepared, must be checked regularly to ensure that the variability of the standard or material from the 'true' value does not exceed method requirements. The accuracy of calibration standards is checked by comparison with a standard from a second source. In cases where a second standard manufacturer is not available, a vendor certified different lot is acceptable for use as a second source. For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst would be considered a second source. The appropriate Quality Control (QC) criteria for specific standards are defined in laboratory SOPs. In most cases, the analysis of an Initial Calibration Verification (ICV) or LCS (where there is no sample preparation) is used as the second source confirmation. These checks are generally performed as an integral part of the analysis method (e.g. calibration checks, laboratory control samples).

All standards and materials must be stored and handled according to method or manufacturer's requirements in order to prevent contamination or deterioration. Refer to the Corporate Environmental Health & Safety Manual or laboratory SOPs. For safety requirements, please refer to method SOPs and the laboratory Environmental Health and Safety Manual.

21.4 DOCUMENTATION AND LABELING OF STANDARDS, REAGENTS, AND REFERENCE MATERIALS

Reagents must be at a minimum the purity required in the test method. The date of reagent receipt and the expiration date are documented. The lots for most of the common solvents and acids are tested for acceptability prior to company wide purchase. [Refer to TestAmerica's Corporate SOP (CA-Q-S-001), Solvent and Acid Lot Testing and Approval.]

All manufacturer or vendor supplied Certificate of Analysis or Purity must be retained, stored appropriately, and readily available for use and inspection. These records are maintained in each laboratory section and in the LIMS. Records must be kept of the date of receipt and date of expiration of standards, reagents and reference materials. In addition, records of preparation of laboratory standards, reagents, and reference materials must be retained, stored appropriately, and be readily available for use and inspection. For detailed information on documentation and labeling, please refer to method specific SOPs.

Commercial materials purchased for preparation of calibration solutions, spike solutions, etc.., are usually accompanied with an assay certificate or the purity is noted on the label. If the assay purity is 96% or better, the weight provided by the vendor may be used without correction. If the assay purity is less than 96% a correction will be made to concentrations applied to solutions prepared from the stock commercial material.

21.4.1 All standards, reagents, and reference materials must be labeled in an unambiguous manner. Standards are logged into the laboratory's LIMS system, and are assigned a unique identification number. The following information is typically recorded in the electronic database within the LIMS.

- Standard ID
- Description of Standard
- Department
- Preparer's name
- Final volume and number of vials prepared

- Solvent type and lot number
- Preparation Date
- Expiration Date
- Standard source type (stock or daughter)
- Standard type (spike, surrogate, other)
- Parent standard ID (if applicable)
- Parent Standard Analyte Concentration (if applicable)
- Parent Standard Amount used (if applicable)
- Component Analytes
- Final concentration of each analyte
- Comment box (text field)

Records are maintained electronically for standard and reference material preparation. These records show the traceability to purchased stocks or neat compounds. These records also include method of preparation, date of preparation, expiration date and preparer's name or initials. Preparation procedures are provided in the Method SOPs.

21.4.2 All standards, reagents, and reference materials must be clearly labeled with a minimum of the following information:

- Expiration Date (include prep date for reagents)
- LIMS Standard ID
- Special Health/Safety warnings if applicable

21.4.3 In addition, the following information may be helpful:

- Date of receipt for commercially purchased items or date of preparation for laboratory prepared items
- Date opened (for multi-use containers, if applicable)
- Description of standard (if different from manufacturer's label or if standard was prepared in the laboratory)
- Concentration (if applicable)
- Initials of analyst preparing standard or opening container

All containers of prepared reagents must include a preparation date, expiration date and an ID number to trace back to preparation.

Procedures for preparation of reagents can be found in the Method SOPs.

Standard ID numbers must be traceable through associated logbooks, worksheets and raw data.

All reagents and standards must be stored in accordance to the following priority: 1) with the manufacturer's recommendations; 2) with requirements in the specific analytical methods as specified in the laboratory SOP.

SECTION 22. SAMPLING (NELAC 5.5.7)

22.1 OVERVIEW

The laboratory does not provide sampling services. The laboratory's responsibility in the sample collection process lies in supplying the sampler with the necessary coolers, reagent water, sample containers, preservatives, sample labels, custody seals, COC forms, ice, and packing materials required to properly preserve, pack, and ship samples to the laboratory

22.2 SAMPLING CONTAINERS

The laboratory offers clean sampling containers for use by clients. These containers are obtained from reputable container manufacturers and meet EPA specifications as required. Any certificates of cleanliness that are provided by the supplier are maintained at the laboratory.

22.2.1 Preservatives

Upon request, preservatives are provided to the client in pre-cleaned sampling containers. In some cases containers may be purchased pre-preserved from the container supplier. Whether prepared by the laboratory or bought pre-preserved, the grades of the preservatives are at a minimum:

- Hydrochloric Acid – Reagent ACS (Certified VOA Free) or equivalent
- Methanol – Purge and Trap grade
- Nitric Acid – Instra-Analyzed or equivalent
- Sodium Bisulfate – ACS Grade or equivalent
- Sodium Hydroxide – Instra-Analyzed or equivalent
- Sulfuric Acid – Instra-Analyzed or equivalent
- Sodium Thiosulfate – ACS Grade or equivalent

22.3 DEFINITION OF HOLDING TIME

The date and time of sampling documented on the COC form establishes the day and time zero. As a general rule, when the maximum allowable holding time is expressed in "days" (e.g., 14 days, 28 days), the holding time is based on calendar day measured. Holding times expressed in "hours" (e.g., 6 hours, 24 hours, etc.) are measured from date and time zero. The first day of holding time ends twenty-four hours after sampling or verified time of sample receipt.

22.4 SAMPLING CONTAINERS, PRESERVATION REQUIREMENTS, HOLDING TIMES

The preservation and holding time criteria specified in the laboratory SOPs are derived from the source documents for the methods. If method required holding times or preservation requirements are not met, the reports will be qualified using a flag, footnote or case narrative. As soon as possible or "ASAP" is an EPA designation for tests for which rapid analysis is advised, but for which neither EPA nor the laboratory have a basis for a holding time.

22.5 SAMPLE ALIQUOTS / SUBSAMPLING

Taking a representative sub-sample from a container is necessary to ensure that the analytical results are representative of the sample collected in the field. The size of the sample container, the quantity of sample fitted within the container, and the homogeneity of the sample need consideration when sub-sampling for sample preparation. It is the laboratory's responsibility to take a representative subsample or aliquot of the sample provided for analysis.

Analysts should handle each sample as if it is potentially dangerous. At a minimum, safety glasses, gloves, and lab coats must be worn when preparing aliquots for analysis.

Guidelines on taking sample aliquots & subsampling are located SOP BR-QA-020.

SECTION 23. HANDLING OF SAMPLES (NELAC 5.5.8)

Sample management procedures at the laboratory ensure that sample integrity and custody are maintained and documented from sampling/receipt through disposal.

23.1 CHAIN OF CUSTODY (COC)

The COC form is the written documented history of any sample and is initiated when bottles are sent to the field, or at the time of sampling. This form is completed by the sampling personnel and accompanies the samples to the laboratory where it is received and stored under the laboratory's custody. The purpose of the COC form is to provide a legal written record of the handling of samples from the time of collection until they are received at the laboratory. It also serves as the primary written request for analyses from the client to the laboratory. The COC form acts as a purchase order for analytical services when no other contractual agreement is in effect. An example of a COC form may be found in Figure 23-1.

23.1.1 Field Documentation

The minimum information the sampler needs to provide at the time of sampling on the container label is:

- Sample identification
- Date and time
- Preservative

During the sampling process, the COC form is completed and must be legible (see Figure 23-1). This form includes information such as:

- Client name, address, phone number and fax number (if available)
- Project name and/or number
- The sample identification
- Date, time and location of sampling
- Sample collectors name
- The matrix description
- The container description
- The total number of each type of container
- Preservatives used
- Analysis requested
- Requested turnaround time (TAT)
- Any special instructions
- Purchase Order number or billing information (e.g. quote number) if available
- The date and time that each person received or relinquished the sample(s), including their signed name.

The samples are stored in a cooler with ice, as applicable, and remain solely in the possession of the client's field technician until the samples are delivered to the laboratory. The sample collector must assure that each container is in his/her physical possession or in his/her view at all times, or stored in such a place and manner to preclude tampering. The field technician relinquishes the samples in writing on the COC form to the sample control personnel at the laboratory or to a TestAmerica courier. Samples are only considered to be received by lab when personnel at the laboratory have physical contact with the samples.

Note: Independent couriers are not required to sign the COC form. The COC is usually kept in the sealed sample cooler. The receipt from the courier is stored in log-in by date; it lists all receipts each date.

23.1.2 Legal / Evidentiary Chain-of-Custody

If samples are identified for legal/evidentiary purposes on the COC, login will complete the custody seal retain the shipping record with the COC, and initiate an internal COC for laboratory use by analysts and a sample disposal record.

23.2 SAMPLE RECEIPT

Samples are received at the laboratory by designated sample receiving personnel and a unique laboratory project identification number is assigned. Each sample container shall be assigned a unique sample identification number that is cross-referenced to the client identification number such that traceability of test samples is unambiguous and documented. Each sample container is affixed with a durable sample identification label. Sample acceptance, receipt, tracking and storage procedures are summarized in the following sections.

Sample receipt procedures are described in laboratory SOP BR-SM-001.

23.2.1 Laboratory Receipt

After samples arrive at the laboratory, sample receiving personnel inspect the coolers and samples. The integrity of each sample is determined by comparing sample labels or tags with the COC and by visual checks of the container for possible damage. Any non-conformance, irregularity, or compromised sample receipt must be documented and brought to the immediate attention of the client. The COC, shipping documents, documentation of any non-conformance, irregularity, or compromised sample receipt, record of client contact, and resulting instructions become part of the project record.

23.2.1.1 Unique Sample Identification

All samples that are processed through the laboratory receive a unique sample identification to ensure that there can be no confusion regarding the identity of such samples at anytime. This system includes identification for all samples, subsamples and subsequent extracts and/or digestates.

The laboratory assigns a unique identification (e.g., Sample ID) code to each sample container received at the laboratory. This Primary ID is made up of the following information (consisting of 4 components):

Example: XXX - 9608 - A - 1

Location ID (3-digit # for your lab) | Login ID | Container Occurrence | Sample Number

The above example states that TestAmerica Burlington Laboratory (Location XXX). Login ID is 9608 (unique to a particular client/job occurrence). The container code indicates it is the first container ("A") of Sample #1.

If the primary container goes through a prep step that creates a "new" container, then the new container is considered secondary and gets another ID. An example of this being a client sample in a 1-Liter amber bottle is sent through a Liquid/Liquid Extraction and an extraction vial is created from this step. The vial would be a SECONDARY container. The secondary ID has 5 components.

Example: XXX - 9608 - A - 1 - A ← Secondary Container Occurrence

Example: 220-9608-A-1-A, would indicate the PRIMARY container listed above that went through a step that created the 1st occurrence of a Secondary container.

With this system, a client sample can literally be tracked throughout the laboratory in every step from receipt to disposal.

23.3 SAMPLE ACCEPTANCE POLICY

The laboratory has a written sample acceptance policy (Figure 23-2) that clearly outlines the circumstances under which samples shall be accepted or rejected. These include:

- a COC filled out completely;
- samples must be properly labeled;
- proper sample containers with adequate volume for the analysis (Sampling Guide) and necessary QC;
- samples must be preserved according to the requirements of the requested analytical method (Sampling Guide);
- sample holding times must be adhered to (Sampling Guide);
- the project manager will be notified if any sample is received in damaged condition.

Data from samples which do not meet these criteria are flagged and the nature of the variation from policy is defined. A copy of the sample acceptance policy is provided to each client prior to shipment of samples.

23.3.1 After inspection and sample acceptance is verified, samples are logged into the LIMS then placed in appropriate refrigerators or storage locations.

23.3.2 Any deviations from these checks that question the suitability of the sample for analysis, or incomplete documentation as to the tests required will be resolved by consultation with the client. If the sample acceptance policy criteria are not met, the laboratory shall either:

- Retain all correspondence and/or records of communications with the client regarding the disposition of rejected samples, or
- Fully document any decision to proceed with sample analysis that does not meet sample acceptance criteria.

23.4 SAMPLE STORAGE

In order to avoid deterioration, contamination or damage to a sample during storage and handling, from the time of receipt until all analyses are complete, samples are stored as per the storage conditions specified for the matrix and test method in laboratory SOPs. In addition, samples to be analyzed for volatile organic parameters are stored in separate refrigerators designated for volatile organic parameters only. Samples are never to be stored with reagents, standards or materials that may create contamination.

To ensure the integrity of the samples during storage, refrigerator blanks are maintained in the volatile sample refrigerators and analyzed at the frequency specified in the laboratory SOP for storage blanks.

Analysts and technicians retrieve the sample container allocated to their analysis from the designated refrigerator and place them on carts, analyze the sample. All unused portions of samples are returned to the secure sample control area where the samples are kept until disposal. Unless otherwise specified for each project, samples are disposed of thirty days after issuance of the data report. Special arrangements may be made to store samples for longer periods of time.

Access to the laboratory is controlled such that sample storage need not be locked at all times unless a project specifically demands it. Samples are accessible to laboratory personnel only. Visitors to the laboratory are prohibited from entering the refrigerator and laboratory areas unless accompanied by an employee of TestAmerica.

23.5 HAZARDOUS SAMPLES AND FOREIGN SOILS

To minimize exposure to personnel and to avoid potential accidents, hazardous and foreign soil samples are stored in an isolated area designated for hazardous waste only.

23.6 SAMPLE SHIPPING

In the event that the laboratory needs to ship samples, the samples are placed in a cooler with appropriate thermal preservation such as dry ice or sufficient wet ice to ensure the samples remain just above freezing and at or below 6.0°C during transit or samples may be shipped frozen or at ambient temperature depending on the preservation requirements of the methodology requested. The samples are carefully surrounded by packing material to avoid breakage (yet maintain appropriate temperature). A trip blank is enclosed for those samples requiring water/solid volatile organic analyses if a trip blank was provided with the sample set received by the client. (see Note). The chain-of-custody form is signed by the sample control technician and attached to the shipping paperwork. Samples are generally shipped overnight express or hand-delivered by a TestAmerica courier to maintain sample integrity. All personnel involved with shipping and receiving samples must be trained to maintain the proper chain-of-custody documentation and to keep the samples intact and on ice. The Environmental, Health and Safety Manual contains additional shipping requirements.

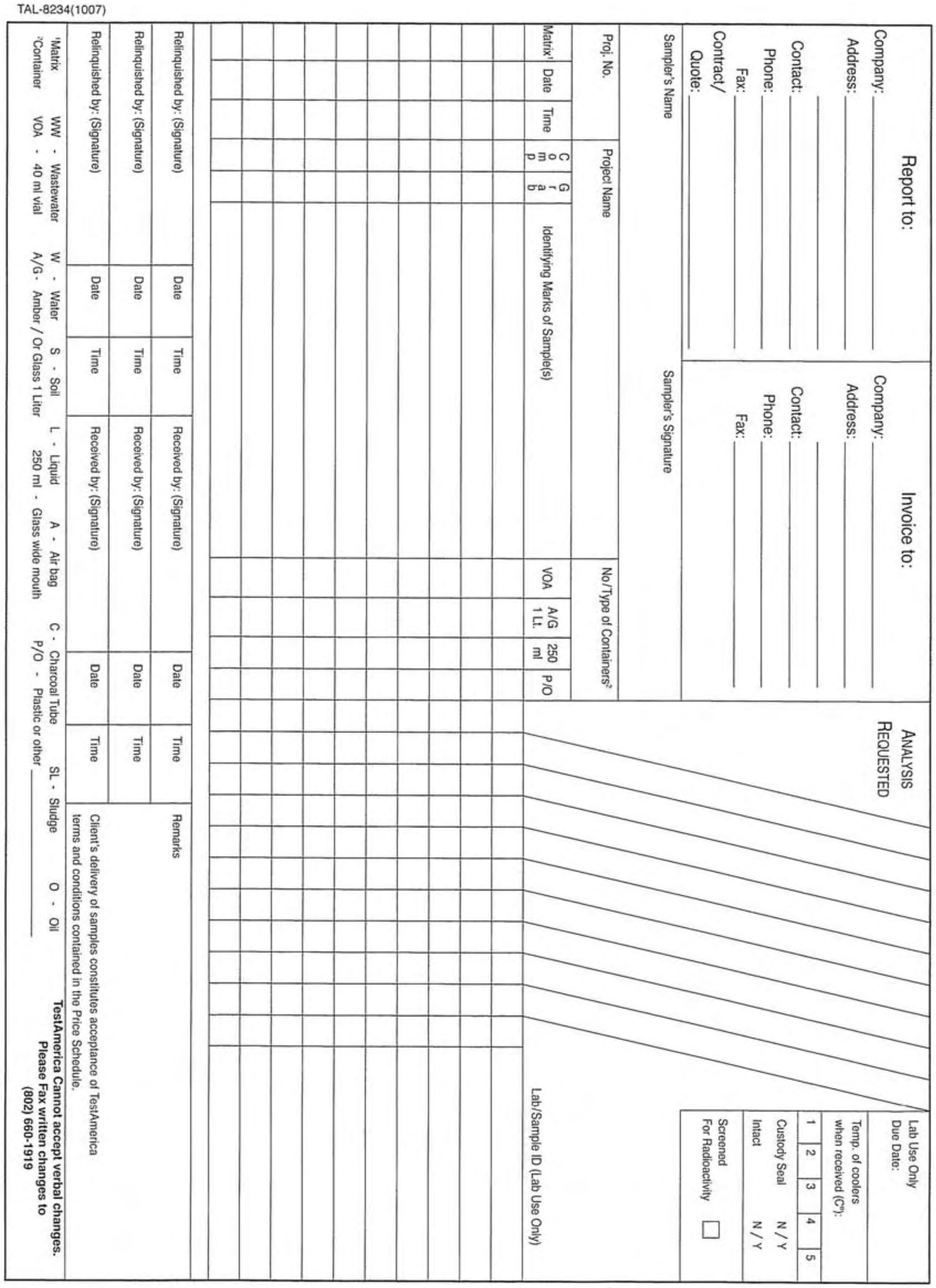
Note: If a client does not request trip blank analysis on the COC or other paperwork, the laboratory will not analyze the trip blanks that were supplied. However, in the interest of good client service, the laboratory will advise the client at the time of sample receipt that it was noted that they did not request analysis of the trip blank; and that the laboratory is providing the notification to verify that they are not inadvertently omitting a key part of regulatory compliance testing.

23.7 SAMPLE DISPOSAL

Samples should be retained for a minimum of 30 days after the project report is sent, however, provisions may be made for earlier disposal of samples once the holding time is exceeded. Some samples are required to be held for longer periods based on regulatory or client requirements (e.g., 60 days after project report is sent). The laboratory must follow the longer sample retention requirements where required by regulation or client agreement. Several possibilities for sample disposal exist: the sample may be consumed completely during analysis, the sample may be returned to the customer or location of sampling for disposal, or the sample may be disposed of in accordance with the laboratory's waste disposal procedures (SOP: BR-EH-001. All procedures in the laboratory Environmental, Health and Safety Manual are followed during disposal. Samples are normally maintained in the laboratory no longer than two months from receipt unless otherwise requested. Unused portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work.

If a sample is part of a known litigation, the affected legal authority, sample data user, and/or submitter of the sample must participate in the decision about the sample's disposal. All documentation and correspondence concerning the disposal decision process must be kept on file. Pertinent information includes the date of disposal, nature of disposal (such as sample depletion, hazardous waste facility disposal, return to client), names of individuals who conducted the arrangements and physically completed the task. When requested, the laboratory will remove or deface sample labels prior to disposal unless this is accomplished through the disposal method (e.g., samples are incinerated).

Figure 23-1. Example: Chain of Custody (COC)



TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Burlington
30 Community Drive, Suite 11
South Burlington, VT 05403 Tel: 802 660 1990

CHAIN OF CUSTODY RECORD

Report to:	Invoice to:	ANALYSIS REQUESTED	Lab Use Only
Company:	Company:		Due Date:
Address:	Address:		Temp. of coolers when received (C°): 1 2 3 4 5
Contact:	Contact:		Custody Seal N / Y
Phone:	Phone:		Intact N / Y
Fax:	Fax:		Screened For Radioactivity ☐
Contract/ Quote:			
Sampler's Name	Sampler's Signature		

Proj. No. | Project Name | No/Type of Containers[2]

Matrix[1]	Date	Time	Comp	Grab	Identifying Marks of Sample(s)	VOA	A/G 1 Lt.	250 ml	P/O											Lab/Sample ID (Lab Use Only)

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Remarks
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Client's delivery of samples constitutes acceptance of TestAmerica terms and conditions contained in the Price Schedule.

[1]Matrix WW - Wastewater W - Water S - Soil L - Liquid A - Air bag C - Charcoal Tube SL - Sludge O - Oil
[2]Container VOA - 40 ml vial A/G - Amber / Or Glass 1 Liter 250 ml - Glass wide mouth P/O - Plastic or other ______

TestAmerica Cannot accept verbal changes. Please Fax written changes to (802) 660-1919

TAL-8234(1007)

Figure 23-2. Example: Sample Acceptance Policy

The receipt of samples is acknowledged on the chain of custody (COC) form with the signature and date/time of the sample custodian. The condition of samples upon receipt is documented on checklists designated for this purpose. Any deficiencies identified during sample receipt are recorded and communicated to the laboratory project manager (PM), who will contact the client and fully document any decision to proceed with analysis in the project record. Consultation with the client should be immediate and timely (next business day or as specified in the project plan). Correspondence records and/or records of conversations concerning the decision to proceed with analysis and/or the disposition of rejected samples is maintained in the project record, and should be maintained in association with the sample receipt checklist. All data associated with samples that did not meet the sample acceptance criteria must be qualified with a Non-Conformance Report (NCR) and/or noted in the project narrative that accompanies the final test report.

Sample receipt is considered deficient when the following conditions are observed:

- Shipping cooler and/or samples are received outside the temperature specification
- Sample bottles are received broken or leaking
- Samples are received beyond holding time
- Samples are received without the appropriate preservation
- Samples are not received in appropriate containers
- Chain of Custody does not match the samples received
- Chain of Custody was not received or is incomplete*
- Custody seals are broken
- Evidence of tampering with the cooler and/or samples
- Headspace in 40mL or 22 mL VOA vials
- Seepage of extraneous water or other material into the samples
- Inadequate sample volume
- Illegible, impermanent ink, or non-unique sample labeling
- One or more coolers missing from a multi parcel shipment
- Shipping container is damaged

**Complete documentation shall include sample identification, the location date/time of collection, collector's name, preservation type, sample type and any special remarks concerning the sample.*

Figure 23-3. Example: Cooler Receipt Form

SAMPLE RECEIPT & LOG IN CHECKLIST

Client:	Date Received:	Log In Date:
ETR:	Time Received:	By:
SDG:	Received By:	Signature:
Project:	# Coolers Received:	PM Signature:
Samples Delivered By: □ Shipping Service □ Courier □ Hand □ Other (specify)		Date:
List Air bill Number(s) or Attach a photocopy of the Air Bill:		

COOLER SCREEN	**YES**	**NO**	**NA**	**COMMENTS**
There is ***no*** evidence to indicate tampering				
Custody seals are present and intact				
Custody seal numbers are present				
If yes, list custody seal numbers:				
Thermal Preservation Type: □ Wet Ice □ Blue Ice □ None □ Other (specify)				

IR Gun ID:	Correction Factor (CF) = °C		
Cooler 1: °C	Cooler 6 °C	Cooler 11 °C	Cooler 16 °C
Cooler 2: °C	Cooler 7 °C	Cooler 12 °C	Cooler 17 °C
Cooler 3: °C	Cooler 8 °C	Cooler 13 °C	Cooler 18 °C
Cooler 4: °C	Cooler 9 °C	Cooler 14 °C	Cooler 19 °C
Cooler 5 °C	Cooler 10 °C	Cooler 15 °C	Cooler 20 °C

Unless otherwise documented, the recorded temperature readings are adjusted readings to account for the CF of the IR Gun

EPA Criteria: 0-6°C, except for air and geo samples which should be at ambient temperature and tissue samples, which may be frozen.

Some clients require thermal preservation criteria of 2-4°C or other such criteria. The PM must notify SM when alternate criteria is specified.

SAMPLE CONDITION	**YES**	**NO**	**NA**	**COMMENTS**
Sample containers were received intact				
Legible sample labels are affixed to each container				
CHAIN OF CUSTODY (COC)	**YES**	**NO**	**NA**	**COMMENTS**
COC is present and includes the following information for each container:				
▪ Sample ID / Sample Description				
▪ Date of Sample Collection				
▪ Time of Sample Collection				
▪ Identification of the Sampler				
▪ Preservation Type				
▪ Requested Tests Method(s)				
▪ Necessary Signatures				
Internal Chain of Custody (ICOC) Required				
If yes to above, ICOC Record initiated for every Worksheet				
SAMPLE INTEGRITY / USABILITY	**YES**	**NO**	**NA**	**COMMENTS**
The sample container matches the COC				
Appropriate sample containers were received for the tests requested				
Samples were received within holding time				
Sufficient amount of sample is provided for requested analyses				
VOA vials do not have headspace or a bubble >6mm (1/4" diameter)				
Appropriate preservatives were used for the tests requested				
pH of inorganic samples checked and is within method specification				
If no, attach Inorganic Sample pH Adjustment Form				
ANOMALY / NCR SUMMARY				

SECTION 24. ASSURING THE QUALITY OF TEST RESULTS (NELAC 5.5.9)

24.1 OVERVIEW

In order to assure our clients of the validity of their data, the laboratory continuously evaluates the quality of the analytical process. The analytical process is controlled not only by instrument calibration as discussed in Section 20, but also by routine process quality control measurements (e.g. Blanks, Laboratory Control Samples (LCS), Matrix Spikes (MS), duplicates (DUP), surrogates, Internal Standards (IS)). These quality control checks are performed as required by the method or regulations to assess precision and accuracy. In addition to the routine process quality control samples, Proficiency Testing (PT) Samples (concentrations unknown to laboratory) are analyzed to help ensure laboratory performance.

24.2 CONTROLS

Sample preparation or pre-treatment is commonly required before analysis. Typical preparation steps include homogenization, grinding, solvent extraction, sonication, acid digestion, distillation, reflux, evaporation, drying and ashing. During these pre-treatment steps, samples are arranged into discreet manageable groups referred to as preparation (prep) batches. Prep batches provide a means to control variability in sample treatment. Control samples are added to each prep batch to monitor method performance and are processed through the entire analytical procedure with investigative/field samples.

24.3 NEGATIVE CONTROLS

Table 24-1. Example – Negative Controls

Control Type	Details
Method Blank (MB)	are used to assess preparation and analysis for possible contamination during the preparation and processing steps.
	The specific frequency of use for method blanks during the analytical sequence is defined in the specific standard operating procedure for each analysis. Generally it is 1 for each batch of samples; not to exceed 20 environmental samples.
	The method blank is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (e.g., Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The method blank goes through all of the steps of the process (including as necessary: filtration, clean-ups, etc.).
Calibration Blanks	are prepared and analyzed along with calibration standards where applicable. They are prepared using the same reagents that are used to prepare the standards. In some analyses the calibration blank may be included in the calibration curve.
Instrument Blanks	are blank reagents or reagent water that may be processed during an analytical sequence in order to assess contamination in the analytical system. In general, instrument blanks are used to differentiate between contamination caused by the analytical system and that caused by the sample handling or sample prep process. Instrument blanks may also be inserted throughout the analytical sequence to minimize the effect of carryover from samples with high analyte content.

Table 24-1. Example – Negative Controls

Control Type	Details
Trip Blank [1]	are required to be submitted by the client with each shipment of samples requiring aqueous and solid volatiles analyses. Additionally, trip blanks may be prepared and analyzed for volatile analysis of air samples, when required by the client. A trip blank may be purchased (certified clean) or is prepared by the laboratory by filling a clean container with pure deionized water that has been purged to remove any volatile compounds. Appropriate preservatives are also added to the container. The trip blank is sent with the bottle order and is intended to reflect the environment that the containers are subjected to throughout shipping and handling and help identify possible sources if contamination is found. The field sampler returns the trip blank in the cooler with the field samples.
Field Blanks [1]	are sometimes used for specific projects by the field samplers. A field blank prepared in the field by filling a clean container with pure reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken. (EPA OSWER)
Equipment Blanks [1]	are also sometimes created in the field for specific projects. An equipment blank is a sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (NELAC)
Holding Blanks	also referred to as refrigerator or freezer blanks, are used to monitor the sample storage units for volatile organic compounds during the storage of VOA samples in the laboratory

[1] When known, these field QC samples should not be selected for matrix QC as it does not provide information on the behavior of the target compounds in the field samples. Usually, the client sample ID will provide information to identify the field blanks with labels such as "FB", "EB", or "TB."

Evaluation criteria and corrective action for these controls are defined in the specific standard operating procedure for each analysis.

24.4 POSITIVE CONTROLS

Control samples (e.g., QC indicators) are analyzed with each batch of samples to evaluate data based upon (1) Method Performance (Laboratory Control Sample (LCS) or Blank Spike (BS)), which entails both the preparation and measurement steps; and (2) Matrix Effects (Matrix Spike (MS) (Matrix spikes are not applicable to air) or Sample Duplicate (MD, DUP), which evaluates field sampling accuracy, precision, representativeness, interferences, and the effect of the matrix on the method performed. Each regulatory program and each method within those programs specify the control samples that are prepared and/or analyzed with a specific batch

Note that frequency of control samples vary with specific regulatory, methodology and project specific criteria. Complete details on method control samples are as listed in each analytical SOP.

24.4.1 Method Performance Control - Laboratory Control Sample (LCS)

The LCS measures the accuracy of the method in a blank matrix and assesses method performance independent of potential field sample matrix affects in a laboratory batch.

The LCS is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (for example: Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The LCS is spiked with verified known amounts of analytes or is made of a material containing known and verified amounts of analytes, taken through all preparation and analysis steps along with the field samples. Where there is no preparation taken for an analysis (such as in aqueous volatiles), or when all samples and standards undergo the same preparation and analysis process (such as Phosphorus), a calibration verification standard is reported as the LCS. In some instances where there is no practical clean solid matrix available, aqueous LCS's may be processed for solid matrices; final results may be calculated as mg/kg or ug/kg, assuming 100% solids and a weight equivalent to the aliquot used for the corresponding field samples, to facilitate comparison with the field samples.

Certified pre-made reference material purchased from a NIST/A2LA accredited vendor may also be used for the LCS when the material represents the sample matrix or the analyte is not easily spiked (e.g. solid matrix LCS for metals, TDS, etc.).

The specific frequency of use for LCS during the analytical sequence is defined in the specific standard operating procedure for each analysis. It is generally 1 for each batch of samples; not to exceed 20 environmental samples.

If the mandated or requested test method, or project requirements, do not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample (and Matrix Spike) where applicable (e.g. no spike of pH). However, in cases where the components interfere with accurate assessment (such as simultaneously spiking chlordane, toxaphene and PCBs in Method 608), the test method has an extremely long list of components or components are incompatible, at a minimum, a representative number of the listed components (see below) shall be used to control the test method. The selected components of each spiking mix shall represent all chemistries, elution patterns and masses, permit specified analytes and other client requested components. However, the laboratory shall ensure that all reported components are used in the spike mixture within a two-year time period.

- For methods that have 1-10 target analytes, spike all components.
- For methods that include 11-20 target analytes, spike at least 10 or 80%, whichever is greater.
- For methods with more than 20 target analytes, spike at least 16 components.
- Exception: Due to analyte incompatibility in pesticides, Toxaphene and Chlordane are only spiked at client request based on specific project needs.
- Exception: Due to analyte incompatibility between the various PCB aroclors, aroclors 1016 and 1260 are used for spiking as they cover the range of all of the aroclors. Specific aroclors may be used by request on a project specific basis.

24.5 SAMPLE MATRIX CONTROLS

Table 24-3. Sample Matrix Control

Control Type	Details	
Matrix Spikes (MS)	Use	used to assess the effect sample matrix of the spiked sample has on the precision and accuracy of the results generated by the method used;
	Typical Frequency [1]	At a minimum, with each matrix-specific batch of samples processed, an MS is carried through the complete analytical procedure. Unless specified by the client, samples used for spiking are randomly selected and rotated between different client projects.If the mandated or requested test method does not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample and Matrix Spike. Refer to the method SOP for complete details
	Description	essentially a sample fortified with a known amount of the test analyte(s).
Surrogate	Use	Measures method performance to sample matrix (organics only).
	Typical Frequency [1]	Are added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. The recovery of the surrogates is compared to the acceptance limits for the specific method. Poor surrogate recovery may indicate a problem with sample composition and shall be reported, with data qualifiers, to the client whose sample produced poor recovery.
	Description	Are similar to matrix spikes except the analytes are compounds with properties that mimic the analyte of interest and are unlikely to be found in environment samples.
Duplicates[2]	Use	For a measure of analytical precision, with each matrix-specific batch of samples processed, a matrix duplicate (MD or DUP) sample, matrix spike duplicate (MSD), or LCS duplicate (LCSD) is carried through the complete analytical procedure.
	Typical Frequency [1]	Duplicate samples are usually analyzed with methods that do not require matrix spike analysis.
	Description	Performed by analyzing two aliquots of the same field sample independently or an additional LCS.
Internal Standards	Use	Are spiked into all environmental and quality control samples (including the initial calibration standards) to monitor the qualitative aspect of organic and some inorganic analytical measurements.
	Typical Frequency [1]	All organic and ICP methods as required by the analytical method.
	Description	Used to correct for matrix effects and to help troubleshoot variability in analytical response and are assessed after data acquisition. Possible sources of poor internal standard response are sample matrix, poor analytical technique or instrument performance.

[1] See the specific analytical SOP for type and frequency of sample matrix control samples.
[2] LCSD's are not performed except when regulatory agencies or client specifications require them. The recoveries for the spiked duplicate samples must meet the same laboratory established recovery limits as the accuracy QC samples. If an LCSD is analyzed both the LCS and LCSD must meet the same recovery criteria and be included in the final report. The precision measurement is reported as "Relative Percent Difference" (RPD). Poor precision between duplicates (except LCS/LCSD) may indicate non-homogeneous matrix or sampling.

24.6 ACCEPTANCE CRITERIA (CONTROL LIMITS)

As mandated by the test method and regulation, each individual analyte in the LCS, MS, or Surrogate Spike is evaluated against the control limits published in the test method. Where there are no established acceptance criteria, the laboratory calculates in-house control limits with the use of control charts or, in some cases, utilizes client project specific control limits. When this occurs, the regulatory or project limits will supersede the laboratory's in-house limits.

Note: For methods, analytes and matrices with very limited data (e.g., unusual matrices not analyzed often), interim limits are established using available data or by analogy to similar methods or matrices.

Once control limits have been established, they are verified, reviewed, and updated as needed. Control limits are established per method (as opposed to per instrument) regardless of the number of instruments utilized.

Laboratory generated % Recovery acceptance (control) limits are generally established by taking $\pm$ 3 Standard Deviations (99% confidence level) from the average recovery of a minimum of 20-30 data points (more points are preferred).

- Regardless of the calculated limit, the limit should be no tighter than the Calibration Verification (ICV/CCV). (Unless the analytical method specifies a tighter limit).

- In-house limits cannot be any wider than those mandated in a regulated analytical method. Client or contract required control limits are evaluated against the laboratory's statistically derived control limits to determine if the data quality objectives (DQOs) can be achieved. If laboratory control limits are not consistent with DQOs, then alternatives must be considered, such as method improvements or use of an alternate analytical method.

- The lowest acceptable recovery limit will be 10% (the analyte must be detectable and identifiable). Exception: The lowest acceptable recovery limit for Benzidine will be 5% and the analyte must be detectable and identifiable.

- The maximum acceptable recovery limit will be 150%.

- The maximum acceptable RPD limit will be 35% for waters and 40% for soils. The minimum RPD limit is 10%.

- If either the high or low end of the control limit changes by $\leq$ 5% from previous, the control chart is visually inspected and, using professional judgment, they may be left unchanged if there is no affect on laboratory ability to meet the existing limits.

24.6.1 The lab must be able to generate a current listing of their control limits and track when the updates are performed. In addition, the laboratory must be able to recreate historical control limits. Procedures for control charts and control limits are described in laboratory SOP BR-QA-013.

24.6.2 A LCS that is within the acceptance criteria establishes that the analytical system is in control and is used to validate the process. Samples that are analyzed with an LCS with recoveries outside of the acceptance limits may be determined as out of control and should be reanalyzed if possible. If reanalysis is not possible, then the results for all affected analytes for samples within the same batch must be qualified when reported. The internal corrective action process (see Section 12) is also initiated if an LCS exceeds the acceptance limits. Sample results may be qualified and reported without reanalysis if:

- The analyte results are below the reporting limit and the LCS is above the upper control limit.

- If the analytical results are above the relevant regulatory limit and the LCS is below the lower control limit.

Or, for NELAC and Department Of Defense (DOD) work, there are an allowable number of Marginal Exceedances (ME):

<11 analytes	0 marginal exceedances are allowed.
11 – 30 Analytes	1 marginal exceedance is allowed
31-50 Analytes	2 marginal exceedances are allowed
51-70 Analytes	3 marginal exceedances are allowed
71-90 Analytes	4 marginal exceedances are allowed
> 90 Analytes	5 marginal exceedances are allowed

- Marginal exceedances are recovery exceedances between 3 SD and 4 SD from the mean recovery limit (NELAC).

- Marginal exceedances must be random. If the same analyte exceeds the LCS control limit repeatedly, it is an indication of a systematic problem. The source of the error must be located and corrective action taken. The laboratory has a system to monitor marginal exceedances to ensure that they are random.

Though marginal exceedences may be allowed, the data must still be qualified to indicate it is outside of the normal limits. If the laboratory allows use of marginal exceedance for a test method, the specification for use will be described in the test method SOP.

24.6.3 If the MS/MSDs do not meet acceptance limits, the MS/MSD and the associated spiked sample is reported with a qualifier for those analytes that do not meet limits. If obvious preparation errors are suspected, or if requested by the client, unacceptable MS/MSDs are reprocessed and reanalyzed to prove matrix interference. A more detailed discussion of acceptance criteria and corrective action can be found in the lab's method SOPs and in Section 12.

24.6.4 If a surrogate standard falls outside the acceptance limits, if there is not obvious chromatographic matrix interference, reanalyze the sample to confirm a possible matrix effect. If the recoveries confirm or there was obvious chromatographic interference, results are reported from the original analysis and a qualifier is added. If the reanalysis meets surrogate recovery criteria, the second run is reported (or both are reported if requested by the client). Under certain circumstances, where all of the samples are from the same location and share similar chromatography, the reanalysis may be performed on a single sample rather than all of the samples and if the surrogate meets the recovery criteria in the reanalysis, all of the affected samples would require reanalysis.

24.7 <u>ADDITIONAL PROCEDURES TO ASSURE QUALITY CONTROL</u>

The laboratory has written and approved method SOPs to assure the accuracy of the test method including calibration (see Section 20), use of certified reference materials (see Section 21) and use of PT samples (see Section 15).

A discussion regarding MDLs, Limit of Detection (LOD) and Limit of Quantitation (LOQ) can be found in Section 19.

- Use of formulae to reduce data is discussed in the method SOPs and in Section 20.
- Selection of appropriate reagents and standards is included in Section 9 and 21.
- A discussion on selectivity of the test is included in Section 5.
- Constant and consistent test conditions are discussed in Section 18.
- The laboratories sample acceptance policy is included in Section 23.

SECTION 25. REPORTING RESULTS (NELAC 5.5.10)

25.1 OVERVIEW

The results of each test are reported accurately, clearly, unambiguously, and objectively in accordance with State and Federal regulations as well as client requirements. Analytical results are issued in a format that is intended to satisfy customer and laboratory accreditation requirements as well as provide the end user with the information needed to properly evaluate the results. Where there is conflict between client requests and laboratory ethics or regulatory requirements, the laboratory's ethical and legal requirements are paramount, and the laboratory will work with the client during project set up to develop an acceptable solution. Refer to Section 7.

A variety of report formats are available to meet specific needs.

In cases where a client asks for simplified reports, there must be a written request from the client. There still must be enough information that would show any analyses that were out of conformance (QC out of limits) and there should be a reference to a full report that is made available to the client. Review of reported data is included in Section 19.

25.2 TEST REPORTS

Analytical results are reported in a format that is satisfactory to the client and meets all requirements of applicable accrediting authorities and agencies. A variety of report formats are available to meet specific needs. The report is printed on laboratory letterhead, reviewed, and signed by the appropriate project manager. At a minimum, the standard laboratory report shall contain the following information:

25.2.1 A report title (e.g. Analytical Report For Samples) with a "sample results" column header.

25.2.2 Each report cover page printed on company letterhead, which includes the laboratory name, address and telephone number.

25.2.3 A unique identification of the report (e.g. work order number) and on each page an identification in order to ensure the page is recognized as part of the report and a clear identification of the end.

Note: Page numbers of report are represented as page # of ##. Where the first number is the page number and the second is the total number of pages.

25.2.4 A copy of the chain of custody (COC).

- Any COCs involved with Subcontracting are included.
- Any additional addenda to the report must be treated in a similar fashion so it is a recognizable part of the report and cannot accidentally get separated from the report (e.g., Sampling information).

25.2.5 The name and address of client and a project name/number, if applicable.

25.2.6 Client project manager or other contact

25.2.7 Description and unambiguous identification of the tested sample(s) including the client identification code.

25.2.8 Date of receipt of sample, date and time of collection, and date(s) of test preparation and performance, and time of preparation or analysis if the required holding time for either activity is less than or equal to 72 hours. For DoD work, the date and time of preparation and analysis are essential information regardless of holding time. Test reports for DoD QSM compliance must include both the data and of sample preparation and analysis.

25.2.9 Date reported or date of revision, if applicable.

25.2.10 Method of analysis including method code (EPA, Standard Methods, etc).

25.2.11 Reporting limit.

25.2.12 Method detection limits (if requested)

25.2.13 Definition of Data qualifiers and reporting acronyms (e.g. ND).

25.2.14 Sample results.

25.2.15 QC data consisting of method blank, surrogate, LCS, and MS/MSD recoveries and control limits.

25.2.16 Condition of samples at receipt including temperature. This may be accomplished in a narrative or by attaching sample login sheets (Refer to Sec. 25.2.4 – Item 3 regarding additional addenda).

25.2.17 A statement expressing the validity of the results, that the source methodology was followed and all results were reviewed for error.

25.2.18 A statement to the effect that the results relate only to the items tested and the sample as received by the laboratory.

25.2.19 A statement that the report shall not be reproduced except in full, without prior express written approval by the laboratory coordinator.

25.2.20 A signature and title of the person(s) accepting responsibility for the content of the report and date of issue. Signatories are appointed by the Lab Director.

25.2.21 When NELAC accreditation is required, the lab shall certify that the test results meet all requirements of NELAC or provide reasons and/or justification if they do not.

25.2.22 The laboratory includes a cover letter.

25.2.23 Where applicable, a narrative to the report that explains the issue(s) and corrective action(s) taken in the event that a specific accreditation or certification requirement was not met.

25.2.24 When soil samples are analyzed, a specific identification as to whether soils are reported on a "wet weight" or "dry weight" basis.

25.2.25 Appropriate laboratory certification number for the state of origin of the sample, if applicable.

25.2.26 If only part of the report is provided to the client (client requests some results before all of it is complete), it must be clearly indicated on the report A complete report must be sent once all of the work has been completed.

25.2.27 Any non-TestAmerica subcontracted analysis results are provided as a separate report on the official letterhead of the subcontractor. All TestAmerica subcontracting is clearly identified on the report as to which laboratory performed a specific analysis.

Note: Refer to the Corporate SOP on Electronic Reporting and Signature Policy (No. CA-I-P-002) for details on internally applying electronic signatures of approval.

25.3 REPORTING LEVEL OR REPORT TYPE

The laboratory routinely offers four levels of quality control reporting.

- Level I is a report with the features described in Section 25.2 above except QC summary information is not included.
- Level II is a Level I report plus QC summary information.
- Level III contains all the information supplied in Level II, but presented on the CLP-like summary forms, and relevant calibration information. No raw data is provided.
- Level IV is the same as Level III with the addition of all raw supporting data.

25.3.1 Electronic Data Deliverables (EDDs)

EDDs are routinely offered as part of TestAmerica's services. TestAmerica Burlington offers a variety of EDD formats including Environmental Restoration Information Management System (ERPIMS), New Agency Standard (NAS), Format A, Excel, Dbase, GISKEY, and Text Files.

EDD specifications are submitted to the IT department by the PM for review and undergo the contract review process. Once the facility has committed to providing data in a specific electronic format, the coding of the format may need to be performed. This coding is documented and validated. The validation of the code is retained by the IT staff coding the EDD.

EDDs shall be subject to a review to ensure their accuracy and completeness. If EDD generation is automated, review may be reduced to periodic screening if the laboratory can demonstrate that it can routinely generate that EDD without errors. Any revisions to the EDD format must be reviewed until it is demonstrated that it can routinely be generated without errors. If the EDD can be reproduced accurately and if all subsequent EDDs can be produced error-free, each EDD does not necessarily require a review.

25.4 SUPPLEMENTAL INFORMATION FOR TEST

The lab identifies any unacceptable QC analyses or any other unusual circumstances or observations such as environmental conditions and any non-standard conditions that may have affected the quality of a result. This is typically in the form of a footnote or a qualifier and/or a narrative explaining the discrepancy in the front of the report.

3.1.1 Numeric results with values outside of the calibration range, either high or low are qualified as ‘estimated’.

3.1.2 Where quality system requirements are not met, a statement of compliance/non-compliance with requirements and/or specifications is required, including identification of test results derived from any sample that did not meet NELAC sample acceptance requirements such as improper container, holding time, or temperature.

3.1.3 Where applicable, a statement on the estimated uncertainty of measurements; information on uncertainty is needed when a client’s instructions so require.

3.1.4 Opinions and Interpretations - The test report contains objective information, and generally does not contain subjective information such as opinions and interpretations. If such information is required by the client, the Laboratory Director will determine if a response can be prepared. If so, the Laboratory Director will designate the appropriate member of the management team to prepare a response. The response will be fully documented, and reviewed by the Laboratory Director, before release to the client. There may be additional fees charged to the client at this time, as this is a non-routine function of the laboratory.

When opinions or interpretations are included in the report, the laboratory provides an explanation as to the basis upon which the opinions and interpretations have been made. Opinions and interpretations are clearly noted as such and where applicable, a comment should be added suggesting that the client verify the opinion or interpretation with their regulator.

25.5 ENVIRONMENTAL TESTING OBTAINED FROM SUBCONTRACTORS

If the laboratory is not able to provide the client the requested analysis, the samples would be subcontracted following the procedures outlined in the Corporate SOP on Subcontracting (SOP # CA-L-S-002).

Data reported from analyses performed by a subcontractor laboratory are clearly identified as such on the analytical report provided to the client. Results from a subcontract laboratory outside of TestAmerica are reported to the client on the subcontract laboratory’s original report stationary and the report includes any accompanying documentation.

25.6 CLIENT CONFIDENTIALITY

In situations involving the transmission of environmental test results by telephone, facsimile or other electronic means, client confidentiality must be maintained.

TestAmerica will not intentionally divulge to any person (other than the Client or any other person designated by the Client in writing) any information regarding the services provided by TestAmerica or any information disclosed to TestAmerica by the Client. Furthermore, information known to be potentially endangering to national security or an entity's proprietary rights will not be released.

Note: This shall not apply to the extent that the information is required to be disclosed by TestAmerica under the compulsion of legal process. TestAmerica will, to the extent feasible, provide reasonable notice to the client before disclosing the information.

Note: Authorized representatives of an accrediting authority are permitted to make copies of any analyses or records relevant to the accreditation process, and copies may be removed from the laboratory for purposes of assessment.

25.6.1 Report deliverable formats are discussed with each new client. If a client requests that reports be faxed or e-mailed, the reports are faxed with a cover sheet or e-mailed with the following note that includes a confidentiality statement similar to the following:

This material is intended only for the use of the individual(s) or entity to whom it is addressed, and may contain information that is privileged and confidential. If you are not the intended recipient, or the employee or agent responsible for delivering this material to the intended recipient, you are hereby notified that any dissemination, distribution or copying of this communication is strictly prohibited. If you have received this communication in error, please notify us immediately by telephone at the 1-800-765-0980 (or for e-mails: please notify us immediately by e-mail or by phone (1-800-765-0980) and delete this material from any computer).

25.7 FORMAT OF REPORTS

The format of reports is designed to accommodate each type of environmental test carried out and to minimize the possibility of misunderstanding or misuse.

25.8 AMENDMENTS TO TEST REPORTS

Corrections, additions, or deletions to reports are only made when justification arises through supplemental documentation. Justification is documented using the laboratory's corrective action system (refer to Section 12).

The revised report is retained as is the original report. The revised report will have the word "revised" or "amended" next to the date rather than the word "reported".

When the report is re-issued, a notation of "report re-issue "is placed on the cover/signature page of the report *or at the top of the narrative page* with a brief explanation of reason for the re-issue and a reference back to the last final report generated. *For Example*: *Report was revised on 11/3/08 to include toluene in sample NQA1504 per client's request. This final report replaces the final report generated on 10/27/08 at 10:47am.*

25.9 POLICIES ON CLIENT REQUESTS FOR AMENDMENTS

25.9.1 Policy on Data Omissions or Reporting Limit Increases

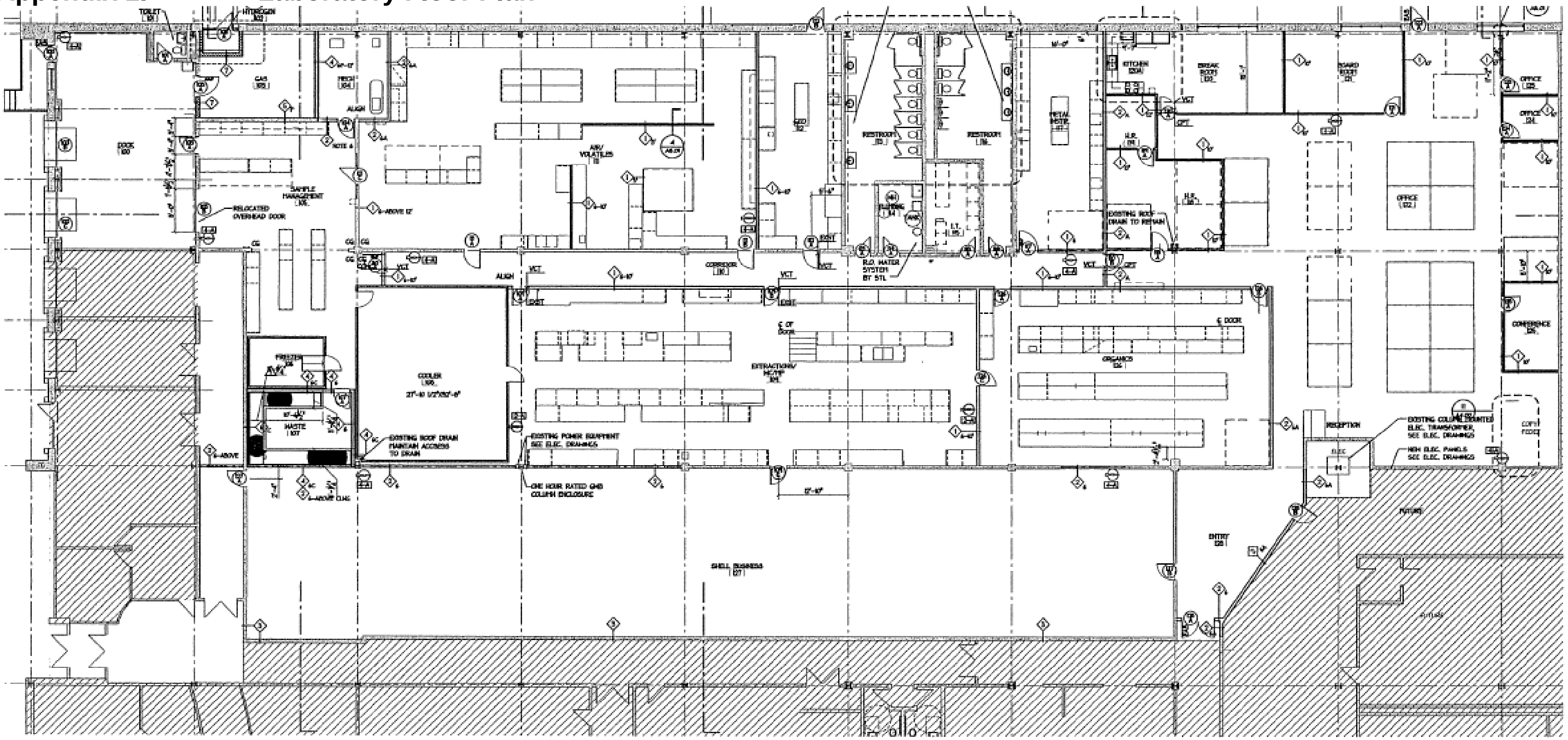
Fundamentally, our policy is simply to not omit previously reported results (including data qualifiers) or to not raise reporting limits and report sample results as ND. This policy has few exceptions. Exceptions are:

- Laboratory error.
- Sample identification is indeterminate (confusion between COC and sample labels).
- An incorrect analysis (not analyte) was requested (e.g., COC lists 8315 but client wanted 8310). A written request for the change is required.
- Incorrect limits reported based on regulatory requirements.
- The requested change has absolutely *no possible* impact on the interpretation of the analytical results and there is *no possibility* of the change being interpreted as misrepresentation by anyone inside or outside of our company.

25.9.2 Multiple Reports

TestAmerica does not issue multiple reports for the same work order where there is different information on each report (this does not refer to copies of the same report) unless required to meet regulatory needs and approved by QA.

Appendix 1. Laboratory Floor Plan



Appendix 2. Glossary/Acronyms

Glossary:

<u>Acceptance Criteria:</u>
Specified limits placed on characteristics of an item, process, or service defined in requirement documents. (ASQC)

<u>Accreditation:</u>
The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory.

<u>Accuracy:</u>
The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (QAMS)

<u>Analyst:</u>
The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality. (NELAC)

<u>Batch:</u>
Environmental samples which are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A preparation batch is composed of one to 20 environmental samples of the same matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An analytical batch is composed of prepared environmental samples (extracts, digestates or concentrates) and /or those samples not requiring preparation, which are analyzed together as a group using the same calibration curve or factor. An analytical batch can include samples originating from various environmental matrices and can exceed 20 samples. (NELAC Quality Systems Committee)

<u>Blank:</u>
A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. (ASQC)

<u>Blind Sample:</u>
A sample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process.

<u>Calibration:</u>
To determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter, instrument, or other device. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements. (NELAC)

<u>Calibration Curve:</u>
The graphical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (NELAC)

<u>Calibration Method:</u>
A defined technical procedure for performing a calibration. (NELAC)

Calibration Standard:
A substance or reference material used to calibrate an instrument (QAMS)

Certified Reference Material (CRM):
A reference material one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation which is issued by a certifying body. (ISO Guide 30–2.2)

Chain of Custody:
An unbroken trail of accountability that ensures the physical security of samples and includes the signatures of all who handle the samples. (NELAC) [5.12.4]

Clean Air Act:
The enabling legislation in 42 U>S>C> 7401 et seq., Public Law 91-604, 84 Stat. 1676 Pub. L. 95-95, 91 Stat., 685 and Pub. L. 95-190, 91 Stat., 1399, as amended, empowering EPA to promulgate air quality standards, monitor and enforce them. (NELAC)

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA/SUPERFUND):
The enabling legislation in 42 U.S.C. 9601-9675 et seq., as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), 42 U.S.C. 9601 et seq., to eliminate the health and environmental threats posed by hazardous waste sites. (NELAC)

Compromised Samples:
Those samples which are improperly sampled, insufficiently documented (chain of custody and other sample records and/or labels), improperly preserved, collected in improper containers, or exceeding holding times when delivered to a laboratory. Under normal conditions, compromised samples are not analyzed. If emergency situation require analysis, the results must be appropriately qualified. (NELAC)

Confidential Business Information (CBI):
Information that an organization designates as having the potential of providing a competitor with inappropriate insight into its management, operation or products. NELAC and its representatives agree to safeguarding identified CBI and to maintain all information identified as such in full confidentiality.

Confirmation:
Verification of the identity of a component through the use of an approach with a different scientific principle from the original method.

Conformance:
An affirmative indication or judgement that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements. (ANSI/ASQC E4-1994)

Correction*:* Actions necessary to correct or repair analysis specific non-conformances. The acceptance criteria for method specific QC and protocols as well as the associated corrective actions. The analyst will most frequently be the one to identify the need for this action as a result of calibration checks and QC sample analysis**.** No significant action is taken to change behavior, process or procedure.

Corrective Action:
The action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO 8402)

Data Audit:
A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data re of acceptable quality (i.e., that they meet specified acceptance criteria). (NELAC)

Data Reduction:
The process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useable form. (EPA-QAD)

Deficiency:
An unauthorized deviation from acceptable procedures or practices, or a defect in an item. (ASQC)

Detection Limit:
The lowest concentration or amount of the target analyte that can be identified, measured, and reported with confidence that the analyte concentration is not a false positive value. See Method Detection Limit. (NELAC)

Document Control:
The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly, and controlled to ensure use of the correct version at the location where the prescribed activity if performed. (ASQC)

Duplicate Analyses:
The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. (EPA-QAD)

Equipment Blank:
Sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (NELAC)

External Standard Calibration:
Calibrations for methods that do not utilize internal standards to compensate for changes in instrument conditions.

Federal Water Pollution Control Act (Clean Water Act, CWA):
The enabling legislation under 33 U.S.C. 1251 et seq., Public Law 92-50086 Stat 816, that empowers EPA to set discharge limitations, write discharge permits, monitor, and bring enforcement action for non-compliance. (NELAC)

Field Blank:
Blank prepared in the field by filing a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken (EPA OSWER)

Holding Times (Maximum Allowable Holding Times):
The maximum times that samples may be held prior to analyses and still be considered valid or not compromised. (40 CFR Part 136)

Internal Standard:
A known amount of standard added to a test portion of a sample and carried through the entire measurement process as a reference for evaluating and controlling the precision and bias of the applied analytical test method. (NELAC)

Internal Standard Calibration:
Calibrations for methods that utilize internal standards to compensate for changes in instrument conditions.

Instrument Blank:
A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. (EPA-QAD)

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample):

A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes, taken through all preparation and analysis steps. Where there is no preparation taken for an analysis (such as in aqueous volatiles), or when all samples and standards undergo the same preparation and analysis process (such as Phosphorus), there is no LCS. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

Laboratory Duplicate:
Aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently. (NELAC)

Least Squares Regression (1^{st} Order Curve):
The least squares regression is a mathematical calculation of a straight line over two axes. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The regression calculation will generate a correlation coefficient (r) that is a measure of the "goodness of fit" of the regression line to the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r must be greater than or equal to 0.99 for organics and 0.995 for inorganics.

Limit of Detection (LOD):
An estimate of the minimum amount of a substance that an analytical process can reliably detect. An LOD is analyte- and matrix-specific and may be laboratory dependent. (Analytical Chemistry, 55, p.2217, December 1983, modified) See also Method Detection Limit.

Matrix:
The component or substrate that contains the analyte of interest.

Matrix Spike (spiked sample or fortified sample):

Prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Matrix Spike Duplicate (spiked sample or fortified sample duplicate):
A second replicate matrix spike is prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.

Method Blank:
A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses. (NELAC)

Method Detection Limit:
The minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40 CFR Part 136, Appendix B)

Negative Control:
Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results. (NELAC)

Positive Control:
Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects. (NELAC)

Precision:
The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. (NELAC)

Preservation:
Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical and/or biological integrity of the sample. (NELAC)

Proficiency Testing:
A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (NELAC) [2.1]

Proficiency Test Sample (PT):
A sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria. (QAMS)

Quality Assurance:
An integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence. (QAMS)

Quality Assurance [Project] Plan (QAPP):
A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. (EAP-QAD)

Quality Control:
The overall system of technical activities which purpose is to measure and control the quality of a product or service so that it meets the needs of users. (QAMS)

Quality Control Sample:
An uncontaminated sample matrix spiked with known amounts of analytes from a source independent from the calibration standards. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system. (EPA-QAD)

Quality Manual:
A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. (NELAC)

Quality System:
A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC (ANSI/ASQC-E-41994)

Quantitation Limits:
The maximum or minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be quantified with the confidence level required by the data user. (NELAC)

Range:
The difference between the minimum and the maximum of a set of values. (EPA-QAD)

Reagent Blank (method reagent blank):
A sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps. (QAMS)

Reference Material:
A material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (ISO Guide 30-2.1)

Reference Standard:
A standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived. (VIM-6.0-8)

Replicate Analyses:
The measurements of the variable of interest performed identically on two or more sub-samples of the same sample within a short time interval. (NELAC)

Report Limit (RL):
The laboratory nominal Quantitation Limit (QL) or the level of sensitivity required by the client but not lower than the LOD.

Resource Conservation and Recovery Act (RCRA):
The enabling legislation under 42 USC 321 et seq. (1976), that gives EPA the authority to control hazardous waste from the “cradle-to-grave”, including its generation, transportation, treatment, storage, and disposal. (NELAC)

Safe Drinking Water Act (SDWA):
The enabling legislation, 42 USC 300f et seq. (1974), (Public Law 93-523), that requires the EPA to protect the quality of drinking water in the U.S. by setting maximum allowable contaminant levels, monitoring, and enforcing violations. (NELAC)

Sample Duplicate:
Two samples taken from and representative of the same population and carried through all steps of the sampling and analytical procedures in an identical manner. Duplicate samples are used to assess variance of the total method including sampling and analysis. (EPA-QAD)

Second Order Polynomial Curve (Quadratic): The 2^{nd} order curves are a mathematical calculation of a slightly curved line over two axis. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The 2^{nd} order regression will generate a coefficient of determination (COD or r^2) that is a measure of the "goodness of fit" of the quadratic curvature the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r^2 must be greater than or equal to 0.99.

Selectivity:
(Analytical chemistry) the capability of a test method or instrument to respond to a target substance of constituent in the presence of non-target substances. (EPA-QAD)

Sensitivity:
The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (NELAC)

Spike:
A known mass of target analyte added to a blank, sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.

Standard Operating Procedures (SOPs):
A written document which details the method of an operation, analysis, or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive tasks. (QAMS)

Standardized Reference Material (SRM):
A certified reference material produced by the U.S. National Institute of Standards and Technology or other equivalent organization and characterized for absolute content, independent of analytical method. (EPA-QAD)

Surrogate:
A substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes.

Systems Audit (also Technical Systems Audit):
A thorough, systematic, qualitative on-site assessment of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system. (EPA-QAD)

Toxic Substances Control Act (TSCA):
The enabling legislation in 15 USC 2601 et seq., (1976) that provides for testing, regulating, and screening all chemicals produced or imported into the United States for possible toxic effects prior to commercial manufacture. (NELAC)

Traceability:
The property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons. (VIM-6.12)

Uncertainty:
A parameter associated with the result of a measurement that characterizes the dispersion of the value that could reasonably be attributed to the measured value.

Acronyms:

BS – Blank Spike
BSD – Blank Spike Duplicate
CAR – Corrective Action Report
CCV – Continuing Calibration Verification
CF – Calibration Factor
CFR – Code of Federal Regulations
COC – Chain of Custody
DOC – Demonstration of Capability
DQO – Data Quality Objectives
DU – Duplicate
DUP - Duplicate
EHS – Environment, Health and Safety
EPA – Environmental Protection Agency
GC - Gas Chromatography
GC/MS - Gas Chromatography/Mass Spectrometry
HPLC - High Performance Liquid Chromatography
ICP - Inductively Coupled Plasma Atomic Emission Spectroscopy
ICV – Initial Calibration Verification
IDL – Instrument Detection Limit
IH – Industrial Hygiene
IS – Internal Standard
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
LIMS – Laboratory Information Management System
MDL – Method Detection Limit
MS – Matrix Spike
MSD – Matrix Spike Duplicate
MSDS - Material Safety Data Sheet
NELAC - National Environmental Laboratory Accreditation Conference
NELAP - National Environmental Laboratory Accreditation Program
PT – Performance Testing
QAM – Quality Assurance Manual
QA/QC – Quality Assurance / Quality Control
QAPP – Quality Assurance Project Plan
RF – Response Factor
RPD – Relative Percent Difference
RSD – Relative Standard Deviation
SD – Standard Deviation
SOP: Standard Operating Procedure
TAT – Turn-Around-Time
VOA – Volatiles
VOC – Volatile Organic

Appendix 3. Laboratory Certifications, Accreditations, Validations

TestAmerica Burlington maintains certifications, accreditations, certifications, and validations with numerous state and national entities. Programs vary but may include on-site audits, reciprocal agreements with another entity, performance testing evaluations, review of the QA Manual, Standard Operating Procedures, Method Detection Limits, training records, etc. Contact the laboratory for the most current information regarding certifications, accreditation and licenses held by the laboratory. As of the effective date of this document, the certifications maintained by the Burlington laboratory are:

Organization	Certificate Number
Connecticut	PH-0751
Delaware	DNREC
Florida	E87467
Maine	VT0008
Minnesota	050-999-436
New Hampshire	200606
New Jersey	VT972
New York	10391
Pennylvania	68-00489
Rhode Island	LAO00298
USDA	S-66352
Vermont	VT-4000

The certificates and parameter lists (which may differ) for each organization may be found on the corporate web site, the laboratory's public server, the final report review table, and in the following offices: QA, marketing, and project management.

APPENDIX K – CONTRACTOR FORMS

Daily Site Report
West Point Military Reservation

CONTRACT NO.:	WORK ORDER NO.	DATE / TIME ON AND OFF SITE

WEATHER/TEMPERATURE: / __________ °F

WORK LOCATION:

PERSONNEL/AFFILIATION (PRINT)	SIGNATURE

SUBCONTRACTOR:	TRADE/SERVICE:
______/	
______/	
______/	
______/	

HEALTH AND SAFETY:

☐ **Daily H&S Brief and Discussion**
- **Prior to work and as needed.**

☐ **UXO Safety Discussion**
- **Prior to work and as needed.**

Discussion Topics:

☐ **Personnel Sign In** ☐ **Review Applicable SOPs** ☐ **Phone/Radio Check** ☐ **Beach Issues** ☐ **Tides** ☐ **First Aid Kit** ☐ **Fire Prevention Equipment** ☐ **Issues / Injuries**

WORK AREA AND EQUIPMENT DOCUMENTATION (Inspection and Condition):

☐ Vehicle Inspection ☐ Survey Equipment Operable ☐ Schonstedt QC Check ☐ Conex Box Insp. ☐ Housekeeping ☐ Other Equipment Inspection / Compliance

Equipment Inspected: ____ ☐ Compliance

____

PPE: ☐ Level D (______________________) Modifications:

Comments:____

WORK COMPLETED:

☐ Surveyor activities (List).	☐ Munitions Constituents Sampling.
☐ Mag and Dig activities (List grids).	☐ UXO Technician Escort activities.
☐ DGM activities (List Grids).	☐ Equipment Transport (mob/demob to/from site-List)
☐ Reacquisition of DGM anomaly targets (List Grids).	☐ Equipment Maintenance
☐ Grid QC (List completed grids).	☐ Equipment Issues (List Below).
☐ Grid QA (CENAB-List completed grids).	☐ ______________________________

Comments:____

MATERIALS DELIVERED (Amount, Condition, and Purpose): None

NONE.

PROBLEMS/RESOLUTIONS:

TRACKING DATA:

Total Number of DGM Grids (List Grids):

____

Total Number of DGM Grids Reacquire (List Grids):

____

Total Number of Mag & Dig Grids Cleared (List Grids):

____

Total Number of Mag & Dig Grids QC (List Grids):

____

Comments:____

____

____

____

FURTHER DISCUSSION (List Topic and Comment):	
PREPARED BY:	**SIGNATURE:**

Daily MEC Report

Date: ____________________________ Contract Number: ______________________________

Delivery Order Number: __________________________ Location: ______________________________________

Weather Conditions: ____

I. Work Summary:

a. Work Planned:

b. Work Accomplished:

c. Explanation of Discrepancy:

d. Inspection Results:

II. Instructions Received from Customer Representative(s):

III. Safety Comments:

IV. UXO Summary

a. UXO Destroyed:

Type	Qty	Disposition

b. Demolition Supplies Used:

Type	Qty	U/I	Disposition

c. Scrap Generation/Disposition:

V. Personnel/Equipment Utilization:

a. Personnel Onsite (e.g., Environmental Engineer, 1st Aid Specialist, Heavy Equipment Operator, Helper, Project Manager, Magnetometer Operator, Senior UXO Specialist, Site Safety Officer, Quality Control Specialist, Surveyor, UXO Tech I, UXO Tech II, UXO Tech III, Unskilled Labor)

Description	Number of Personnel	Man-Hours	Weston/Subcontractor

b. Equipment Utilization (e.g., Backhoe, wheeled; Backhoe, tracked; Car (sedan); Pickup (1/2 ton); Pickup (3/4 ton); Radio, handheld; Sport utility Vehicle; EM-61; Schonstedt; Forrester; Digital Camera; GPS; Remote Firing Device (RFD))

Description	Number of Pieces	Hours

VI. Comments/Concerns:

VII. Signature(s)/Date

Project Manager

Senior UXO Supervisor

PROJECT QUALITY CONTROL/QUALITY ASSURANCE QC/QA CHECKLIST

WORK ORDER NO.: ____________________

CLIENT: ____________________

PROJECT TITLE/ DESCRIPTION: ____________________

LOCATION: ____________________

PROJECT DIRECTOR: ____________________

PROJECT MANAGER: ____________________

CHECKLIST COMPLETED BY: ____________________

DATE COMPLETED: ____________________ **FILE NO.:** ____________________

REVIEWER: ____________________

REVIEWER SIGNATURE AND DATE: ____________________

LEVEL OF QC/QA *(Basic, normal or critical, as defined in Table 1 of Project QC/QA Plan Work Instruction)*:

☐ Basic ☐ Normal ☐ Critical

PROJECT ORGANIZATION AND RESPONSIBILITY *(Name, project role, and responsibility, including supervisory and management personnel and subconsultants)*:

WESTON PROJECT TEAM:

NAME	PROJECT ROLE/RESPONSIBILITY

CLIENT PROJECT TEAM *(Name, project role, and responsibility, including other consultants and contractors working on the project)*:

NAME	PROJECT ROLE

STATEMENT OF PROJECT PURPOSE AND OBJECTIVES: ______________________________

____

WESTON SCOPE *(by project task)*: Complete attached Table A. List specific tasks *(e.g., items in work breakdown structure)*.

QC OBJECTIVES AND PROCEDURES: Complete Table A. For each specific project task, identify the QC objectives *(for examples, see Subsection 5.1.5 of Project QC/QA Plan)* and QC procedures *(for examples, see Subsection 5.1.6 of Project QC/QA Plan)*.

DOCUMENTATION PROCEDURES *(e.g., procedures for documenting verbal instructions, meetings, telephone conversations, and calculations, such as completion of minutes, reports, letters, memoranda; distribution of documentation; filing requirements, etc.)*:

____

DOCUMENT CONTROL *(procedures for the preparation, review, approval, issuance, and revision of documents that prescribe activities, specify requirements, or establish design and deliverable documents)*:

____

QA AUDITS OF COMPLIANCE TO PROJECT QC/QA PLAN *(schedule, auditor, distribution of findings, identification of corrective action, etc.)*:

____

CORRECTIVE ACTION PROCEDURES *(corrective action, person responsible for implementing corrective action, schedule, and person responsible for evaluation of appropriate corrective action and follow-up to verify proper implementation)*:

____

PROJECT QUALITY CONTROL/QUALITY ASSURANCE QC/QA CHECKLIST (continued)

TABLE A

SUMMARY OF QC OBJECTIVES/PROCEDURES BY PROJECT TASK

PROJECT TASK	QC OBJECTIVES*	TASK COMPONENTS	QC PROCEDURES*

* Examples of QC objectives and procedures are summarized in Subsections 5.1.5 and 5.1.6 of Project QC/QA Work Instruction. Table B also contains some examples for typical tasks.

TABLE B

EXAMPLE QC OBJECTIVES/PROCEDURES FOR PROJECT TASKS

PROJECT TASK	QC OBJECTIVES*	TYPICAL TASK COMPONENTS	QC PROCEDURES*
Completion of Sampling and Analysis Summary Report	Comply with Sampling and Analysis Plan (SAP) procedures	Review SAP to determine Scope of Work (number of samples, analytical methods and parameters, etc.) and QC criteria (types and numbers of QC samples, allowable ranges, etc.).	Compare Scope of Work elements in SAP to completed work elements to ensure all required items will have been completed. Document the comparison. Compare results of laboratory QC samples to allowable criteria outlined in laboratory control charts or SAP. Document the comparison.
	Complete Summary Report as required by specifications and contract.	Review specifications and contract to determine requirements for Summary Report. Prepare table of contents. Prepare draft and final reports using approved table of contents (incorporating comments as necessary).	Have peer or PM concur that elements required in a Summary Report are included in the table of contents. Document the concurrence. Have peer or PM review reports. Document comments or concurrence.
Off-Site Disposal of Hazardous Wastes	Comply with specifications and contract. Comply with applicable federal and state regulations.	Review specifications and contract to determine requirements for off-site disposal. Prepare summary of requirements. Review regulations to determine applicable requirements (e.g., manifests, placards, etc.). Prepare summary of requirements. Contact RCRA Hotline for confirmation not clear on requirements.	Have peer or PM review summary of requirements, including regulations, to ensure concurrence. Document review. Distribute approved summary of requirements to project team to ensure clear understanding. Develop checklists for site personnel to ensure requirements are satisfied prior to transport. When completed, distribute checklists, including filing system.

* Examples of QC objectives and procedures are summarized in Subsections 5.1.5 and 5.1.6 of Project QC/QA Work Instruction.

Quality Control/ Quality Assurance Checklist

Date: ____________ Time: ____________ Work Order #: ______________________

Contract #: ______________________ Location: ______________________

Level of QC/QA: Basic _____ Normal _____ Critical _____

Instructions from Clients:

Quality Controlled Items

Requirement	Feature	Identifier	Grid # (If applicable)	Pass/Fail	Comments

IV. Signatures: I acknowledge that I have been briefed on the results of this inspection and will take corrective actions (if necessary).

______________________ Site QC Specialist Officer

______________________ Sr. UXO Supervisor/Project Manager

Examples of Requirement, Feature, and Identifier combinations to be used in the above grid:

Requirement	Feature	Identifier
Brush Removal	Brush removal	Grid #
DGM	Data analysis	Grid #
DGM	Data collection	Grid #
DGM	Equipment check	EM61
DGM	Equipment check	EM61 HH
DGM	Equipment check	EM61 MKII
DGM	Equipment check	G858
Explosives	Receipt	Receipt

Requirement	Feature	Identifier
Explosives	Storage	Storage
Explosives	Transportation	Transportation
Explosives	Use	Use
MEC removal	Subsurface	Grid #
MEC removal	Surface	Grid #
Survey	Boundary	Boundary
Survey	Grid	Grid #
Survey	Reacquisition	Grid #

WESTON SOLUTIONS℠

Safety Inspection Log

Date: ______________ Time: ______________ Work Order #: ____

Contract #: ______________ Location: ____

Weather Conditions: ____

Type of Inspection: Daily ______ Weekly ______ Special ______ Reinspection ______

Location Inspection: (List by grid Number, coordinates, or description) ____

Activity: ____

II. Inspection Requirement	Satisfactory	Unsatisfactory	N/A
Surface Sweep			
Subsurface Sweep			
Evacuation Technique			
Personal Protection Equipment			
Work Practices			
Site Control			
First Aid Equipment			
Fire Fighting Equipment			
Explosives Transportation			
Explosives Storage			
Disposal Operations			

Overall Inspection Results: Satisfactory ______ Unsatisfactory ______

III. Comment ____

____

Work stopped due to safety violation: Yes ______ No ______

Safety violations noted: ____

Corrective Measures: ____

Reinspection required: Yes ______ No ______

IV. Signatures: I acknowledge that I have been briefed on the results of this inspection and will take corrective actions (if necessary).

___________________________________ Site Safety Officer

___________________________________ Sr. UXO Supervisor/Project Manager

Safety Meeting Attendance Log

Date:		Time:		Contract Number:	

Delivery Order Number:		Location:	

Weather Conditions:	

I. Safety Meeting Topics (Briefly describe):	

II. Attendees:	

Name (Print)	Signature	Company

Name (Print)	Signature	Company

III. Verification:

I certify that the personnel listed on this roster received the briefing described above. Site personnel not attending this meeting will be briefed before beginning their assigned duties.

____________________________ ____________________________

Site Safety Officer Date

Site Visitors Log

Contract No. W9133L-09-F-0304 Delivery Order No. ______________________ Location: Ricochet Area, Ft. Indiantown Gap Military Res.

Date Name		Company	Telephone Number	Safety Briefing Received	Time		Escort Required
					In	Out	

Weston Solutions, Inc., 1400 Weston Way, West Chester, PA 19380
(610) 701-3500

Custody Document

Document Number: ______________________ **Date:** ______________________

I certify that the items listed below have been transferred to the United States Army.

Printed Name: ______________________ **Date:** ______________________
Signature: ______________________

Item	Quantity/Description

The United States Army accepts all responsibilityand liability for the above listed items. All items are received in an as is condition with no guarantees provided or implied.

Remarks/Comments: ______________________

Acknowledgement of Receipt/Transfer

Print Name:	**Signature:**	**Date:**
Print Name:	**Signature:**	**Date:**
Print Name:	**Signature:**	**Date:**
Print Name:	**Signature:**	**Date:**
Print Name:	**Signature:**	**Date:**

Schonstedt Daily Check Out and Return Procedure

Month ____________________ Work Site ________________

Serial No. _________________ Project No. _______________

Signature of Operator	Comments	Date		CHECK OUT PROCEDURE	Check case for damage; open case	Check instrument for damage	Open battery compartment	Install batteries	Audio switch in "A" position	Power up; adjust sensitivity control	Set volume control	Verify digital display	Report to test grid	Test grid result; Pass/Fail	RETURN PROCEDURE	Clean instrument	Open battery compartment	Remove and store batteries	Close battery compartment	Return instrument to storage case	Return case to storage area	
		1																				
		2																				
		3																				
		4																				
		5																				
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		29																				
		30																				
		31																				

Heavy Equipment Inspection Log

Month ____________________ Work Site ________________

Serial No. ________________ Project No. ______________

Signature of Operator	Comments	Date	Brakes	Track Condition	First Aid Kit	Oil Level	Water Level	Hydraulic Level	Horn	Back-up Alarm	Exhaust System	Windshield Wipers	Mirrors	Glass/Cab	Fuel Tank/Piping						
		1																			
		2																			
		3																			
		4																			
		5																			
		6																			
		7																			
		8																			
		9																			
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		29																			
		30																			
		31																			

Grid Sweep Log

Project Name/Location: Ft. Indiantown Gap/Ricochet Area

Grid No.: ____________ Size _____ X _____

Date Started: ____________

Date Completed: ____________

Insert Magnetic North Direction

Work Order No.: 12767.099.001

Team No.: ____________

UXO Supervisor: ____________

UXO Supervisor ____________

Total Anomalies	Total Excavations	Anomalies > _____ ft.	Total UXO	Pounds MEC Scrap	Pounds Non-MEC Scrap

UXO	NOMENCLATURE	DEPTH

REFERENCE PT. EACH INCREMENT LINE EQUALS _______ X _______ FT.

ACTION:	DATE	SIGNATURE
Mag Sweep Complete		
Excavation Complete		
Quality Control Complete		
Client Quality Assurance Complete		

REMARKS:

Weston Solutions, Inc

Demolition Material Accountability Form

1. Project Name: ______________________________ 2. Project Location: ____________________________ 3. Deltek No. ____________

4. Explosive Description: ____ 5. Marks and Identification: ____________________________

6. Manufacturer ____ 7. Storage Location: ____________________________________

8. Date Received	9. Quantity In	10. Unit of Issue	11. Quantity Out	12. Balance	13. Date Expended	14. Printed Name and Initials

Demolition Material Accountability Form -- Instructions

1. Project Name - Name assigned project. (For example: Tobyhanna Artillery Ranges).
2. Geographical location. (For example: Tobyhanna, PA).
3. Project Number - Assigned by Weston Corporate office.
4. Explosives Description - Item name (For example: blasting caps, boosters, and detonating cord).
5. Marks and Identification - Identification as specified by the Manufacturer; Lot number for U.S. military explosives.
6. Manufacturer - manufacturer of item and country of origin (For example: Atlas Powder, USA; Govt).
7. Storage Location - Proper name of storage magazine (For example: Igloo J180; Bldg. #18; USACE Bunker #1; Mag 2).
8. Date Received - Date that the transaction occurs.
9. Quantity In - Quantity gained by the transaction; if no quantity is lost, mark column with -0-.
10. Unit of Issue - Unit of measure (For example: each, case, foot).
11. Quantity Out - Quantity lost by the transaction; if no quantity is gained, mark column with -0-.
12. Balance - Running balance of quantity on hand after the transaction.
13. Printed Name and Initials - Name and initials of individual performing the transaction (Print clearly).

Additional Instructions:

1. All data entered on Demolition Material Accountability Form should be entered in ink.
2. Lines not used on Demolition Material Accountability Form should be marked through with a line and marked "not used."
3. When a mistake is written on Demolition Material Accountability Form, DO NOT ERASE OR WHITE OUT--- mark through data with single line, initial change, and make correct entry on new line.

WESTON SOLUTIONS

Weston Solutions, Inc.

Magazine Data Card

1. Project Name, Location:	Project Number:	3. Explosive Manufacturer	4. Marks of Identification:
5. Storage Location:	6. Explosive Description:		

7. Date	8. Action/Purpose	9. Qty In	10. Qty Out	11. Balance	12. Printed Name	13. Signature

Magazine Data Card Instructions

1. Project Name, Location - Name assigned project and geographical location. (For example: TOAR Artillery Ranges,Pennslyvania)
2. Project Number - Assigned by Weston Corporate office
3. Explosive Manufacturer - Manufacturer of item and country of origin (For example: Atlas Powder, USA; Govt
4. Marks and Identification - Identification as specified by the Manufacturer; Lot number for US military explosives
5. Storage Location - Proper name of storage magazine (For example: Igloo J180; Bldg. #18; COE Bunker #1; Mag 2)
6. Explosives Description - Item name (For example: blasting caps, boosters, and detonating cord)
7. Date - Date the transaction occurs.
8. Action/Purpose - Purpose for transaction. (For example: intial receipt, inventory, demolition use, return to inventory, transfer, and previous balance.)
9. Quantity In - Quantity gained by the transaction; if no quantity is lost, mark column with -0-.
10. Quantity Out - Quantity lost by the transaction; if no quantity is gained, mark column with -0-.
11. Balance - Running balance of quantity on hand after the transaction.
12. Printed Name and Initials - Name of the individual performing the transaction (Print clearly).
13. Signature - Signature of the individual performing the transaction.

Additional Instruction:

1. All data entered on Magazine Data Card Form should be entered in ink.
2. Lines not used on Magazine Data Card Form should be marked through with a line and marked "not used".
3. When a mistake is written on Magazine Data Card Form, DO NOT ERASE OR WHITE OUT--- mark through data with single line, initial change, and make correct entry on new line.

WESTON SOLUTIONS

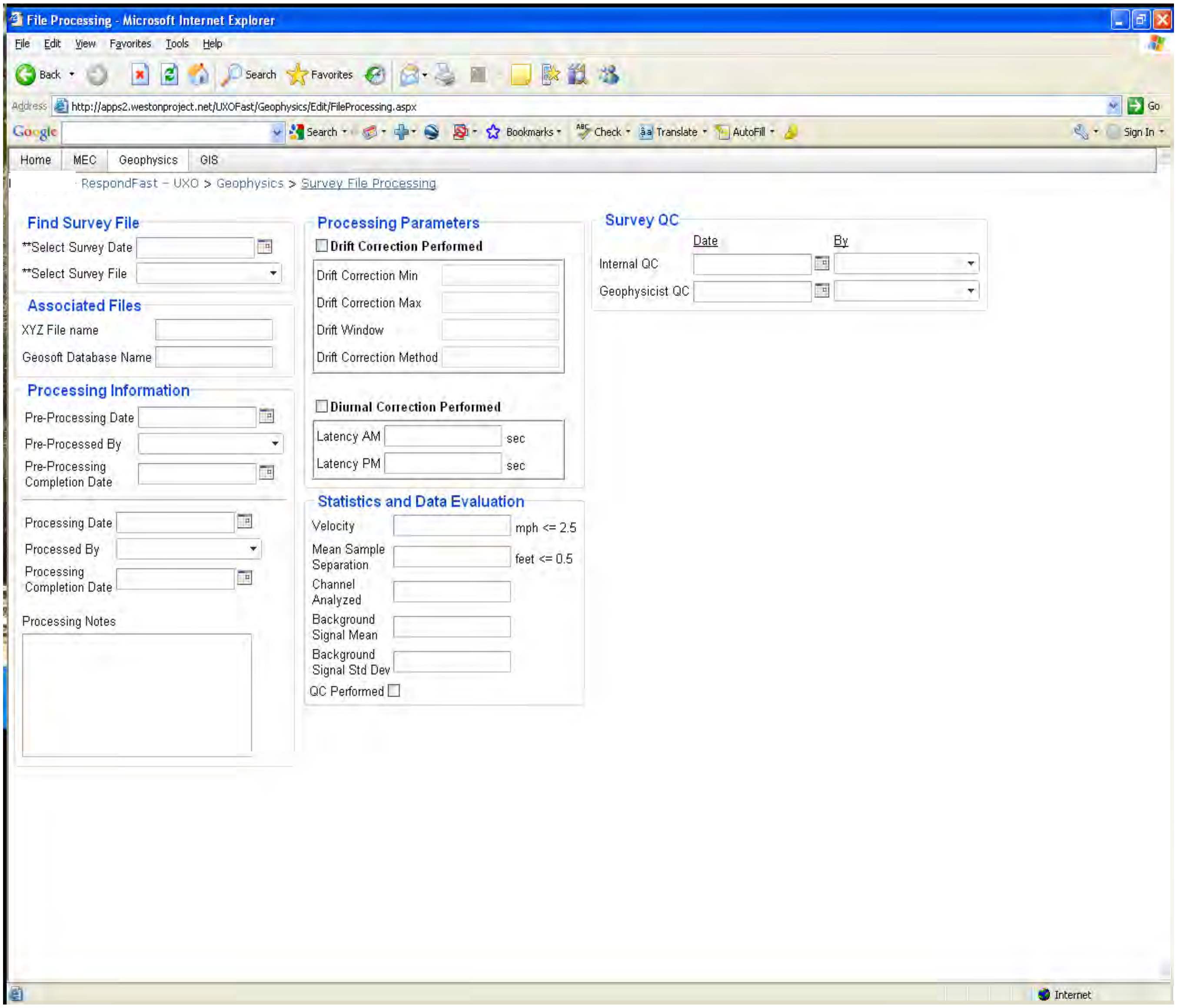
Daily Notes

Project	*Date*

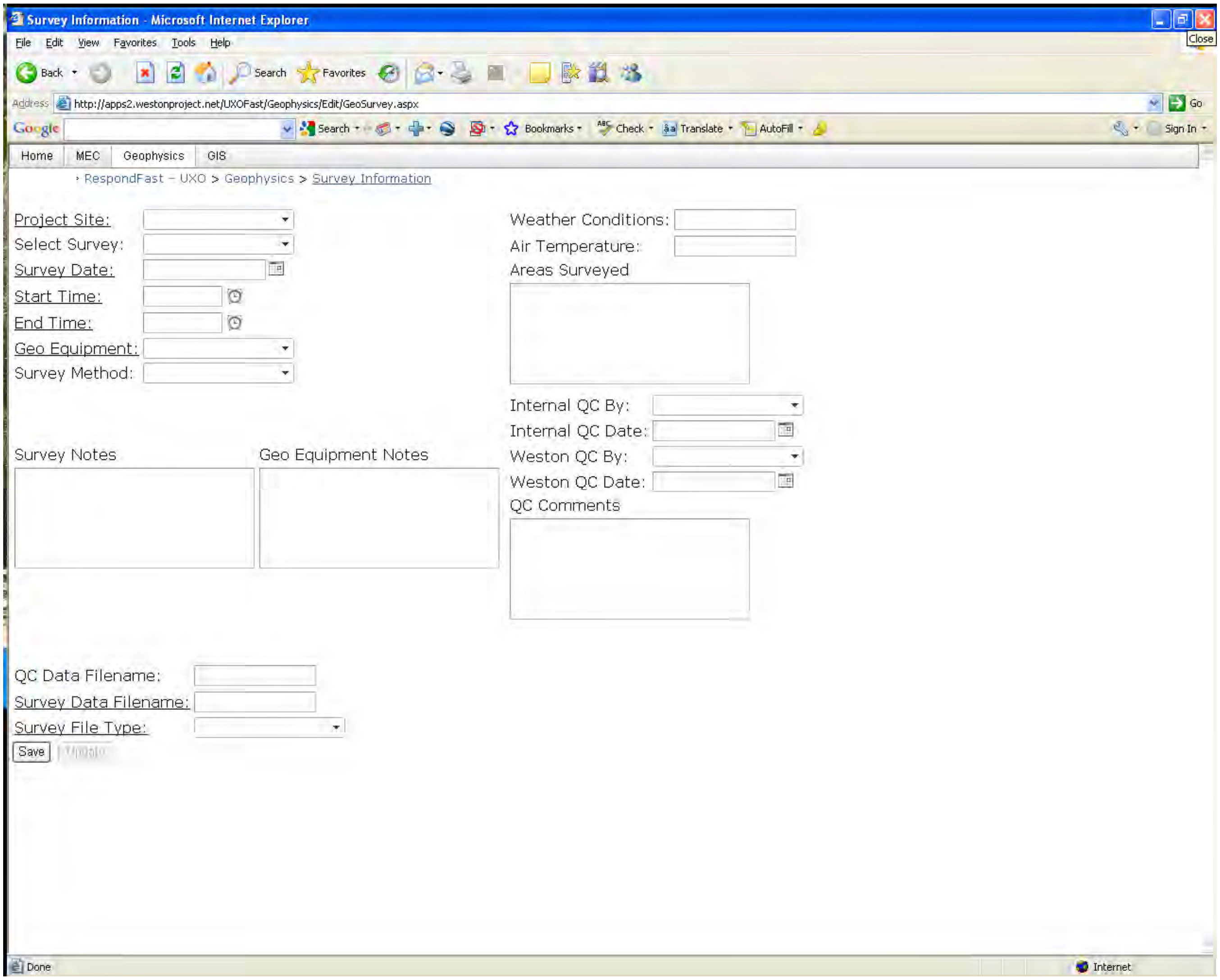
Days Weather

Daily Notes

Daily EM Acreage	*Total EM Acreage*



Example WESTON's UXOFast Processing and QC Form



Example of WESTON's UXOFast Survey Information Form

Geophysical Dig Sheet and Target History

Project Name		Geophysical Contractor	
Project Location		Project Geophysicist	
Date		Site Geophysicist	
Coordinate System		Field Team	
Survey Area ID		COE Design Center POC	
Sector	Grid	COE Project Engineer	
Field Book ID		COE Geophysicist	

Reacquisition Geophysical Equipment Used	Component	Serial #	Grid Background Value (mV/nT)	Date	Time

Unique Target ID	Original Survey						Reacquisition Survey			Dig Results													Post-Dig UXO QC Results			Post-Dig Geophysical QC		
													Offset															
	Easting Coord. (ft/m)	Northing Coord. (ft/m)	Channel ID (ie -C1 o r C4 , top sensor, gradient)	Response Amplitude (units*)	Dig Priority (0 is no dig-known anomaly source, 1 is highest dig recommendation, e tc..)	Date	Channel ID (ie -C1 o r C4 , top sensor, gradient)	Response Amplitude (units*)**	Date	Anomaly type ***	Approx. weight (lbs-oz/kg g)	Comments	Offset Easting Coord. (ft/m)	Offset Northing Coord.(ft/m)	Distance (ft/m)	Direction (N, NE, etc.)	Orientation of Nose (Azimuth deg) **	Inclination of Nose (deg) **	Depth to Top of Item (in/cm)	Digital Photo Filename **	Date	Team Leader Initials	Excavation Hole Cleared?	UXO QC Spec. Initials	Date	Agreement between Dig Results & Geophysical Data ? (G=good , P =poor, U=unacceptable)	Geophysicist QC Initials	Date

APPENDIX L – ACCIDENT PREVENTION PLAN/SITE SAFETY AND HEALTH PLAN

(Currently under separate review)

APPENDIX M – EXPLOSIVES SITE PLAN

DEPARTMENT OF THE ARMY
US ARMY DEFENSE AMMUNITION CENTER
1 C TREE ROAD
MCALESTER OK 74501-9053

REPLY TO
ATTENTION OF

JMAC-ESM 5 August 2010

MEMORANDUM FOR U.S. Army Engineering and Support Center, Huntsville, (CEHNC-CX-MM/Mr. Zange or Mr. Becker), P.O. Box 1600, Huntsville, AL 35807-4301

SUBJECT: DDESB Approval of an Explosives Site Plan, Military Munitions Response Program, Remedial Investigation for Munitions Response Sites at West Point Military Reservation, West Point, NY

1. References:

a. Your memorandum, 19 Jul 10, subject: Explosives Site Plan (ESP), Military Munitions Response Program (MMRP), Remedial Investigation (RI) for Munitions Response Sites (MRS's) at West Point Military Reservation, West Point, NY, July 2010.

b. DOD 6055.09-STD, Ammunition and Explosives Safety Standards, 29 Feb 08 with Change 2 dated 21 Aug 09.

c. Memorandum, Department of Defense Explosives Safety Board, DDESB-PE, 5 Aug 10, SAB (encl).

2. The subject ESP transmitted by reference 1.a has been reviewed in accordance with reference 1.b. Reference 1.c provides Department of Defense Explosives Safety Board (DDESB) final approval. This approval will be made part of the administrative record for the site.

3. The POC is Ms. Charlotte Curtis, JMAC-ESM, (918) 420-8742 or DSN 956-8742, email charlotte.curtis@us.army.mil.

Signed by Jim Toburen
for/CLIFFORD H. DOYLE
M EC Team Leader
Explosives Safety Knowledge,
OE and Chemical Division
US Army Technical Center for Explosives Safety

Encl
as

CF: (w/encl)
Office of the Director of Army Safety, (DACS-SF/Mr. Patton), 223 23rd Street, Crystal Plaza 5, Suite 980, Arlington, VA 22202
Office of the Deputy Assistant Secretary of the Army for Environment, Safety, and Occupational Health, Special Assistant for Munitions, (DASA-DESOH/Mr. King), 110 Army Pentagon, Washington, DC 20310-0110
U.S. Army Corps of Engineers (CESO/Ms Roberts), 20 Massachusetts Avenue, NW, Washington, DC 20314-1000

DEPARTMENT OF DEFENSE EXPLOSIVES SAFETY BOARD
2461 EISENHOWER AVENUE
ALEXANDRIA, VIRGINIA 22331-0600

AUG 0 3 2010

DDESB-PE

MEMORANDUM FOR DIRECTOR, U.S. ARMY DEFENSE AMMUNITION CENTER
ATTENTION: JMAC-ESM

SUBJECT: DDESB Approval of an Explosives Site Plan, Military Munitions Response Program, Remedial Investigation for Munitions Response Sites at West Point Military Reservation, West Point, NY

References: (a) DAC JMAC-ESM Memorandum of 22 July 2010, Subject: Request for DDESB Approval for an Explosives Site Plan (ESP), Military Munitions Response Program (MMRP), Remedial Investigation (RI) for Munitions Response Sites (MRS) at West Point Military Reservation, West Point, NY, July 2010

(b) DoD 6055.09-STD, DoD Ammunition and Explosives Safety Standards, 29 February 2008, Incorporating Change 2, 21 August 2009

(c) DDESB TP-15, Approved Protective Construction, Revision 3, May 2010

(d) DDESB TP-16, Methodologies for Calculating Primary Fragment Characteristics, Revision 3, 1 April 2009

(e) United States Army Corps of Engineers, Baltimore District, Memorandum for the Record of 29 June 2010, MFR001, Explosive Safety Subject: Investigation Into the Circumstances Surrounding the Incident of Debris Throw From Disposal Operations Conducted on 29 May 2010 as a Result of the Ongoing Time Critical Removal Action (TCRA) Being Conducted on the Mount Hope (Tilcon) Rock Quarry

The Department of Defense Explosives Safety Board (DDESB) Staff has reviewed the subject explosives site plan (ESP) forwarded by reference (a), against the requirements of reference (b). Based on the information provided, approval is granted for removal and treatment of material potentially presenting an explosive hazard (MPPEH) and munitions and explosives of concern (MEC) at West Point Military Reservation, West Point, NY. This approval is based on the following:

a. The efforts addressed in this ESP involve manual unintentional detonation operations and intentional detonations supporting a remedial investigation of 11 Munition Response Sites.

b. The results of this ESP will be used to prepare an explosives safety submission per reference (a).

c. The attached Table lists the munition with the greatest fragmentation distance (MGFD) for each MRS; the team separation distance (TSD); the minimum separation distance (MSD) for unintentional detonations for nonessential personnel from manual operations; and the MSD for intentional single in-grid detonations for nonessential personnel.

d. The use of sandbags are authorized as an engineering control for intentional detonations involving the MEC identified in reference (a) provided the Army ensures usage per reference (c), paragraph C6.2.7.5.

e. Note, since the MGFD for MRS Battery Knox - TD Land MRS (WSTPT-004-R-02) is the 8-inch Parrot Projectile, which is classified as an Extremely Heavy Case munition per reference (d), the Army shall ensure compliance with the recommendations provided in reference (e) when sandbags are used with Extremely Heavy Case munitions.

f. Demolition materials, per reference (a), will be delivered as needed.

g. Prior to initiation and through completion of on-site explosives operations, all nonessential personnel will be evacuated and prevented from entering any area/facility encumbered by the MSD required for the operation being conducted, or explosives operations will be suspended if nonessential personnel enter the MSD.

h. MPPEH will be inspected and classified as material documented as safe prior to release to the public.

If changes occur during or after completion of this effort that could increase explosive hazards to site workers or the public due to the presence of military munitions at the site, an amendment to this ESP must be submitted to DDESB for review and approval.

The point of contact for this action is Mr. Tony Dunay, (703) 325-3513, DSN 221-3513, E-mail address: tony.dunay@ddesb.osd.mil.

FOR

CURTIS M. BOWLING
Chairman
DDESB

Attachment
As stated

TABLE

MRS	MGFD	TSD[1] (ft)	MSD[2] (ft) unintentional detonation	MSD[3] (ft) intentional detonation
Artillery Firing Range (WSTPT-001-R-01) Fort Clinton - West (WSTPT-008-R-01) North Athletic Field (WSTPT-011-R-01) Target Hill (WSTPT-017-R-01) Lusk Reservoir (WSTPT-019-R-01) Redoubt No. 2 (WSTPT-020-R-01)	75 mm HE Mk I Projectile	50	238	1,702
Battery Knox - TD Land MRS (WSTPT-004-R-02)	8-inch Parrot Projectile	39	197	2,620
Grey Ghost Housing Area (WSTPT-010-R-01) Seacoast Battery (WSTPT-013-R-01) Siege Battery (WSTPT-015-R-01) Michie Stadium (WSTPT-022-R-01)	3-inch Stokes Mortar	54	219	1,346

[1] Based on K40 of MGFD
[2] For nonessential personnel based on the greater of K40 or the hazardous fragment distance of the MGFD
[3] For nonessential personnel based on the greater of K328 or the maximum fragment distance of the MGFD

DEPARTMENT OF THE ARMY
US ARMY DEFENSE AMMUNITION CENTER
1 C TREE ROAD
MCALESTER OK 74501-9053

REPLY TO
ATTENTION OF

JMAC-ESM 22 July 2010

MEMORANDUM FOR Department of Defense Explosives Safety Board (DDESB-PE/Mr. Alchowiak), 2461 Eisenhower Avenue, Alexandria, VA 22331-0600

SUBJECT: Request for DDESB Approval for an Explosives Site Plan (ESP), Military Munitions Response Program (MMRP), Remedial Investigation (RI) for Munition Response Sites (MRS) at West Point Military Reservation, West Point, NY, July 2010

1. References:

a. Memorandum, CEHNC-CX-MM (Mr. Zange, Mr. Becker), Subject: Explosives Site Plan (ESP), Military Munitions Response Program (MMRP), Remedial Investigation (RI) for Munition Response Sites (MRS) at West Point Military Reservation, West Point, NY, July 2010.

b. DOD 6055.09-STD, Ammunition and Explosives Safety Standards, 29 Feb 08 with Change 2 dated 21 Aug 09.

2. Reference 1.a with enclosed ESP is provided for your review in accordance with chapter 12 of reference 1.b. We have reviewed the subject ESP and recommend approval.

3. This ESP addresses the Remedial Investigation for various MRSs at West Point Military Reservation, West Point, NY. The projected start date is 01 August 2010.

4. The munition with the greatest fragmentation distance (MGFD) for Artillery Firing Range MRS, Fort Clinton MRS, North Athletic Field MRS, Target Hill MRS, Lusk Reservoir MRS, and Redoubt No. 2 MRS is the 75 mm HE MK1. The MGFD for the Battery Knox TD Land MRS is the 8 Inch Parrot. The MGFD for the Grey Ghost Housing Area MRS, Seacoast Battery MRS, Seige Battery MRS, and the Michie Stadium MRS is the 3” Stokes HE.

5. The POC is Ms. Charlotte Curtis, JMAC-ESM, DSN 956-8742, commercial (918) 420-8742, email charlotte.curtis@us.army.mil.

Encl

CLIFFORD H. DOYLE
MEC Team Leader
Explosives Safety Knowledge, OE and Chemical Division
US Army Technical Center for Explosives Safety

SUBJECT: Request for DDESB Approval for an Explosives Site Plan (ESP), Military Munitions Response Program (MMRP), Remedial Investigation (RI) for Munition Response Sites (MRS) at West Point Military Reservation, West Point, NY, July 2010

CC: (w/encl)

Office of the Director of Army Safety, (DACS-SF/Mr. Patton), 223 23rd Street, Crystal Plaza 5, Suite 980, Arlington, VA 22202

Office of the Deputy Assistant Secretary of the Army for Environment, Safety, and Occupational Health, Special Assistant for Munitions, (DASA-DESOH/Mr. King), 110 Army Pentagon, Washington, DC 20310-0110

U.S. Army Corps of Engineers (CESO/Ms Roberts), 20 Massachusetts Avenue, NW, Washington, DC 20314-1000

Military Munitions Center of Expertise, (CEHNC-CX-MM/Mr. Zange/Mr. Becker), P.O. Box 1600, Huntsville, AL 35807-4301

DEPARTMENT OF THE ARMY
HUNTSVILLE CENTER, CORPS OF ENGINEERS
P.O. BOX 1600
HUNTSVILLE, ALABAMA 35807-4301

REPLY TO
ATTENTION OF:

CEHNC-CX-MM 19 July 2010

MEMORANDUM FOR US Army Technical Center for Explosives Safety, Explosives Safety Knowledge, OE and Chemical Division, (SJMAC-ESM/Mr. Cliff Doyle), Building 35, 1C Tree Road, McAlester, OK 74501-9053

SUBJECT: Explosives Site Plan (ESP), Military Munitions Response Program (MMRP) Remedial Investigation (RI) for Munition Response Sites (MRS's) at West Point Military Reservation, West Point, NY, July 2010

1. References:

a. ER 385-1-95, Safety and Health Concerns for Munitions and Explosives of Concern (MEC) Projects, March 2007.

b. DOD 6055.09-STD, Ammunition and Explosives Safety Standards, February 2008.

c. Email, (CENAB-EN-HI/Mr. Paul Greene), subject: West Point ESP, 19 July 2010.

2. This ESP is submitted for review and approval at the request of the installation, per reference 1c. They have requested the US Army Corps of Engineers (USACE) submit this up through the review and approval chain on their behalf.

3. This ESP is submitted to address the RI for MRS's, Artillery Firing Range (WSTPT-001-R-01), Battery Knox - TD Land MRS (WSTPT-004-R-02), Fort Clinton – West (WSTPT-008-R-01), Grey Ghost Housing Area (WSTPT-010-R-01), North Athletic Field (WSTPT-011-R-01), Seacoast Battery (WSTPT-013-R-01), Seige Battery (WSTPT-015-R-01), Target Hill (WSTPT-017-R-01), Lusk Reservoir (WSTPT-019-R-01), Redoubt No. 2 (WSTPT-020-R-01), and Michie Stadium (WSTPT-022-R-01) at West Point Military Reservation West Point, New York.

4. This memorandum constitutes Direct Reporting Unit approval for USACE participation per reference 1a.

5. If you have any questions, please contact Mr. Walt Zange at (256) 895-1586 or Mr. Dave Becker at (256) 895-1513.

Encl

For SUZANNE MURDOCK, P.E.
Chief, Military Munitions Division
Environmental and Munitions
Center Of Expertise

CF: (electronically w/o encls)
HQUSACE, (CESO-SWD/Ms. Blanca Roberts)
USACE, (CENAB-EN-HI/Mr. Paul Greene)

REMEDIAL INVESTIGATION (RI)
EXPLOSIVES SITE PLAN (ESP)

- Artillery Firing Range (WSTPT-001-R-01)
- Battery Knox - TD Land MRS (WSTPT-004-R-02)
- Fort Clinton – West (WSTPT-008-R-01)
- Grey Ghost Housing Area (WSTPT-010-R-01)
- North Athletic Field (WSTPT-011-R-01)
- Seacoast Battery (WSTPT-013-R-01)
- Seige Battery (WSTPT-015-R-01)
- Target Hill (WSTPT-017-R-01)
- Lusk Reservoir (WSTPT-019-R-01)
- Redoubt No. 2 (WSTPT-020-R-01)
- Michie Stadium (WSTPT-022-R-01)

MILITARY MUNITIONS RESPONSE ACTION (MMRP)

West Point Military Reservation
West Point, NY

July 2010

Prepared by
USACE Baltimore District

REMEDIAL INVESTIGATION (RI) EXPLOSIVES SITE PLAN (ESP)

MILITARY MUNITIONS RESPONSE ACTION (MMRP)

West Point Military Reservation
West Point, NY

Prepared by:

United States Army Corps of Engineers

Baltimore District

Garrison Review and Approval:

Division Chief: Mr. Keith Katz

West Point Installation Safety Office

IMNE-MIL-SO

TABLE OF CONTENTS

Section Page

1. Site:

a. Name: West Point Military Reservation (Sites listed below)

b. State: New York

2. Anticipated Dates:

a. Start: October 2010

3. Purpose:

a. A Remedial Investigation is required for eleven (11) sites at this location based on the historic ordnance activities proximate to and within the site and the Site Investigation (SI) findings in order to further characterize the following areas:

- Artillery Firing Range (WSTPT-001-R-01)
- Battery Knox - TD Land MRS (WSTPT-004-R-02)
- Fort Clinton – West (WSTPT-008-R-01)
- Grey Ghost Housing Area (WSTPT-010-R-01)
- North Athletic Field (WSTPT-011-R-01)
- Seacoast Battery (WSTPT-013-R-01)
- Seige Battery (WSTPT-015-R-01)
- Target Hill (WSTPT-017-R-01)
- Lusk Reservoir (WSTPT-019-R-01)
- Redoubt No. 2 (WSTPT-020-R-01)
- Michie Stadium (WSTPT-022-R-01)

4. Site Background and Current Conditions: The information contained in each section's background was gleaned from the Site Inspection Report and Historical Records Review for the installation:

a. Artillery Firing Range (WSTPT-001-R-01) – The Artillery Firing Range MRS consists of 171 acres and is comprised of three overlapping former artillery ranges: Sacred Heart Cemetery Range, the Silver Depository Range, and the Adolphs Pond Range. The MR site includes three parcels of land located to the south and west of the main campus. The two northern parcels of the MR site are adjacent to each other and the third parcel is a non-contiguous parcel located to the south. The northeastern portions of the historic artillery ranges extend beyond the installation boundary into the Crows Nest Formerly Used Defense Site (FUDS) Area. In addition, a portion of the eastern edges of the Sacred Heart Cemetery Range and the Adolphs Pond Range are located within the Fort

b. Battery Knox - TD Land MRS (WSTPT-004-R-02) – Approximately 141 acres and located on the eastern bank of the Hudson River. Firing of projectiles from the battery is believed to have been at targets in the Hudson River, but some projectiles may have overshot the targets and impacted the eastern bank.

c. Fort Clinton – West (WSTPT-008-R-01) – The Fort Clinton MRS (WSPT-008-R-01) is comprised of 27 acres and consists of two non-contiguous parcels of land. The first parcel is located at the site of historic Fort Clinton to the southwest of Gees Point on the northeast portion of the installation. The second parcel is located just southeast of Crows Nest FUDS Area and extends south of Lee Housing along the range fan for Siege Battery. The site was in operation from 1778 to 1927.

d. Grey Ghost Housing Area (WSTPT-010-R-01) – Approximately 23.7 acres located in the central campus area, west of the batteries and athletic fields. Operations at the site included small arms use at a machine gun range and rifle/pistol range from 1920 to 1950.

e. North Athletic Field (WSTPT-011-R-01) – Approximately 14 acres located near the western shore of the Hudson River within the central campus area of West Point. In 1937 dirt from Target Hill, which had been used as an artillery target area from 1903 until 1935, was moved to the North Athletic field to increase the surface area of the athletic fields.

f. Seacoast Battery (WSTPT-013-R-01) – The Seacoast Battery is comprised of 2 acres of land within the boundaries of West Point on Constitution Island. The Seacoast Battery was established sometime between 1836 and 1850 and demolished sometime during WWII. The Seacoast Battery MRS is the land area on Constitution Island where impact of projectiles may have occurred.

g. Seige Battery (WSTPT-015-R-01) – Siege Battery is comprised of 179 acres and includes two noncontiguous areas. The western portion of the site includes land located on the slope of the hill below the Battle Monument, at what is now called Trophy Point, and extends to the northwest. The eastern portion of the site is located on Constitution Island.

h. Target Hill (WSTPT-017-R-01) – Approximately 14 acres located near the western bank of the Hudson River north of the athletic fields. This site is surrounded by the Siege Battery MR site. Target Hill was as target practice for batteries located along the north side of West Point from approximately 1890 until the 1930s for short-range artillery training. In the early 1900s target butts for a rifle range were also located with the site.

i. Lusk Reservoir (WSTPT-019-R-01) – The Lusk Reservoir MRS (WSPT-019-R-01) consists of 83.19 acres and is located in the central portion of the West Point campus. The firing point is located to the east of Lusk Reservoir and the fan extends to the northwest to where it intersects with the range fan for the Artillery Firing Range.

j. Redoubt No. 2 (WSTPT-020-R-01) – The Redoubt No. 2 consists of 19.61 acres located east of the intersection of Highways 218 and 9W and west of Dassori Pond. The firing point is located in the vicinity of historic Redoubt No. 2 and the fan extends to the north to encompass land not addressed by other closed ranges or operational range area.

k. Michie Stadium (WSTPT-022-R-01) – The Michie Stadium encompasses approximately 9.4 acres in and around Michie Stadium, which is located near the center of the Main Post area and to the west of Lusk Reservoir.

5. **Executing Agencies:**
   a. US Army Environmental Command
   b. West Point Military Reservation
   c. US Army Corps of Engineers, Baltimore District

6. **Scope of Investigative Action:**
   a. A surface and manual subsurface investigative action to depth of detection is required for this RI.

7. **Safety Criteria:**
   a. The munition with the greatest fragmentation distance (MGFD) at the Munitions Response Area (MRA) is identified in Table 7-1 per Munition Response Site (MRS). During the course of this removal action if MEC with a greater fragmentation distance is encountered, the MSD will be adjusted in accordance with DDESB Technical Paper 16 and the Fragmentation Database, work will continue and an amendment to this ESP submitted.

b. See Appendix B for Fragmentation Data Sheets.

c. See Table 7-1 for Minimum Separation Distances.

d. Any occupied buildings or public roadways in the MSD areas during MEC operations will be evacuated and/or roadways blocked to prevent non-essential personnel from entering during the conduct of MEC operations. Guards will be posted as necessary to ensure work is halted if non-essential personnel enter the MSD.

Table 7-1
Minimum Separation Distances

Munitions Response Site (MRS)	Munition with the Greatest Fragmentati on Distance (MGFD)	MSD (ft)				
		Unintentional Detonations		Intentional Detonations		
		Hazardous Fragment Distance (HFD)	Team Separation Distance (K40)	Without Engineering Controls (MFD)	Using Engineering Controls (Sandbags)	
Artillery Firing Range	75 mm HE MK I	238	50	1702	200	
Battery Knox TD Land	8 Inch Parrot	197	39	2620	**220**	
Fort Clinton -W	75 mm HE MK I	238	50	1702	200	
Grey Ghost Housing Area	3” Stokes HE	219	54	1346	200	
North Athletic Field	75 mm HE MK I	238	50	1702	200	
Seacoast Battery	3” Stokes HE	219	54	1346	200	
Seige Battery	3” Stokes HE	219	54	1346	200	
Target Hill	75 mm HE MK I	238	50	1702	200	
Lusk Reservoir	75 mm HE MK I	238	50	1702	200	
Redoubt No 2	75 mm HE MK I	238	50	1702	200	
Michie Stadium	3” Stokes HE	219	54	1346	200	

8. Methods of Disposal:

a. Recovered MEC will be blown in place. No movement or consolidation of MEC is anticipated. The contractor will not maintain any explosives on site. Explosives will be delivered to the project location on an “On-Call” basis.

b. The MSD for intentional detonations when conducting BIP disposal operations is identified in Table 7-1 and is depicted in Figures 3-13.

c. All recovered MEC and Material Potentially Presenting an Explosive Hazard (MPPEH) identified as Material Documented as an Explosive Hazard (MDEH) will be destroyed by the contractor on site, same day found. In the event this can not be accomplished due to weather (lightning) or delivery of explosives then items will be guarded until disposal.

d. All inspected and certified Material Documented as Safe (MDAS) items will be handled and accounted for per the guidance established in DoD Instruction 4140.62.

e. Sandbag Mitigation may be used for intentional detonations as delineated in the "Use of Sand Bags for Mitigation of Fragmentation and Blast Effects due to Intentional Detonation of Munitions," HNC-ED-CS-S 98-7, dated August 1998. This EC will be only be used with shape charge as donor charge and will be applied to mitigate fragmentation and blast hazards to the MSD indentified in Table 7-1. A copy of HNC-ED-CSS-98-7 will be available on site if this EC is applied. Only one MEC will be destroyed at a time using this technique.

9. Maps: See Appendix A

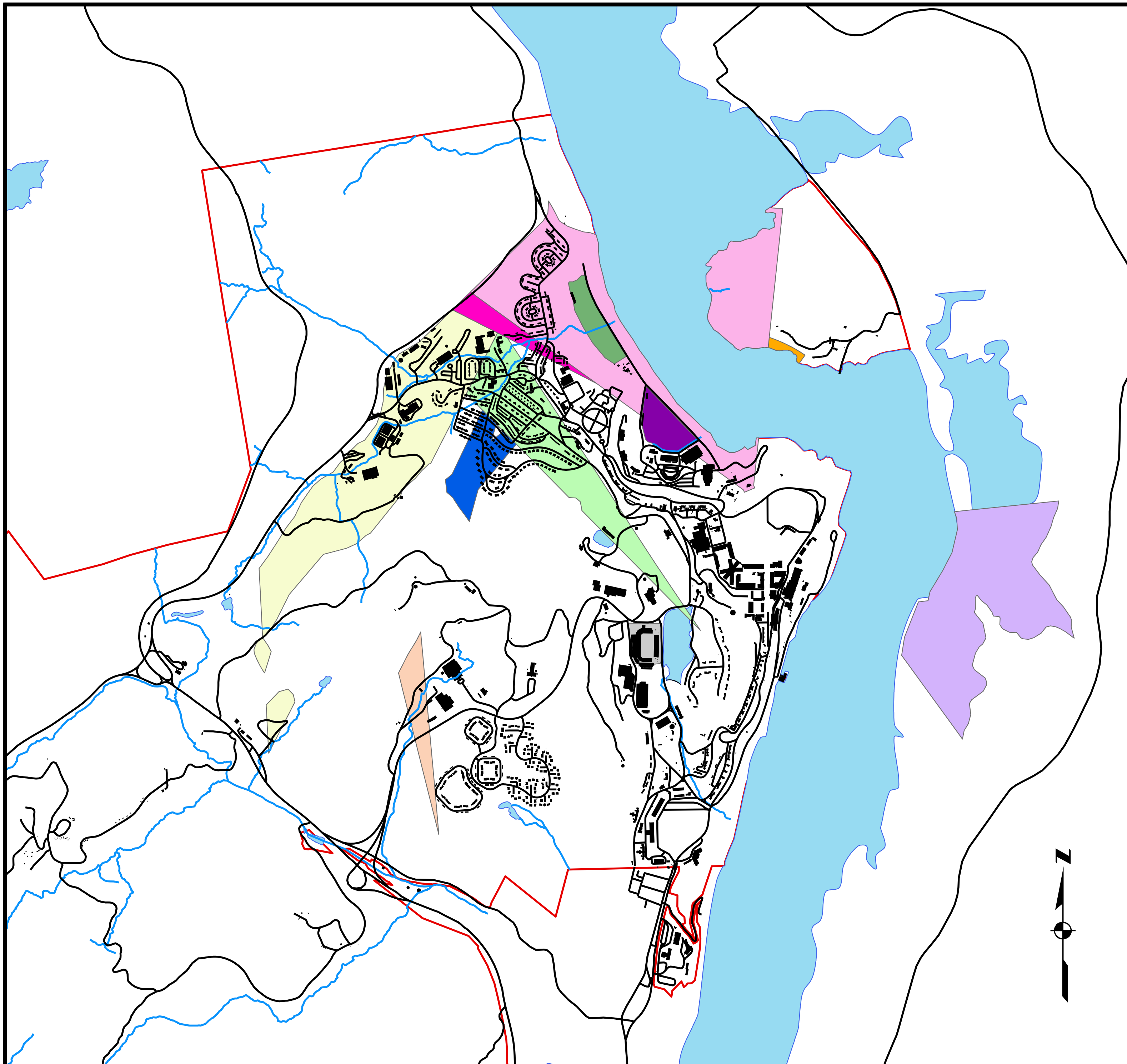
10. Fragmentation Calculation Sheets: See Appendix B

APPENDIX A
FIGURES

USMA
West Point, NY

US Army Corps of Engineers

Figure 1.
Regional Map of West Point



USMA
West Point, NY

US Army Corps of Engineers

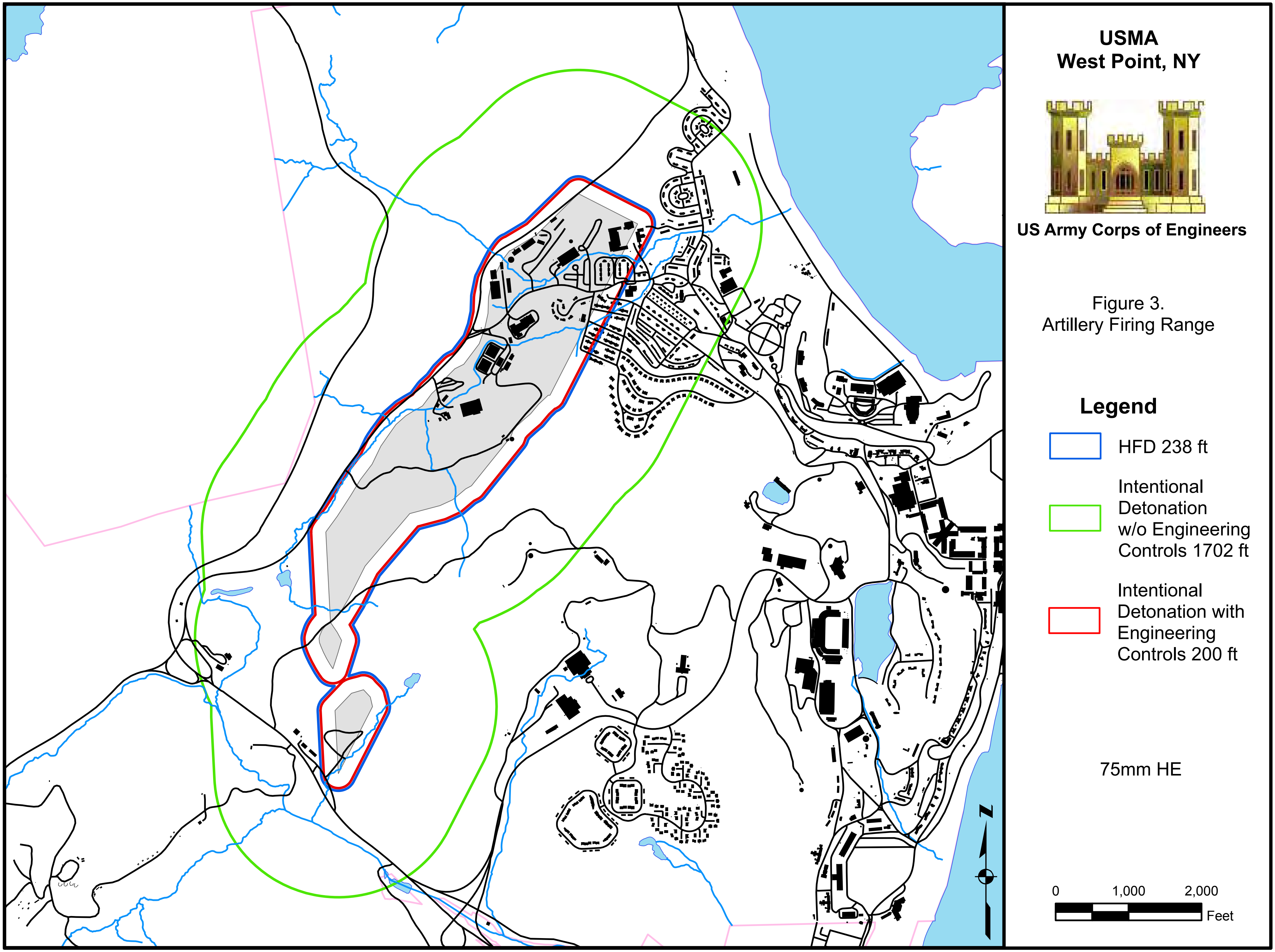
Figure 2

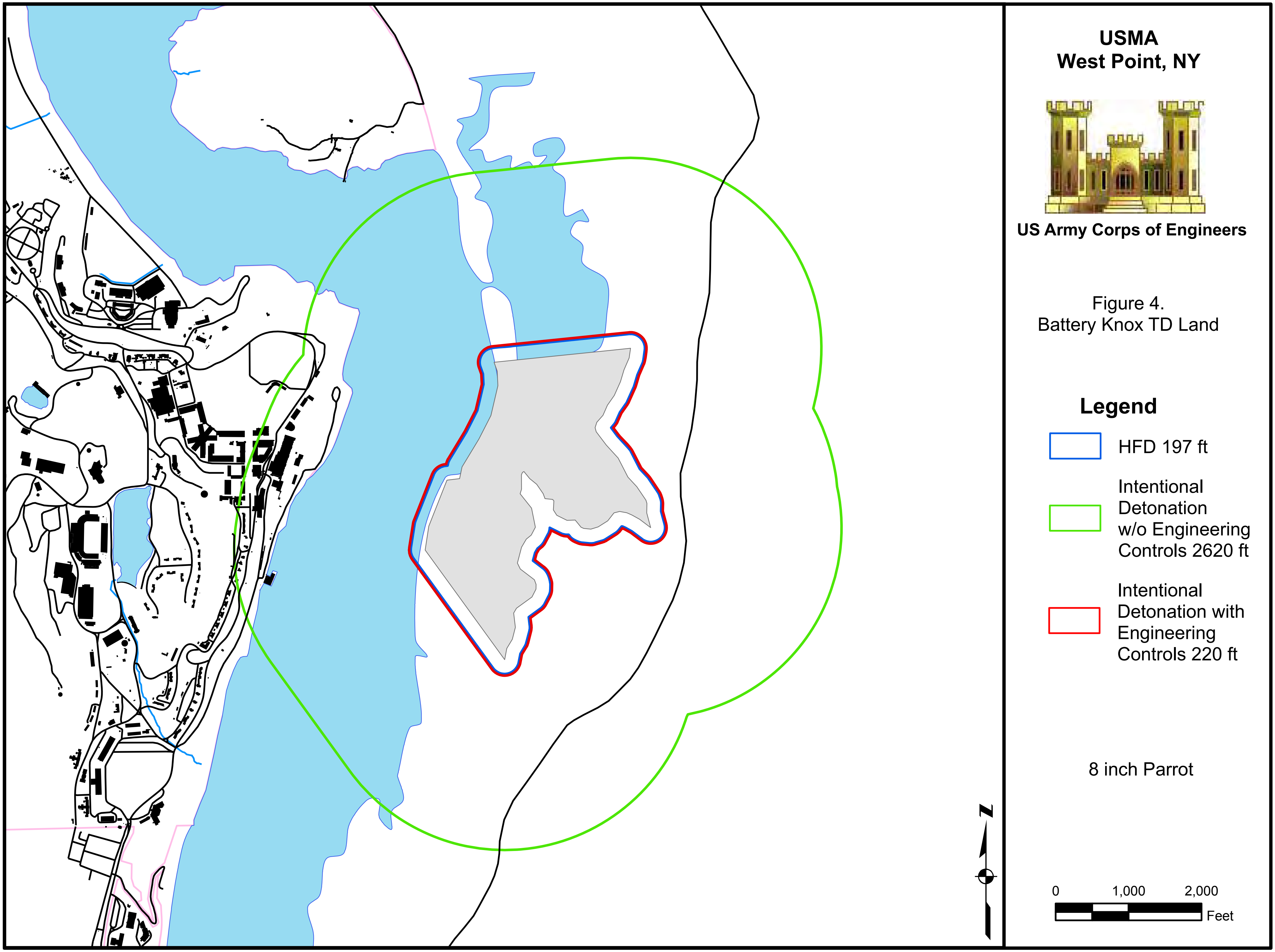
Legend

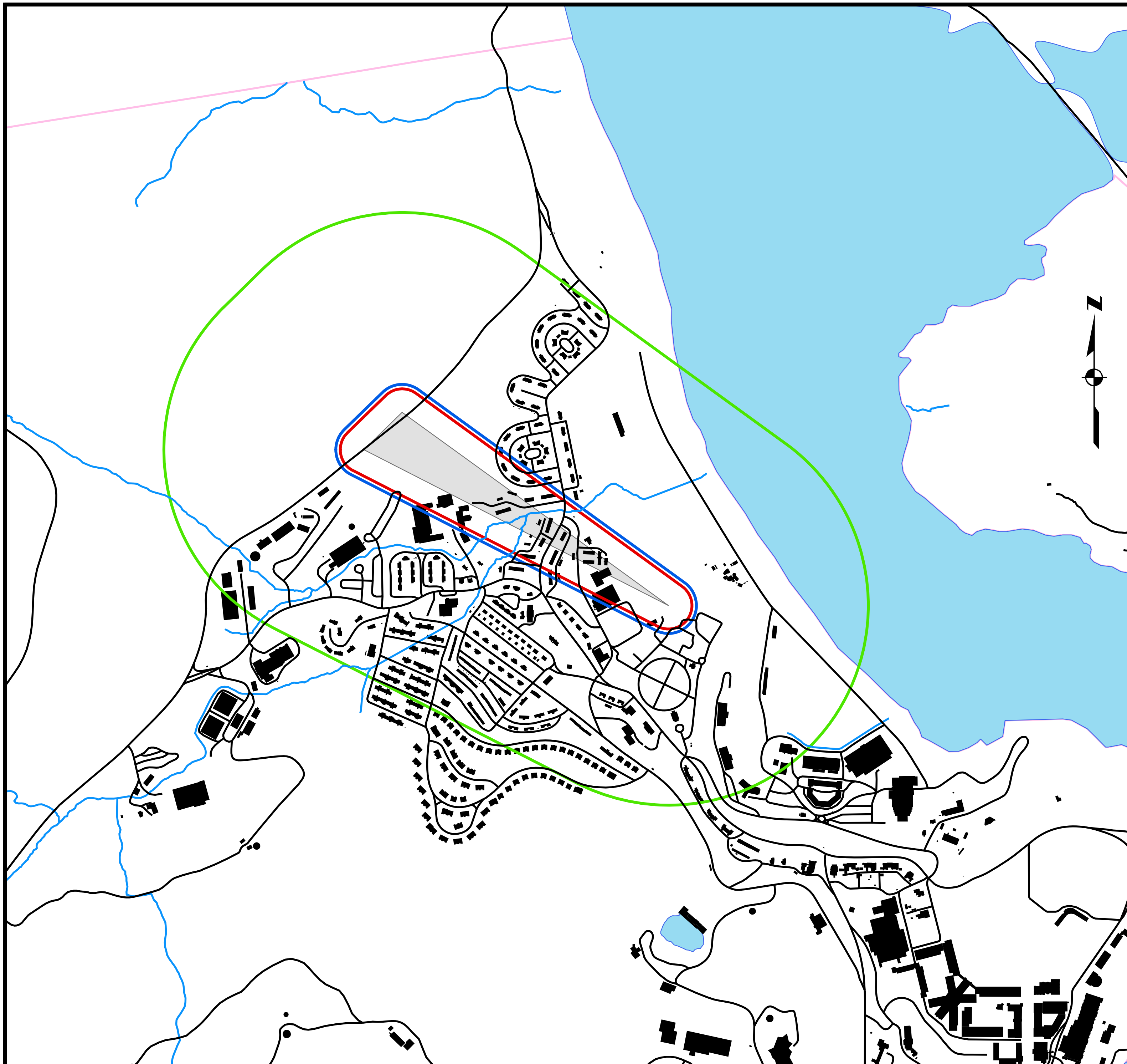
MRS Location

- Artillery Firing Range
- Battery Knox-TD - Land
- Fort Clinton - West
- Grey Ghost Housing Area
- Lusk Reservoir
- Michie Stadium
- North Athletic Field
- Redoubt No. 2
- Seacoast Battery
- Siege Battery
- Target Hill

0 2,000 4,000 Feet


USMA
West Point, NY
US Army Corps of Engineers
Figure 3.
Artillery Firing Range
Legend
HFD 238 ft
Intentional Detonation w/o Engineering Controls 1702 ft
Intentional Detonation with Engineering Controls 200 ft
75mm HE
N
0
1,000
2,000
Feet


USMA
West Point, NY
US Army Corps of Engineers
Figure 4.
Battery Knox TD Land
Legend
HFD 197 ft
Intentional Detonation w/o Engineering Controls 2620 ft
Intentional Detonation with Engineering Controls 220 ft
8 inch Parrot
N
0
1,000
2,000
Feet



USMA
West Point, NY

US Army Corps of Engineers

Figure 5.
Fort Clinton - West

Legend

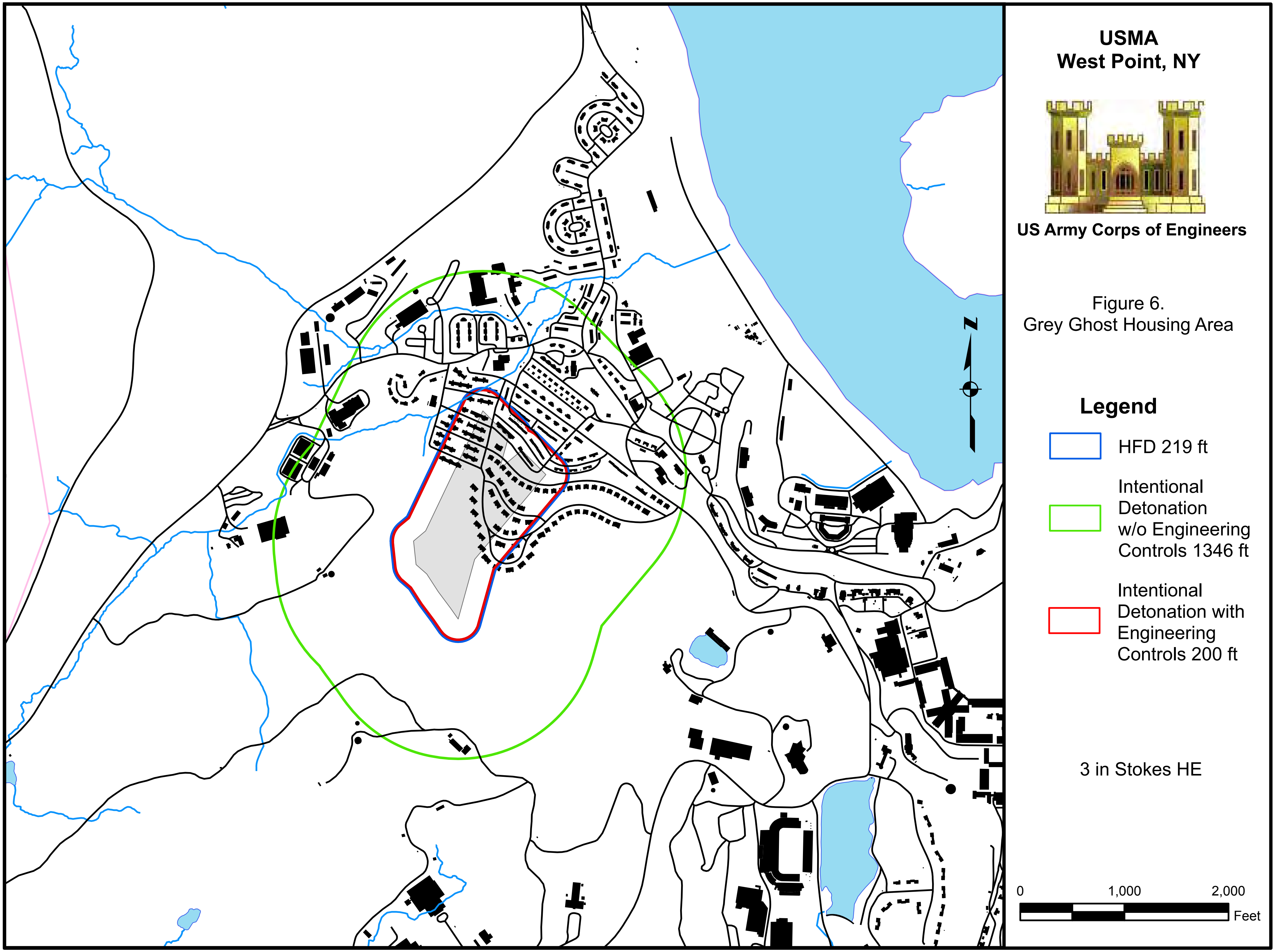
HFD 238 ft

Intentional Detonation w/o Engineering Controls 1702 ft

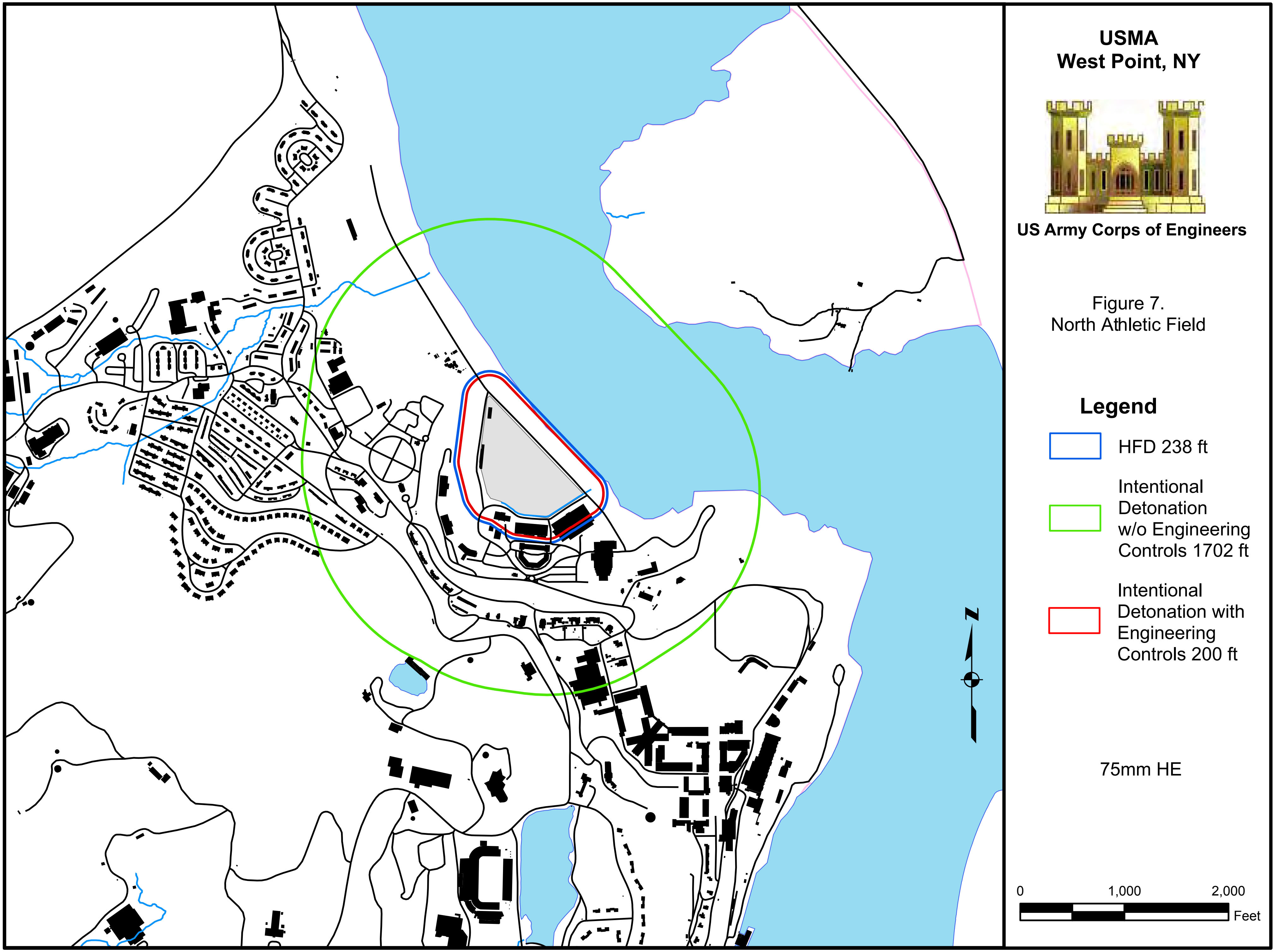
Intentional Detonation with Engineering Controls 200 ft

75mm HE

0 1,000 2,000 Feet



USMA
West Point, NY
US Army Corps of Engineers
Figure 6.
Grey Ghost Housing Area
N
Legend
HFD 219 ft
Intentional Detonation w/o Engineering Controls 1346 ft
Intentional Detonation with Engineering Controls 200 ft
3 in Stokes HE
0
1,000
2,000
Feet


USMA
West Point, NY
US Army Corps of Engineers
Figure 7.
North Athletic Field
Legend
HFD 238 ft
Intentional Detonation w/o Engineering Controls 1702 ft
Intentional Detonation with Engineering Controls 200 ft
N
75mm HE
0
1,000
2,000
Feet

USMA
West Point, NY

US Army Corps of Engineers

Figure 8.
Seacoast Battery

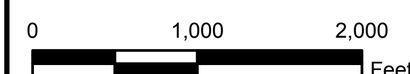
Legend

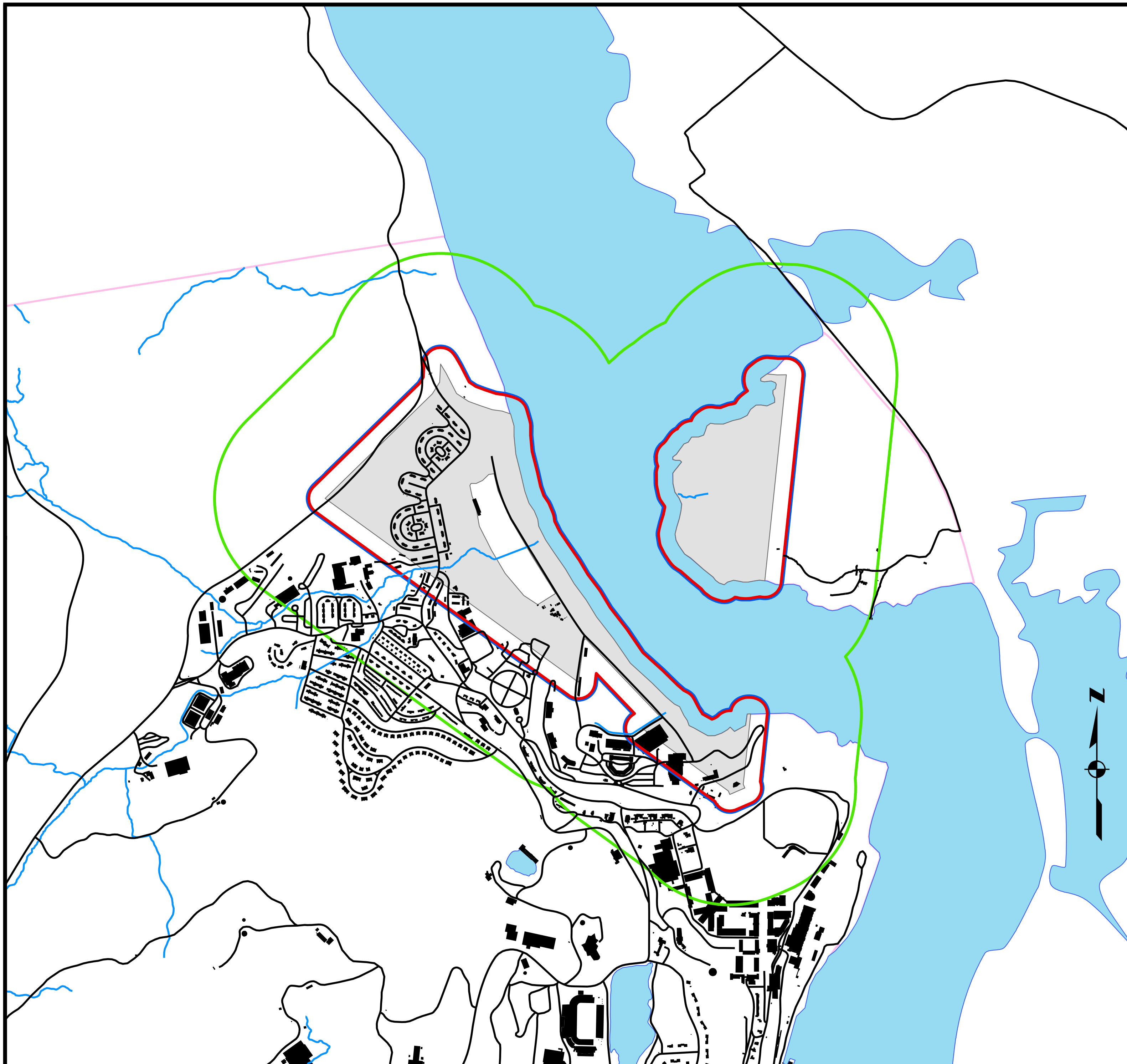
HFD 219 ft

Intentional Detonation w/o Engineering Controls 1346 ft

Intentional Detonation with Engineering Controls 200 ft

3 in Stokes HE





USMA
West Point, NY

US Army Corps of Engineers

Figure 9.
Seige Battery

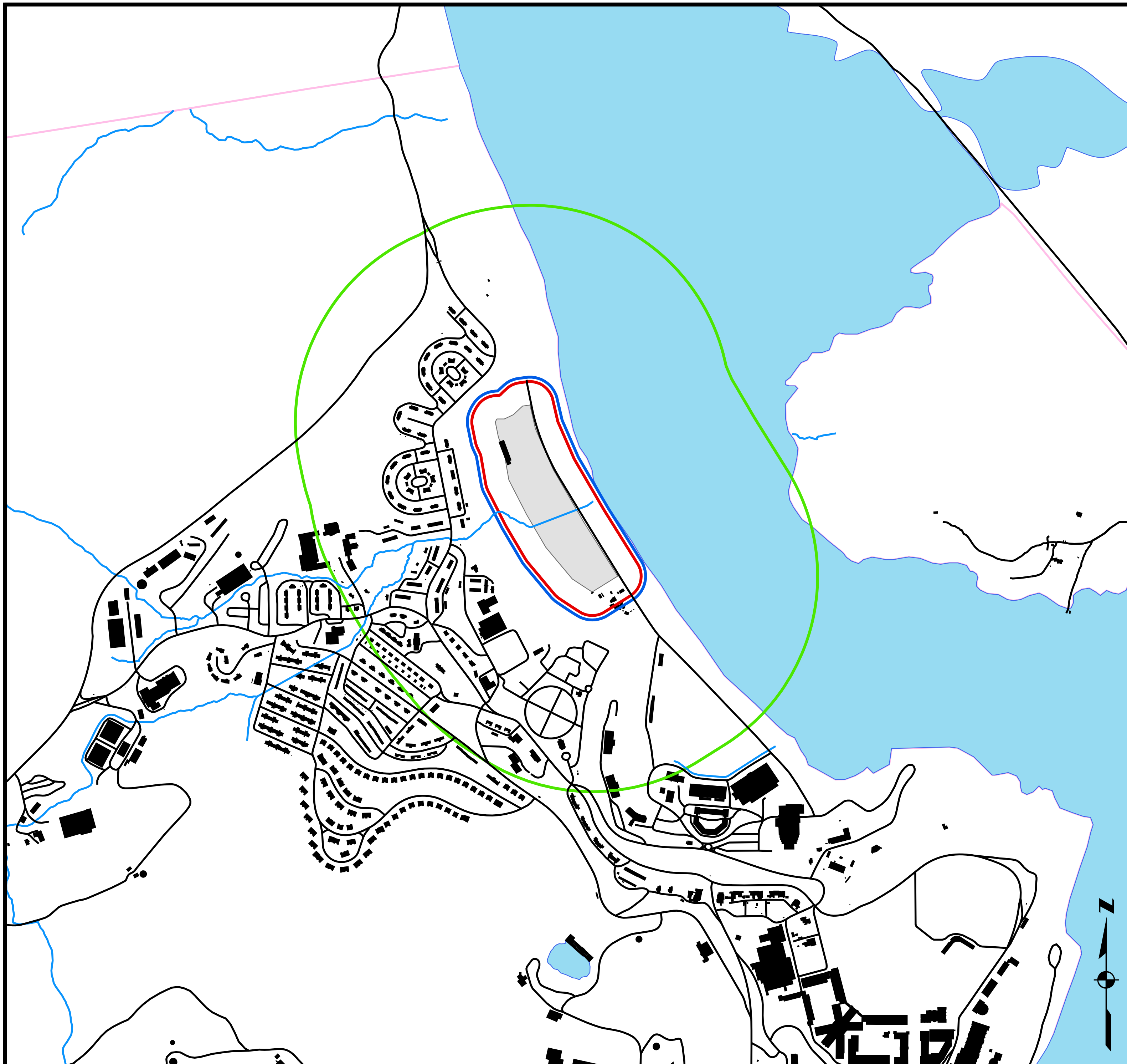
Legend

HFD 219 ft

Intentional Detonation w/o Engineering Controls 1346 ft

Intentional Detonation with Engineering Controls 200 ft

3 in Stokes HE



USMA
West Point, NY

US Army Corps of Engineers

Figure 10.
Target Hill

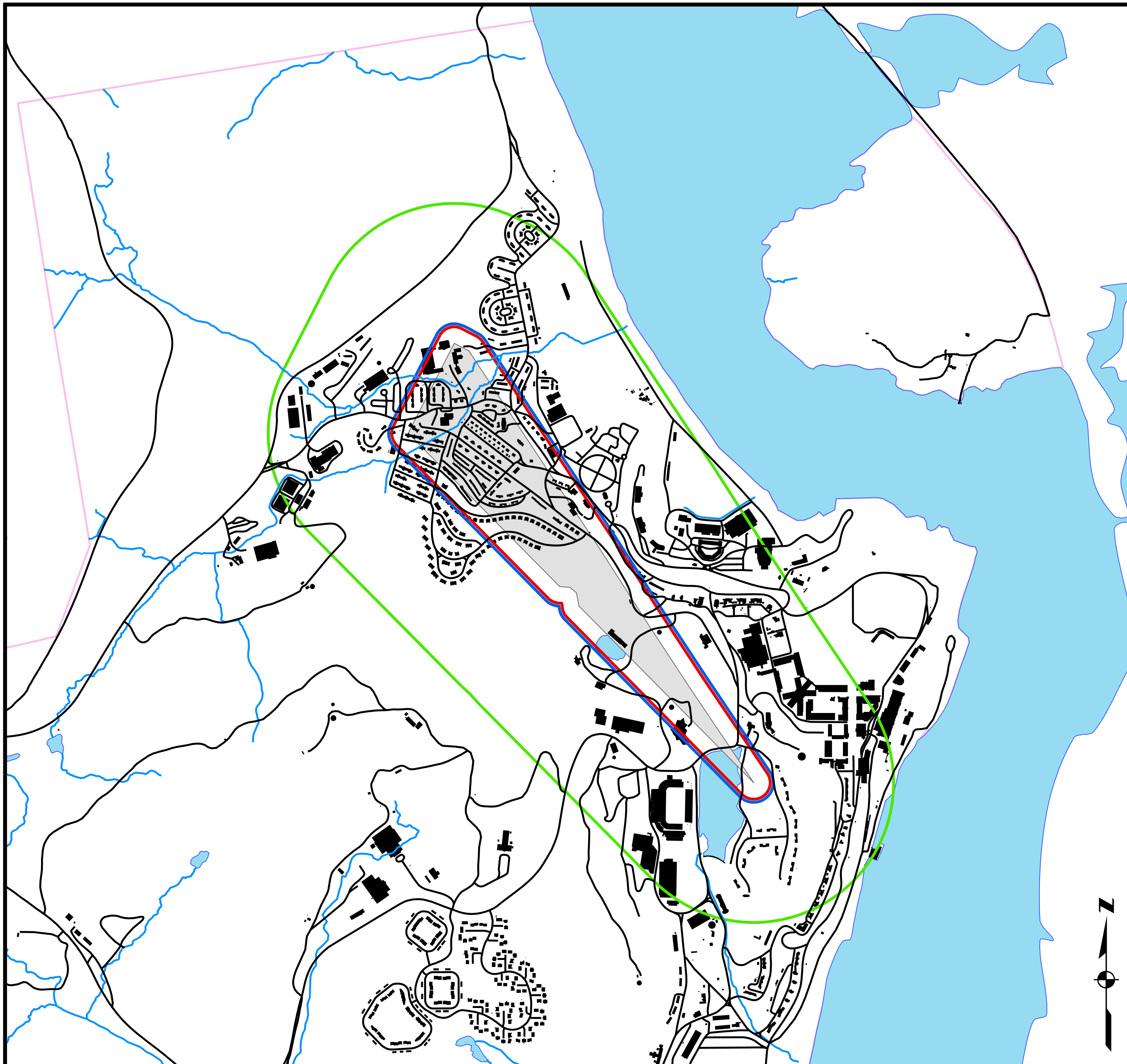
Legend

HFD 238 ft

Intentional Detonation w/o Engineering Controls 1702 ft

Intentional Detonation with Engineering Controls 200 ft

75mm HE



USMA
West Point, NY

US Army Corps of Engineers

Figure 11.
Lusk Reservoir

Legend

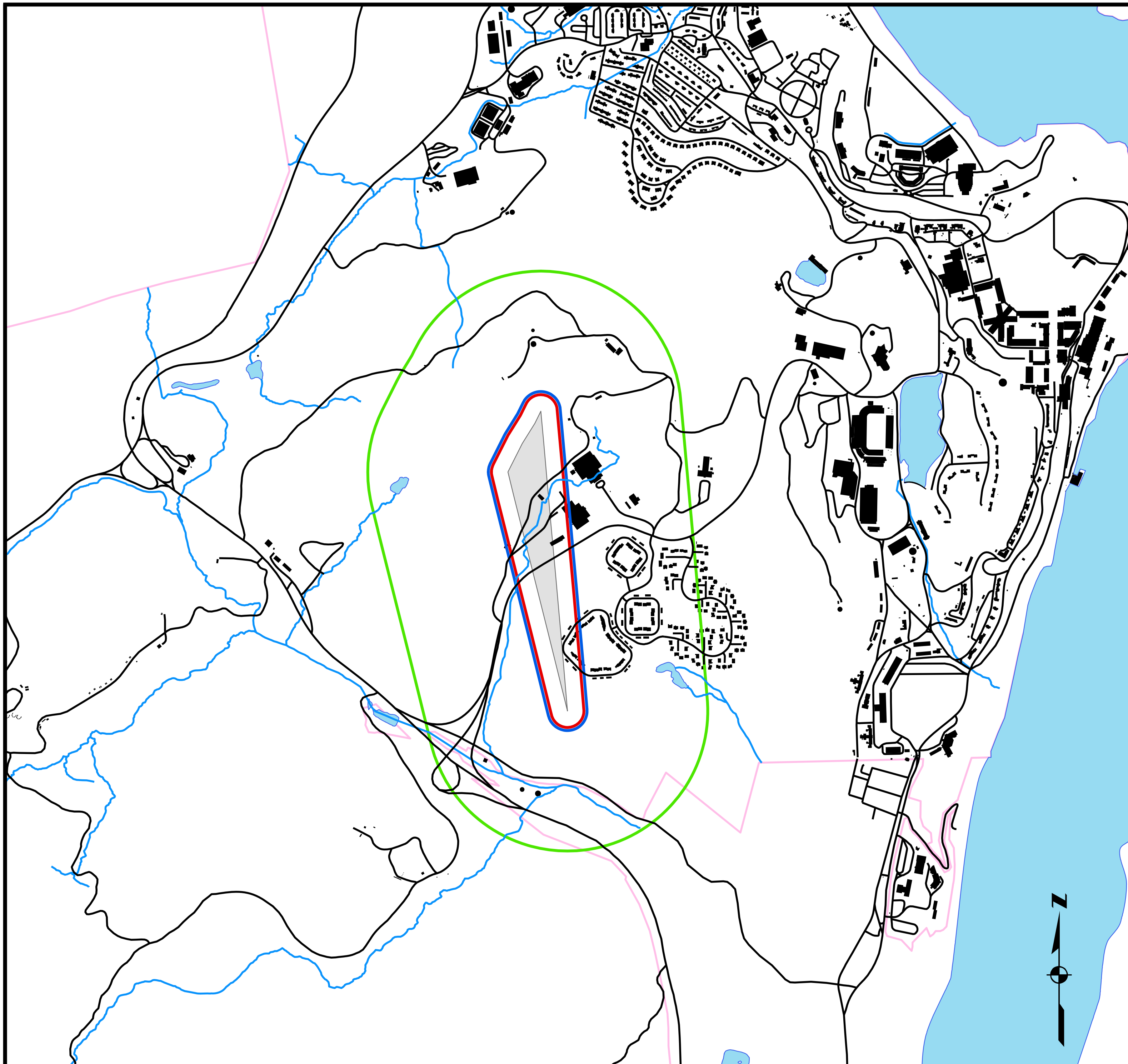
HFD 238 ft

Intentional Detonation w/o Engineering Controls 1702 ft

Intentional Detonation with Engineering Controls 200 ft

75mm HE

0 1,000 2,000
Feet



USMA
West Point, NY

US Army Corps of Engineers

Figure 12.
Redoubt No. 2

Legend

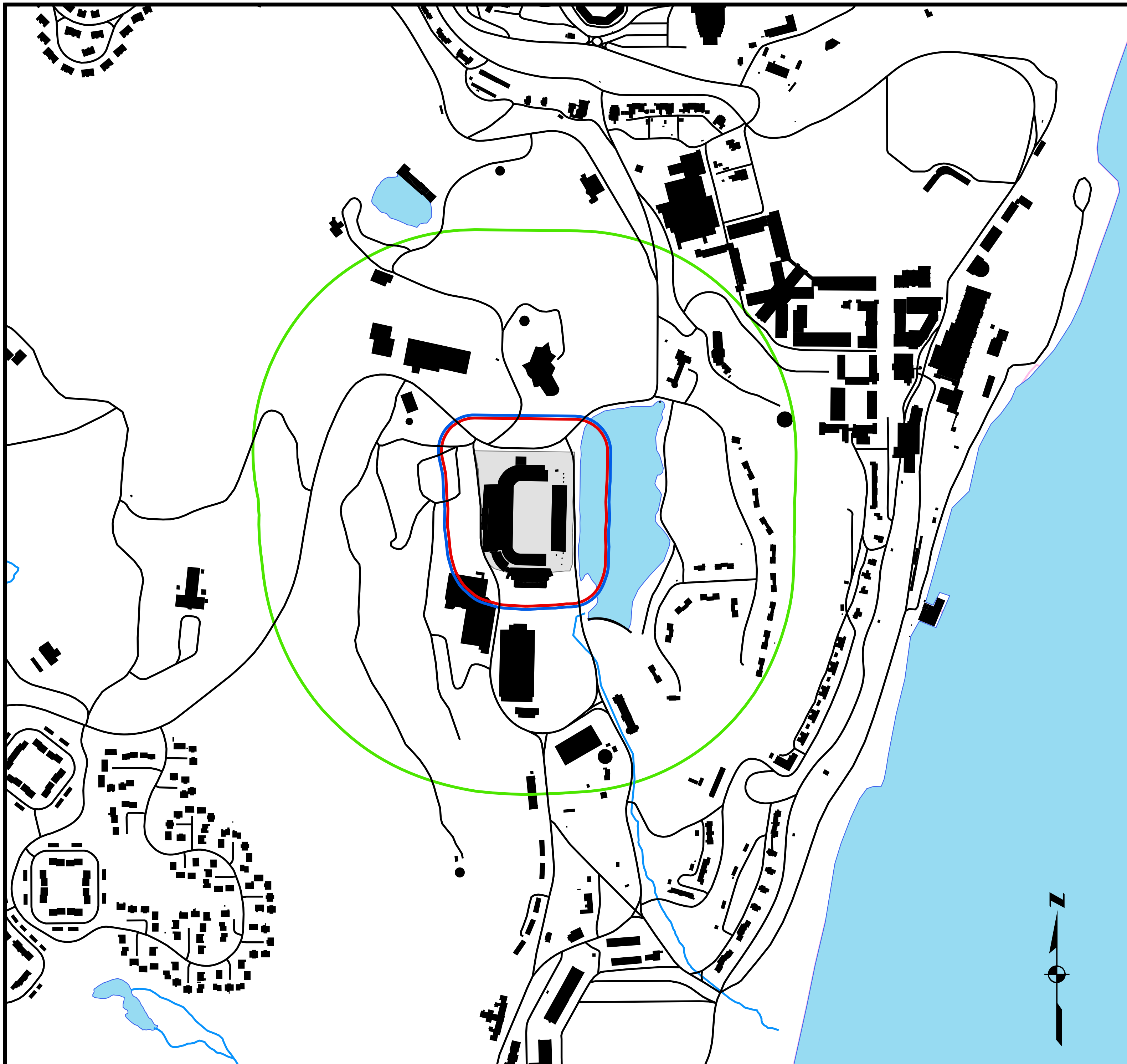
HFD 238 ft

Intentional Detonation w/o Engineering Controls 1702 ft

Intentional Detonation with Engineering Controls 200 ft

75mm HE

0 1,000 2,000 Feet



USMA
West Point, NY

US Army Corps of Engineers

Figure 13.
Michie Stadium

Legend

HFD 219 ft

Intentional Detonation w/o Engineering Controls 1346 ft

Intentional Detonation with Engineering Controls 200 ft

3 in Stokes HE

0 500 1,000
Feet

APPENDIX B

FRAGMENTATION DATA CALCULATION SHEETS

FRAGMENTATION DATA REVIEW FORM

Database Revision Date 8/15/09

Category:	HE Rounds	DODIC:	
Munition:	75 mm Mk I	Date Record Created:	7/30/2004
		Last Date Record Updated:	7/30/2004
Primary Database Category:	projectile	Individual Last Updated Record:	Crull
Secondary Database Category:	75 mm	Date Record Retired:	
Munition Case Classification:	Robust		

Munition Information and Fragmentation Characteristics

Explosive Type:	TNT
Explosive Weight (lb):	1.64000
Diameter (in):	2.9528
Max Fragment Weight (lb):	0.153065
Critical Fragment Velocity (fps):	3479

Theoretical Calculated Fragment Range

HFD [Distance to No More Than 1 Hazardous Fragment per 600 Square Feet] (ft):	238
MFD-V [Vertical Distance of Max Weight Fragment] (ft):	1298
MFD-H [Horizontal Distance of Maximum Weight Fragment] (ft):	1702

Overpressure Distances

Inhabited Building Distance (12 psi), K40 Distance:	50
Inhabited Building Distance (09 psi), K50 Distance:	63
Intentional MSD (0065 psi), K328 Distance:	411

Minimum Thickness to Prevent Perforation

4000 psi Concrete (Prevent Spall):	3.77
Mild Steel:	0.73
Hard Steel:	0.60
Aluminum:	1.50
LEXAN:	4.88
Plexi-glass:	3.31
Bullet Resist Glass:	2.71

Required Sandbag Thickness

Max Fragment Weight (lb)SB:	0.153065
Critical Fragment Velocity (fps)SB:	3479
Kinetic Energy 106 (lb-ft2/s2)SB:	0.9263
Required Wall Roof Sandbag Thickness (in)SB:	24
Expected Maximum Sandbag Throw Distance (ft)SB:	125
Minimum Separation Distance (ft)SB:	200

Water Containment System and Minimum Separation Distance:

Max Fragment Weight (lb)W:	0.153065
Critical Fragment Velocity (fps)W:	3479
Kinetic Energy 106 (lb-ft2/s2)W:	0.9263
Water Containment System:	1100 gal tank
Minimum Separation Distance (ft)W:	200

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FRAGMENTATION DATA REVIEW FORM

Database Revision Date 8/15/09

Category:	Black Powder Roun
Munition:	8" Parrott
Primary Database Category:	projectile
Secondary Database Category:	8 in
Munition Case Classification:	Extremely Heavy C
DODIC:	
Date Record Created:	7/30/2004
Last Date Record Updated:	7/11/2007
Individual Last Updated Record:	Crull
Date Record Retired:	

Munition Information and Fragmentation Characteristics

Explosive Type:	Black Powder
Explosive Weight (lb):	2.00000
Diameter (in):	8.0000
Max Fragment Weight (lb):	5.879073
Critical Fragment Velocity (fps):	705

Theoretical Calculated Fragment Range

HFD [Distance to No More Than 1 Hazardous Fragment per 600 Square Feet] (ft):	197
MFD-V [Vertical Distance of Max Weight Fragment] (ft):	1822
MFD-H [Horizontal Distance of Maximum Weight Fragment] (ft):	2620

Overpressure Distances

Inhabited Building Distance (12 psi), K40 Distance:	39
Inhabited Building Distance (09 psi), K50 Distance:	49
Intentional MSD (0065 psi), K328 Distance:	324

Minimum Thickness to Prevent Perforation

4000 psi Concrete (Prevent Spall):	4.88
Mild Steel:	0.53
Hard Steel:	0.43
Aluminum:	0.99
LEXAN:	4.94
Plexi-glass:	3.42
Bullet Resist Glass:	3.04

Required Sandbag Thickness

Max Fragment Weight (lb)SB:	5.879073
Critical Fragment Velocity (fps)SB:	705
Kinetic Energy 106 (lb-ft2/s2)SB:	1.4610
Required Wall Roof Sandbag Thickness (in)SB:	36
Expected Maximum Sandbag Throw Distance (ft)SB:	220
Minimum Separation Distance (ft)SB:	220

Water Containment System and Minimum Separation Distance:

Max Fragment Weight (lb)W:	5.879073
Critical Fragment Velocity (fps)W:	705
Kinetic Energy 106 (lb-ft2/s2)W:	1.4610
Water Containment System:	1100 gal tank
Minimum Separation Distance (ft)W:	275

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FRAGMENTATION DATA REVIEW FORM

Database Revision Date 8/15/09

Category:	HE Rounds	DODIC:	
Munition:	3" Stokes	Date Record Created:	7/30/2004
		Last Date Record Updated:	7/30/2004
Primary Database Category:	mortar	Individual Last Updated Record:	Crull
Secondary Database Category:	3 in	Date Record Retired:	
Munition Case Classification:	Robust		

Munition Information and Fragmentation Characteristics

Explosive Type:	TNT
Explosive Weight (lb):	2.10000
Diameter (in):	3.0000
Max Fragment Weight (lb):	0.043600
Critical Fragment Velocity (fps):	6189

Theoretical Calculated Fragment Range

HFD [Distance to No More Than 1 Hazardous Fragment per 600 Square Feet] (ft):	219
MFD-V [Vertical Distance of Max Weight Fragment] (ft):	1071
MFD-H [Horizontal Distance of Maximum Weight Fragment] (ft):	1346

Overpressure Distances

Inhabited Building Distance (12 psi), K40 Distance:	54
Inhabited Building Distance (09 psi), K50 Distance:	68
Intentional MSD (0065 psi), K328 Distance:	446

Minimum Thickness to Prevent Perforation

4000 psi Concrete (Prevent Spall):	3.73
Mild Steel:	0.68
Hard Steel:	0.56
Aluminum:	1.46
LEXAN:	4.38
Plexi-glass:	2.87
Bullet Resist Glass:	2.26

Required Sandbag Thickness

Max Fragment Weight (lb)SB:	0.043600
Critical Fragment Velocity (fps)SB:	6189
Kinetic Energy 106 (lb-ft2/s2)SB:	0.8350
Required Wall Roof Sandbag Thickness (in)SB:	24
Expected Maximum Sandbag Throw Distance (ft)SB:	125
Minimum Separation Distance (ft)SB:	200

Water Containment System and Minimum Separation Distance:

Max Fragment Weight (lb)W:	0.043600
Critical Fragment Velocity (fps)W:	6189
Kinetic Energy 106 (lb-ft2/s2)W:	0.8350
Water Containment System:	1100 gal tank
Minimum Separation Distance (ft)W:	200

Print This Form Close Form

APPENDIX N – NEW YORK NATURAL HERITAGE PROGRAM REPORT

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
Division of Fish, Wildlife & Marine Resources
New York Natural Heritage Program
625 Broadway, 5th Floor, Albany, New York 12233-4757
Phone: (518) 402-8935 • **Fax:** (518) 402-8925
Website: www.dec.ny.gov

December 29, 2010

John Gerhard
Weston Solutions, Inc
1400 Weston Way
West Chester, PA 19380

Dear Mr. Gerhard:

In response to your recent request, we have reviewed the New York Natural Heritage Program database with respect to an Environmental Assessment of the proposed Remedial Investigations – Military Munitions Response Program – West Point and 11 Munitions Response Sites, locations as indicated on the map you provided, located in Highlands and Philipstown, Orange and Putnam Counties.

Enclosed is a report of rare or state-listed animals and plants, significant natural communities, and other significant habitats, which our databases indicate occur, or may occur, on your site o r in the immediate vicinity of your site. For most sites, comprehensive field surveys have not been conducted; the enclosed report only includes records from our databases. We cannot provide a definitive statement as to the presence or absence of all rare or state-listed species or natural communities. This information should not be substituted for on-site surveys that may be required for environmental impact assessment.
PLEASE NOTE: Some Project Sites are NEAR Hudson Highlands and Storm King New York State Parks.

The enclosed report may be included in documents that will be available to the public. However, any enclosed maps displaying locations of rare species are considered sensitive information, and are intended only for the internal use of the recipient; they should not be included in any document that will be made available to the public, without permission from the New York Natural Heritage Program.

The presence of the plants and animals identified in the enclosed report may result in this project requiring additional review or permit conditions. For further guidance, and for information regarding other permits that may be required under state law for regulated areas or activities (e.g. regulated wetlands), please contact the appropriate NYS DEC Regional Office, Division of Environmental Permits, as listed at www.dec.ny.gov/about/39381.html.

1341

This project location is adjacent to a designated Significant Coastal Fish and Wildlife Habitat. This habitat is part of New York State's Coastal Management Program (CMP), which is administered by the NYS Department of State (DOS). Projects which may impact the habitat are reviewed by DOS for consistency with the CMP. For more information regarding this designated habitat and applicable consistency review requirements, please contact:

Jeff Zappieri - (518) 474-6000P
NYS Department of State
Office Coastal, Local Government and Community Sustainability
1 Commerce Plaza, 99 Washington Avenue,
Albany, NY 12231

Our databases are continually growing as records are added and updated. If this proposed project is still under development one year from now, we recommend that you contact us again so that we may update this response with the most current information.

Sincerely,
Tara Salerno sp
Tara Salerno, Information Services
New York Natural Heritage Program

\# 1341

Enc.
cc: Reg. 3
Shaun Keeler, Bureau of Fisheries, Albany
Tom Lyons, NYS OPRHP, Empire State Pl, Bldg #1, 17th Floor, Albany, 12238

[Type text]

Natural Heritage Report on Rare Species

NY Natural Heritage Program, NYS DEC, 625 Broadway, 5th Floor, Albany, NY
12233-4757
(518) 402-8935

~The information in this report includes only records entered into the NY Natural Heritage databases as of the date of the report. This report is not a definitive statement on the presence or absence of all rare species or significant natural communities at or in the vicinity of this site.
~Refer to the User's Guide for explanations of codes, ranks and fields.
~We do not provide maps for species most vulnerable to disturbance.

Natural Heritage Report on Rare Species and Ecological Communities

REPTILES

					Office Use
Crotalus horridus **Timber Rattlesnake**	**NY Legal Status:**	Threatened	**NYS Rank:**	S3 - Vulnerable	7891
	Federal Listing:		**Global Rank:**	G4 - Apparently secure	ESU
	County:	Orange			
	Town:	Highlands			
	Location:	There are **two documented** locations within 1.5 miles of the project site. Animals can move 1.5 miles or more from documented locations. For information on the population at this location and management considerations, please contact the NYS DEC Regional Wildlife Manager for the Region where the project is located.			

1 Records Processed

More detailed information about many of the rare and listed animals in New York, including biology, identification, habitat, conservation, and management, are available online in Natural Heritage's Conservation Guides at www.acris.nynhp.org, from NatureServe Explorer at http://www.natureserve.org/explorer, and from NYSDEC at http://www.dec.ny.gov/animals/7494.html.

NY Natural Heritage Program, NYS DEC, 625 Broadway, 5th Floor, Albany, NY
12233-4757
(518) 402-8935

-The information in this report includes only records entered into the NY Natural Heritage databases as of the date of the report. This report is not a definitive statement on he presence or absence of all rare species or significant natural communities at or in the vicinity of this site.
-Refer to the User's Guide for explanations of codes, ranks and fields.
-Location maps for certain species and communities may not be provided 1) if the species is vulnerable to disturbance, 2) if the location and/or extent is not precisely known, 3) if the location and/or extent is too large to display, and/or 4) if the animal is listed as Endangered or Threatened by New York State.

Natural Heritage Report on Rare Species and Ecological Communities

ꞁIRDS

Haliaeetus leucocephalus

Office Use

Bald Eagle Nonbreeding

NY Legal Status:	Threatened	**NYS Rank:**	S2S3B,S2N - Imperiled	5782
Federal Listing:		**Global Rank:**	G5 - Secure	ESU
Last Report:	**	**EO Rank:**	**	
County:	Putnam			S
Town:	Philipstown			
Location:	At, or in the vicinity of, the project site.			
General Quality and Habitat:	**For information on the population at this location and management considerations, please contact the NYS DEC Regional Wildlife Manager for the Region where the project is located.			

Ixobrychus exilis

Office Use

Least Bittern Breeding

NY Legal Status:	Threatened	**NYS Rank:**	S3B,S1N - Vulnerable	8769
Federal Listing:		**Global Rank:**	G5 - Secure	ESU
Last Report:	**	**EO Rank:**	**	
County:	Putnam			
Town:	Philipstown			
Location:	At, or in the vicinity of, the project site.			
General Quality and Habitat:	**For information on the population at this location and management considerations, please contact the NYS DEC Regional Wildlife Manager for the Region where the project is located.			

꞉OMMUNITIES

Cliff community

This occurrence of Cliff Community is considered significant from a statewide perspective by the NY Natural Heritage Program. It is either an occurrence of a community type that is rare in the state or a high quality example of a more common community type. By meeting specific, documented significance criteria, the NY Natural Heritage Program considers this occurrence to have high ecological and conservation value.

Office Use

NY Legal Status:	Unlisted	**NYS Rank:**	S4	1849
Federal Listing:		**Global Rank:**	G5	
Last Report:	1994-10-14	**EO Rank:**		
County:	Putnam			S
Town:	Philipstown			
Location:	Constitution Island			
General Quality and Habitat:	The occurrence is small, but in excellent condition, and unusually large for a Hudson River island, undisturbed except for a navigation light tower. Granite/gneiss cliff on an island on the east side of the Hudson River, with 50-100 feet nearly vertical cliffs, and dwarf trees and shrubs in crevices and ledges. Cliff extends to Hudson River intertidal shore on west, and is surrounded by chestnut oakforest and pitch pine-oak-heath rocky summits to the north and east, and grades into gentler slopes with talus slope woodland to the south.			

Pitch pine-oak-heath rocky summit

This occurrence of Pitch Pine-Oak-Heath Rocky Summit is considered significant from a statewide perspective by the NY Natural Heritage Program. It is either an occurrence of a community type that is rare in the state or a high quality example of a more common community type. By meeting specific, documented significance criteria, the NY Natural Heritage Program considers this occurrence to have high ecological and conservation value.

Office Use

NY Legal Status: Unlisted | **NYS Rank:** S3S4 | 7905
Federal Listing: | **Global Rank:** G4
Last Report: 1994-07-17 | **EO Rank:**
S
County: Putnam
Town: Philipstown
Location: Constitution Island
General Quality and Habitat: Somewhat small area, mature, in good condition, some crests are undisturbed. A low diversity pine, oak, and heath community on granite or gneiss of the highest ridges of an island in the Hudson River. There are small patches of bare rock areas that are like pavement interspersed with the vegetation or along cliff edges. The community occurs in a mosaic with chestnut oak forest, oak-hemlock forest, and swamp.

Pitch pine-oak-heath rocky summit

This occurrence of Pitch Pine-Oak-Heath Rocky Summit is considered significant from a statewide perspective by the NY Natural Heritage Program. It is either an occurrence of a community type that is rare in the state or a high quality example of a more common community type. By meeting specific, documented significance criteria, the NY Natural Heritage Program considers this occurrence to have high ecological and conservation value.

Office Use

NY Legal Status: Unlisted | **NYS Rank:** S3S4 | 6745
Federal Listing: | **Global Rank:** G4
Last Report: 1998-07-02 | **EO Rank:**
County: Orange
Town: Highlands
Location: Crows Nest
General Quality and Habitat: Moderate size area in excellent condition, with minor disturbances. An open canopy pine barrens on an exposed rocky hilltop with dense scrub oak layer; heaths and grasses increase at edges of rocky openings, on this rocky hill along western shore of the Hudson River.

Appalachian oak-hickory forest

This occurrence of Appalachian Oak-Hickory Forest is considered significant from a statewide perspective by the NY Natural Heritage Program. It is either an occurrence of a community type that is rare in the state or a high quality example of a more common community type. By meeting specific, documented significance criteria, the NY Natural Heritage Program considers this occurrence to have high ecological and conservation value.

Office Use

NY Legal Status: Unlisted | **NYS Rank:** S4 | 4591
Federal Listing: | **Global Rank:** G4G5
Last Report: 1998-08-21 | **EO Rank:**
County: Orange
Town: Highlands
Location: West Point
General Quality and Habitat: The forest has good species composition, few exotics, and is a well protected, small- to medium-sized community. Some successional vegetation suggests past logging. A system of granitic ridges bordering the Hudson River with some areas of limestone. There is a broad range of natural communities on the lower slopes and talus with chestnut oak forest dominant. Hemlock-northern hardwoods, oak-tulip tree forest, and beech-maple mesic forest also occur. This community of Appalachian oak-hickory forest community occurs as a mosaic with red cedar rocky summit and rocky summit grassland. This community is a closed to semi-open oak-hickory forest with scattered rocky openings with many grasses, scrub oak and heath shrubs on upper slopes of rocky hill along west shore of the Hudson River. A television tower access road crosses through the forest.

Oak-tulip tree forest

This occurrence of Oak-Tulip Tree Forest is considered significant from a statewide perspective by the NY Natural Heritage Program. It is either an occurrence of a community type that is rare in the state or a high quality example of a more common community type. By meeting specific, documented significance criteria, the NY Natural Heritage Program considers this occurrence to have high ecological and conservation value.

Office Use

2258

NY Legal Status: Unlisted
NYS Rank: S2S3
Federal Listing:
Global Rank: G4
Last Report: 1998-10-30
EO Rank:
County: Orange
Town: Cornwall, Highlands
Location: Black Rock Forest
General Quality and Habitat: This is a large size intact landscape. Young to mature forest with very few (<1%) exotic species. Final classification may effect rank. This community would be more accurately defined within the red oak-sugar maple alliance of the national classification. The community occurs as a mosaic dominated by red oak and sugar maple, but includes pockets of true, mature, beech-maple mesic forestas well as oak-tulip tree forest. The community is found at the site at lower elevations in areas with moister, deeper soils. The community is generally adjacent to chestnut oak forest on the dryer higher elevations. The community is adjacent to and transitional with hemlock northern hardwood forests in north-facing ravines. There are small (approximately 10 acre) patches of successional northern hardwoods within the forest.

Acidic talus slope woodland

This occurrence of Acidic Talus Slope Woodland is considered significant from a statewide perspective by the NY Natural Heritage Program. It is either an occurrence of a community type that is rare in the state or a high quality example of a more common community type. By meeting specific, documented significance criteria, the NY Natural Heritage Program considers this occurrence to have high ecological and conservation value.

Office Use

4347

NY Legal Status: Unlisted
NYS Rank: S3
Federal Listing:
Global Rank: G4?
Last Report: 1998-10-30
EO Rank:
County: Orange
Town: Highlands
Location: Black Rock Forest
General Quality and Habitat: Very large size, large contiguous talus slope. Mature forest with large trees. Good landscape context, well protected, good species composition. Few exotics. This community occupies the lower slope of a rocky hill that is part of a larger system of rock ridges. The slope descends to the east toward the Hudson River. Above the talus are cliffs and upper slopes with Appalachian oak-hickory forest, red cedar rocky summit and rocky summit grassland patches. Above this is the broad, outer summit with chestnut oak forest and pine-oak heath rocky summit at the top. Below the acidic talus slope woodlands are steep slopes with little exposed rock and a oak-tulip tree or hemlock-northern hardwood forest. There are several summit knolls and one permanent stream (Cascade Brook) along the slope. There are many vernal pools in low vales between the knolls.

Appalachian oak-hickory forest

This occurrence of Appalachian Oak-Hickory Forest is considered significant from a statewide perspective by the NY Natural Heritage Program. It is either an occurrence of a community type that is rare in the state or a high quality example of a more common community type. By meeting specific, documented significance criteria, the NY Natural Heritage Program considers this occurrence to have high ecological and conservation value.

Office Use

3748

NY Legal Status: Unlisted
NYS Rank: S4
Federal Listing:
Global Rank: G4G5
Last Report: 1998-07-30
EO Rank:
County: Orange
Town: Highlands
Location: Black Rock Forest
General Quality and Habitat: The forest is fairly small, has good species composition, has few exotics, and is well protected. A system of granitic ridges bordering the Hudson River with some areas of limestone-type rock. Ridges have intervening valleys of varying slope and depth. There are many bedrock exposures, boulders and scree. The lower slopes have talus. Most of the area is forested. The most common forest types are chestnut oak, Appalachian oak-hickory and maple-dominated (beech-maple and maple-basswood). Summits of ridges are a mosaic of rocky summit grassland, red cedar rocky summit and oak woodland natural communities.

Red cedar rocky summit

This occurrence of Red Cedar Rocky Summit is considered significant from a statewide perspective by the NY Natural Heritage Program. It is either an occurrence of a community type that is rare in the state or a high quality example of a more common community type. By meeting specific, documented significance criteria, the NY Natural Heritage Program considers this occurrence to have high ecological and conservation value.

Office Use 1461

NY Legal Status: Unlisted
NYS Rank: S3
Federal Listing:
Global Rank: G3G4
Last Report: 1998-07-30
EO Rank:
County: Orange
Town: Highlands
Location: Black Rock Forest
General Quality and Habitat: The community is fairly large-sized and undisturbed, but subject to occasional fires. There is good landscape context and few exotics. A system of granitic ridges bordering the Hudson River with some areas of circumneutral rock. Ridges have intervening valleys of varying slope and depth. There are many bedrock exposures, boulders and scree. The lower slopes have talus. Most of the areais forested. The most common forest types are chestnut oak, Appalachian oak-hickory and maple-dominated (beech-maple and maple-basswood). Summits of ridges are a mosaic of rocky summit grassland, red cedar rocky summit and oak woodland natural communities.

Rocky summit grassland

This occurrence of Rocky Summit Grassland is considered significant from a statewide perspective by the NY Natural Heritage Program. It is either an occurrence of a community type that is rare in the state or a high quality example of a more common community type. By meeting specific, documented significance criteria, the NY Natural Heritage Program considers this occurrence to have high ecological and conservation value.

Office Use 9242

NY Legal Status: Unlisted
NYS Rank: S3
Federal Listing:
Global Rank: G3G4
Last Report: 1998-08-21
EO Rank:
County: Orange
Town: Highlands
Location: Crows Nest
General Quality and Habitat: Very high quality despite some invasives (inevitable in a habitat subject to natural disturbances and vegetational shifts). A system of granitic ridges bordering the Hudson River with some areas of limestone. There is a broad range of natural communities on the lower slopes and talus with acidic talus slope woodland and chestnut oak forest dominant. Hemlock-northern hardwoods, oak-tulip tree forest, appalchian oak-hickory, beech-maple mesic forest and others also occur. This example of rocky summit grassland occurs as a mosaic with red cedar rocky summit on a steep slope rather than on the ridge top itself.

Red cedar rocky summit

This occurrence of Red Cedar Rocky Summit is considered significant from a statewide perspective by the NY Natural Heritage Program. It is either an occurrence of a community type that is rare in the state or a high quality example of a more common community type. By meeting specific, documented significance criteria, the NY Natural Heritage Program considers this occurrence to have high ecological and conservation value.

Office Use 9244

NY Legal Status: Unlisted
NYS Rank: S3
Federal Listing:
Global Rank: G3G4
Last Report: 1998-08-21
EO Rank:
County: Orange
Town: Highlands
Location: West Point
General Quality and Habitat: Relatively large, very high quality despite some invasives (inevitable in a habitat subject to natural disturbances and vegetational shifts). Mature community with cycles of woody die-back and regeneration. Community now has a low number of live cedars.Unusually steep slopes within this natural community complex. No human disturbance. Excellent landscape context. A system of granitic ridges bordering the Hudson River with some areas of limestone. There is a broad range of natural communities on the lower slopes and talus with chestnut oak forest dominant. Hemlock-northern hardwoods, oak-tulip tree forest, appalchian oak-hickory, beech-maple mesic forest and others also occur. This community of red cedar rocky summit occurs as a mosaic with rocky summit grassland on a steep slope rather than on the ridge top itself.

Chestnut oak forest

This occurrence of Chestnut Oak Forest is considered significant from a statewide perspective by the NY Natural Heritage Program. It is either an occurrence of a community type that is rare in the state or a high quality example of a more common community type. By meeting specific, documented significance criteria, the NY Natural Heritage Program considers this occurrence to have high ecological and conservation value.

Office Use

5150

NY Legal Status: Unlisted
NYS Rank: S4
Federal Listing:
Global Rank: G5
Last Report: 1998-10-30
EO Rank:
County: Orange
Town: Cornwall, Highlands
Location: Black Rock Forest
General Quality and Habitat: Large size, relatively undisturbed, approaching mature forest, in an extensive, relatively undisturbed landscape. This community is the matrix forest community at mid to upper elevations. At lower elevations beech-maple mesic and oak-tulip tree forests (red oak-sugar maple) occur, with hemlock-northern hardwood forest in the north-facing ravines. The rocky peaks among the chestnut oak forest have pitch pine-oak-heath rocky summit community. Several ponds and reservoirs occur within the forest, some with adjacent marsh areas. There is evidence of cutting throughout this forest, however much of it appears mature andhas not been cut in recent decades. There are very few exotic species except along woods roads. To the north and west occurs low density housing and rolling farmland. To the northeast is state park land, to the east and south is military academy land.

Chestnut oak forest

This occurrence of Chestnut Oak Forest is considered significant from a statewide perspective by the NY Natural Heritage Program. It is either an occurrence of a community type that is rare in the state or a high quality example of a more common community type. By meeting specific, documented significance criteria, the NY Natural Heritage Program considers this occurrence to have high ecological and conservation value.

Office Use

2820

NY Legal Status: Unlisted
NYS Rank: S4
Federal Listing:
Global Rank: G5
Last Report: 2000-10-19
EO Rank:
County: Orange, Rockland
Town: Cornwall, Haverstraw, Highlands, Ramapo, Stony Point, Tuxedo, Woodbury
Location: Harriman
General Quality and Habitat: An extremely large, predominantly mature forest with low disturbance in a relatively undisturbed landscape. This tremendous matrix forest blankets the majority of the Hudson Highlands in this region. Other communities embedded within this one include hemlock northern hardwood forest, beech maple mesic forest, pitch pine-oak-heath rocky summit, hemlock-hardwood swamp, red maple-hardwood swamp, highbush blueberry bog thicket, acidic talus slope woodland, rocky summit grassland, vernal pool, and Appalachian oak-hickory forest. In general, there are few exotic species in the heart of the chestnut oak forest patches. Heavily developed land is common just beyond the boundaries of this community.

Chestnut oak forest

This occurrence of Chestnut Oak Forest is considered significant from a statewide perspective by the NY Natural Heritage Program. It is either an occurrence of a community type that is rare in the state or a high quality example of a more common community type. By meeting specific, documented significance criteria, the NY Natural Heritage Program considers this occurrence to have high ecological and conservation value.

Office Use

8452

NY Legal Status: Unlisted
NYS Rank: S4
Federal Listing:
Global Rank: G5
Last Report: 2000-10-19
EO Rank:
County: Orange
Town: Cornwall, Highlands, Woodbury
Location: West Point
General Quality and Habitat: This is a large chestnut oak forest that is minimally disturbed by military activities and that is located in a relatively populated region yet has excellent quality natural communities both abutting and enveloped within this community. An extensive matrix forest covering nearly 60% of all land within the West Point Military Reservation. This chestnut oak forest is found most commonly on well drained slopes, but also occurs on rounded summits and valley floors where the soil remains well drained. Other communities surrounded by this matrix forest include hemlock hardwood swamp, acidic talus slope woodland, rocky summit grassland, vernal pool, hemlock northern hardwood forest, and red maple hardwood swamp. This forest joins additional chestnut oak forest to the north (Black Rock Forest) and the south (Harriman State Park) to create an truly extensive, interconnected matrix forest.

Brackish intertidal mudflats

This occurrence of Brackish Intertidal Mudflats is considered significant from a statewide perspective by the NY Natural Heritage Program. It is either an occurrence of a community type that is rare in the state or a high quality example of a more common community type. By meeting specific, documented significance criteria, the NY Natural Heritage Program considers this occurrence to have high ecological and conservation value.

Office Use

5755

NY Legal Status: Unlisted

Federal Listing:

Last Report: 2000-10-11

NYS Rank: S1S2

Global Rank: G3G4

EO Rank:

County: Putnam

Town: Philipstown

Location: Constitution Marsh

General Quality and Habitat: The mudflats community is a relatively large, good example with some exotic species. No Hudson River marsh is entirely unaffected or unaltered by human activity, historical or current. The artificial features at Constitution Marsh (i.e., the railroad berm and channelization) enhance the stability of the marsh and past disturbances are well healed by vegetational development. A sparsely vegetated community that occurs along the muddy, tidally influenced edges of a much larger Typha-dominated graminoid marsh. The brackish tidal marsh-brackish intertidal mudflats complex lies in a well-protected shallow inlet of the Hudson River estuary. Approximately 55% of the inlet is brackish tidal marsh and 45% consists of intertidal mudflats. Constitution Island to the west is mostly forested with chestnut oak forest and is bordered by a large shrub swamp that was likely part of the marsh prior to construction of the railroad grade that currently bisects the area. The southern half of the marsh grades into extensive mudflats and deeper water areas.

Brackish tidal marsh

This occurrence of Brackish Tidal Marsh is considered significant from a statewide perspective by the NY Natural Heritage Program. It is either an occurrence of a community type that is rare in the state or a high quality example of a more common community type. By meeting specific, documented significance criteria, the NY Natural Heritage Program considers this occurrence to have high ecological and conservation value.

Office Use

5374

NY Legal Status: Unlisted

Federal Listing:

Last Report: 2000-10-11

NYS Rank: S3S4

Global Rank: G4

EO Rank:

County: Putnam

Town: Philipstown

Location: Constitution Marsh

General Quality and Habitat: The marsh is a relatively large, good example with some exotic species. No Hudson River marsh is entirely unaffected or unaltered by human activity, historical or current. The artificial features at Constitution Marsh (i.e., the railroad berm and channelization) enhance the stability of the marsh and past disturbances are well healed by vegetational development. A Typha-dominated graminoid marsh with scattered sections of peltate-leaved vegetation and some shrubby areas. This tidal marsh lies in a well-protected shallow inlet of the Hudson River estuary. Approximately 55% of the inlet is brackish tidal marsh and 45% consists of intertidal mudflats. Constitution Island to the west is mostly forested with chestnut oak forest and is bordered by a large shrub swamp that was likely part of the marsh prior to construction of the railroad grade that currently bisectsthe area. The south half of the marsh grades into extensive mudflats and deeper water areas. Land along the east side of the marsh is forested (chestnut oak forest) and sloping, with many small intermittent streams that empty into the Hudson River.

DRAGONFLIES and DAMSELFLIES

Libellula needhami

					Office Use
Needham's Skimmer	NY Legal Status:	Unlisted	NYS Rank:	S2S3 - Imperiled	12401
	Federal Listing:		Global Rank:	G5 - Secure	
	Last Report:	2006-07-24	EO Rank:	Excellent or Good	
	County:	Putnam			
	Town:	Philipstown			
	Location:	Constitution Marsh			
	General Quality and Habitat:	The rank is based on the generic global ranking specifications of May 1, 2007. The population size is unknown, but suitable habitat is present in greater than 300 acres of tidal marsh. The entire marsh is protected and this population will likely persist well into the future. This is the northern portion of a brackish tidal marsh. This portion of the marsh had been a superfund site and was dredged and restored in the recent past. An area of open water, Foundry Cove, is present adjacent to the area where the odonates were observed and the main portion of Constitution Marsh is immediately to the south. The vegetation of the marsh is primarily cattail, with arrowhead, arrow arum, wild rice, swamp rose mallow, rushes, and other marsh vegetation present. The restored portion of the marsh has been invaded by purple loosestrife.			

FISH

Acipenser brevirostrum

					Office Use
Shortnose Sturgeon	NY Legal Status:	Endangered	NYS Rank:	S1 - Critically imperiled	1091
	Federal Listing:	Endangered	Global Rank:	G3 - Vulnerable	HRF BOF
	Last Report:	**	EO Rank:	**	USFWS
	County:	Albany, Bronx, Columbia, Dutchess, Greene, New York, Orange, Putnam, Rensselaer, Rockland,			
	Town:	Albany - City , Athens, Beacon -City, Bethlehem, Catskill, Clarkstown, Clermont, Coeymans, Colonie,			
	Location:	At, or in the vicinity of, the project site.			
	General Quality and Habitat:	Shortnose sturgeon are found in the long tidal portion of Hudson River. The river constitutes the lower part of a 315 mile stream system. It is fed upstream by two large main channel streams, which provide 80% of the freshwater input, and numerous other For more information, including management considerations, please contact the NYS DEC Hudson River Fisheries Unit at 845-256-3071.			

Acipenser oxyrinchus

					Office Use
Atlantic Sturgeon	NY Legal Status:	No Open Season	NYS Rank:	S1 - Critically imperiled	11464
	Federal Listing:	Candidate	Global Rank:	G3 - Vulnerable	HRF
	Last Report:	1997	EO Rank:	Excellent or Good	USFWS
	County:	Dutchess, Orange, Putnam, Rockland, Westchester			
	Town:	Beacon -City, Cornwall, Cortlandt, Fishkill, Highlands, New Windsor, Newburgh - City, Newburgh - Town,			
	Location:	Lower Hudson River			
	General Quality and Habitat:	The rank is based on the draft element global ranking form of 1994. The fish were observed in a river.			

Menidia menidia

					Office Use
Atlantic Silverside	NY Legal Status:	Unlisted	NYS Rank:	S2S3 - Imperiled	11813
	Federal Listing:		Global Rank:	G5 - Secure	
	Last Report:	1986-pre	EO Rank:	Extant	
	County:	Putnam			
	Town:	Philipstown			
	Location:	Constitution Marsh			
	General Quality and Habitat:	The fish were found in a marsh.			

MAMMALS

Myotis leibii

Office Use 1809

Eastern Small-footed Myotis
Maternity colony

NY Legal Status: Special Concern
NYS Rank: S2 - Imperiled
Federal Listing:
Global Rank: G3 - Vulnerable
Last Report: 2002-07-10
EO Rank: Extant
County: Putnam
Town: Philipstown
Location: At, or in the vicinity of, the project site.
General Quality and Habitat: **For information on the population at this location and management considerations, please contact the NYS DEC Regional Wildlife Manager for the Region where the project is located.

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Anadromous Fish Concentration Area

Office Use 607 S

NY Legal Status: Unlisted
NYS Rank: S3 - Vulnerable
Federal Listing:
Global Rank: GNR - Not ranked
Last Report: 1986
EO Rank: Extant
County: Putnam
Town: Philipstown
Location: Constitution Marsh
General Quality and Habitat: 400 acres wetland, tidal, brackish, freshwater, emergent marsh.

Waterfowl Winter Concentration Area

Office Use 1513 S

NY Legal Status: Unlisted
NYS Rank: S3S4 - Vulnerable
Federal Listing:
Global Rank: GNR - Not ranked
Last Report: 1986
EO Rank: Extant
County: Putnam
Town: Philipstown
Location: Constitution Marsh
General Quality and Habitat: 400 acre wetland, tidal, brackish, freshwater, emergent marsh.

Anadromous Fish Concentration Area

Office Use 9586 S

NY Legal Status: Unlisted
NYS Rank: S3 - Vulnerable
Federal Listing:
Global Rank: GNR - Not ranked
Last Report: 1986
EO Rank: Extant
County: Dutchess, Orange, Putnam, Rockland, Westchester
Town: Cornwall, Cortlandt, Fishkill, Highlands, Peekskill - City, Philipstown, Stony Point
Location: Hudson River Mile 44-56
General Quality and Habitat: The habitat is a 12 mile section of deep turbulent narrow river.

/ASCULAR PLANTS

Bidens laevis

Smooth Bur-marigold

NY Legal Status:	Threatened	**NYS Rank:**	S2 - Imperiled	Office Use 1716
Federal Listing:		**Global Rank:**	G5 - Secure	
Last Report:	2003-09-03	**EO Rank:**	Good	S
County:	Putnam			
Town:	Philipstown			
Location:	Constitution Marsh			
General Quality and Habitat:	Approximately 400 plants were observed in a well-protected and good quality marsh system. The plants are located in a brackish tidal marsh with other tall herbs adjacent to a tidal creek. The soils are mucky and are flooded with the tides. Nearby in the marsh are dense stands of Typha cf. angustifolia. There is no Bidens laevis or many otherherbs growing amongst these dense Typha patches. Mostly the Bidens laevis is in full sun, but in a few places the adjacent forested uplands shade some of the population at least during part of the day.			

Cardamine longii

Long's Bittercress

NY Legal Status:	Threatened	**NYS Rank:**	S2 - Imperiled	Office Use 391
Federal Listing:		**Global Rank:**	G3? - Vulnerable	
Last Report:	2003-08-14	**EO Rank:**	Good or Fair	
County:	Putnam			
Town:	Philipstown			
Location:	Constitution Island			
General Quality and Habitat:	A minimum of 75 plants are in a well protected tidal marsh complex. The plants are located in the intertidal area along tidal creeks/tributaries and bays of the Hudson River. The plants are located near the edge of the dense marsh vegetation of the marsh communities and into the more open mud flat communities. The plants occur on mucky soils over solid gravel. The area is completely open with no shrub or tree canopy. The herbaceous cover is moderate to sparse. Most of this area was subject to a major heavy metal cleanup project and the soils were completely removed.			

Carex cumulata

Clustered Sedge

NY Legal Status:	Threatened	**NYS Rank:**	S2S3 - Imperiled	Office Use 5204
Federal Listing:		**Global Rank:**	G4? - Apparently secure	
Last Report:	1997-08-25	**EO Rank:**	Good or Fair	S
County:	Putnam			
Town:	Philipstown			
Location:	Constitution Island			
General Quality and Habitat:	35 plants in expanding population. Rich rocky woodland: Along swamp outlet stream in rich oak woods.			

Carex straminea

Straw Sedge

NY Legal Status:	Endangered	**NYS Rank:**	S1 - Critically imperiled	Office Use 4364
Federal Listing:		**Global Rank:**	G5 - Secure	
Last Report:	1998-07-06	**EO Rank:**	Fair	S
County:	Orange			
Town:	Highlands			
Location:	Patrick Trail			
General Quality and Habitat:	There are approximately 50 plants in marginal unprotected habitat. 1998: successional old field type habitat associated with a powerline right-of-way, gravel road edges and marginal areas near athletic field and buildings. 1992: Hilltop with sandy gravelly loam in grassy [powerline] right-of-way bordering an oak woods.			

Carex striatula

Lined Sedge

Office Use 4834 S

NY Legal Status: Endangered
Federal Listing:
Last Report: 1994-06-19
County: Orange
Town: Highlands
Location: Crows Nest Creek
NYS Rank: S1 - Critically imperiled
Global Rank: G4G5 - Apparently secure
EO Rank: Fair
General Quality and Habitat: Fewer than 20 plants in protected habitat. Probably more plants downstream. Full extent of occurrence not determined. Deciduous rocky woodland in ravine and granite rocks with chestnut oak. Soil: rock outcrop-hollis complex.

Crassula aquatica

Water Pigmyweed

Office Use 3004 S

NY Legal Status: Endangered
Federal Listing:
Last Report: 1994-07-17
County: Putnam
Town: Philipstown
Location: Constitution Island
NYS Rank: S1 - Critically imperiled
Global Rank: G5 - Secure
EO Rank: Fair or Poor
General Quality and Habitat: Only a few plants in stressful environment, but habitat potential exists for additional populations. Intertidal rocky shore. Horizontal crack about 1.2 m long and 10-15 cm thick in rock outcrop (gneiss) in intertidal Hudson River. Soil is held in by small herbs. The inlet location is better protected from strong waves. West-facing.

Endodeca serpentaria

Virginia Snakeroot

Office Use 3158 S

NY Legal Status: Endangered
Federal Listing:
Last Report: 1998-07-21
County: Orange
Town: Highlands
Location: Black Rock Forest
NYS Rank: S2 - Imperiled
Global Rank: G4 - Apparently secure
EO Rank: Excellent or Good
General Quality and Habitat: There are approximately 100 plants scattered across two hillsides of a high quality chestnut oak forest in a well protected area. Chestnut oak forest with large patches of Carex pennsylvanica and rocky outcrops. The hillside slope has many large boulders and rock outcrops. These are surrounded by large stands of Carex pennsylvanica. Breaking up the sweep of green Carex pennsylvanica are islands of decomposing leaf litter. These leaves appear to be collecting in small basins where water may flow and collect. The aristolochia plants appear to be restricted to these moist basins. It appears that during rain fall and the spring melt,water moves across the surface of hillside and around the rocks until it finds a collection point where it may percolate into the soil below. At these collection points, fallen leaves from previous years are able to collect.

Lycopus rubellus

Gypsy-wort

Office Use 7723 S

NY Legal Status: Endangered
Federal Listing:
Last Report: 1995-su
County: Putnam
Town: Philipstown
Location: Constitution Island
NYS Rank: S1 - Critically imperiled
Global Rank: G5 - Secure
EO Rank: Poor
General Quality and Habitat: A few plants in precarious position. Growing in cracks of wooden posts and stone mortar wall of boat dock on the Hudson River.

Oxalis violacea

Violet Wood-sorrel

NY Legal Status:	Threatened	**NYS Rank:**	S2S3 - Imperiled	Office Use 9717
Federal Listing:		**Global Rank:**	G5 - Secure	
Last Report:	1994-05-24	**EO Rank:**	Fair	S
County:	Putnam			
Town:	Philipstown			
Location:	Constitution Island			
General Quality and Habitat:	Dense 1.5 Square meter patch of about 100 plants in rich woodland with disturbed understory. Rich woodland with disturbed understory, near high tide mark and higher.			

Pinus virginiana

Virginia Pine

NY Legal Status:	Endangered	**NYS Rank:**	S1 - Critically imperiled	Office Use 8275
Federal Listing:		**Global Rank:**	G5 - Secure	
Last Report:	1994-08-24	**EO Rank:**	Fair or Poor	S
County:	Orange			
Town:	Highlands			
Location:	Crows Nest			
General Quality and Habitat:	One mature tree and two saplings in natural habitat. Pitch pine-oak-heath rocky summit: summit of mountain with scrub oak barrens.			

Sagittaria montevidensis var. spongiosa

Spongy Arrowhead

NY Legal Status:	Threatened	**NYS Rank:**	S2 - Imperiled	Office Use 3176
Federal Listing:		**Global Rank:**	G5T4 - Apparently secure	
Last Report:	2003-09-09	**EO Rank:**	Excellent or Good	S
County:	Putnam			
Town:	Philipstown			
Location:	Constitution Marsh			
General Quality and Habitat:	There are estimated nearly 1000 plants scattered throughout a well-protected, good quality marsh complex. The plants are located on the exposed brackish intertidal mud flats near the low tide mark. This mudflat is located within a bay near the mouth of a tidal creek and adjacent to the tidal marsh communities. A few plants are located amoungst the taller herbaceous plants, but most plants are located in the open mudflats below high tide.			

Symphyotrichum subulatum var. subulatum

Saltmarsh Aster

NY Legal Status:	Threatened	**NYS Rank:**	S2 - Imperiled	Office Use 5475
Federal Listing:		**Global Rank:**	G5T5 - Secure	
Last Report:	2000-10-11	**EO Rank:**	Fair	
County:	Putnam			
Town:	Philipstown			
Location:	Constitution Marsh			
General Quality and Habitat:	This is a small population in a well-protected area with more available habitat to search. The first population is located within a sparsely vegetated rocky intertidal shore. The second population is located in a tall graminoid marsh with perhaps 40% Phragmites and 40% cattail dominance. The plants are located at the edge of the marsh along the bank of a tidal channel. The tidal channel is without shallow margins and emergent vegetation. The channel banks are abrupt with no evidence of disturbance (e.g., muskrat).			

NY Natural Heritage Program, NYS DEC, 625 Broadway, 5th Floor,
Albany, NY 12233-4757
(518) 402-8935

HISTORICAL RECORDS

The following plants and animals were documented in the vicinity of the project site at one time, but have not been documented there since 1979 or earlier, or there is uncertainty regarding their continued presence.
There is no recent information on these plants and animals in the vicinity of the project site and their current status there is unknown. In most cases the precise location of the plant or animal in this vicinity at the time it was last documented is also unknown and therefore location maps are generally not provided.
If appropriate habitat for these plants or animals is present in the vicinity of the project site, it is possible that they may still occur there.

Natural Heritage Report on Rare Species and Ecological Communities

VASCULAR PLANTS

Sabatia campanulata

Office Use 3437

Slender Marsh-pink

NY Legal Status: Endangered

NYS Rank: S1 - Critically imperiled

Federal Listing:

Global Rank: G5 - Secure

Last Report: no date

EO Rank: Historical, no recent information; Failed to find during most recent search

County: Putnam
Town: Philipstown
Location: Constitution Island
Directions: The plants were near the West Point foundry.
General Quality and Habitat: No plants were found.

Sisyrinchium mucronatum

Office Use 3425

Michaux's Blue-eyed-grass

NY Legal Status: Endangered

NYS Rank: S1 - Critically imperiled

Federal Listing:

Global Rank: G5 - Secure

Last Report: 1967-06-20

EO Rank: Historical, no recent information

County: Orange
Town: Cornwall, Highlands
Location: Black Rock Forest
Directions: Roadside bank, Black Rock Forest.
General Quality and Habitat: Roadside bank.

APPENDIX O – RESTORATION PROCEDURES

Soil Excavation and Restoration

<u>Excavation and Restoration at Target Hill and North Athletic Fields MRSs</u> - Turf shall be scored around the shape of the excavation with a square point shovel or similar tool. The turf shall be removed being sure to include the grasses fibrous roots. The turf shall be set aside on a tarp for reuse.

Soil shall be stockpiled on a tarp or similar device to prevent loss or damage to surrounding areas. The Contractor shall segregate excavated soils based on soil color and depth. When backfilling soil shall be replaced in the same order it was removed, compacting as necessary until the original grade is achieved. Excavations will be backfilled with the soil that was removed from the excavation. Soil from different excavations shall not be mixed with soil from other excavations. Sod will be reused on the excavation from which it was removed being sure the turf is at the same grade as the surrounding grass.

Excavations shall not be performed within 10 feet of the dripline of any trees. If an anomaly is identified within the dripline of a tree notify the USACE and the installation Agronomist for a determination on whether the anomaly will be excavated.

The contractor is responsible for 30 days after the excavation for ensuring the replanted sod survives. At the end of 30 days the sites will be inspected by the government. Any dead sod patches will be repaired with turf patch by the contractor at no additional cost to the government. The contractor shall get approval from the installation agronomist for the turf patch product used.

Protection of Existing Facilities - Protect landscaping structures, paving, monitoring wells and other features outside of the limits of the Work. Install barriers or grade the area surrounding the excavation to prevent the flow of surface water into the excavation. Provide fences, barricades or any other means necessary to protect the public from entering the work area or open excavations.

The Contractor shall restore objects or site features damaged by the work to a condition equivalent to pre-construction conditions. Replant salvaged vegetation, replace damaged vegetation with similar new plantings. Replace or restore other miscellaneous salvaged or damaged objects or site features, such as signs, planters, lighting, etc. that were disturbed because of the Work.

<u>Excavation and Restoration at Non-Athletic Field MRSs</u> – In wooded areas, detritus including leaf and root matter will be carefully set aside of the excavation for reuse. Soil shall be stockpiled on a tarp or similar device to prevent loss or damage to surrounding areas. Excavations shall be backfilled before moving to the next location and in the same day soil was removed. When backfilling, soil shall be replaced in the same order it was removed, compacting as necessary until the original grade is achieved. Excavations will be backfilled with the soil that was removed from the excavation. Soil from different excavations shall not be mixed with soil from other excavations. Once the excavation is backfilled, detritus shall be replaced over all exposed soil.

APPENDIX P – PROCEDURES FOR PROTECTION OF ARCHAEOLOGICAL OR HISTORICAL ARTIFACTS

USMA CRM STANDARD OPERATING PROCEDURE 16-1:

PROTECTION OF ARCHAELOGICAL OR HISTORICAL ARTIFACTS

DIRECTORATE OF HOUSING AND PUBLIC WORKS
UNITED STATES MILITARY ACADEMY
West Point, New York 10996-1592

MAENEN-CR — 29 September 1995
STANDING OPERATING
PROCEDURE NO. 16-1

PROTECTION OF ARCHAELOGICAL OR HISTORICAL ARTIFACTS

1. PURPOSE: To establish guidelines for protection and preservation of all archaeological and historical artifacts uncovered during any excavation, demolition, construction, maintenance, or other action that may expose artifacts.

2. OBJECTIVE: To protect archaeological and historical sites that may inadvertently be discovered, until they are examined by appropriate authorities.

3. SCOPE: This SOP applies to all divisions within the Directorate of Housing and Public Works (DHPW), contractors and/or others working for DHPW, and encompasses all work performed for and at the United States Military Academy (USMA).

4. DISCUSSION: An artifact is defined as any bone relic, memorabilia, or any item of historic or archaeological significance that is exposed through construction, demolition, excavation or maintenance procedures. Some examples of artifacts are: bones, printed matter or other papers, weapons, projectiles, arrowheads, sabers, uniform fragments, buttons, bottles, jars, pottery, tools, portions of, or rubble from structures that previously existed and any other items of historical or archaeological significance.

5. RESPONSIBILITIES:

a. All supervisors involved in any type of construction, demolition, excavation or maintenance of facilities should be aware of the procedures set forth in this SOP.

b. Each individual employee will notify his/her supervisor when a suspected artifact is discovered.

This SOP supersedes SOP 16-1 dated 1 November 1993

c. Chiefs, Environmental Management Division, Engineering Plans and Services Division, Energy Resource Management Division, and Utilities and Facilities Division, DHPW, will take necessary action to ensure that guide specifications (special conditions) provide for protection of Military Property and Relics in all construction contracts, maintenance and repair contracts and or work orders.

6. PROCEDURES: When a suspected artifact is found:

a. Stop work immediately. Further action may damage or destroy valuable artifacts.

b. Notify supervisor of discovery of possible artifact.

c. Supervisor will contact the Cultural Resource Office (Annex A).

d. The Cultural Resource Manager will contact the Museum Director telephonically at the West Point Museum to seek appropriate assistance to determine the significance of possible artifacts uncovered during construction. The Cultural Resources Manager will also telephonically contact the Chief, Military History Division, Department of History, to determine what if any significance the possible artifact might have on the accepted history of West Point. If it is determined that artifacts of significance have been found, the Cultural Resource Manager will contact the New York State Historic Preservation Office (NYS HPO) to seek further preservation guidance. All found objects are considered property of the Federal government.

e. DHPW personnel, working with the NYSHPO staff, will determine what action will be taken to preserve the artifacts exposed as well as those which may not yet be exposed. Possible actions are:
(1) Complete stoppage of work until all artifacts are removed in an approved manner.
(2) Temporary stoppage of work until already disturbed artifacts are removed and conditions indicate that no other artifacts will be found.
(3) Continuation of work as planned with continued observation for artifacts.

f. If an artifact is found anytime other than during the duty hours, the following procedure should be followed:
(1) Stop work immediately.
(2) The supervisor or the highest grade employee on the job will contact the Central Power Plant. Central Power Plant personnel will initiate home phone calls until one of the appropriate persons on the after hours list has been reached.
(3) The supervisor or the highest grade employee on the job will give a preliminary assessment of the possible artifact and any other pertinent details to the person contacted by the Central Power Plant, who will request work to cease until the USMA Cultural Resource Manager can examine the site, or authorize the work to continue. A site visit may not be necessary to make this decision.

g. If repair work is being performed under emergency conditions, the protection of artifacts shall be secondary to safety of human life and property.

7. REFERENCES:

a. Archaeological Resources Protection Act of 1979 (16 U.S.C. 470a).

b. Archaeological and Historic Preservation Act of 1974, as amended (16 U.S.C.469a).

c. National Historic Preservation Act of 1966, as amended (16 U.S.C. 470-470m).

d. Executive Order 11593, Protection and Enhancement of the Cultural Environment (16 U.S.C. 470).

e. AR 420-40, Historic Preservation.

/S/
MICHAEL F. COLACICCO
Colonel, EN
Engineer

Encl
(Annex A)

ANNEX A SOP 16-1

Telephone Numbers for Points of Contact:

Greg Church
Cultural Resources Manager
DPW-EPSD 938-5853

West Point Museum 938-3671
or
(Mr. Michael Moss, Mr. Michael McAfee) 938-7342

Chief, Military History Division 938-3537

Operations Officer 938-2926

Deputy Engineer 938-3415

Engineer 938-3416