FINAL

SITE INSPECTION REPORT
PICATINNY ARSENAL, NEW JERSEY

APRIL 2008

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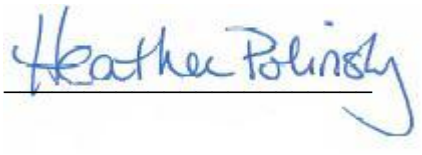
DoD Contract Number: W912DR-05-D-0004

Reviewed and Approved by:



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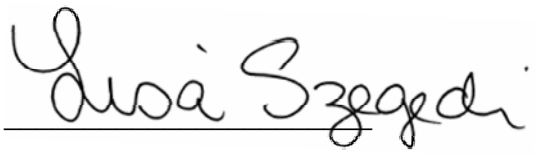

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April 2008

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Acronym	Definition
ALSI	Analytical Laboratory Services, Inc.
AMSL	Above Mean Sea Level
AP	Armor Piercing
bgs	Below Ground Surface
Bldg.	Building
BLU	Bomb Live Unit
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response, Compensation, & Liability Act
CSM	Conceptual Site Model
CTC	Cost to Complete
CTT	Closed, Transferred, and Transferring
DERP	Defense Environmental Restoration Program
DMM	Discarded Military Munitions
DoD	Department of Defense
DOE	Department of Energy
DRMO	Defense Reutilization & Marketing Office
EOD	Explosive Ordnance Disposal
EPA	U.S. Environmental Protection Agency
EUL	Enhanced Use Lease
^{o}F	Degrees Fahrenheit
FS	Feasibility Study
FUDS	Formerly Used Defense Site
FY	Fiscal Year
GPO	Geophysical Prove Out
GPS	Global Positioning System
HE	High Explosive

Acronym	Definition
HMX	Cyclotetramethylene-tetranitramine
HRR	Historical Records Review
IRP	Installation Restoration Program
lb.	Pound
LLC	Limited Liability Company
LOC	Level of Concern
LUC	Land Use Control
MC	Munitions Constituents
MEC	Munitions and Explosives of Concern
mm	Millimeter
MMRP	Military Munitions Response Program
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
MS/MSD	Matrix Spike/Matrix Spike Duplicate
N/A	Not Applicable
NFA	No Further Action
NJ	New Jersey
NJDEP	New Jersey Department of Environmental Protection
PA	Preliminary Assessment
PBX	Polymer Bonded Explosive
PETN	Pentaerythritol tetranitrate
PSE&G	Public Service Electric and Gas
PTA	Picatinny Arsenal
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control

Acronym	Definition
R&D	Research & Development
RBC	Risk Based Concentration
RCI	Residential Communities Initiative
RDX	Cyclotrimethylene trinitramine
RI	Remedial Investigation
ROD	Record of Decision
RPD	Relative Percent Difference
RTI	Radiation Technology, Inc.
SARA	Superfund Amendment and Reauthorization Act
SCC	Soil Cleanup Criteria
SDZ	Surface Danger Zone
SI	Site Inspection
TCRA	Time Critical Removal Action
TNT	Trinitrotoluene
TPP	Technical Project Planning
U.S.	United States
USACE	United States Army Corps of Engineers
U.S.C.	United States Code
USGS	United States Geological Survey
UXO	Unexploded Ordnance
WW	World War

GLOSSARY OF TERMS

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

Defense Site – Locations that are or were owned by, leased to, or otherwise possessed or used by the DoD. The term does not include any operational range, operating storage or manufacturing facility, or facility that is used for or was permitted for the treatment or disposal of military munitions.

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 (UXO), 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 – The detection, identification, on-site evaluation, rendering safe, recovery, and final disposal of UXO and other munitions that have become an imposing danger, for example, by damage or deterioration.

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

Formerly Used Defense Site (FUDS) – A DoD program that focuses on compliance and cleanup efforts at sites that were formerly used by the DoD. A FUDS property is eligible for the Military Munitions Response Program if the release occurred prior to October 17, 1986; the property was

transferred from DoD control prior to October 17, 1986; and the property or project meets other FUDS eligibility criteria.

Military Munitions – All ammunition products and components produced for or used by the armed forces for national defense and security, including ammunition products or components under the control of the DoD, United States Coast Guard, Department of Energy (DOE), and National Guard. The term includes confined gaseous, liquid, and solid propellants; explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries, including bulk explosives and chemical warfare agents; chemical munitions; rockets; guided and ballistic missiles; bombs; warheads; mortar rounds; artillery ammunition; small arms ammunition; grenades; mines; torpedoes; depth charges; cluster munitions and dispensers; demolition charges; and devices and components thereof.

The term does not include wholly inert items; improvised explosive devices; and nuclear weapons, nuclear devices, and nuclear components other than non-nuclear components of nuclear devices that are managed under the nuclear weapons program of the DOE after all required sanitization operations under the Atomic Energy Act of 1954 (42 United States Code [U.S.C.] 2011 et seq.) have been completed.

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

Munitions Debris – 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, includes: UXO, as defined in 10 U.S.C. 101(e)(5); DMM, as defined in 10 U.S.C. 2710(e)(2); and MC (*e.g.*,

trinitrotoluene [TNT], cyclotrimethylenetrinitramine [RDX]) present in high enough concentrations to pose an explosive hazard.

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

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

Transferred Range – A range that is no longer under military control and had been leased by the DoD, transferred, or returned from the DoD to another entity, including federal entities. This includes a military range that is no longer under military control, but that was used under the terms of an executive order, special-use permit or authorization, right-of-way, public land order, or other instrument issued by the federal land manager. Additionally, property that was previously used by the military as a range, but did not have a formal use agreement, also qualifies as a transferred range.

Transferring Range – A range that is proposed to be leased, transferred, or returned from the DoD to another entity, including federal entities. This includes a military range that was used under the terms of a withdrawal, executive order, special-use permit or authorization, right-of-way, public land order, or other instrument issued by the federal land manager or property owner. An active range will not be considered a transferring range until the transfer is imminent (generally defined as the transfer date is within 12 months and a receiving entity has been notified).

Unexploded Ordnance – Military munitions that (A) have been primed, fused, armed, or otherwise prepared for action; (B) have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material; and (C) remain unexploded either by malfunction, design, or any other cause.

EXECUTIVE SUMMARY

The Department of Defense (DoD) established the Military Munitions Response Program (MMRP) under the Defense Environmental Restoration Program (DERP) to address unexploded ordnance (UXO), discarded military munitions (DMM), and munitions constituents (MC) located on defense sites. Properties classified as operational military ranges, permitted munitions disposal facilities, or operating munitions storage facilities are not eligible for the MMRP, nor are sites that had releases after September 30, 2002. The United States (U.S.) Army's inventory of closed, transferred, and transferring (CTT) military ranges and defense sites has identified sites with UXO, DMM, or MC eligible for action under the MMRP. This Site Inspection (SI) report presents the results of the MMRP SI conducted at Picatinny Arsenal (PTA) in Morris County, New Jersey (NJ).

The DoD is currently establishing policy and guidance for munitions response actions under the MMRP. However, key program drivers developed to date conclude that munitions response actions will be conducted under the process outlined in the National Contingency Plan (NCP) (40 Code of Federal Regulations 300) as authorized by the Comprehensive Environmental Response, Compensation and Liability Act of 1980, 42 United States Code (U.S.C.) 9605, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), Pub. L. 99-499 (hereinafter CERCLA). The Phase 3 CTT Range Inventory Report for Picatinny Arsenal, New Jersey, completed in December 2003, marks the completion of the Preliminary Assessment (PA) phase of work under CERCLA. Each of the sites found to be MMRP eligible in the CTT Inventory report have been carried through to the SI phase of the MMRP, although there have been changes to site names and acreages and the number of sites have changed through discovery of additional information or through consolidation of munitions response sites (MRS). This SI report is part of the CERCLA process and will complete the PA/SI requirement for the MMRP eligible sites.

PTA Overview

PTA (also referred to as the installation), which covers 6,491 acres, is located in Morris County, NJ, approximately 45 miles west of New York City. The installation is bordered by many major highways including State Route 15, Interstate 80, and U.S. Route 46. A detailed description of the installation history can be found in Section 2.1 of the Final Historical Records Review (HRR) Report, dated November 2006.

Under the base realignment and closure (BRAC), DoD has determined that PTA will remain open and will gain new missions. Their primary mission is to become an integrated weapons and armaments specialty site for guns and ammunition. To help support this mission, PTA is the site of the Armaments Research, Development and Engineering Center (ARDEC), whose mission is conducting and managing research and development (R&D) for all assigned weapons systems. PTA has also established several partnerships with academia and industry and has involved them in the R&D process. Under BRAC, it is anticipated that approximately 650 additional personnel will be assigned to PTA within the next several years. Therefore, significant development and redevelopment is scheduled to occur at PTA over both the short and long-term.

The SI report addresses a total of 10 MMRP eligible sites at PTA. Note that 14 sites were identified in the PTA HRR. The number of sites has changed since all sites with on and off-post portions are now separated into two sites and since many of the remaining sites have been consolidated. A summary of the site changes is given in Table ES-1.

Table ES-1 Crosswalk Between HRR MRSs and SI MRSs

SI MRS	HRR MRSs Consolidated in SI MRS
1926 Explosion Radius	1926 Explosion MRS
	Former DRMO Yard and Former Burning Ground
	Former Projectile Range
1926 Explosion Site – Off-Post	1926 Explosion Site – Off-Post
Former Munitions and Propellant Test Area	Former Munitions and Propellant Test Area
Former Operational Areas	Former Operational Area South[a]

SI MRS	HRR MRSs Consolidated in SI MRS
	Dredge Pile and Former Sanitary Landfill
	Waste Burial Area Near Sites 19 & 34
Green Pond MRS	Green Pond MRS
Inactive Munitions Waste Pit	The on-post portion of the Inactive Munitions Waste Pit
Inactive Munitions Waste Pit – Off-Post	The off-post portion of the Inactive Munitions Waste Pit
Lakes MRS	The on-post portion of Lake Denmark
	Picatinny Lake Site
Lake Denmark – Off-Post	The off-post portion of Lake Denmark
Shell Burial Grounds	Shell Burial Ground Near Bldg. 3150
	Shell Burial Ground Near Bldg. 3100

a During the HRR, the UXO Find Near Berkshire Trail was identified as an MRS. However, based on information obtained after the HRR was completed, a portion of the Former Operational Area of Interest was changed from an Area of Interest to an MRS in the SI Work Plan. The UXO Find Near Berkshire Trail MRS was consolidated with the new MRS since it was encompassed by the Former Operational Area South MRS.

SI Field Activities

The SI at PTA included both MEC and MC field activities, which were conducted from 16 July 2007 through 18 July 2007. For all of the off-post MRSs, field screening included the collection of sufficient information to determine whether an accelerated response for MEC was required. For on-post sites, field screening/sampling included the collection of sufficient information to determine if MEC or MC were present at the MMRP sites. Fieldwork involved locating surface evidence of MEC through instrument assisted visual surveys and, at one site, collecting soil samples for MC of concern (copper, iron, lead, zinc, and explosives). Visual observations were used to determine sampling locations. A hand-held global positioning system (GPS) unit was used to record MEC/munitions debris locations, as well as other site observations and sampling locations.

The goal of the MEC field activities was to gather sufficient evidence to support (or contradict) the historical information documented in the Historical Records Review (HRR), to determine the

appropriate next actions based on the evidence, and to complete Munitions Response Site Prioritization Protocol (MRSPP) worksheets for each MRS. The MEC field activities included a biased magnetometer assisted surface sweep of the following MRSs (approximately 10% of the site acreage for most sites). Note that these were the site names as identified in the SI Work Plan. For this SI, the sites have been consolidated as discussed in Table ES-1.

- 1926 Explosion Site – Off-Post
- Former Munitions and Propellant Test Area
- Former Projectile Range (now part of the 1926 Explosion Radius MRS)
- Inactive Munitions Waste Pit (off-post portion) (called Inactive Munitions Waste Pit – Off-Post in SI)
- Lake Denmark (off-post portion) (called Lake Denmark – Off-Post in SI)

The goal of the MC field activities was to determine whether the site had been impacted by historical munitions related activities by obtaining and analyzing surface soil samples for MC. Analytical methods used included U.S. Environmental Protection Agency (EPA) Methods 6010B for copper, iron, lead, and zinc and EPA Method 8330A for explosives. Anomaly avoidance techniques were utilized during the MC field sampling activities, where necessary. A weight of evidence approach was used to evaluate the data. Analytical data were compared to the following comparison criteria. The inorganic data were also screened against the site-specific background levels established for PTA under the Installation Restoration Program (IRP).

- New Jersey Department of Environmental Protection (NJDEP) Residential Direct Contact Soil Cleanup Criteria (SCC)
- EPA Region 3 Risk Based Concentrations (RBCs) for Non-Industrial Soils

For on-post portions of an MRS, the information obtained during the SI Field Work was used to make one of three SI recommendations (*i.e.*, Remedial Investigation (RI)/Feasibility Study (FS), immediate response, or no further action (NFA)). Note that an NFA recommendation is not made solely on the visual survey data, but is based on weight of evidence. Other information, including but not limited to, historical data, information obtained during personnel interviews, and analytical data, were also taken into consideration.

For off-post portions of an MRS, the information obtained during the SI Field Work was used to determine if an immediate response if required. Sufficient information was obtained during the HRR to indicate the potential presence of MEC for the on-post portions of all MRSs that have off-post areas. Therefore, all off-post portions of an MRS were recommended for an RI/FS, regardless of the outcome of the survey.

SI Findings and Recommendations

During the visual surveys, no MEC items were found at any of the sites and munitions debris was only found at the Former Projectile Range, which overlaps, and is now part of the 1926 Explosion Radius MRS. Copper, iron, lead and zinc were found in the soil samples collected from the Former Projectile Range at levels above site-specific background levels and at levels that exceeded the comparison criteria. These contaminants are consistent with MC already associated with the 1926 Explosion Radius MRS.

A summary of the findings and recommendations for each of the MRSs at PTA, based on research conducted for the HRR and the SI, along with the results of the SI field activities, is provided in Table ES-2.

Table ES-2 Site Inspection Findings and Recommendations

MRS Acreage	SI Recommendation	Basis for Recommendation	
		MEC	MC
1926 Explosion Radius (PICA-003-R-01)			
1,562 acres	RI/FS – focus on MEC and MC. Note that those portions of the site where MC are being addressed under the IRP will not require additional MC work under the Active Army MMRP Program.	▪ Based on information obtained from PTA's safety office, numerous MEC items have been found within the boundary of this site including high explosive (HE) and armor piercing (AP) projectiles and shells, small, medium, and large caliber ammunition, bomb live units (BLU), and munitions debris ▪ During the visual survey conducted during the SI field work, munitions debris associated with trip flares was observed near the former projectile	▪ Copper, iron, lead, and zinc were detected in surficial soil samples at levels greater than site-specific background levels and at levels that exceed the comparison criteria ▪ No explosives were detected in the surficial soil samples above laboratory reporting limits ▪ Many IRP sites are located either wholly or

MRS Acreage	SI Recommendation	Basis for Recommendation	
		MEC	**MC**
		range	partially within the radius of this site. Extensive sampling, performed under the IRP, has indicated the presence of metals and explosives in soil, surface water and sediment at levels above LOCs at several locations throughout this site. Perchlorate was detected in groundwater samples at concentrations above the LOC.
1926 Explosion Site – Off-Post (PICA-004-R-01)			
833 acres	▪ An accelerated response action for all areas of Mt. Hope Quarry that will be mined in the future and were not included in the original TCRA ▪ RI/FS – focus on MEC and MC	▪ During a series of explosions at storage magazines on PTA, approximately 2.5 million pounds of explosives detonated and were thrown out from the explosion center ▪ There have been numerous MEC finds at this MRS at Mt. Hope Quarry including nine finds between 2002 and 2007 ▪ During a TCRA performed at Mt. Hope Quarry between December 2006 and March 2007, 21 HE ordnance items and four inert ordnance items were found ▪ After the TCRA was completed, two munitions debris items were found at Mt. Hope Quarry outside the area where the TCRA was performed ▪ It should be noted that no MEC or munitions debris were observed on the surface during the visual survey, which was conducted on areas outside the quarry	Although no known MC sampling has occurred at this site, metals and explosives have been detected in soil, surface water, and sediment samples collected from the 1926 Explosion Radius MRS.
Former Munitions and Propellant Test Area (PICA-001-R-01)			
25 acres	RI/FS – focus on MEC	▪ This site was used as a recoilless rifle range for large diameter projectiles ▪ Although no MEC or munitions debris were observed at this site during the SI field work, evidence of historical range activity was observed; structures observed included a battleship gun turret and slug butt	MC at this site are being addressed under the IRP and therefore, will not be included in the Active Army MMRP program

MRS Acreage	SI Recommendation	Basis for Recommendation	
		MEC	MC
Former Operational Areas (PICA-006-R-01)			
1,977 acres	RI/FS – focus on MEC and MC. Note that those portions of the site where MC are being addressed under the IRP will not require additional MC work under the Active Army MMRP Program.	▪ Based on information obtained from PTA's safety office, numerous MEC items have been found within the boundary of this site including HE projectiles and shells, small, medium, and large caliber ammunition, BLUs, and munitions debris ▪ A dredge pile and sanitary landfill located within the boundary of this MRS are both reported MEC disposal areas and MEC were found during utility trenching in the landfill ▪ Munitions debris and 40-mm grenades have been observed on a waste burial area near the southern portion of this MRS	Many IRP sites are located either wholly or partially within the radius of this site. Extensive sampling, performed under the IRP, has indicated the presence of metals and explosives in soil, surface water and sediment at levels above LOCs at several locations throughout this site. No perchlorate samples were collected within this site.
Green Pond MRS (PICA-005-R-01)			
1.1 acres	RI/FS – focus on MEC	▪ MEC have been observed protruding from, and buried alongside, the banks of the brook; the source of the MEC is unknown ▪ Based on information obtained from PTA's safety office, a 66-mm shell was found in Green Pond Brook where the 9th Street Bridge crosses the brook	MC at this site are being addressed under the IRP and therefore, will not be included in the Active Army MMRP program
Inactive Munitions Waste Pit (PICA-013-R-01)			
94 acres	RI/FS – focus on MEC and MC	▪ It was reported that this site was used for the testing and storage of munitions and explosives ▪ Although no MEC or munitions debris were observed at this site during the SI field work, evidence of historical range activity was observed; structures observed included a burn cage and gun turret	Four surface soil samples and two sediment samples were collected from this site. Both explosives and metals were detected in the samples; some of the parameters exceeded the comparison criteria.
Inactive Munitions Waste Pit – Off-Post (PICA-014-R-01)			
7.5 acres	RI/FS – focus on MEC and MC	▪ This site falls within the safety fan for a historic on-post range used for the testing and storage of munitions and explosives ▪ No MEC or munitions debris were observed on the surface of this site during the SI visual survey	Although no known MC sampling has occurred at this site, metals and explosives have been detected in soil and sediment samples collected from the Inactive Munitions Waste Pit MRS.

MRS Acreage	SI Recommendation	Basis for Recommendation	
		MEC	MC
Lakes MRS (PICA-008-R-01)			
758 acres	RI/FS focus on MEC	▪ This site had several ranges on it including 60-mm, 81-mm, and 4.2-inch inert projectile ranges, a 20-mm cannon range, and a 3-inch Barbette gun firing range ▪ Geophysical surveys conducted at this site have indicated anomalous readings in the lakes ▪ It is believed that UXO and munitions debris were discarded into Picatinny Lake following the 1926 explosion ▪ Several MEC items have been found on land within the safety fans of the ranges including a 60-mm fuzed mortar, rocket motor housing sleeves, unattached fins, and base detonating fuzes ▪ An island within this site was used to test flares and pyrotechnics ▪ Picatinny Lake was used for the underwater storage of smokeless powder and explosives ▪ It was reported that an explosive related accident at one of the buildings within this site may have dispersed explosives into Picatinny Lake	MC at this site are being addressed under the IRP and therefore, will not be included in the Active Army MMRP program
Lake Denmark – Off-Post (PICA-012-R-01)			
96 acres	RI/FS – focus on MEC and MC	▪ This site is located within the safety fan of some of the ranges associated with Lake Denmark, which is included in the Lakes MRS	Although no known MC sampling has occurred at this site, metals have been detected in sediment samples collected from the Lake MRS.
Shell Burial Grounds (PICA-010-R-01)			
5.5 acres	RI/FS – focus on MEC	▪ This site was used for the disposal of approximately 25 tons of explosives from the 1926 explosion. Material disposed of includes projectiles, mines, depth charges, fuzes, explosives, small arms ammunition, propellants, and possibly rocket fuels. ▪ This site was also used for explosives disposal by the Navy until 1945	MC at this site are being addressed under the IRP and therefore, will not be included in the Active Army MMRP program

ACKNOWLEDGEMENTS

The Site Inspection (SI) field activities were performed at Picatinny Arsenal from 16 July 2007 to 18 July 2007 by Malcolm Pirnie, Inc. The entire SI process began in November 2006 and is scheduled to conclude in April 2008. Malcolm Pirnie, Inc. would like to acknowledge the following people for their participation and cooperation throughout the SI process:

United States Army Environmental Command:

Mary Ellen Maly, Military Munitions Response Program Manager
Paul Schafer, Environmental Restoration Manager
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1 INTRODUCTION

MMRP Overview

The Department of Defense (DoD) established the Military Munitions Response Program (MMRP) under the Defense Environmental Restoration Program (DERP) to address unexploded ordnance (UXO), discarded military munitions (DMM), and munitions constituents (MC) located on defense sites. Properties classified as operational military ranges, permitted munitions disposal facilities, or operating munitions storage facilities are not eligible for the MMRP, nor are sites that had releases after September 30, 2002. The United States (U.S.) Army's inventory of closed, transferred, and transferring (CTT) military ranges and defense sites has identified sites with UXO, DMM, and/or MC that are eligible for action under the MMRP. This Site Inspection (SI) report presents the results of the MMRP SI conducted at Picatinny Arsenal (PTA or the "installation") in Morris County, New Jersey (NJ).

The DoD is currently establishing policy and guidance for munitions response actions under the MMRP. Key program drivers developed to date conclude that munitions response actions will be conducted under the process outlined in the National Contingency Plan (40 Code of Federal Regulations 300) as authorized by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 United States Code (USC) 9605, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, Pub. L. 99-499 (hereinafter CERCLA). The Phase 3 CTT Range Inventory report for PTA, completed in December 2003 by Malcolm Pirnie, Inc., marks the completion of the Preliminary Assessment (PA) phase under CERCLA. The next step in the process was the SI (CERCLA terminology).

Malcolm Pirnie performed the SI on PTA from 16 July 2007 to 18 July 2007. This SI report addresses the following ten MMRP eligible sites. Note that 14 sites were identified in the PTA Historical Records Review (HRR). The number of sites has changed since all sites with on and off-post portions are now separated into two sites and since many of the remaining sites have

been consolidated. This is described in detail in Section 2, Installation Overview, under Munitions Response Sites (MRS) Overview.

- 1926 Explosion Radius (includes the following MRSs identified in the HRR; 1926 Explosion Site, Former DRMO Yard and Former Burning Ground, and Former Projectile Range)
- 1926 Explosion Site – Off-Post
- Former Munitions and Propellant Test Area
- Former Operational Areas (includes the following MRSs identified in the HRR or the SI Work Plan; Former Operational Area South, Dredge Pile and Former Sanitary Landfill, and Waste Burial Area Near Sites 19 & 34)
- Green Pond MRS
- Inactive Munitions Waste Pit (includes the on-post portion of the Inactive Munitions Waste Pit identified in the HRR)
- Inactive Munitions Waste Pit – Off-Post (includes the off-post portion of the Inactive Munitions Waste Pit identified in the HRR)
- Lake MRS (includes the following MRSs identified in the HRR; the on-post portion of Lake Denmark and Picatinny Lake Site)
- Lake Denmark – Off-Post (includes the off-post portion of the Lake Denmark Site identified in the HRR)
- Shell Burial Grounds (includes the following MRSs identified in the HRR; Shell Burial Ground Near Bldg. 3150 and Shell Burial Ground Near Bldg. 3100)

Purpose, Scope, and Objectives

The primary goal of the MMRP SI is to collect a sufficient amount of information necessary to make one of the following decisions regarding MC and/or Munitions and Explosives of Concern (MEC): 1) whether a Remedial Investigation (RI)/Feasibility Study (FS) is required at a site, 2) whether an immediate response is needed, or 3) whether the site qualifies for no further action (NFA)[1]. The SI at PTA addresses both MEC and MC issues for the MMRP eligible sites.

1 If a site has an existing interim remedial action, which includes the MEC hazard and that calls for land use controls (LUC), the site can be given an NFA at the RI stage since any action is occurring under the interim action. However, if a site does not have an interim action, and the remedy is LUCs, the site cannot be given an NFA.

Another objective of the SI is to determine whether the MRSs identified in the HRR and SI Work Plan can be consolidated based on historical information, MEC types present, current and future land use, and/or geography. The secondary goal of the SI is to collect information for building the MMRP, including Cost to Complete (CTC) estimates and to complete the Munitions Response Site Prioritization Protocol (MRSPP) for the MMRP eligible MRSs.

The goals of the field activities were to confirm if MEC are present at the MMRP sites and to determine if the sites have been impacted by MC. The field activities for the SI were not intended to confirm all types of MEC present, determine MEC density, define the limits of the MEC impacts, or determine the nature and extent of MC contamination. Furthermore, the MEC visual survey was only intended to identify MEC that lie on the ground surface; subsurface MEC, if present, could not be identified.

Project Drivers

The key legislative, administrative, and historical precedents for managing MMRP sites include the following:

DERP Management Guidance (September 2001)

The DERP Management Guidance established an MMRP element for UXO, DMM, and MC defense sites. The history of DERP dates back to SARA, 1986. The scope of the DERP is defined in 10 U.S.C. §2701(b), which states that the:

> Goals of the program shall include the following: … (1) The identification, investigation, research and development, and cleanup of contamination from hazardous substances, and pollutants and contaminants. (2) Correction of other environmental damage (such as detection and disposal of unexploded ordnance) which creates an imminent and substantial endangerment to the public health or welfare or to the environment.

Army DERP Management Guidance for Active Installations (November 2004)

The Army DERP Management Guidance provides guidance for active installations and non-Base Realignment and Closure (BRAC) excess properties on the management of the Army Installation

Restoration Program, the MMRP, and the Building Demolition and Debris Removal Program categories that are related to environmental cleanup. The Army DERP Management Guidance does not apply to Army restoration activities overseas, the BRAC Environmental Restoration Program, the Compliance-Related Cleanup Program or the Formerly Used Defense Sites (FUDS) Restoration Program. The guidance document was provided to implement the Army's DERP in accordance with the DoD Management Guidance for the DERP (September 2001). The Army DERP Management Guidance supplements the roles, responsibilities and procedures contained in Army Regulation 200-1 (AR 200-1) and Department of the Army Pamphlet 200-1 (DA PAM 200-1).

National Defense Authorization Act (Fiscal Year [FY] 02) (Sections 311-312)

Sections 311-312 of the National Defense Authorization Act of FY02 reinforced the DoD's 2001 DERP Management Guidance by tasking the DoD to develop and maintain an inventory of defense sites that are known or suspected to contain UXO, DMM, or MC. Section 311 requires the DoD to develop a protocol for prioritizing defense sites for response activities in consultation with the states and tribes. Section 312 requires the DoD to create a separate program element to ensure that the DoD can identify and track munitions response funding.

The September 2001 Management Guidance for the DERP and the National Defense Authorization Act FY02, described above, established the MMRP. The DERP and the MMRP provide guidance and methods for conducting a baseline inventory of defense sites containing, or potentially containing, UXO, DMM, or MC.

2 INSTALLATION OVERVIEW

Installation Background

PTA, which covers 6,491 acres, is located in Morris County, NJ approximately 45 miles (72,420 meters) west of New York City. The installation is bordered by numerous major highways including State Route 15, Interstate 80, and U.S. Route 46. Map 2-1 provides the location of PTA and shows the locations of the MRSs.

PTA was established in the late 1800s as a storage and powder depot. Production activities began several years before the Spanish-American War, which started in 1898. By the beginning of World War I (WWI), which took place between 1914 and 1918, PTA was manufacturing smokeless powder and munitions of various sizes. By the end of the war, PTA had begun new operations including the melt-loading of projectiles, the manufacture of pyrotechnic signals and flares, the experimental manufacture of modern propellants, high explosives (HE), fuzes, and metal components, and the loading of TNT and amatol into bombs and projectiles.

In 1926, a series of lightning induced explosions occurred on the eastern portion of PTA, on property owned by the Navy; this land was subsequently transferred to the Army in 1960. Reportedly, nearly everything within a 3,000-foot radius of the explosion center was burned or otherwise destroyed; shell fragments were found up to 1 mile (1,609 meters) away. Altogether, approximately 2.4 million pounds (lbs.) of explosives detonated. After the explosion, PTA was rebuilt, and during WWII, PTA was producing thousands of pounds of smokeless powder, tetryl, ethylenedinitramine, boosters, primers, and detonators. PTA also produced thousands of pounds of explosives for the Korean and Vietnam Wars including smokeless powder, C-4 composition, T-9 composition, igniters, 60-millimeter (mm) mortar propellant powder, solvent powder, nitroglycerin, TNT, and experimental HE, including polymer bonded explosives (PBX), cyclotetramethylene-tetranitramine (HMX), pentaerythrite tetranitrate (PETN), and Composition B. After the Vietnam War, PTA continued research and development (R&D) work on nuclear and non-nuclear weapons.

Under BRAC, DoD has determined that PTA will remain open and be realigned, gaining new missions; this will result in a significant amount of development at PTA over the next decade. Their primary mission is to become an integrated weapons and armaments specialty site for guns and ammunition. To help support this mission, PTA is the site of the Armaments Research, Development and Engineering Center (ARDEC), whose mission is conducting and managing R&D for all assigned weapons systems. PTA has also established several partnerships with academia and industry and has involved them in the R&D process.

PTA currently employs 3,939 people; 73 military personnel, 2,950 DoD civilians, and 916 contractors. Approximately 753 military personnel and immediate family members reside at the arsenal in on-base housing. It is anticipated that under BRAC, PTA will gain approximately 650 personnel over the next several years.

MRSs Overview

The HRR, dated November 2006, identified 14 MRSs at PTA. However, based on information obtained after the HRR was completed, a portion of the Former Operational Area of Interest was changed from an Area of Interest to an MRS for the SI Work Plan (Former Operational Area South). This MRS encompassed the UXO Find Near Berkshire Trail MRS, as well as the following former Areas of Interest, which were identified in the HRR:

- Baseball Fields
- Former Motors/Rocket Fuel Test Area (RI Concept Plan Site 4, PICA-157)
- Inactive Rocket Fuel Test Areas (RI Concept Plan Site 2, PICA-008)

Therefore, although the SI Work Plan also identified 14 MRSs, one of the sites was different than what was identified in the HRR.

For this SI, a total of ten MRSs are identified. This is because one of the objectives of the SI was "to determine whether the 14 MRSs currently identified can be consolidated based on historical information, MEC types present, land use, and/or geography." As a result of an evaluation of all of these factors, some of the MRSs identified in the HRR and SI Work Plan have been separated

while others have been consolidated. Refer to Table 2-1 for a summary of the MRSs included in this SI Report, a summary of any changes to the site, and, as applicable the rationale for consolidation.

Table 2-1 Summary of MRSs Consolidation

SI MRS Name[a]	MRSs in Grouping[b]	Rationale
1926 Explosion Radius	1926 Explosion Site Former DRMO Yard and Former Burning Ground Former Projectile Range	The conceptual site models (CSM) for all of these sites are very similar since they share the following characteristics: 1. The Former Defense Reutilization & Marketing Office (DRMO) Yard and Former Burning Ground and the Former Projectile Range are located wholly within the radius of the 1926 Explosion MRS. 2. Many of the MEC items found within the 1926 Explosion MRS are not related to the explosion as they were manufactured after 1926; these items are similar to the known and potential MEC associated with the Former DRMO Yard and Former Burning Ground and the Former Projectile Range. 3. The current and future land uses for these sites are the same. According to the Short and Long-Term Real Property Master Plan for PTA, a significant amount of development will be occurring in the downtown area of PTA due to BRAC; all of these sites are located in or near downtown. 4. These sites all share similar transport mechanisms and migration routes.
1926 Explosion Site – Off-Post	1926 Explosion Site – Off-Post	This site was not consolidated with the other off-post MRSs since the MEC density for this site is expected to be much greater than the MEC density at the other off-post sites.
Former Munitions and Propellant Test Area	Former Munitions and Propellant Test Area	This site was not consolidated with any other MRSs since its future land use differs from the future land use for the remainder of the sites. It is anticipated that this MRS will be reactivated as a range at some point in the future.
Former Operational Areas	Former Operational Area South	The CSMs for all of these sites are very similar since they share the following characteristics: 1. The Dredge Pile and Former Sanitary Landfill and the Waste Burial Area Near Sites 19 & 34 are located wholly within the Former Operational Area South boundary. 2. Many of the MEC items associated with the Former Operational

SI MRS Name[a]	MRSs in Grouping[b]	Rationale
	Dredge Pile and Former Sanitary Landfill Waste Burial Area Near Sites 19 & 34	Area South are similar to the known and potential MEC associated with the Dredge Pile and Former Sanitary Landfill and the Waste Burial Area Near Sites 19 & 34. 3. The current and future land uses for these sites are the same. It is expected that a significant amount of development will be occurring in the downtown area of PTA due to BRAC, with some development in other areas of the installation. The majority of the Former Operational Area South and all of the Dredge Pile and Former Sanitary Landfill and Waste Burial Area Near Sites 19 & 34 are located outside of downtown. 4. These sites all share similar transport mechanisms and migration routes.
Green Pond MRS	Green Pond MRS	This site was not consolidated with any other MRSs for the following reasons: 1. This is the only site that is a brook; therefore, the CSM is different. 2. It is possible that MEC at this site may be transported off-installation through stream flow, which would require stream stabilization. Therefore, it is anticipated that any remedies developed for this site would differ from the remedies adopted for the other MRSs.
Inactive Munitions Waste Pit	Inactive Munitions Waste Pit	This site was not consolidated with any other MRSs as it is located in a buffer area between active ranges and its current and future land uses differs from the current and future land uses of the remainder of the sites. This site was, however, split into two sites; the on-post portion and the off-post portion. The Inactive Munitions Waste Pit MRS contains the on-post portion while the Inactive Munitions Waste Pit – Off-Post contains the off-post portion.
Inactive Munitions Waste Pit – Off-Post	Inactive Munitions Waste Pit	In the HRR, the Inactive Munitions Waste Pit was listed as one site. Since the land uses on and off-post are dissimilar, this site was separated into on and off-post portions. Although PTA has three off-post MRSs this site was not consolidated with either one for the following reasons: 1. The MEC density for this site is expected to be much lower than the MEC density at the 1926 Explosion – Off-Post MRS. 2. This site is located on a steep mountainside and is difficult to access; the other two off-post sites are easily accessible and are actively used for commercial operations. Therefore, the current and future land uses differ.

SI MRS Name[a]	MRSs in Grouping[b]	Rationale
Lakes MRS	Lake Denmark Picatinny Lake Site	In the HRR, Lake Denmark was listed as one site. Since the land uses on and off-post are dissimilar, this site was separated into on and off-post portions. The Lakes MRS includes the on-post portion only. The CSMs for the on-post portion of Lake Denmark and Picatinny Lake are very similar since they share the following characteristics: 1. The majority of both sites are covered by a lake 2. Both sites have the same current and future uses (*i.e.*, recreation and non-potable water) 3. Both sites have the same LUCs in place (*i.e.*, swimming is banned and fish consumption advisories are in effect) 4. They have similar MEC and expected MEC densities 5. Dam upgrades are expected for both lakes
Lake Denmark – Off-Post	Lake Denmark	In the HRR, Lake Denmark was listed as one site. Since the land uses on and off-post are dissimilar, this site was separated into on and off-post portions. Although PTA has three off-post MRSs this site was not consolidated with either one for the following reasons: 1. The MEC density for this site is expected to be much lower than the MEC density at the 1926 Explosion – Off-Post MRS 2. The land use for this site is different than the land use for the Inactive Munitions Waste Pit – Off-Post (see write up for Inactive Munitions Waste Pit – Off-Post)
Shell Burial Grounds	Shell Burial Ground Near Building (Bldg.) 3150 Shell Burial Ground Near Bldg. 3100	The CSMs for these sites are identical since they share the following characteristics: 1. The current and future land use for the sites is the same; access is restricted 2. Both sites have the same MEC; discarded material from the 1926 explosion and from Navy operations 3. Both sites have similar MEC density and depth and share the transport mechanisms/migration routes

a These are the site names used in this report. Since some MRSs were formed by the consolidation of numerous sites, this name may not previously appear in either the HRR or SI Work Plan.

b These represent the names used in the HRR and SI Work Plan

Brief descriptions of the ten MRSs at PTA are provided in Section 4.0; more detailed descriptions of these sites are presented in the HRR and SI Work Plan.

Previous Investigations

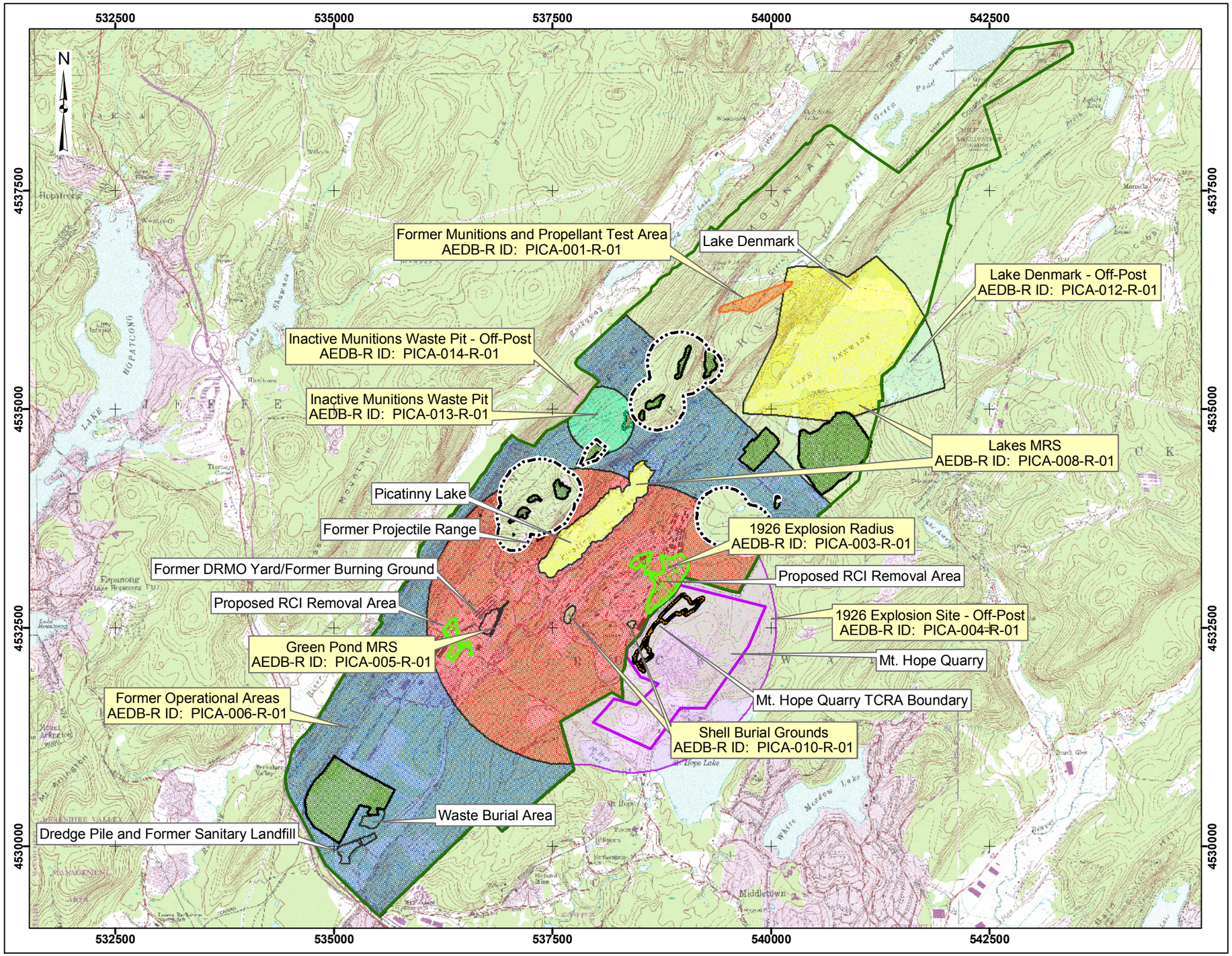
Detailed descriptions of the previous investigations that were conducted at PTA are presented in the HRR. Based on the data repositories reviewed for the SI, the following additional investigations were identified that contain relevant information and supplement information presented in this report:

- PTA Facility-Wide Background Study, May 2002
- UXO Find Map and UXO Table, date unknown
- Draft Final Time Critical Removal Action Report, August 23, 2007
- Picatinny Arsenal, Real Property Master Plan: Short Range Component, February 2007
- Picatinny Arsenal, Real Property Master Plan: Long Range Component, February 2007

Site Inspection
Picatinny Arsenal, NJ

MALCOLM PIRNIE

Map 2-1
Munitions Response Sites



Legend

- Installation Boundary
- Mt. Hope Quarry
- TCRA Boundary
- Proposed RCI Removal Area

Military Range Area

- Operational Range Area
- Surface Danger Zone

Military Response Sites

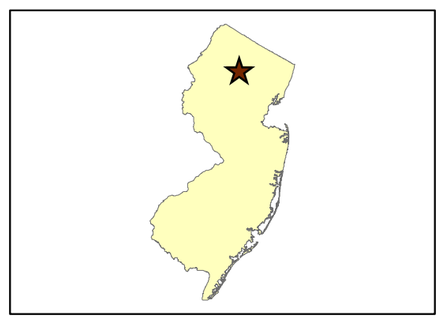
- Shell Burial Grounds
- Lakes MRS
- 1926 Explosion Radius
- Former Operational Areas
- Lake Denmark - Off-Post
- 1926 Explosion Site - Off-Post
- Green Pond MRS
- Former Munitions And Propellant Test Area
- Inactive Munitions Waste Pit - Off-Post
- Inactive Munitions Waste Pit

0 700 1,400 2,800 Meters

Data Source: Safety Map 1974
Topo: Microsoft Terraserver, USGS Digital Raster Graphic, 2006

Coordinate System: UTM Zone 18N
Datum: NAD 83
Units: Meters

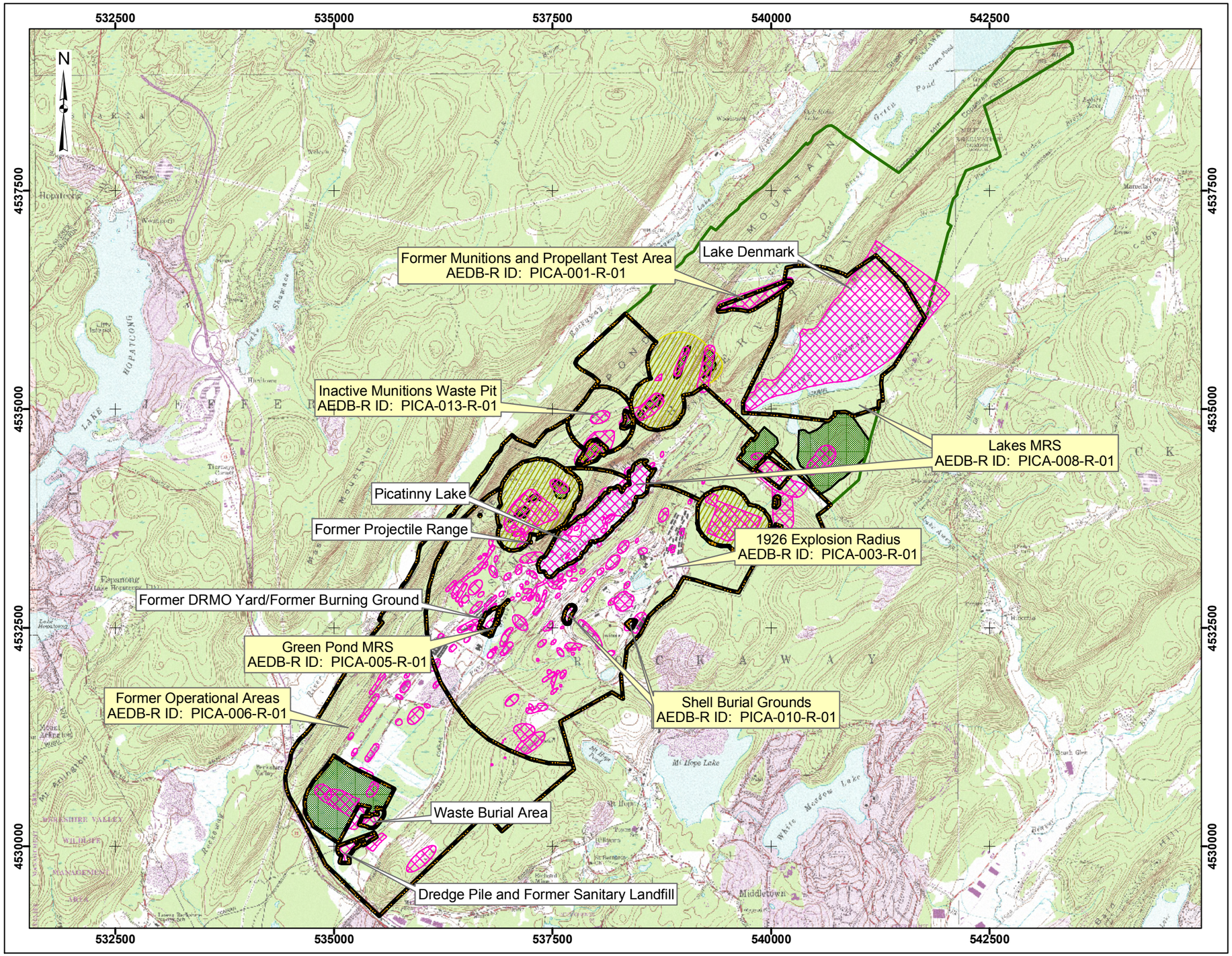
Contract: W912DR-05-D-0004
Edition: Final SI Report
Date: April 2008



Site Inspection
Picatinny Arsenal, NJ

MALCOLM PIRNIE

Map 2-2
Installation Restoration Program Sites



Legend

- Installation Boundary

Military Range Area

- Munitions Response Sites
- Installation Restoration Program Sites
- Operational Range Area
- Surface Danger Zone

0 700 1,400 2,800 Meters

Data Source: Safety Map 1974
Topo: Microsoft Terraserver, USGS Digital Raster Graphic, 2006

Coordinate System: UTM Zone 18N
Datum: NAD 83
Units: Meters

Contract: W912DR-05-D-0004
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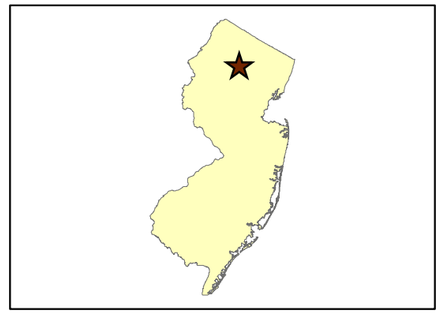

3 SITE INSPECTION OVERVIEW

Site Inspection Tasks

The PTA SI included both MEC and MC field activities, which were conducted from 16 July 2007, through 18 July 2007. Field activities included locating surface evidence of MEC through instrument assisted visual surveys and the collection of surface soil samples for MC of concern (copper, iron, lead, zinc, and explosives). The purpose of the field activities on-post was to collect sufficient information to support one of the following decisions: 1) whether an RI/FS is required at a site, 2) whether an immediate response is needed, or 3) whether the site qualifies for NFA. Note that an NFA recommendation is not made solely on visual survey data, but is based on weight of evidence. The purpose of the field activities off-post was to determine if an immediate response is needed. A hand-held global positioning system (GPS) unit was used to record MEC and munitions debris observation locations, as well as MC sampling locations.

MEC Overview

Sufficient historical data were available for the following MRSs to recommend advancing these sites to an RI/FS without additional MEC field work. Note that the MRS names are listed as they appeared in the SI Work Plan. Refer to Section 4 for a summary of the information available for each site.

- 1926 Explosion Site (now consolidated into the 1926 Explosion Radius MRS)
- Dredge Pile and Former Sanitary Landfill (now consolidated into the Former Operational Areas MRS)
- Former DRMO Yard and Former Burning Ground (now consolidated into the 1926 Explosion Radius MRS)
- Former Operational Area South (now consolidated into the Former Operational Areas MRS)
- Green Pond Site
- Inactive Munitions Waste Pit (now separated into the Inactive Munitions Waste Pit and the Inactive Munitions Waste Pit – Off-Post; MEC SI field activities were only recommended for the off-post portion)

- Lake Denmark (a portion was consolidated into the Lakes MRS and a portion was separated into the Lake Denmark – Off-Post MRS)
- Picatinny Lake Site (now consolidated into the Lakes MRS)
- Shell Burial Ground Near Bldg. 3150 (now consolidated into the Shell Burial Grounds MRS)
- Shell Burial Ground Near Bldg. 3100 (now consolidated into the Shell Burial Grounds MRS)
- Waste Burial Areas Near Sites 19 & 34 (now consolidated into the Former Operational Areas MRS)

Sufficient historical data were also available for the following MRSs to recommend advancing these sites to an RI/FS without additional MEC field work. However, since these MRSs fall off-post, a visual survey was conducted to determine if surface MEC are present and an accelerated response is required. Note that the MRS names are listed as they appeared in the SI Work Plan. Refer to Section 4 for a summary of the information available for each site.

- 1926 Explosion Site – Off-Post
- Inactive Munitions Waste Pit (now separated into the Inactive Munitions Waste Pit and the Inactive Munitions Waste Pit – Off-Post; MEC SI field activities were only recommended for the off-post portion)
- Lake Denmark (a portion was consolidated into the Lakes MRS and a portion was separated into the Lake Denmark – Off-Post MRS; MEC SI field activities were only recommended for the off-post portion)

Since historical data did not definitively indicate the presence of MEC at the following MRSs, MEC field activities were conducted. Note that the MRS names are listed as they appeared in the SI Work Plan. Refer to Section 4 for a summary of the information available for each site.

- Former Munitions and Propellant Test Area
- Former Projectile Range (now consolidated into the 1926 Explosion Radius MRS)

The goal of the MEC field activities was to determine if MEC is present on the surface at each MRS. Due to the potential hazards associated with the presence of MEC, a UXO Technician escorted the field team members during the reconnaissance activities using a handheld Schonstedt magnetometer to conduct MEC avoidance techniques. Observations made during the site walk were used to determine soil sampling locations.

MC Overview

Extensive MC sampling has been conducted at this installation under the Installation Restoration Program (IRP). IRP samples have been collected from various media, including soil, surface water, sediment, and groundwater, and have been analyzed for a variety of parameters including metals, explosives, and, in groundwater, perchlorate. Plates 1, 2, and 3 provide the locations and results of the IRP samples.

MC are completely addressed under the IRP (*i.e.*, through an RI/FS and, as applicable a subsequent Record of Decision (ROD)), and are therefore not included in the MMRP for the following four MRSs. Refer to Map 2-2 for the locations of the IRP Sites. It should be noted that FSs and RODs are not complete for all of these sites; however, they are scheduled to be completed at a later date under the IRP.

- Former Munitions and Propellant Test Area
- Green Pond MRS
- Lakes MRS
- Shell Burial Grounds

The following two MRSs are collocated with numerous IRP Sites; therefore, sufficient data were available to recommend advancing these sites to an RI/FS without additional sampling. It should be noted that MC at these collocated IRP sites are being addressed under the IRP. Therefore, only the areas of the MMRP sites that are not collocated with IRP sites need to be addressed for MC under the MMRP.

- 1926 Explosion Radius – Although many MC samples are available for this site, four MC samples were collected during the SI; these samples were collected near a former

projectile range. This is because in the HRR and SI Work Plan the Former Projectile Range was a separate MRS and no MC data were available. However, for this SI Report, many sites were consolidated and the Former Projectile Range is now part of the 1926 Explosion Radius MRS.

- Former Operational Areas

The remaining MRSs (1926 Explosion Site – Off-Post, Inactive Munitions Waste Pit, Inactive Munitions Waste Pit – Off-Post, and Lake Denmark – Off-Post) are not collocated with IRP Sites; however, sufficient data are still available to recommend advancing these sites to an RI/FS without additional sampling.

The goal of the MC field activities was to determine if MC is present at levels potentially posing an unacceptable risk. These samples were collected in biased locations where evidence (visual) of munitions related use was observed. The rationale for each soil sample location is provided in the Soil Sample Logs included in Appendix B. Samples were analyzed for copper, iron, lead, zinc, and explosives using U.S. Environmental Protection Agency (EPA) Methods 6010B (metals) and 8330A (explosives). Anomaly avoidance techniques were utilized during the MC field sampling activities, where necessary.

Summaries of both the MEC and MC activities conducted at each of the MRSs are provided in Section 4. Deviations from the procedures described in the work plan that occurred during the SI field activities are outlined below:

- The small property in the southernmost portion of the 1926 Explosion Site – Off-Post, east of the Tilcon Quarry Entrance, was not surveyed because it was surrounded by a wetland and was inaccessible. The area surrounding the wetland was surveyed.
- The SI Work Plan did not propose a visual survey at Mt. Hope Quarry; however, during the visual survey of the 1926 Explosion Site – Off-Post a small portion of the quarry property was surveyed since there was no clear delineation between the quarry and the adjacent property and due to the tree canopy, only sporadic satellite coverage was available for the GPS so it was not always possible to determine exact locations.

- The SI Work Plan proposed a visual survey of approximately 10 acres of land within the 1926 Explosion Site – Off-Post; however, approximately 15 acres were surveyed. This is because the proposed path of the visual survey in the SI Work Plan was not continuous among parcels owned by the different property owners. However, during the survey, continuous paths were surveyed.
- The proposed visual survey and soil sampling for the former projectile range, which has been consolidated into the 1926 Explosion Radius MRS, was relocated to the area surrounding the range since the range was inaccessible. The known firing point was enclosed by a building and the slug butt was entirely enclosed by a fence with no visible entrance gate. In addition, the area inside the fence was heavily vegetated.
- In the SI Work Plan no MEC activities were planned for the on-post portion of the Inactive Munitions Waste Pit. However, during the survey of the off-post portion of this site, a portion of the on-post area was also surveyed. This is because there was no clear delineation between the on and off-post portions (*i.e.*, area was not fenced), satellite coverage for the GPS was spotty so it was not always possible to determine exact locations, and with the exception of the area near the PTA boundary, much of the site was steeply sloped and difficult to access.
- During the Lake Denmark – Off-Post visual survey, the EPA project manager for the Radiation Technology, Inc. (RTI) Superfund Site and the General Manager for Sterigenics, the company that currently leases the property, requested that the survey area also include a berm that covers a ten inch main water line from a pumphouse on Lake Denmark to Sterigenics' production area. They were concerned about this area being actively walked by numerous personnel. Therefore, although this area was not proposed for a visual survey in the SI Work Plan, this area was also visually surveyed.

Table 3-1 Summary of MEC Technical Project Planning (TPP) Decisions

SI MRS	HRR MRS	MEC SI Activities[a]	
		Activity	Purpose
1926 Explosion Radius	1926 Explosion Site	No SI field activities. Recommend advancing to RI/FS based on known MEC.	Not Applicable (N/A)
	Former DRMO Yard and Former Burning Ground	No SI field activities. Recommend advancing to RI/FS based on known MEC.	N/A
	Former Projectile Range	Conduct magnetometer-assisted visual survey of entire site (< 1 acre).	Identify MEC presence to support Army CTC estimates and MRSPPs and evaluate need for MEC accelerated response, RI, or NFA determination. If given an NFA recommendation, this site will be rolled into the 1926 Explosion MRS.
1926 Explosion Site – Off-Post[b]	1926 Explosion Site – Off-Post	Conduct magnetometer-assisted visual survey of approximately 10 acres of land adjacent to PTA, excluding the Mt. Hope Quarry. Regardless of result, recommend advancing to RI/FS based on known MEC.	Identify if MEC are present (other than at Mt. Hope Quarry) to evaluate need for MEC accelerated response
Former Munitions and Propellant Test Area	Former Munitions and Propellant Test Area	Conduct magnetometer-assisted visual survey of ~ 2.5 acres near firing point and impact area.	Identify MEC presence to support Army CTC estimates and MRSPPs and evaluate need for MEC accelerated response, RI, or NFA determination
Former Operational Areas	Former Operational Area South[c]	No SI field activities. Recommend advancing to RI/FS based on known MEC.	N/A
	Dredge Pile and Former Sanitary Landfill	No SI field activities. Recommend advancing to RI/FS based on known MEC.	N/A
	Waste Burial Areas Near Sites 19 & 34	No SI field activities. Recommend advancing to RI/FS based on known MEC.	N/A
Green Pond MRS	Green Pond Site	No SI field activities. Recommend advancing to RI/FS based on known MEC.	N/A
Inactive Munitions Waste Pit	Inactive Munitions Waste Pit	No SI field activities. Recommend advancing to RI/FS based on HRR data.	N/A
Inactive Munitions Waste Pit – Off-	Inactive Munitions Waste Pit[b]	Conduct magnetometer-assisted visual survey of 1 acre	Identify MEC presence to support Army CTC estimates

SI MRS	HRR MRS	MEC SI Activities[a]	
		Activity	Purpose
Post		of land adjacent to PTA border	and MRSPPs and evaluate need for MEC accelerated response
Lakes MRS	Lake Denmark	No SI field activities. Recommend advancing to RI/FS based on HRR data.	N/A
	Picatinny Lake Site	No SI field activities. Recommend advancing to RI/FS based on known MEC and HRR data.	N/A
Lake Denmark – Off-Post	Lake Denmark[b]	Conduct magnetometer-assisted visual survey of between 2 to 5 acres of land adjacent to the lake, off-post and southwest of RTI.	Identify MEC presence to support Army CTC estimates and MRSPPs and evaluate need for MEC accelerated response
Shell Burial Grounds	Shell Burial Ground Near Bldg. 3150	No SI field activities. Recommend advancing to RI/FS based on known MEC.	N/A
	Shell Burial Ground Near Bldg. 3100	No SI field activities. Recommend advancing to RI/FS based on known MEC.	N/A

a The activities detailed in this table are based on both the TPP session as well as comments received on the SI Work Plan. The sites are listed in this table as they appeared in the HRR and SI Work Plan since consolidation of MRSs did not occur until this SI Report.

b Multiple property owners were identified for each of the MRSs with off-post portions. After the TPP, it was requested that the off-post visual surveys be distributed among all property owners

c After submittal of the HRR, a UXO find map, along with a table that details the MEC found at each location, was discovered in PTA's safety office (Appendix I). Based on this information, the Former Operational Area South MRS, which encompasses the UXO Find Near Berkshire Trail MRS, was identified.

Table 3-2 Summary of MC TPP Decisions

SI MRS	HRR MRS[a]	MC SI Activities	
		Activity[b]	Purpose
1926 Explosion Radius	1926 Explosion Site	No SI field activities. Recommend advancing to RI/FS based on existing data.	N/A
	Former DRMO Yard and Former Burning Ground	No activities are proposed as part of the SI since this site is covered under the IRP.	N/A

SI MRS	HRR MRS[a]	MC SI Activities	
		Activity[b]	Purpose
	Former Projectile Range	Collect two composite and two discrete surface soil samples and analyze for specific metals including copper, iron, lead, and zinc (6010B) and explosives (8330A) (biased where possible).	Provide data to support NFA or RI determination. Screen soil data using New Jersey Department of Environmental Protection (NJDEP) Residential Soil Cleanup Criteria (SCC) or EPA non-industrial risk based concentrations (RBC) where SCC are not available. Inorganic data will also be screened against the site-specific background levels established for PTA under the IRP.
1926 Explosion Site – Off-Post	1926 Explosion Site – Off-Post	No SI field activities. Recommend advancing to RI/FS based on existing data.	N/A
Former Munitions and Propellant Test Area	Former Munitions and Propellant Test Area	No activities are proposed as part of the SI since this site is covered under the IRP.	N/A
Former Operational Areas	Former Operational Area South	No SI field activities. Recommend advancing to RI/FS based on existing data.	N/A
	Dredge Pile and Former Sanitary Landfill	No activities are proposed as part of the SI since this site is covered under the IRP.	N/A
	Waste Burial Areas Near Sites 19 & 34	No activities are proposed as part of the SI since this site is covered under the IRP.	N/A
Green Pond MRS	Green Pond Site	No activities are proposed as part of the SI since this site is covered under the IRP.	N/A
Inactive Munitions Waste Pit	Inactive Munitions Waste Pit	No activities are proposed as part of the SI. Recommend advancing to RI/FS based on existing data.	N/A
Inactive Munitions Waste Pit – Off-Post	Inactive Munitions Waste Pit	No activities are proposed as part of the SI. Recommend advancing to RI/FS based on existing data.	N/A
Lakes MRS	Lake Denmark	No activities are proposed as part of the SI since this site is covered under the IRP.	N/A
	Picatinny Lake Site	No activities are proposed as part of the SI since this site is covered under the IRP.	N/A

SI MRS	HRR MRS[a]	MC SI Activities	
		Activity[b]	Purpose
Lake Denmark – Off-Post	Lake Denmark	No SI field activities. Recommend advancing to RI/FS based on existing data.	N/A
Shell Burial Grounds	Shell Burial Ground Near Bldg. 3150	No activities are proposed as part of the SI since this site is covered under the IRP.	N/A
	Shell Burial Ground Near Bldg. 3100	No activities are proposed as part of the SI since this site is covered under the IRP.	N/A

a The sites are listed in this table as they appeared in the HRR and SI Work Plan since consolidation of MRSs did not occur until this SI Report.

b For all MRSs where an RI for MC is not recommended based on available analytical data for the site, this recommendation could change if information contrary to the current CSM is obtained.

Site Inspection Findings

The results of the SI field activities conducted at PTA, including MEC and MC findings for each MRS, are discussed in Section 4.0. The MEC/munitions debris items identified, as well as other significant visual observations, were recorded using a Trimble Geoexplorer XT hand-held GPS unit. Sampling locations were recorded using the hand-held GPS unit and were photodocumented; notes regarding each location were written in the soil sampling logs. The field notes and observations made during the SI field activities are summarized in Appendix A (Field Notes) and Appendix B (Field Forms and Photographic Log). Analytical data and the data validation report are provided in Appendix E. Geographic coordinates of field observations (including MEC items, munitions debris items, and other notable items) and surface soil sampling locations are provided in Appendix C. The prioritization protocol and CTC data extraction tables are included in Appendices F and G, respectively. The ordnance technical data sheets are provided in Appendix D. The TPP meeting minutes are provided in Appendix H.

Analytical data were compared to the following comparison criteria:

- NJDEP residential SCC
- USEPA Region 3 RBCs for Residential Soils
- PTA site-specific background levels for metals, established under the IRP (inorganic results only)

4 SITE INSPECTION DETAILS

This section presents the site-specific information for each MRS at PTA. Each MRS section includes a site description and historical overview, an overview of the field work activities that occurred on the site, the results of the field work, the CSM, a site summary, and site recommendations.

4.1 1926 Explosion Radius (AEDB-R ID: PICA-003-R-01)

4.1.1 Site Description and Historical Overview

This MRS includes the on-post area affected by the explosion of the Lake Denmark Naval Ammunition Depot in 1926. The 1926 Explosion Radius MRS consists of the explosion center and the area within a 1-mile radius, minus off-post property, areas that fall on operational ranges, areas that fall on surface danger zones (SDZs) for operational ranges where there is the potential for an ongoing release of MEC due to the use of the range, and areas identified as separate MRSs. Thus, the 1926 Explosion Radius MRS consists of 1,562 acres. Refer to Map 2-1 to see the location of this MRS on the installation.

The Lake Denmark Naval Ammunition Depot, which was located on what is currently the eastern portion of PTA, near Picatinny Lake, was used by the Navy from the late 1800s to the 1960s, mainly for storage of materials such as HEs, smokeless powder, black powder, and projectiles. On July 10, 1926, lightning struck the southwest end of the depot, setting off a series of explosions. According to a historical report, it was estimated that 2.5 million pounds of explosives detonated in the explosion, including:

- TNT
- 25-lb. Navy Mark I bombs, loaded and plugged
- Mark II bombs, each containing 50 lbs. TNT
- Mark III bombs, each loaded with TNT
- Mark IV aircraft bombs with approximately 250 lbs. of TNT in each bomb
- Mark V bombs, each loaded with TNT
- Bomb accessories (*e.g.*, fins, tails)

- Aerial bombs, TNT center section
- 14-inch Class "B", loaded and fused
- 14-inch armor piercing (AP) rounds, loaded and fused
- 8-inch shells, loaded and fused
- 5-inch shells, loaded and fused

In addition, the following explosives burned but did not detonate:

- Explosive "D"
- Picric acid

At the time of the explosions, the Navy property contained between 160 and 200 buildings; approximately 40 to 50 of these were used for explosives storage. Three large craters; two near the south-central portion of the installation and one near the installation boundary, were created in the explosion. These three craters are discussed later in this report as the Shell Burial Grounds. Reportedly, nearly everything within a 3,000-foot radius of the explosion center was burned or otherwise destroyed. Many of the buildings within 4,000 feet (1,219 meters) of the explosion center were significantly damaged; some minor damage, such as broken windows and bulging roofs, was also reported for buildings farther than 4,000 feet (1,219 meters). Unexploded shells were found up to three-quarters of a mile from the explosion center, while shell fragments were found up to 1 mile away. Since 1926, there have been numerous MEC finds at the installation that are associated with the explosion.

A Former DRMO Yard and Former Burning Ground, covering approximately 9.5 acres, is located near the southwestern portion of the 1926 Explosion Radius MRS, southwest of Picatinny Lake. According to maps from the 1930s and 1940s, this area was previously a low-lying marsh. From 1955 to the mid-1990s the Former DRMO Yard was used for the storage of a variety of unwanted materials at the installation, including material used in the manufacturing and testing of explosives, pyrotechnics, and munitions. It was reported that at one time, dumpsters that contained flashed and unflashed shells were located on this property. Very few historical references are available for the Former Burning Ground; however, a 1921 report

indicates that the site was used for the burning of boxes of smokeless powder and TNT in a pit. It is likely that use of this burning ground was discontinued around WWII, when the current burning ground was built on the southern portion of the installation. In 1993, buried UXO were found in the DRMO Yard during installation of a fence post.

A former projectile range is also located within the 1926 Explosion Radius MRS; this range is located near the northwestern portion of Picatinny Lake. This range consisted of a covered firing point (Bldg. 622) and a slug butt (Bldg. 646) and was constructed in 1943 for use as a projectile range. Firing on the range was directed from west to east. No information was available to indicate munitions types that were used on the range; however, based on site features, it appears that the range would have been utilized for testing smaller diameter projectiles, such as 20-mm, 37-mm, and 40-mm. Based on aerial photographs, it appears this range was last utilized sometime between 1951 and 1963. In the 1963 aerial photograph the area is overgrown with trees or underbrush. The site is not overlapped by any of the neighboring IRP sites, but does lie adjacent to numerous sites which have been investigated under the IRP.

As part of an Army Residential Communities Initiative (RCI), PTA plans on redeveloping a portion of the installation for military housing; this includes the Farley Avenue, the Navy Hill, and the Fishers Pond Housing Areas. All of these areas fall within the 1926 Explosion Radius MRS. The redevelopment will include demolition, construction, maintenance, renovation, replacement, rehabilitation, and development of Army family housing and ancillary supporting facilities. A 50-year Enhanced Use Lease (EUL) with GMH Military Housing Limited Liability Company (LLC) for 113 houses on Farley Avenue and Navy Hill was signed on May 1, 2006. Since a significant amount of intrusive work (*e.g.*, utility upgrades and installation) will be associated with the rehabilitation and development/redevelopment of these housing units, a removal action was started in winter 2008 for approximately 50 acres of land in the RCI area. The purpose of the removal action is to support the rehabilitation of the housing area and to ensure that the surrounding property is safe for residents. The removal action is planned to include both geophysical and intrusive MEC investigations. If MEC is found during the investigation, pre and post-MEC removal MC sampling will be conducted.

4.1.2 Field Work Activities

4.1.2.1 MEC Activities and Purpose

The 1926 Explosion Radius MRS has been recommended for further investigation during the RI/FS phase of the MMRP based on information collected during the HRR. However, at the time the SI Work Plan was developed, the MRSs had not yet been consolidated. Therefore, the Former Projectile Range, which is now part of this MRS, was a separate site. As stated in the SI Work Plan, no site-specific information about the presence of MEC at this range was available; therefore, a visual survey along 5-foot transects was proposed. The visual survey could not be conducted as described in the Work Plan since the range was completely fenced in. Additional detail about the survey is included in Section 4.1.3.1. Refer to Map 4-1 for a map showing the locations of this survey.

4.1.2.2 MC Activities and Purpose

The 1926 Explosion Radius MRS has been recommended for further investigation during the RI/FS phase of the MMRP based on information collected during the HRR. However, since the MRSs had not yet been consolidated at the time the SI Work Plan was developed, and no MC data were available for the Former Projectile Range, MC sampling was recommended for the range. As stated in the SI Work Plan, two composite and two discrete surface soil samples were to be collected from the range. Since the range was inaccessible, these samples were collected from property adjacent to the range. All samples were analyzed for metals and explosives using EPA Methods 6010B and 8330A, respectively. The analytical data were screened using NJDEP Residential SCC or EPA non-industrial RBC where SCC were not available. Inorganic data were also screened against the site-specific background levels established for PTA under the IRP.

4.1.3 Field Work Results

4.1.3.1 MEC Results

A visual survey was conducted over approximately 0.45 acres of the area surrounding the former projectile range, which is located within the 1926 Explosion Radius MRS. See Map 4-1 for an

illustration of the path of the survey. Although a visual survey of the range was planned, the range was inaccessible. The structures associated with both the firing point and slug butt were still present on site. However, the entire site was enclosed within an aging rusted fence with no visible entrance gate. In addition, the site was heavily vegetated with vines and other similar undergrowth and the structure that was formerly used as the slug butt was in severe disrepair and did not appear safe to enter. Therefore, the field crew conducted the survey around the perimeter of the range. The area surveyed is located within the 1926 Explosion Radius MRS. It should be noted that based on field observations, the range location has been modified (*i.e.*, moved east) from the location shown in the HRR and SI Work Plan.

During the survey no MEC was identified; however munitions debris including expended trip flares, flare brackets, and flare spoons were observed. Munitions debris was observed in two separate locations adjacent to the range. The first observation was made to the south of the firing point and included numerous pieces of debris associated with trip flares. The second observation of munitions debris was made to the north of the slug butt and only included a spoon associated with trip flares. Due to the cluster of items to the south of the firing point it appears that the items were discarded, not expended, in this area. In addition, several structures and surface features were identified on the range during the survey. Information regarding the observations made during the survey is given in Table 4-1 and on Map 4-1.

Figure 4-1: Munitions debris south of firing point

Figure 4-2: Spoon associated with trip flares north of slug butt

Figure 4-3: Outer shell of munitions item near slug butt

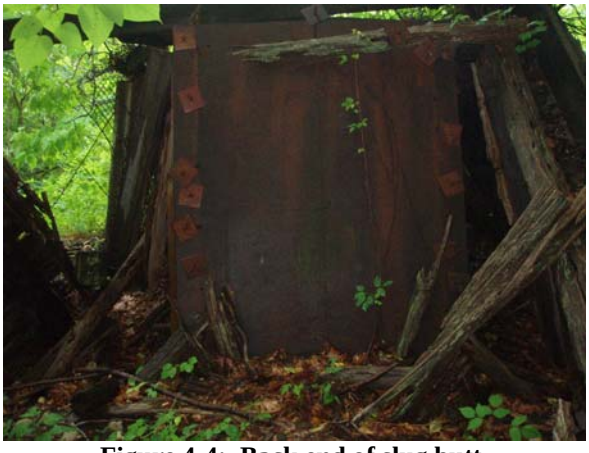

Figure 4-4: Back end of slug butt

Table 4-1 Visual Survey Observations at the Former Projectile Range

Item ID	Description
MEC Item	
None	None
Munitions Debris	
Expended Trip Flares	These are cylindrical containers
Flare brackets	These are metal brackets that attach trip flares to trees or poles
Flare spoon	These are metallic spoons that trip the firing pin when the flares are activated
Structures/Debris	
Bldg. 622	A concrete block structure with a steel roof, historically identified as Bldg. 622, was observed in the area historically known as the firing point
Slug Butt	A structure constructed of 6' x 6' pieces of lumber and a steel box is located in the area historically known to be the slug butt of this range; this structure is surrounded by a fence
Surface Features	
Cliff of boulders	A cliff of massive boulder was located to the east of the slug butt; the boulders were approximately 200 feet in height

4.1.3.2 MC Results

Two biased composite and two biased grab soil samples were collected; one composite and one grab sample were collected from each location where munitions debris was observed during the visual survey (See Section 4.1.3.1). These samples were analyzed for specific metals (*i.e.*, copper, iron, lead, and zinc) and explosives. The metals selected are associated with the munitions previously used at this range. Matrix spike/matrix spike duplicate (MS/MSD) samples and field duplicate samples were also collected. The analytical data are summarized in Table 4-2 and sample locations are shown on Map 4-1.

The following are the analytical results from the soil samples collected near the former projectile range:

Copper

- Three of the samples exceeded the site-specific background level (11.3 milligrams per kilogram (mg/kg), the SCC (600 mg/kg) and the RBC (3,100 mg/kg)
- One sample exceeded the site-specific background level and the SCC, but not the RBC

Iron

- Two of the samples exceeded the site-specific background level (13,500 mg/kg) and the RBC (55,000 mg/kg); there is no SCC for iron
- Two samples did not exceed the site-specific background level or the RBC

Lead

- All four samples exceeded the site-specific background level (25.8 mg/kg), the SCC (400 mg/kg) and the RBC[2] (400 mg/kg)

Zinc

- One of the samples exceeded the site-specific background level (38.9 mg/kg), the SCC (1,500 mg/kg) and the RBC (23,000 mg/kg)
- Three of the samples exceeded the site-specific background level and the SCC, but not the RBC

Explosives

- No explosives were detected above laboratory reporting limits

[2] This value is a screening RBC value since EPA does not have a consensus Reference Dose or Cancer Slope Factor for inorganic lead.

Site Inspection
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Map 4-1
SI Field Activities and Findings
Former Projectile Range within 1926 Explosion Radius

Legend

- Former Projectile Range
- Surface Danger Zone
- Buildings
- Site Survey
- Munitions Debris
- Surface Soil Sample

Notes: 1) When the SI Work Plan was developed, the 1926 Explosion Radius and the Former Projectile Range were separate MRS. However, for the SI Report, these sites have been consolidated

2) A visual survey of the entire Former Projectile Range was proposed in the SI Work Plan, however, the majority of the range is inaccessible because the firing point was enclosed by a building and the slugbutt was entirley enclosed by a fence with no visible entrance gate

3) Transects for the visual survey were not conducted in straight lines because of sporadic GIS satellite coverage, site topography and dense vegetation. GIS interference was caused by overhead tree canopy.

0 3.5 7 14 21 Meters

Data Source: Aerials: NJDEP, CIR Orthoimagery, 2002
CTT Data: AEC, CTT Range Inventory, 2005

Coordinate System: UTM Zone 18N
Datum: NAD 83
Units: Meters

Contract: W912DR-05-D-0004
Edition: Final SI Report
Date: April 2008

Table 4-2 Former Projectile Range Analytical Data

Contaminant of Concern	Sample Concentration	Laboratory RL	Background Level	NJDEP Residential SCC	Region 3 Non-industrial RBC
Sample ID: PTA-SSC-01 (in mg/kg)					
1,3,5-TNB	ND	0.25	NA	-	2,300 (N)
1,3-DNB	ND	0.25	NA	-	7.8 (N)
2,4,6-TNT	ND	0.25	NA	-	21 (C)
2,4-DNT	ND	0.25	NA	1	160 (N)
2,6-DNT	ND	0.25	NA	1	78 (N)
2-AM-4,6-DNT	ND	0.25	NA	-	-
2-NT	ND	0.25	NA	-	780 (N)
3-NT	ND	0.25	NA	-	-
4-AM-2,6-DNT	ND	0.25	NA	-	-
4-NT	ND	0.25	NA	-	-
HMX	ND	0.25	NA	-	3,900 (N)
NB	ND	0.25	NA	28	39 (N)
RDX	ND	0.25	NA	-	5.8 (C)
Tetryl	ND	0.25	NA	-	310 (N)
Copper	3,940	3	11.3	600	3,100 (N)
Iron	37,900	15	13,500	-	55,000 (N)
Lead	1,220	2	25.8	400	400 (N)
Zinc	32,500	15	38.9	1,500	23,000 (N)
Sample ID: PTA-SSG-02 (in mg/kg)					
1,3,5-TNB	ND	0.25	NA	-	2,300 (N)
1,3-DNB	ND	0.25	NA	-	7.8 (N)
2,4,6-TNT	ND	0.25	NA	-	21 (C)
2,4-DNT	ND	0.25	NA	1	160 (N)
2,6-DNT	ND	0.25	NA	1	78 (N)
2-AM-4,6-DNT	ND	0.25	NA	-	-
2-NT	ND	0.25	NA	-	780 (N)
3-NT	ND	0.25	NA	-	-
4-AM-2,6-DNT	ND	0.25	NA	-	-
4-NT	ND	0.25	NA	-	-
HMX	ND	0.25	NA	-	3,900 (N)

Contaminant of Concern	Sample Concentration	Laboratory RL	Background Level	NJDEP Residential SCC	Region 3 Non-industrial RBC
NB	ND	0.25	NA	28	39 (N)
RDX	ND	0.25	NA	-	5.8 (C)
Tetryl	ND	0.25	NA	-	310 (N)
Copper	2,970	2	11.3	600	3,100 (N)
Iron	10,600	8	13,500	-	55,000 (N)
Lead	763	0.8	25.8	400	400 (N)
Zinc	2,360	2	38.9	1,500	23,000 (N)
Sample ID: PTA-SSC-03 (in mg/kg)					
1,3,5-TNB	ND	0.25	NA	-	2,300 (N)
1,3-DNB	ND	0.25	NA	-	7.8 (N)
2,4,6-TNT	ND	0.25	NA	-	21 (C)
2,4-DNT	ND	0.25	NA	1	160 (N)
2,6-DNT	ND	0.25	NA	1	78 (N)
2-AM-4,6-DNT	ND	0.25	NA	-	-
2-NT	ND	0.25	NA	-	780 (N)
3-NT	ND	0.25	NA	-	-
4-AM-2,6-DNT	ND	0.25	NA	-	-
4-NT	ND	0.25	NA	-	-
HMX	ND	0.25	NA	-	3,900 (N)
NB	ND	0.25	NA	28	39 (N)
RDX	ND	0.25	NA	-	5.8 (C)
Tetryl	ND	0.25	NA	-	310 (N)
Copper	9,290	2	11.3	600	3,100 (N)
Iron	156,000 J	79	13,500	-	55,000 (N)
Lead	2,070	0.8	25.8	400	400 (N)
Zinc	8,370 J	8	38.9	1,500	23,000 (N)
Sample ID: PTA-SSG-04 (in mg/kg)					
1,3,5-TNB	ND	0.25	NA	-	2,300 (N)
1,3-DNB	ND	0.25	NA	-	7.8 (N)
2,4,6-TNT	ND	0.25	NA	-	21 (C)
2,4-DNT	ND	0.25	NA	1	160 (N)
2,6-DNT	ND	0.25	NA	1	78 (N)
2-AM-4,6-DNT	ND	0.25	NA	-	-

Contaminant of Concern	Sample Concentration	Laboratory RL	Background Level	NJDEP Residential SCC	Region 3 Non-industrial RBC
2-NT	ND	0.25	NA	-	780 (N)
3-NT	ND	0.25	NA	-	-
4-AM-2,6-DNT	ND	0.25	NA	-	-
4-NT	ND	0.25	NA	-	-
HMX	ND	0.25	NA	-	3,900 (N)
NB	ND	0.25	NA	28	39 (N)
RDX	ND	0.25	NA	-	5.8 (C)
Tetryl	ND	0.25	NA	-	310 (N)
Copper	9,340	1	11.3	600	3,100 (N)
Iron	285,000	64	13,500	-	55,000 (N)
Lead	2,280	0.6	25.8	400	400 (N)
Zinc	19,800	13	38.9	1,500	23,000 (N)

Notes:
mg/kg milligram per kilogram
TNB trinitrobenzene
ND non-detect
N/A not applicable
(-) no available value
N noncarcinogenic
DNB dinitrobenzene
DNT dinitrotoluene
AM amino
NT nitrotoluene
NB nitrobenzene
C carcinogenic
J Indicates result was qualified as estimated by data validator due to high field duplicate relative percent difference (RPD)

Yellow highlight The sample result is greater than the site-specific background, the SCC, and the RBC
Aqua highlight The sample result is greater than the site-specific background and the RBC; there is no SCC for that contaminant
Green highlight The sample result is greater than the site-specific background and the SCC, but not the RBC

4.1.4 Conceptual Site Model

4.1.4.1 MMRP Site Profile

4.1.4.1.1 Area and Layout

The 1926 Explosion Radius is approximately 1,562 acres and covers a large portion of the south-central part of PTA, including the majority of the downtown area.

4.1.4.1.2 Structures

There are hundreds of buildings located within the site area. This MRS encompasses the majority of the buildings and parking lots from south of Farley Avenue to an area close to the

northern end of Picatinny Lake. The buildings are used for manufacturing, storage, testing, R&D, administration, as well as military housing.

4.1.4.1.3 Utilities

The utilities servicing the buildings within the 1926 Explosion Radius MRS are assumed to include electricity, drinking water, sewer, and telephone/communications.

4.1.4.1.4 Boundaries

The 1926 Explosion Radius MRS is bordered to the south by 4th Street, to the east by the installation boundary, and to the west by the ridgeline of Green Pond Mountain. It is located approximately 1,000 feet (305 meters) south of the northern end of Picatinny Lake.

4.1.4.1.5 Security

A fence is present around the entire boundary of PTA, with the exception of some sections of the 3500 area. Public entry to the installation is restricted to two gates, the front (main) entrance and the Mt. Hope entrance. The gates are continuously monitored by video surveillance and a contracted security force, referred to as DoD Civilian Police. However, access to the majority of the 1926 Explosion Radius MRS is not restricted once on the installation. The former DRMO yard and former burning ground are surrounded by a chain link fence that has an entrance gate on East 6th Street and the former projectile range is completely fenced.

4.1.4.2 Physical Profile

4.1.4.2.1 Climate

PTA is located in the Continental climate zone of the eastern United States and has a climate minimally influenced by the ocean. The mean annual precipitation is 47.85 inches. Monthly precipitation amounts are similar throughout the year (between 3 and 5 inches), with slightly heavier precipitation rates in July and August. The highest average temperatures for the area (72.4 degrees Fahrenheit [oF]) are recorded in July, and the lowest (27.4 oF) are recorded in January. Prevailing winds are from the northwest from October through April and from the southwest from March through September. Specific climate data were recorded at Boonton, NJ,

from 1951 through 1982. Boonton is located approximately 8 miles (12,875 meters) southeast of PTA.

4.1.4.2.2 Geology

The arsenal is located on the Green Pond Syncline within the New Jersey Highlands physiographic province. The province is composed of faulted and folded Proterozoic to Devonian Rocks that form a series of valleys and ridges aligned northeast to southwest. Four bedrock formations, ranging in age from Precambrian to Silurian, underlie PTA. From oldest to youngest, these formations include Precambrian gneiss and other metamorphic rocks, which underlie a majority of the site, Cambrian Hardyston quartzite, Cambrian Leithsville dolomite, and Silurian Green Pond Conglomerate. These formations are generally obscured by overlying Pleistocene till and stratified drift formed in relict streams and lakes. Based on previous drilling activities conducted at the site, the depth to bedrock is greater than 125 feet.

4.1.4.2.3 Topography

PTA is located in the New Jersey Highlands physiographic province, between the Appalachian Piedmont physiographic province to the southeast and the Valley and Ridge province to the northwest. The New Jersey Highlands Region is part of the larger New York-New Jersey Highlands, which encompasses 1.1 million acres of Appalachian ridges and valleys stretching from the Hudson to the Delaware River.

PTA encompasses Picatinny Valley, which is approximately 7 miles (11,265 meters) long, and a parallel intermontane valley (Green Pond Gorge), which is about 2 miles (3,219 meters) long. The installation is situated between Green Pond Mountain on the northwest, Copperas Mountain on the east, and an unnamed hill on the southeast. Overall, the dominant topographic gradient is from the northeast to the southwest, with severe slopes present along the northwestern boundary of PTA along Green Pond Mountain.

The majority of the installation appears on the Dover U.S. Geologic Survey (USGS) topographic quadrangle. Elevations on PTA range from 685 to 1,287 feet above mean sea level (amsl) along

the ridgeline of Green Pond Mountain. In general, elevations are lower to the south and east and higher to the north and west. Buildings associated with the arsenal are situated primarily on the valley floor or southeastern slopes. Several former firing and testing ranges are on Green Pond Mountain.

4.1.4.2.4 Soil

There are 26 soil types on the installation that are recognized by the U.S. Department of Agriculture and Soil Conservation Service. Soils in the area are primarily coarse-textured sandy loams that are derived from bedrock, glacial till, and colluvium. The northwest portion of PTA is rugged with rocky slopes and little soil. The southern end of PTA is bordered by a terminal moraine consisting of poorly sorted sand, gravel, and boulders. The western portion is underlain by a thin layer of glacial till up to 20 feet thick and consisting of sand, gravel, and boulders. The eastern portion has gentler slopes and more uniform till with a thickness of 10 to 25 feet. The valley floor is underlain by till and drift from relict lakes and streams at a thickness of up to 200 feet. Up to five hydric soil types were identified at PTA, primarily in isolated depressional areas along the valley floor where organic deposits settled following glaciation.

Soil within the 1926 Explosion Radius MRS consists of clay silt loams, loam, silt, sand, clay, gravel, rock outcropping, and glacial till.

4.1.4.2.5 Hydrogeology

Three aquifers underlying PTA have been identified during previous subsurface investigations. An unconfined stratified drift aquifer, which is the water table aquifer, is perched on top of fine sand and silt lake sediments. These sediments form a discontinuous leaky confining bed between the water table aquifer and a lower confined glacial till aquifer consisting primarily of sand and gravel. The confined glacial till aquifer is the primary water source for PTA. A bedrock aquifer is also present and is separated from the confined glacial till aquifer by weathered bedrock with a maximum known thickness of 60 feet. It is assumed that portions of this MRS overlie all three aquifers.

4.1.4.2.6 Hydrology

PTA is situated in New Jersey Watershed Management Area 6 and is an important recharge area for northern New Jersey's primary water supply. There are two large lakes (Lake Denmark and Picatinny Lake), four perennial brooks (Green Pond, Burnt Meadow, Bear Swamp, and Ames), 18 ponds, several intermittent streams, and a few springs/seeps on the installation. Surface water drains primarily from northeast to southwest following the topographic gradient of the area.

The primary drainage feature on the installation is Green Pond Brook. It originates at a 500-acre spring-fed lake, known as Green Pond, located adjacent to the northern border of the installation. On PTA, Green Pond Brook's width varies from 10 to 30 feet (three to nine meters), with a maximum depth of 5 feet. Burnt Meadow Brook originates from Egbert Lake and flows through Lake Denmark prior to its convergence with Green Pond Brook near the middle of the arsenal. Green Pond Brook continues to flow southwest and through Picatinny Lake before exiting the installation to the southwest. Approximately 1 mile (1,609 meters) south of the installation, Green Pond Brook joins the Rockaway River. The Rockaway River flows east through the Boonton Reservoir before joining the Passaic River.

Bear Swamp Brook joins Green Pond Brook on the southern end of the installation. Bear Swamp Brook has a width between 3 and 7 feet (0.9 to two meters) and a maximum depth of 2 feet. Ames Brook carries headwaters off of 250 acres of PTA and exits the installation along the eastern boundary.

Lake Denmark and Picatinny Lake are man-made features that collectively comprise 360 acres of open water. The lakes were constructed in the 1880s and are primarily used for industrial water supply and recreation. The maximum depth of Lake Denmark is approximately seven feet; Picatinny Lake's maximum depth is approximately 20 feet.

PTA contains 1,250 acres of mostly forested and scrub/shrub wetlands. Red maple swamp forests, lakes and ponds, and their associated wetlands comprise 92% of all wetlands present on the installation. The largest tract of red maple swamp is present on the southern end of PTA.

Palustrine shrub lands are hydrologically connected to Lake Denmark. Prior to development of the arsenal and surrounding area, a majority of the lower one-third of the valley was occupied by wetlands. Hydric soils are found on 26% of PTA, mainly in the Picatinny Valley and scattered riparian areas throughout the installation.

Waterbodies within the radius of the 1926 Explosion MRS include most of Picatinny Lake, EOD Pond, North and South basins, Fisher's Pond, Bear Swamp Brook, Green Pond Brook, and several small streams.

4.1.4.2.7 Vegetation

PTA is located within the Appalachian Oak forest region, a subdivision of the Eastern Deciduous Forest Biome. According to the Installation Natural Resources Management Plan, approximately 70% (4,082 acres) of the installation is characterized by second-growth forest on formerly cleared farmlands. Mixed oak (*Quercus*) species compose 65% (2,656 acres) of the forested land on PTA. Generally, wooded stands at lower elevations of the installation are dominated by species within the red oak subgroup (*e.g.*, red oak [*Q. rubra*], black oak [*Q. velutina*], scarlet oak [*Q. coccinea*]), while stands at higher elevations are dominated by chestnut oak (*Q. montana*).

Northern hardwood and red maple swamp forest types are the second dominant forest types on PTA, with each comprising 13% of the forested area (545 and 532 acres, respectively). Typical northern hardwood species are sugar maple *(Acer rubrum*) and American beech (*Fagus grandifolia*). Most northern hardwood stands are located in Picatinny Valley and along the eastern ridge. Mature red maple swamp forest is present on the hydric and muck soil types at the base of the valley.

4.1.4.3 Land Use and Exposure Profile

4.1.4.3.1 Current Land Use/Activities

The 1926 Explosion Radius MRS has hundreds of buildings used for various purposes including manufacturing, storage, testing, R&D, administration, and housing. This MRS also contains parking lots, recreational areas, and undeveloped property.

4.1.4.3.2 Current Human Receptors

The current human receptors on the 1926 Explosion Radius MRS include PTA personnel, PTA residents, contractors/visitors, and trespassers. Contractors/visitors include utility workers and visitors of PTA personnel and PTA residents. Since PTA is a fenced, guarded, and patrolled installation, it is not likely that trespassers from outside the installation would penetrate the perimeter of PTA and access the MRS. For the purpose of this CSM, trespassers are considered individuals who have access to PTA but are not authorized to be present in specific areas of the MRS. The most likely "trespassers" would therefore be PTA personnel, PTA residents, and contractors/visitors, and the potential exposure of trespassers is described by the potential exposure pathways for the latter receptor groups. It is possible that these trespassers can access any area of the MRS that is unsecured; therefore, exposure to this receptor population is not likely to occur on the former projectile range, which is completely fenced.

4.1.4.3.3 Potential Future Land Use

According to the Draft Real Property Master Plan: Short Range Component, February 2007, and the Draft Real Property Master Plan: Long Range Component, February 2007, under BRAC, it was recommended that PTA become an "integrated weapons and armaments specialty site for guns and ammunition." This will be accomplished by realigning six other DoD commands to PTA. As a result, a significant amount of development is planned for PTA in both the short-term (through FY2012) and long-term. In the short-term, the proposed development within the 1926 Explosion Radius MRS includes:

- Emergency Services Center Phases I and II (projected start FY07 and FY09) – a fire station and police/MP station will be built in downtown PTA near the intersections of Farley Avenue, Buffington Road, and Bott Road

- Packaging, Handling, Shipping, and Transportation Center (projected start FY08) – a packaging, handling, shipping, and transportation center, along with an outdoor test area, will be built near Picatinny Lake at the intersections of Babbit Road, Buffington Road, and 16th Avenue
- Child Development/School Age Service Center (projected start FY2010) – will be built near EOD Pond near Jenkins Road
- Explosive Machining and Prototyping Facility (projected start FY2010) – will be built near Bldg. 230, off of Phipps Road
- Explosive Ordnance Disposal Technology Facility (projected start FY2012) – this will include several buildings for experimentation and assembly/disassembly as well as storage magazines. They will be built near the intersections of S.N.G Road and Upper H.X.E. Road.
- RCI Housing – the existing Farley Avenue, Navy Hill, and Fishers Pond Housing Areas will be redeveloped/rehabilitated
- Replacement of the service water distribution system - it is assumed that much of this system is located within the radius of the 1926 Explosion Radius MRS

The proposed long-term development items are detailed below. Since a large portion of PTA's downtown, as well as numerous buildings, are located within the 1926 Explosion Radius MRS, it is assumed that much of the proposed development will also occur within this area.

- Demolition of approximately 220 buildings throughout the installation
- Construction of numerous new buildings throughout the installation
- Improve and widen some roads in the downtown area
- Some other general improvements (*e.g.*, pave roads, add curbs, improve parking lots)

4.1.4.3.4 Potential Future Human Receptors

The potential future human receptors are the same as the current human receptors (*i.e.*, installation personnel, contractors/visitors, and residents). However, the number of potential receptors is expected to increase significantly. According to the Draft Real Property Master Plans for PTA, it is projected that approximately 650 additional personnel will be assigned to

PTA by FY 2012 as a result of BRAC. Additional contractors would include future construction workers associated with the proposed development of the site.

4.1.4.3.5 Zoning/Land Use Restrictions

Zoning maps were reviewed for Rockaway and Jefferson townships to determine zoning districts in the area of PTA. A majority of PTA is located in Rockaway Township and is zoned as a low-density single family detached residential district. A majority of the land located southeast of PTA is zoned as single family planned residential development, with a smaller portion zoned as a mining district. Small residential, office/residential and multi-family residential districts are present adjacent to the southern end of PTA. Commercial, industrial, and office districts are present within the Borough of Rockaway located east/southeast, including some adjacent to PTA. For example, Mount Hope Quarry is located adjacent to PTA on the western boundary.

A majority of the land in Jefferson Township, located northeast of PTA, is zoned for rural conservation. Smaller districts zoned for commercial, industrial, and low- to medium-density residential use are adjacent to the southern end of PTA at Berkshire Valley. Additionally, small commercial and low-density residential zones are located adjacent to the northeastern end of PTA in the communities of Upper Longwood, Woodstock, Petersburg, and Milton.

Within PTA, LUCs are, or will be, associated with many of the IRP sites. In addition, PTA's Safety Office requires that they be contacted prior to any personnel conducting intrusive/subsurface work at the installation. The Safety Office then determines, on a case by case basis, whether a MEC investigation is necessary prior to conducting the work.

4.1.4.3.6 Beneficial Resources

PTA contains the largest tract of undeveloped, forested public land in the New Jersey Highlands Region. The collective acreage of PTA's undeveloped lands that are contiguous with adjacent public lands and safety easements on adjacent private properties is 4,780 acres. The connectivity between undeveloped parcels provides important habitat for wildlife species with large home

ranges, and it facilitates species migration and recruitment. The unbroken forested area may provide seasonal habitat for the federally listed endangered Indiana bat (*Myotis sodalis*).

In addition, the vast undeveloped acreage serves as an important groundwater recharge area for New Jersey's Watershed Management Area 6. Watershed Management Area 6 is comprised of the Whippany, Rockaway, and Upper Passaic watersheds and is northern New Jersey's principal water supply.

A major contributing factor to the recharge potential at PTA is the 1,250 acres of wetlands scattered throughout the installation. Wetlands function in storm water retention, pollutant filtration, and nutrient recycling. Green Pond Brook, PTA's primary drainage system, flows into the Rockaway River. The Rockaway River is recognized by the State of New Jersey as a high quality waterway.

There are 10 recognized cover types within five wetland regimes at PTA. The variety of wetland habitats provides for a diverse assemblage of plant and animal species. Seven state-listed endangered plants are found at PTA; four occur in Lake Denmark and three are associated with wetlands on the installation.

Non-consumptive and consumptive uses of wildlife occur at PTA, as well. Picatinny Peak is a designated hawk-watching site, and the NJ Audubon Society has held annual bird surveys at the installation since 1993. The Picatinny Rod and Gun Club has a put-and-take program for ring-necked pheasant (*Phasasianus colchius*). In addition, various game species, including whitetail deer (*Odocoileus virginianius*), wild turkey (*Meleagris gallopavo*), and ruffed grouse (*Bonasa umbellus*) are present at PTA.

Trout fishing is popular in Upper Green Pond Brook. A rare self-sustaining population of brook trout (*Salvalinus fontinalis*) is present in Upper Green Pond Brook. PTA also conducts a rainbow and brown trout stocking program in the middle portion of the brook. A few popular species fished for in the lakes and ponds are largemouth bass (*Micropterus salmoides*), yellow

perch (*Perca flavescens*), and catfish. Waterfowl species hunted at PTA include wood duck (*Aix sponsa*), mallard (*Anas platyrhynchos*), and green winged teal (*Anas carolinensis*).

4.1.4.3.7 Demographics/Zoning

PTA is located 4 miles (6,437 meters) north of the city of Dover, in Rockaway Township, Morris County, NJ. There are 753 permanent residents and 3,939 employees at PTA. The nearest towns are: Wharton (population: 6,298), located 3 miles (4,828 meters) to the south; Dover (population: 18,188), located 4 miles (6,437 meters) to the south; Rockaway (population: 6,473), located 4 miles (6,437 meters) to the southeast; Boonton (population: 8,496), located 8 miles (12,875 meters) to the southeast; and Morristown (population: 18,544), located 15 miles (24,140 meters) to the southeast. With the exception of Mt. Hope Quarry, which is located adjacent to the southeast portion of PTA, the area immediately surrounding PTA is either undeveloped or sparsely developed residential property.

4.1.4.4 Ecological Profile

4.1.4.4.1 Habitat Type

The following information was adapted from the Integrated Natural Resources Management Plan for PTA. PTA contains a variety of wildlife habitats, including upland forest (60%), forested wetland (9%), and lakes and associated scrub/shrub wetlands (9%). Mixed oak, northern hardwood, hemlock, and red maple swamp are the four predominant forest types on the installation. Scrub/shrub habitat is mainly found in wetlands associated with Lake Denmark.

There are 10 recognized cover types within five wetland regimes at PTA. Lakes and ponds account for 33% of the total wetland acreage. Vegetated wetland cover types include palustrine scrub/shrub, palustrine forested, and wet meadow. Red maple (*Acer rubrum*), aspen (*Populus sp.*), gray birch (*Betula populifolia*), and hemlock (*Tsuga canadensis*) are predominant tree species within the palustrine forests at PTA.

Aquatic habitats are present in the two large lakes (Lake Denmark and Picatinny Lake), 18 ponds, and four perennial brooks (Green Pond, Burnt Meadow, Bear Swamp, and Ames) on the

installation. In addition, the presence of intermittent streams and springs/seeps contribute to biodiversity since they provide habitat for ephemeral aquatic and amphibian species.

While the majority of the 1926 Explosion Radius MRS is developed, there are some undeveloped areas consisting of patches of forest, wetlands, lakes, ponds, and streams.

4.1.4.4.2 Degree of Disturbance

The degree of disturbance is high as the majority of the site is developed or planned for construction or enhancement.

4.1.4.4.3 Ecological Receptors

Ecological receptors at PTA consist of flora and fauna on the installation, as well as their ecosystems. Nearly 25% of New Jersey's 2,117 known native flora have been documented at PTA. Faunal diversity at PTA is exhibited by 41 mammal species, 26 fish species, 21 amphibian species, 19 reptile species, and 208 bird species.

Approximately 70% of PTA is forested, while 21% of PTA is considered wetland; some of these areas overlap. PTA also provides habitat for urban wildlife as 19% of the land at the installation is improved or semi-improved. Urban wildlife are species adapted to human presence and include small mammals (*e.g.*, gray squirrels [*Scirius carolinensis*], eastern cottontail rabbits [*Sylvagus floridanus*]) and songbirds (*e.g.*, American robin [*Turdus migratorius*], song sparrow [*Melospiza melodia*]). Little brown bats [*Myotis lucifugus*] are the most often observed species in the cantonment and semi-improved areas, while the northern long-eared bat (*M. septentrionalis*) is the most prevalent species in the forested portions of PTA.

No federally threatened or endangered plant species have been documented at PTA. Seven state listed endangered plants are found at PTA; four occur in Lake Denmark, and three are associated with wetlands on the installation. The state listed stiff clubmoss (*Lycopodium annotinum*) was recently documented and found in only a few colonies at PTA. There are 14 New Jersey designated floral species of special concern that occur in the remote northern portion of PTA.

In 1993 and 1994, it was documented that federally listed, endangered Indiana bats were hibernating in abandoned mines within 2 miles (3,219 meters) of PTA. It is also believed that the Indiana bat depends on PTA for summer habitat. According to a Screening Level Ecological Report for Site 54 at PTA, a summer roost area for the Indiana bat is located in Area J near the G-2 Pond. One federally listed threatened animal, the bog turtle (*Clemmys muhlenburgii*), is known to occur at PTA. The last documented sighting of a bog turtle was in the shrub-swamp wetlands associated with Green Pond in 1987.

State listed endangered wildlife species at PTA include the bog turtle, timber rattlesnake (*Crotalus horridus*), red-shouldered hawk (*Buteo lineatus*), and bobcat (*Felis rufus*). The critically imperiled pied-billed grebe (*Podilymbus podiceps*) may nest and breed in the shrub swamp areas of Lake Denmark. Twelve state listed threatened species occur at PTA; only four are permanent residents, while the other eight are species of migratory birds.

According to NJDEP's i-Map Landscape Project layer, this site contains habitat with at least one occurrence of a state threatened species.

4.1.4.5 Munitions/Release Profile

4.1.4.5.1 Munitions Types and Release Mechanisms

Table 4-3 presents a summary of MEC types that are known or expected to exist within the 1926 Explosion Radius MRS based on the information collected for the HRR. The mechanisms by which the MEC were released into the environment are also listed.

Table 4-3 Summary of Potential Munitions Debris and MEC – 1926 Explosion Radius MRS

Munitions Debris Observed During SI Field Activities[a]	Munitions Debris / MEC Identified During HRR	Primary Release Mechanism
▪ Expended trip flares ▪ Flare brackets ▪ Flare spoons	▪ 25-lb. Navy Mark I bombs, loaded and plugged ▪ Mark II bombs, each containing 50 lbs. TNT ▪ Mark III bombs, each loaded with TNT ▪ Mark IV aircraft bombs with approximately 250 lbs. of TNT in each bomb ▪ Mark V bombs, each loaded with TNT ▪ Bomb accessories (*e.g.*, fins, tails) ▪ Aerial bombs, TNT center section ▪ 14-inch Class "B", loaded and fused ▪ 14-inch AP rounds, loaded and fused ▪ 8-inch shells, loaded and fused ▪ 5-inch shells, loaded and fused ▪ Any munitions or equipment that were used on, or passed through, PTA from approximately 1921 to the 1980s ▪ Bomb Live Unit (BLU) 42 ▪ BLU 26 ▪ 40-mm projectile ▪ 1-lb. HE ▪ M42 grenade ▪ 20- to 40-mm inert projectile rounds ▪ Rockets from static testing activities	▪ Series of explosions at a storage magazine ▪ Discarded or malfunctioned munitions ▪ Munitions firing

a – The munitions debris were observed near the former projectile range on the northwest portion of this site

4.1.4.5.2 Maximum Probable Penetration Depth

The maximum probable penetration depth is not applicable to this site since munitions were not fired or tested across the majority of the site. In addition, at the only range (the former projectile range) associated with this site, munitions were fired into a slug butt. It is likely that most of the munitions are below the surface either due to the explosion and potential burial or because the munitions were discarded and likely covered. The depths of MEC depend on the intensity of the explosion and any activities that have further buried or uncovered the MEC and on how MEC not associated with the explosion were discarded

4.1.4.5.3 MEC Density

The density of MEC is unknown; however, the following items were found, and documented by PTA's safety office, within the 1926 Explosion Radius MRS in 1967 and between 1986 and 1998. Note that records for other years are not available. To determine which items are potentially related to the explosion, the items have been separated into two lists; items manufactured on or before 1926 that could potentially be associated with the explosion and items manufactured after 1926 that are not associated with the explosion. No additional details regarding the types of MEC found are available. The quantity of each item found is given in parentheses.

Items Potentially Manufactured On or Before 1926

1. 1-lb. HE (10)
2. 5-inch HE (1)
3. 3,4, and 5-inch navy shells (180)
4. 6-inch AP (1)
5. 6-inch HE (1)
6. 14-inch AP (1)
7. 155-mm cartridges (10)
8. 155-mm cartridges, empty (2)
9. #250 bombs (2)
10. small arms ammunition (4,239)

Items Manufactured After 1926

1. 2.75-inch HE (1)
2. 3-inch HE (1)
3. 20-mm cartridges (35)
4. 20-mm HE, inert (1)
5. 20-mm target practice tracer (50)
6. 37-mm AP (1)
7. 40-mm cartridge (2)
8. 40-mm HE, dual purpose (4)
9. 40-mm practice round (2)
10. 57-mm cartridges (2)
11. 60-mm, inert (3)
12. 90-mm, inert (5)
13. 105-mm (2)
14. 105-mm, inert (2)
15. 106-mm HE, anti-tank (1)
16. APHE, empty (1)

17. BDU63, inert (1)
18. blasting cap (1)
19. blasting cap, inert (1)
20. BLU 26 (7)
21. BLU 33 (1)
22. BLU 42 (3)
23. cartridge casing (1)
24. flash grenade (1)
25. fuze (1)
26. fuze, inert (1)
27. grenade, empty (3)
28. HE azides (3)
29. HE (14)
30. mine (1)
31. mine, inert (1)
32. M42 grenade (4)
33. M51 fuze, inert (1)
34. M557 fuze, inert (4)
35. M577 fuze, inert (1)
36. MK24 (1)
37. pyrotechnics (4)

4.1.4.5.4 Munitions Debris

During the visual survey of the perimeter of the former projectile range, munitions debris associated with trip flares was observed at two separate locations; to the south of the firing point and to the north of the slug butt. In addition, a historical report on the 1926 explosion indicates that shell fragments were found up to 1 mile (1,609 meters) away from the explosion center.

4.1.4.5.5 Associated MC

It was reported that TNT, Class "B" explosives, Explosive "D" (*i.e.*, ammonium picrate), smokeless powder (which could contain nitrocellulose, nitroglycerin, nitroguanidine, bismuth, and lead) and picric acid were being stored in the buildings involved in the 1926 explosion (refer to the appropriate Ordnance Technical Data Sheets in Appendix G). In addition, the former projectile range is located within the 1926 Explosion Radius MRS and the primary MC associated with the range includes propellants. Chemicals typically associated with propellants include lead, copper, zinc, TNT and its derivatives, RDX, and HMX. Four surficial soil samples were collected from the perimeter of the range at locations where munitions debris were

observed during the SI field work. Analysis of these samples indicated the presence of copper, iron, lead, and zinc at levels greater than site-specific background levels and greater than comparison criteria. No explosives were detected above laboratory reporting limits in any of the samples.

In addition, many IRP sites are located either wholly or partially within the radius of this MRS. As a result, extensive MC sampling has been conducted at this MRS as part of the IRP. Samples were collected from various media, including soil, surface water, sediment, and groundwater, and have been analyzed for a variety of parameters including metals, explosives, and, in groundwater, perchlorate. As shown on Plates 1 and 2, metals and explosives were detected at concentrations greater than the levels of concern (LOC)[3] in soil, surface water, and sediment at several locations throughout the 1926 Explosion Radius MRS. As shown on Plate 3, perchlorate was detected in groundwater at concentrations greater than the LOC.

With the exception of the SI sampling conducted at the former projectile range, no known MC sampling has occurred at this MRS outside of the IRP site locations. Therefore, the MC data collected at the IRP sites were extrapolated to the non-IRP portions of the 1926 Explosion Radius MRS. It should be noted that it is unknown if the MC detected at the IRP sites are indicative of contamination directly related to the 1926 explosion. Refer to Figure 2-2 for the locations of the IRP sites. Analysis of samples collected from IRP sites located within the 1926 Explosion Radius MRS have indicated the presence of the following metals and explosives:

- Copper was detected at a maximum concentration of 68,500 mg/kg, which exceeds the PTA surface soil background concentration (11.3 mg/kg), the NJDEP Residential SCC (600 mg/kg), and the EPA Region 3 non-industrial RBC (3,100 mg/kg)
- Lead was detected at a maximum concentration of 10,300 mg/kg, which exceeds the PTA surface soil background concentration (25.8 mg/kg), the NJDEP Residential SCC (400 mg/kg), and the EPA Region 3 non-industrial RBC (400 mg/kg)

[3] The LOCs used in the IRP include NJDEP's non-residential SC and EPA Region 3 Industrial RBCs

- Zinc was detected at a maximum concentration of 23,100 mg/kg, which exceeds the PTA surface soil background concentration (38.9 mg/kg), the NJDEP Residential SCC (1,500 mg/kg), and the EPA Region 3 non-industrial RBC (23,000 mg/kg)
- 2,4,6-TNT was detected at a maximum concentration of 12,019 mg/kg, which exceeds the EPA Region 3 non-industrial RBC (21 mg/kg); there is no NJDEP Residential SCC for this compound
- HMX was detected at a maximum concentration of 2,815 mg/kg, which is below the EPA Region 3 non-industrial RBC (3,900 mg/kg); there is no NJDEP Residential SCC for this compound
- NB was detected at a maximum concentration of 9,251 mg/kg, which exceeds the NJDEP Residential SCC (28 mg/kg) and the EPA Region 3 non-industrial RBC (39 mg/kg)
- Nitrocellulose was detected at a maximum concentration of 24,000 mg/kg, nitroguanidine was detected at a maximum concentration of 4.8 mg/kg, and picric acid was detected at a maximum concentration of 440 mg/kg; there are no NJDEP Residential SCCs or EPA Region 3 non-industrial RBCs for these compounds
- Nitroglycerin was detected at a maximum concentration of 4,030 mg/kg, which is above the EPA Region 3 non-industrial RBC (7.8 mg/kg); there is no NJDEP Residential SCC for this compound
- Tetryl was detected at a maximum concentration of 418,000 mg/kg, which exceeds the EPA Region 3 non-industrial RBC (310 mg/kg); there is no NJDEP Residential SCC for this compound

4.1.4.5.6 Transport Mechanisms/Migration Routes

The primary transport mechanisms identified for the 1926 Explosion Radius MRS include:

Soil Disturbance: The current degree of disturbance is relatively high, as the area is developed and building construction/maintenance and utility maintenance may require intrusive activities. A significant amount of future development is planned in this area and this development could uncover potential MEC or MC that are in the surface or subsurface.

Erosion: Erosion of soil may uncover MEC. MC adsorbed to soil particles may migrate in surface water runoff from surface soil to nearby water bodies. Many IRP sites are located either wholly or partially within the 1926 Explosion Radius MRS. Since the remedy at many of these sites includes capping, the cap would eliminate erosion as a primary transport/migration route for that portion of this site. However, installation of the cap would increase soil disturbance.

Frost Heave: Periodic, alternating freezing and thawing during the winter may cause MEC to rise from the soil subsurface to the soil surface.

Infiltration: Based on the soil types associated with the 1926 Explosion Radius MRS, the potential exists for MC to migrate from one environmental medium to another (surface to subsurface soil to groundwater) through infiltration of percolating precipitation.

Recharge and Discharge: Groundwater may discharge to water bodies, and surface water may recharge groundwater depending on time of year, rainfall/snowmelt amounts, and location within the site.

4.1.4.6 Pathway Analysis

4.1.4.6.1 MEC

Figure 4-5 illustrates the MEC pathway analysis prepared for the 1926 Explosion Radius MRS. The MEC Pathway Analysis shows that complete exposure pathways exist for PTA personnel, PTA residents, and contractors/visitors who may contact, via handling or treading underfoot, MEC in surface soil or surficial sediments of the waterbodies within the 1926 Explosion Radius MRS. Complete exposure pathways exist for biota that may contact MEC in surface soil or surficial sediments and that may nest or burrow at the site and thereby contact MEC in subsurface soil. Complete exposure pathways also exist for contractors who may need to access underground utilities in the subsurface soil or may perform intrusive work during future construction activities. It should be noted that clearance must be given by PTA's Safety Office prior to any subsurface activity.

4.1.4.6.2 MC

Figure 4-6 illustrates the MC pathway analysis prepared for the 1926 Explosion Radius MRS. As illustrated in the MC pathway analysis, soil and surface water/sediment impacted by MC are the primary source media for all human and ecological receptors.

Complete exposure pathways exist for PTA personnel, PTA residents, and contractors/visitors who may contact MC in surface soil. Complete exposure pathways also exist for contractors who may contact MC in subsurface soil or subsurface sediment while accessing underground utilities or performing intrusive work during future construction activities. Exposure routes include ingestion, dermal contact, and inhalation of dust. Complete exposure pathways exist for biota that may contact MC in surface soil and that may nest or burrow at the site and may contact MC in subsurface soil.

There are complete exposure pathways for PTA personnel and PTA residents who may fish or go boating in any of the water bodies on the 1926 Explosion Radius MRS and who may be consequently exposed to MC in surface water via dermal contact and to sediment via incidental ingestion and dermal contact. While swimming is banned at PTA, it is possible that recreational users, primarily children or teenagers, might engage in swimming[4]. Therefore, ingestion of surface water is a potentially complete pathway for PTA residents. Complete exposure pathways also exist for aquatic and semi-aquatic biota (*i.e.*, vegetation, invertebrates, fish, and waterfowl) that may be exposed to MC from directly ingested/assimilated surface water and sediment.

While the potable water supply at PTA, which is from groundwater wells, is monitored semiannually and treated for volatile chemicals, potentially complete exposure pathways exist for potable water users. PTA personnel and PTA residents may contact MC in potable water via ingestion and dermal contact.

4 It should be noted that PTA has established several institutional controls including swimming bans and fish advisories for several of their water bodies.

Potentially complete exposure pathways through the food chain exist for assimilative/bioaccumulative MC to both human and ecological receptors. PTA personnel and PTA residents may ingest MC that have bioaccumulated in game animals hunted in the undeveloped portions of the 1926 Explosion Radius MRS. Although catch-and-release fishing is practiced by most anglers at PTA, some may consume their catch. Therefore, human consumption of fish is a potentially complete exposure pathway. Terrestrial, semi-aquatic, and aquatic wildlife may ingest MC assimilated in vegetation and bioaccumulated in prey species. These pathways are potentially complete due to the nature and variability of the process of assimilation into plants and bioaccumulation into wildlife. These processes are highly dependent on the particular MC and environmental conditions, as well as on the conditions of the individual plant or wildlife species.

Figure 4-5: MEC Exposure Pathway Analysis – 1926 Explosion Radius MRS

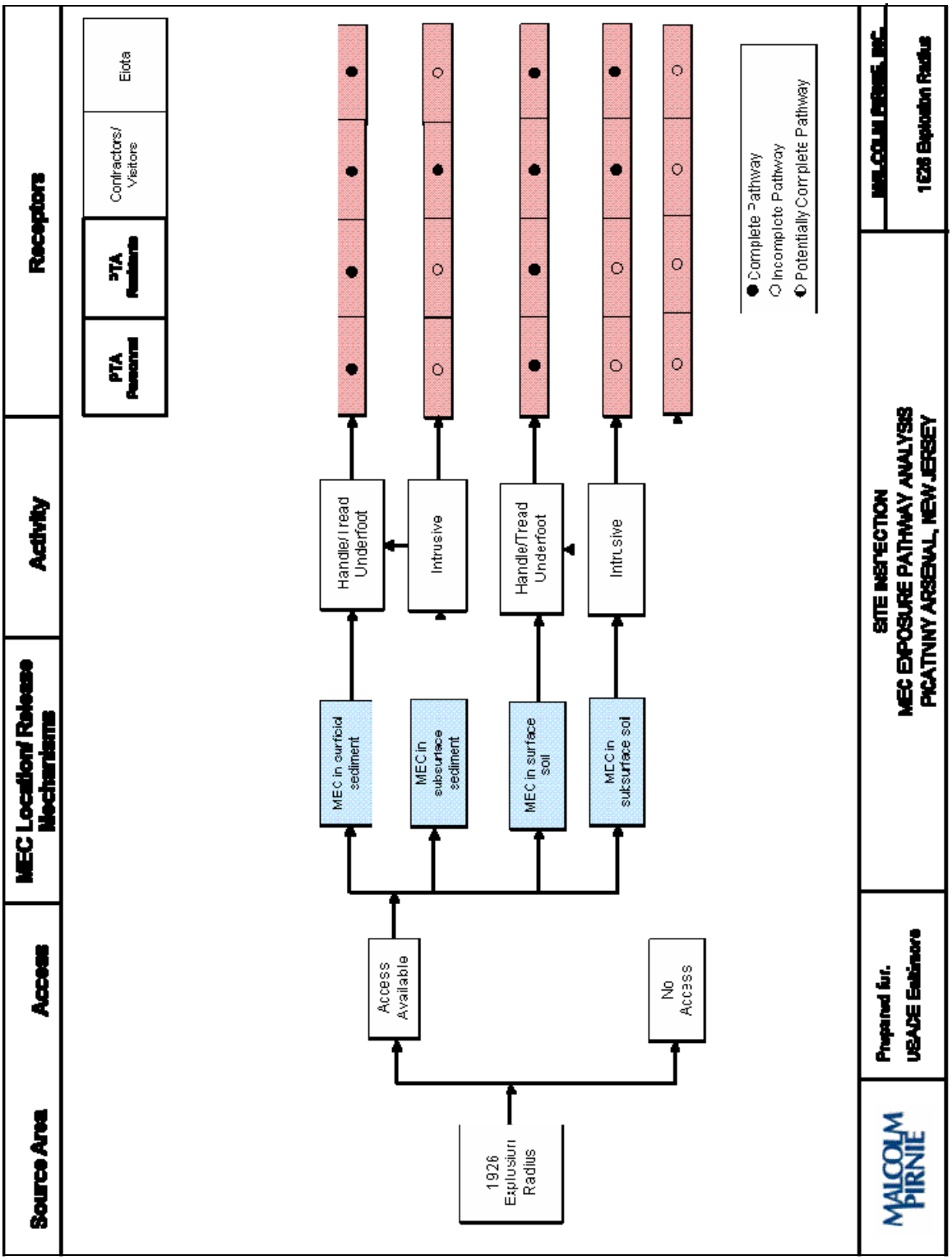
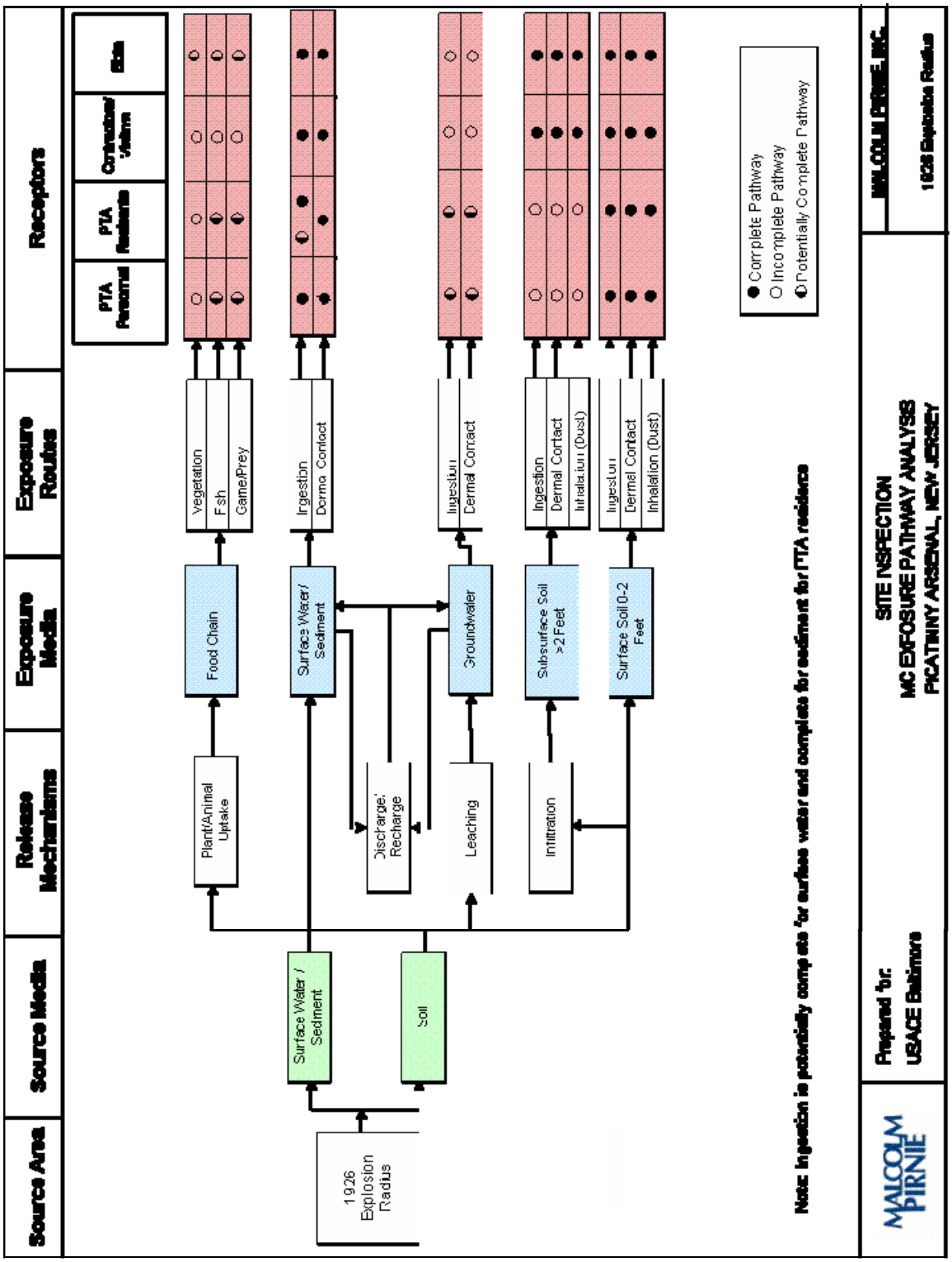


Figure 4-6: MC Exposure Pathway Analysis – 1926 Explosion Radius MRS



4.1.5 Site Summary and Conclusions

4.1.5.1 MEC

A visual survey was conducted over approximately 0.45 acres of the area surrounding the former projectile range and munitions debris was observed at two separate locations adjacent to the range. The survey was conducted within the boundary of the 1926 Explosion Radius MRS. See Map 4-1 for an illustration of the path of the survey. At the time the field work was conducted, the former projectile range and the 1926 Explosion MRS were separate MRSs; however, the former projectile range is now part of the 1926 Explosion Radius MRS. No other MEC activities were conducted within the 1926 Explosion Radius MRS as sufficient information was obtained during the HRR to recommend this site proceed to RI/FS under the MMRP. Therefore, the entire site, including the former DRMO yard and former burning ground and the former projectile range are recommended for an RI/FS.

4.1.5.2 MC

Two composite and two grab samples were collected from biased locations adjacent to the former projectile range and analyzed for copper, lead, iron, zinc, and explosives. No explosives were detected above laboratory reporting limits. All four metals were found at levels that exceeded site-specific background levels and LOCs. At the time the field work was conducted, the former projectile range and the 1926 Explosion MRS were separate MRSs; however, the MRSs have been consolidated for this SI Report and these two sites are no longer separate. No other MC activities were conducted at the 1926 Explosion Radius MRS during the SI as sufficient information was obtained during the HRR to recommend this site proceed to RI/FS under the MMRP.

It should be noted that many IRP sites are located within the radius of this MRS. As MC at these IRP sites are being addressed under the IRP, those portions of this MRS will not require additional MC work under the Active Army MMRP program. Refer to Map 2-2 for the locations of the IRP Sites.

4.1.6 Site Summary and Conclusions

Sufficient information for the 1926 Explosion Radius MRS was obtained during the HRR to recommend a RI/FS focused on MEC and MC.

4.2 1926 Explosion Site – Off-Post (AEDB-R ID: PICA-004-R-01)

4.2.1 Site Description and Historical Overview

This MRS consists of all off-post properties that fall within a 1-mile (1,609 meters) radius of the explosion center of the 1926 explosion. Refer to Section 4.1.1 for a description of the 1926 Explosion Radius MRS. The 1926 Explosion Site – Off-Post consists of vacant land and commercial property, including the Mt. Hope Quarry, which covers the largest area of this MRS. The quarry is located adjacent to PTA on the eastern side of the fence line that marks the installation boundary.

Review of recent aerial photographs shows the active quarry face to currently be approximately 700 feet (213 meters) from the fence line and approximately 1,100 feet (325 meters) from the closest shell burial area, which represents the closest former crater from the 1926 explosion. Over the past four years, which is how long explosive ordnance disposal (EOD) records are kept, several MEC finds were made at the quarry; all of the items found were manufactured prior to 1926. After the HRR began, the frequency of the MEC finds at the quarry increased; this is assumed to be related to the quarry's active face moving toward PTA. As a result, from December 2006 to March 2007 a time critical removal action (TCRA) was performed for 22.6 acres of the quarry, which was the area identified by the quarry manager as planned rock blast/processing areas. The purpose of the TCRA was to significantly reduce the imminent safety hazard presented to the Mt. Hope Quarry employees.

Activities performed during the TCRA included:

- Site preparation – included a site survey, limited brush clearing, installation of a geophysical prove-out (GPO) area, and installation of grid points
- GPO – conducted prior to the geophysical investigation to demonstrate and document the site-specific capabilities of the survey system

- Geophysical investigation – included data acquisition, mapping, and identifying and reacquiring identified anomalies
- Intrusive Investigations – included excavation of anomalies
- Target disposal – all targets certified as MEC were disposed of by the PTA EOD unit

The TCRA resulted in the recovery of 25 MEC items; 21 of these contained HE. All of the MEC items found are consistent with the items associated with the 1926 explosion. The 21 HE-containing items were disposed of through on-site explosive disposal operations performed by the PTA's EOD unit. Two of the 21 HE filled MEC items were low-ordered by the PTA EOD unit and then transported back to PTA for disposal. The other four MEC items discovered were determined to be inert (empty) munitions debris. At the completion of the TCRA intrusive and disposal activities, 3,775-lbs. of munitions/metallic debris were inspected, certified, and transferred to C&M Metals Recycling, LLC. Scrap metal found during intrusive operations (1,583-lbs.) was disposed of at the Tilcon metal recycling area within Mount Hope Quarry. The project was completed without accident or incident. See Map 4-2 for a detailed illustration of the MRS.

Since the TCRA has been completed, Tilcon started mining approximately six acres of the quarry that were not included in the removal action. It was reported that this area is further from the installation boundary than the TCRA area. During this mining, some munitions debris was discovered. Therefore, a second removal action is planned in spring 2008 for those portions of Mt. Hope Quarry where mining is occurring outside of the first TCRA area.

4.2.2 Field Work Activities

4.2.2.1 MEC Activities and Purpose

The land located within the radius of the 1926 Explosion Site – Off-Post MRS has seven different owners. As described above, MEC is known to be present at this MRS on Mt. Hope Quarry. However, it is unknown if MEC is present on the other parcels. As such, a visual survey was to be conducted for a portion of each owner's property. The purpose for conducting a visual survey at an MRS where the presence of MEC has been confirmed was to determine if a

more immediate action was needed for any of the other off-post areas. The site walk was conducted on approximately 15 acres of the 833-acre site using a transect approach. The line of sight from the survey path was a 20 foot swath. Due to the potential hazards associated with the potential presence of MEC, a UXO Technician used MEC avoidance techniques to escort the field team members through this area during the reconnaissance activities.

4.2.2.2 MC Activities and Purpose

The 1926 Explosion Site – Off-Post has been recommended for further investigation during the RI/FS phase of the MMRP based on information collected during the HRR. Although there are no known MC samples collected from this site, numerous samples have been collected from the 1926 Explosion Radius MRS. The results from these samples, which have indicated the presence of metals and explosives at levels above LOCs, were extrapolated to this MRS. Therefore, no MC field activities were conducted at this site during the PTA SI.

4.2.3 Field Work Results

4.2.3.1 MEC Results

During the visual survey of approximately 15 acres of the site (refer to Map 4-2 for the location of the survey) no MEC or munitions debris were observed on the surface. The survey covered portions of land owned by the County of Morris, Ilac Realty, LLC, K. Doland, Mount Hope Waterpower Project, LLC, Mount Hope Rock Products, and Rockaway Township. A small parcel of land owned by SMC-DAG, Inc. was also proposed to be surveyed in the SI Work Plan. However, this area was inaccessible since it was surrounded by a wetland with very dense tall grass. The area surrounding this parcel was surveyed.

Several structures and surface features were identified on this site during the survey. Information regarding the observations made during the survey is given in Table 4-4 and on Map 4-2.

Figure 4-7: Cultural debris, including paint cans

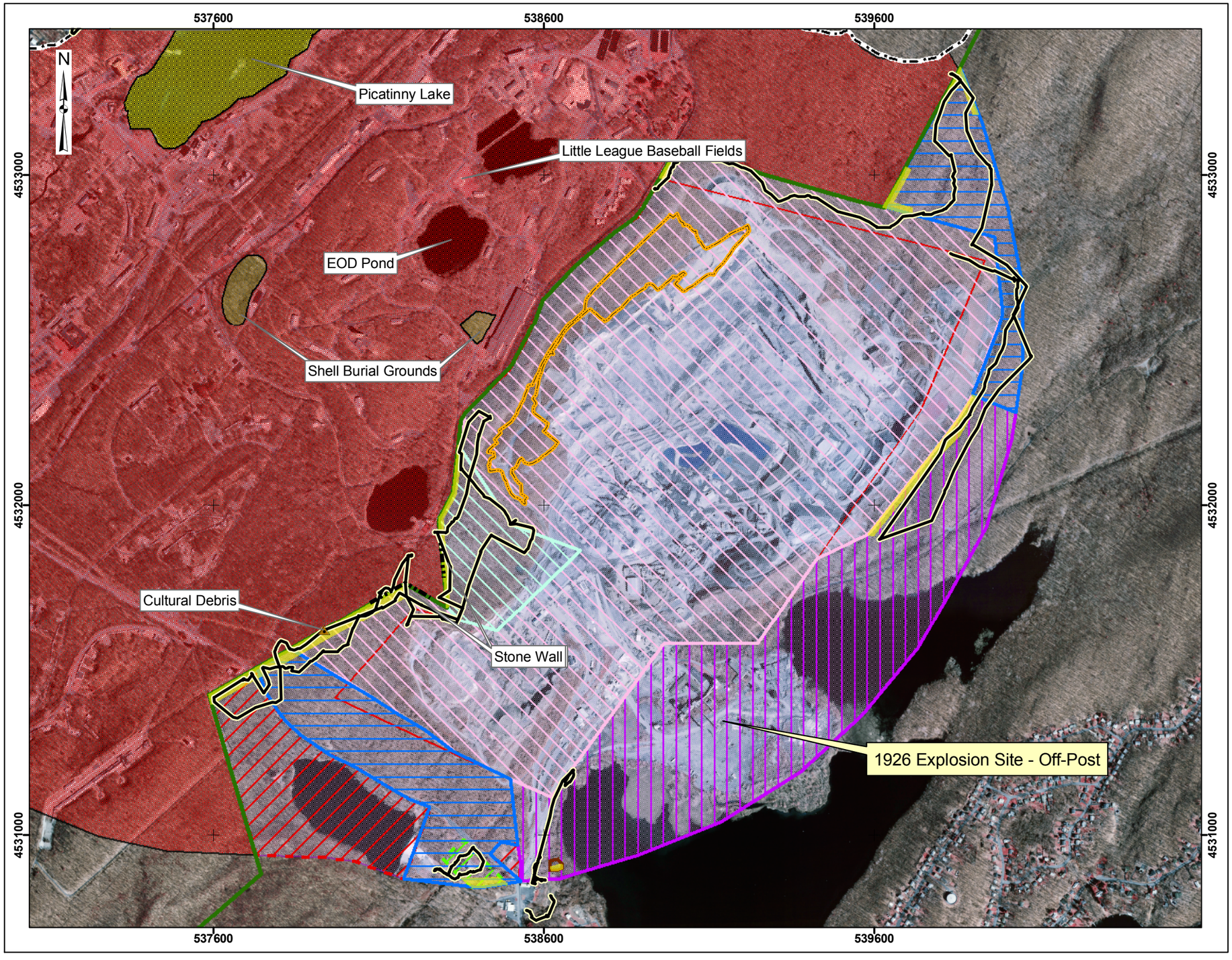
Table 4-4 Site Discoveries at the 1926 Explosion Site Off-Post

Item ID	Description
MEC Item	
None	None
Munitions Debris	
None	None
Structures/Debris	
Public Utility	Public utility towers run through the site in several locations
Cultural Debris	Large piles of cultural debris were located on the property between the installation and the quarry in the southern portion of the MRS.
Surface Features	
Stone Wall	A stone wall about five feet high is located near the eastern boundary of the installation/western boundary of the quarry on the south end of the MRS.

4.2.3.2 MC Results

No MC field activities were conducted at the 1926 Explosion Site – Off-Post during the PTA SI.

Site Inspection
Picatinny Arsenal, NJ



Map 4-2
SI Field Activities and Findings
1926 Explosion Site - Off-Post

Legend

- Installation Boundary
- SI Work Plan Proposed Visual Survey
- Mt. Hope Quarry
- TCRA Boundary
- Site Survey
- Munitions Debris

Military Range Area

- 1926 Explosion Radius
- 1926 Explosion Site - Off-Post
- Surface Danger Zone

Off-Post Owners*

- County of Morris
- Ilac Realty, LLC
- K. Doland
- Mount Hope Rock Products
- Mount Hope Waterpower Project, LLC
- Rockaway Township
- SMC-DAG, Inc.

*Notes: 1) Off-Post Owner area locations are approximate

2) Transects for the visual survey were not conducted in straight lines because of sporadic GIS satellite coverage, site topography and dense vegetation. GIS interference was caused by overhead tree canopy.

0 220 440 880 Meters

Data Source: Aerials: NJDEP, CIR Orthoimagery, 2002
CTT Data: AEC, CTT Range Inventory, 2005

Coordinate System: UTM Zone 18N
Datum: NAD 83
Units: Meters

Contract: W912DR-05-D-0004
Edition: Final SI Report
Date: April 2008

4.2.4 Conceptual Site Model

4.2.4.1 MMRP Site Profile

4.2.4.1.1 Area and Layout

The 1926 Explosion Site – Off-Post covers approximately 833 acres and is located outside the eastern boundary of PTA.

4.2.4.1.2 Structures

Structures located within this MRS include commercial businesses and their associated buildings including those structures associated with the operations of Mt. Hope Quarry. In addition, public utility towers, large piles of cultural debris, and a stone wall were all observed during the visual survey.

4.2.4.1.3 Utilities

The utilities servicing the buildings within the 1926 Explosion Site – Off-Post are assumed to include electricity, drinking water, sewer, and telephone/communications. Public electric lines are located in the southern portion of the MRS. The locations of other utilities are unknown.

4.2.4.1.4 Boundaries

This MRS is bordered by PTA to the north, south, and west. The radius of the site runs through the approximate middle of Hope Lake.

4.2.4.1.5 Security

The site is located outside the secured PTA boundary. There is a guarded gate at the main entrance to the Mt. Hope Quarry and the quarry has signs posted along the perimeter of the property.

4.2.4.2 Physical Profile

4.2.4.2.1 Climate

General climate information is presented in Section 4.1.4.2.1.

4.2.4.2.2 Geology

Due to the proximity to PTA, it is assumed that general information about PTA geology is applicable to this MRS. General geology information is presented in Section 4.1.4.2.2.

4.2.4.2.3 Topography

This MRS, which is approximately 800 to 1,000 feet amsl, contains moderately steep terrain sloping east-southeast toward Hope Lake and Mt. Hope Pond.

4.2.4.2.4 Soil

The 1926 Explosion Site – Off-Post contains rock outcrop and Rockaway sandy loam.

4.2.4.2.5 Hydrogeology

Due to the proximity to PTA, it is assumed that general information about PTA hydrogeology is applicable to this MRS. General hydrogeology information is presented in Section 4.1.4.2.5.

4.2.4.2.6 Hydrology

Both Mt. Hope Pond and portions of Hope Lake are located within this MRS.

4.2.4.2.7 Vegetation

Based on the site walk conducted for the SI, the vegetation at the 1926 Explosion Site - Off-Post appears to consist largely of deciduous trees. The under story consists of heavy brush that at times impeded the site survey.

4.2.4.3 Land Use and Exposure Profile

4.2.4.3.1 Current Land Use/Activities

The 1926 Explosion Site – Off-Post contains vacant land and several businesses, including Mt. Hope Quarry.

4.2.4.3.2 Current Human Receptors

The current human receptors on the 1926 Explosion Site – Off-Post include Mt. Hope Quarry personnel, off-PTA workers (*e.g.*, workers associated with other businesses, contractors, utility workers), visitors to the quarry or other businesses, recreationists (*e.g.*, hunters, fisherpeople), and trespassers.

4.2.4.3.3 Potential Future Land Use

According to the existing property owners, there are no current plans to change the land use at the site. Therefore, the future land use remains the same as the current land use. Each of the property owners have been notified about the potential presence of MEC on their property and have agreed to inform PTA personnel of any changes in land use or ownership.

4.2.4.3.4 Potential Future Human Receptors

As no change in land use is known at this time, the future human receptors are the same as the current human receptors.

4.2.4.3.5 Zoning/Land Use Restrictions

General information about zoning is presented in Section 4.1.4.3.5. In addition, a large portion of the site is located in the Highlands Preservation Area. Major development in the Highlands Preservation Area is restricted and regulated.

4.2.4.3.6 Beneficial Resources

General information about beneficial resources is presented in Section 4.1.4.3.6. Information concerning additional beneficial resources specific to the site was not available.

4.2.4.3.7 Demographics/Zoning

General information about demographics/zoning is presented in Section 4.1.4.3.7.

4.2.4.4 Ecological Profile

4.2.4.4.1 Habitat Type

There are patches of forest, wetlands, and lakes used by state threatened and endangered plants and animals, including several invertebrate species. This site is located in both a Highlands Preservation Area and a Highlands Planning Area.

4.2.4.4.2 Degree of Disturbance

The degree of disturbance is high since the majority of this MRS is a quarry.

4.2.4.4.3 Ecological Receptors

General information about ecological receptors is provided in Section 4.1.4.4.3. As previously discussed, habitat used by state threatened and endangered species is present at this site.

4.2.4.5 Munitions/Release Profile

4.2.4.5.1 Munitions Types and Release Mechanisms

Table 4-5 presents a summary of MEC types that are known or expected to exist within the 1926 Explosion Site – Off-Post based on the information collected for the HRR and the TCRA. The mechanism by which the MEC were released into the environment was a series of explosions caused by a lightning strike at a storage magazine.

Table 4-5 Summary of Potential & Actual Munitions Debris & MEC - 1926 Explosion Site - Off-Post

Munitions Debris / MEC Observed During SI Field Activities	Munitions Debris / MEC Identified During HRR and TCRA	Primary Release Mechanism
None	▪ 25-lb. Navy Mark I bombs, loaded and plugged ▪ Mark II bombs, each containing 50 lbs. TNT ▪ Mark III bombs, each loaded with TNT ▪ Mark IV aircraft bombs with approximately 250 lbs. of TNT in each bomb ▪ Mark V bombs, each loaded with TNT ▪ Bomb accessories (*e.g.*, fins, tails) ▪ Aerial bombs, TNT center section ▪ 14-inch Class “B”, loaded and fused ▪ 14-inch AP rounds, loaded and fused ▪ 8-inch shells, loaded and fused	Series of explosions

Munitions Debris / MEC Observed During SI Field Activities	Munitions Debris / MEC Identified During HRR and TCRA	Primary Release Mechanism
	▪ 5-inch shells, loaded and fused ▪ 6-inch HE projectiles ▪ 4-inch HE projectiles	

4.2.4.5.2 Maximum Probable Penetration Depth

Munitions were not fired or tested in this area, so the standard penetration depth calculation is not applicable. Munitions at the 1926 Explosion Site – Off-Post would likely be below the surface because of the explosion and potential burial, but not from penetration. The depths of MEC depend on the intensity of the explosion and any activities that have further buried or uncovered the MEC. During the TCRA, MEC were found at the quarry at depths ranging from one to 48 inches below ground surface (bgs).

4.2.4.5.3 MEC Density

No MEC was observed on the surface during the SI visual survey indicating that MEC density on the surface at the 1926 Explosion Site - Off-Post may be low in certain areas of the site. However, it should be noted that 21 MEC items containing HE were found on 22.6 acres of Mt. Hope Quarry during the TCRA and an additional nine MEC items were found prior to the TCRA. These items have since been disposed of by PTA's EOD unit.

4.2.4.5.4 Munitions Debris

No munitions debris was observed at the 1926 Explosion Site Off – Post during the SI visual survey. However, four munitions debris items were found on 22.6 acres of Mt. Hope Quarry during the TCRA. These items have since been disposed of by PTA's EOD unit.

4.2.4.5.5 Associated MC

It was reported that TNT, Class "B" explosives, Explosive "D" (*i.e.*, ammonium picrate), smokeless powder (which could contain nitrocellulose, nitroglycerin, nitroguanidine, bismuth, and lead) and picric acid were being stored in the buildings involved in the explosion (refer to the appropriate Ordnance Technical Data Sheets in Appendix G). In addition, although no

known sampling events have occurred outside of PTA boundaries, as discussed in Section 4.1.4.5.5, numerous MC samples have been collected throughout the 1926 Explosion Radius MRS. These samples have indicated the presence of metals and explosives in soil, sediment and surface water and perchlorate in groundwater at levels above LOCs. MC for this site will be extrapolated from the on-post property results.

4.2.4.5.6 Transport Mechanisms/Migration Routes

The primary transport mechanisms identified for the 1926 Explosion Site – Off-Post include:

Soil Disturbance: At the Mt. Hope Quarry, the current degree of disturbance is high. The quarry's process for obtaining rock for the crusher includes removing vegetation, scraping away the overburden, and removing the rock by detonation. The degree of disturbance for areas of the site located outside the boundaries of the Mt. Hope Quarry operation is relatively low, as the area is not densely populated. In addition, a large portion of the site is located in the Highlands Preservation Area, and major development in the Highlands Preservation Area is restricted and regulated.

Erosion: Erosion of soil may uncover MEC. MC adsorbed to soil particles may migrate in surface water runoff from surface soil to Hope Lake or Mt Hope Pond.

Frost Heave: Periodic, alternating freezing and thawing during the winter may cause MEC to rise from the soil subsurface to the soil surface.

Infiltration: Based on the soil types associated with the 1926 Explosion Site – Off-Post, the potential exists for MC to migrate from one environmental medium to another (surface to subsurface soil to groundwater) through infiltration of percolating precipitation. Note that this applies to the Rockaway sandy loam and is likely not applicable to the rock outcrop areas.

Recharge and Discharge: Groundwater may discharge to water bodies, and surface water may recharge groundwater, depending on time of year, rainfall/snowmelt amounts, and location.

4.2.4.6 Pathway Analysis

4.2.4.6.1 MEC

Figure 4-8 illustrates the MEC pathway analysis prepared for the 1926 Explosion Site – Off-Post. The MEC Pathway Analysis shows complete exposure pathways exist for the Mt. Hope Quarry personnel who may contact, via handling/treading underfoot, MEC in surface and subsurface soil. Potentially complete exposure pathways exist for off-PTA workers/visitors and recreationists/trespassers who may contact MEC in surface soil or surficial sediment. In the event that off-PTA contractors or utility workers perform intrusive work, there is also the potential for exposure to MEC in subsurface soil or subsurface sediment. Exposure pathways are complete for biota that may contact MEC in surface soil during feeding and nesting activities and in subsurface soil during burrowing. Potentially complete exposure pathways exist for aquatic and semi-aquatic ecological receptors that may contact MEC in the surficial sediments of Hope Lake or Mt. Hope Pond.

4.2.4.6.2 MC

Figure 4-9 illustrates the MC pathway analysis for the 1926 Explosion Site – Off-Post. As illustrated in the MC pathway analysis, soil and surface water/sediment impacted by MC are the primary source media for all human and ecological receptors. None of the exposure pathways are complete, since no investigations for MC have been conducted in the 1926 Explosion Site Off-Post area.

Potentially complete exposure pathways exist for Mt. Hope Quarry personnel who may contact MC in surface and subsurface soil. Potentially complete exposure pathways exist for off-PTA workers/visitors and recreationists/trespassers who may contact MC in surface soil. In the event that off-PTA contractors or utility workers perform intrusive work, there is also the potential for exposure to MC in subsurface soil. Exposure routes include direct contact, ingestion, and inhalation of dust. Biota may contact MC in surface soil through feeding/preening activities and MC in subsurface soil through burrowing activities.

Off-PTA recreationists who may fish or go boating in Hope Lake or Mt. Hope Pond may be exposed to MC in surface water via dermal contact or to MC in sediment via incidental ingestion and dermal contact. Ingestion of surface water is a potentially complete pathway, because it is not known whether Hope Lake or Mt. Hope Pond are used for swimming. Aquatic and semi-aquatic biota (*e.g.*, vegetation, invertebrates, fish, and waterfowl) may be exposed to MC from directly ingested/assimilated surface water and sediment.

The source of potable water off-PTA is not known; therefore, potentially complete pathways for groundwater cannot be discounted. Potentially complete exposure pathways exist for off-PTA workers who may contact MC in potable water via ingestion and dermal contact.

Potentially complete exposure pathways through the food chain exist for assimilative/ bioaccumulative MC to both human and ecological receptors. Recreationists who engage in hunting or fishing in the area and consume their catch may ingest MC that have bioaccumulated in fish or game animals (*e.g.*, waterfowl, deer). Terrestrial, semi-aquatic, and aquatic wildlife may ingest MC assimilated in vegetation and bioaccumulated in prey species. These pathways are potentially complete due to the nature and variability of the process of assimilation into plants and bioaccumulation into wildlife. These processes are highly dependent on the particular MC and environmental conditions, as well as on the conditions of the individual plant or wildlife species.

Figure 4-8: MEC Exposure Pathway Analysis – 1926 Explosion Site – Off-Post

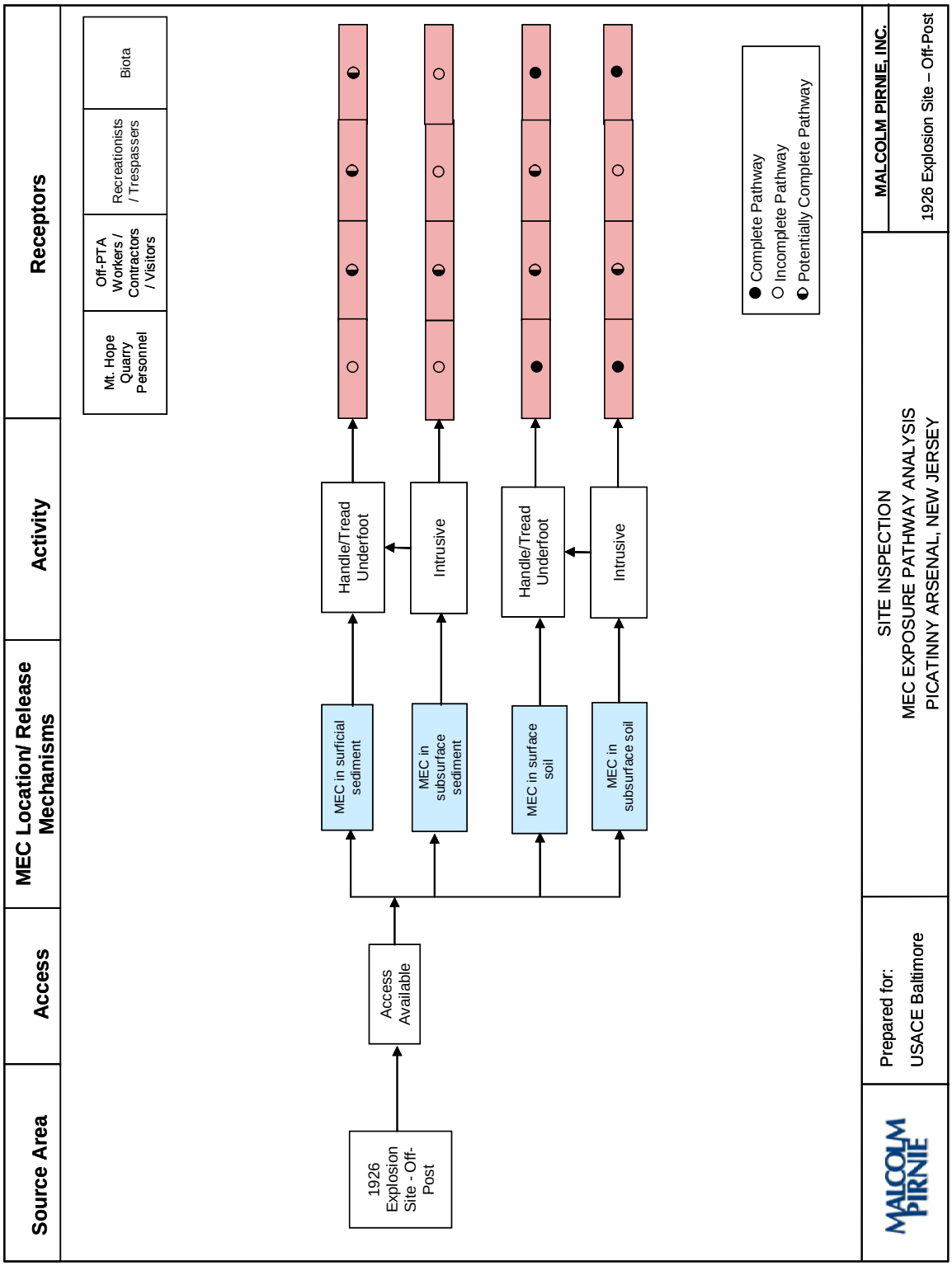
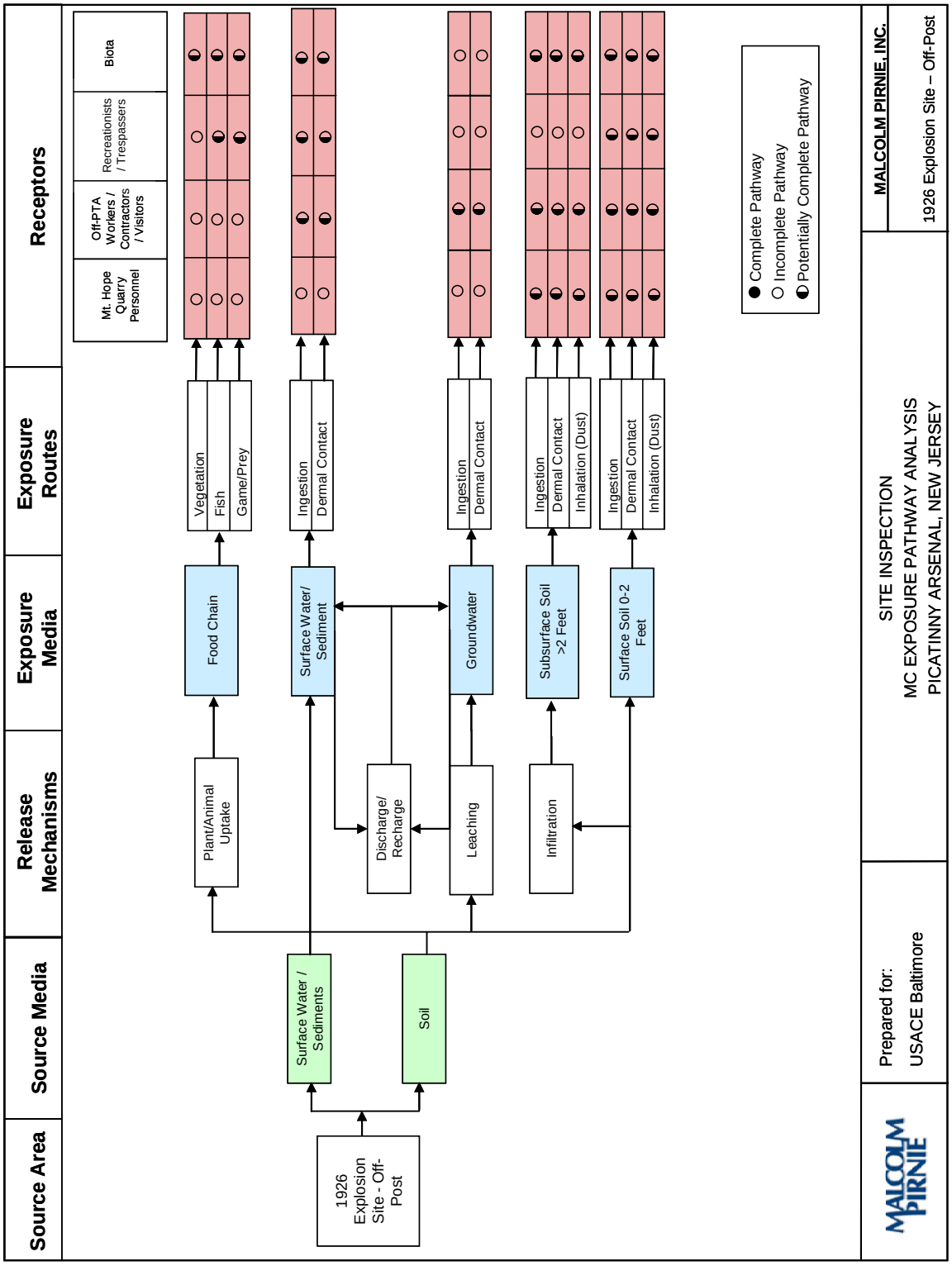


Figure 4-9: MC Exposure Pathway Analysis – 1926 Explosion Site – Off-Post



4.2.5 Site Summary and Conclusions

4.2.5.1 MEC

A visual survey of approximately 15 acres of the total 833 acre site was conducted to confirm if MEC are present at this MRS. Map 4-2 shows the areas where the visual survey was conducted and the path of the site walk. During the visual survey, no MEC items or munitions debris were identified. However, after the TCRA at Mt Hope Quarry was completed, several munitions debris items were found in an area outside of the TCRA boundary.

4.2.5.2 MC

No MC activities were conducted at the 1926 Explosion Site – Off-Post during the SI. Sufficient information was obtained during the HRR to recommend this site proceed to RI/FS under the MMRP.

4.2.6 Site Recommendations

Based on existing data and known MEC at the site, the 1926 Explosion Site - Off-Post is recommended for an RI/FS for both MEC and MC. Due to observations made during the SI field work an accelerated response action is not recommended for the majority of this MRS. However, based on munitions debris findings made at Mt. Hope Quarry after the completion of the TCRA, an accelerated response action is recommended for any areas of the quarry that will be mined in the future and fall outside the original TCRA area.

4.3 Former Munitions and Propellant Test Area (AEDB-R ID: PICA-001-R-01)

4.3.1 Site Description and Historical Overview

This MRS covers approximately 25 acres and is located northwest of Lake Denmark in the northern half of the installation. This range consists of one firing point with two lines of fire, 900-yard and 500-meter, and was reportedly utilized as a recoilless rifle range for large diameter projectiles. Two buildings (Bldgs. 1240 and 1243), a berm, and gun turret were located at the firing point. One building (Bldg. 1242A) was also located at the impact area of the 900-yard range. The site was in use from 1964 to sometime between 1989 and 1991. Aerial photographs from 1940 and 1951 show the site as completely undeveloped and heavily wooded. No

information was available to indicate which weapons systems were used on-site; however, the 57-mm M18, 75-mm M20, 90-mm M67, 105-mm M27, and 106-mm M40 recoilless rifles were in use during the timeframe this range was operated. There was also no information detailing specific munitions fired on the range, the configuration of the munitions, or how the range was used.

4.3.2 Field Work Activities

4.3.2.1 MEC Activities and Purpose

The HRR identified that MEC are potentially present at this site since it was formerly used as a range. As such, a visual survey was conducted during the SI to determine if MEC are present at the surface of this MRS. The purpose of the survey was to obtain sufficient information to support the Army CTC estimates and MRSPPs and to determine what recommendation (*i.e.*, accelerated response, NFA, or RI/FS) is appropriate for the site. The survey, which was concentrated around the firing point and impact areas, was conducted on approximately 2 acres of the 25-acre site using a transect approach. Due to the potential hazards associated with potential MEC, the UXO Technician escorted the field team members through this area using MEC avoidance techniques during the reconnaissance activities.

4.3.2.2 MC Activities and Purpose

The Former Munitions and Propellant Test Area has been recommended for NFA for MC during the RI/FS phase of the MMRP based on information collected during the HRR. According to the PA/SI prepared under the IRP, NFA is being recommended for this site. Therefore, MC are being addressed under the IRP and will not be included in the Active Army MMRP program.

4.3.3 Field Work Results

4.3.3.1 MEC Results

A site survey was conducted over approximately 2 acres of the 25–acre site. Refer to Map 4-3 for the location of the survey. The line of sight from the survey path was a 20-foot swath. No MEC or munitions debris were identified on the surface; however, several structures and surface

features were identified on the Former Munitions and Propellant Test Area; information regarding these items is given in Table 4-6 and they are shown on Map 4-3.

Figure 4-10: Metal structure located at firing point

Figure 4-11: Metal structure located at slug butt

Table 4-6 Site Discoveries at the Former Munitions and Propellant Test Area

Item ID	Description
MEC Item	
None	None
Munitions Debris	
None	None
Structures/Debris	
Battleship gun turret	A steel structure that measures about 13.5 feet x 10 feet; it is located on an elevated concrete foundation behind the berm (see surface features below)

Item ID	Description
900-yard slug butt	This is a steel and wood structure used as a target. It is located on the southwestern portion of the site.
Conduit and metal boxes	A conduit that runs from the line of fire, down range was identified. Metals boxes (possibly camera or control boxes) that periodically connect to the conduit, were also present.
Debris	Box shaped metallic structures were found throughout the areas surveyed. In addition, what appeared to be debris from a protective bunker was found near the firing point.
Surface Features	
Large berm	A berm bounds the firing point to the north
Green Pond Mountain	The side of the mountain is covered with very large boulders and acts as the back stop behind the slug butt of the 900-yard range.

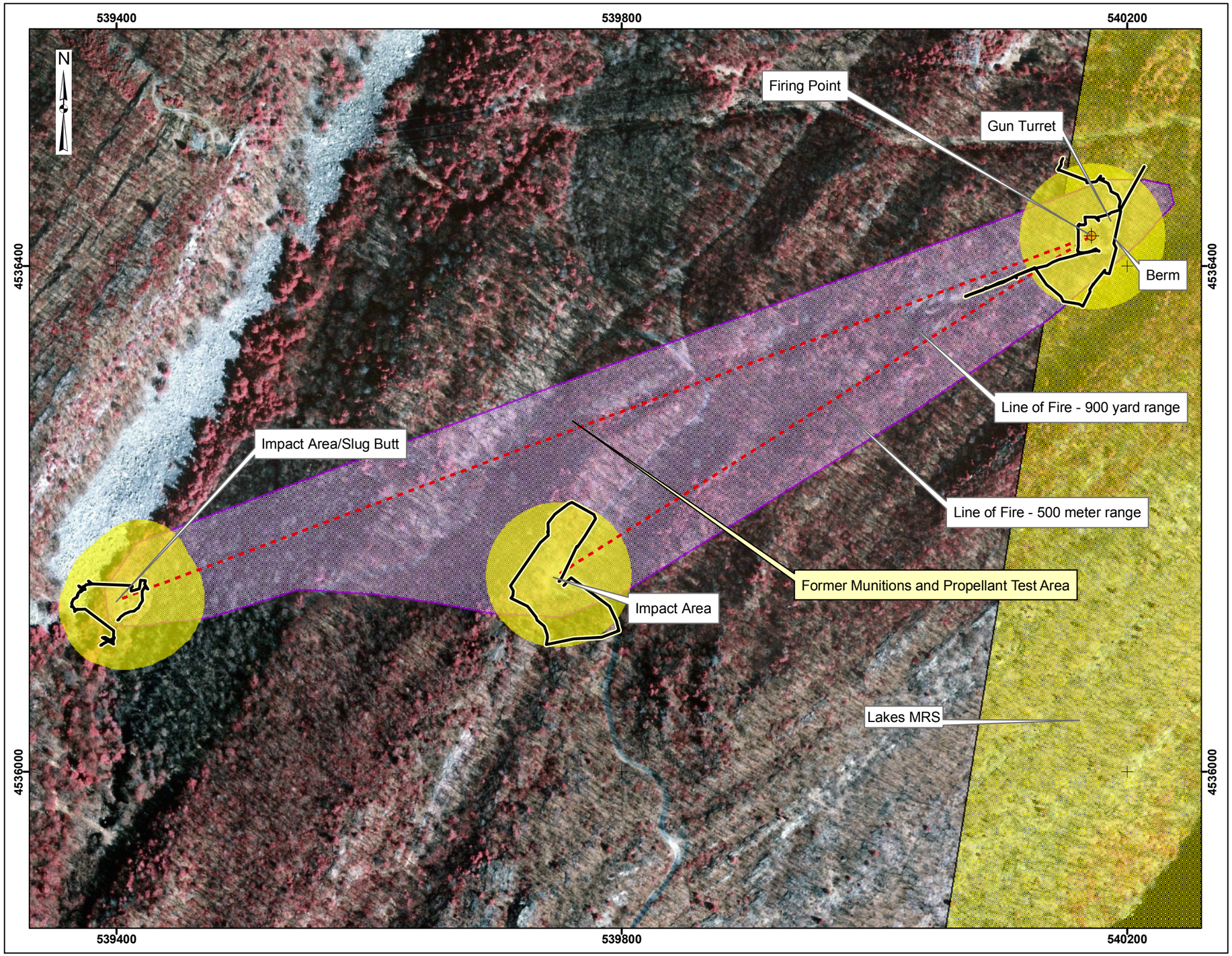
4.3.3.2 MC Results

No MC field activities were conducted at the Former Munitions and Propellant Test Area during the PTA SI.

Site Inspection
Picatinny Arsenal, NJ

MALCOLM PIRNIE

Map 4-3
SI Field Activities and Findings
Former Munitions and Propellant Test Area



Legend

- Line of Fire
- SI Work Plan Proposed Area for Visual Survey
- Adjacent MRS
- Site Survey

Military Range Area

- Former Munitions And Propellant Test Area

Notes: 1) Transects for the visual survey were not conducted in straight lines because of sporadic GIS satellite coverage, site topography and dense vegetation. GIS interference was caused by overhead tree canopy.

0 50 100 200 Meters

Data Source: Aerials: NJDEP, CIR Orthoimagery, 2002
CTT Data: AEC, CTT Range Inventory, 2005

Coordinate System: UTM Zone 18N
Datum: NAD 83
Units: Meters

Contract: W912DR-05-D-0004
Edition: Final SI Report
Date: April 2008

4.3.4 Conceptual Site Model

4.3.4.1 MMRP Site Profile

4.3.4.1.1 Area and Layout

The Former Munitions and Propellant Test Area, which covers approximately 25 acres, is located in the northwestern portion of PTA. The site contained two separate lines of fire with a common firing area. This MRS overlaps a portion of the edge of the SDZ for the 20-mm cannon range at Lake Denmark.

4.3.4.1.2 Structures

Structures currently on this MRS include a large berm, a battleship gun turret (13.5 feet x 10 feet), water tank cradles, and conduits periodically connected by metal boxes; the conduits are associated with the 900-yard range line of fire. In addition, a slug butt, constructed of steel beams and plates and 12 foot X 12 foot pieces of lumber, was identified at the target area. Large metal boxes were found scattered throughout the MRS, particularly in the target area.

4.3.4.1.3 Utilities

There are no known utilities at this site.

4.3.4.1.4 Boundaries

The Former Munitions and Propellant Test Area is bordered by undeveloped land to the north and south, Copperas Ridge Road to the east, and Green Pond Mountain to the west.

4.3.4.1.5 Security

Access to PTA is restricted by guards and surveillance at every entrance. A locked gate controls access to the Former Munitions and Propellant Test Area. No personnel are allowed on site during testing operations at nearby ranges.

4.3.4.2 Physical Profile

4.3.4.2.1 Climate

General information about PTA climate is presented in Section 4.1.4.2.1.

4.3.4.2.2 Geology

General geologic information about PTA is presented in 4.1.4.2.2. Bedrock at this site consists of the Green Pond Conglomerate, which is overlain by alluvial material. Depth to bedrock ranges from the surface to 10 feet bgs.

4.3.4.2.3 Topography

General information about installation topography is presented in Section 4.1.4.2.3. This site consists of rolling hills, with elevations ranging from 1,000 to 1,100 feet amsl.

4.3.4.2.4 Soil

General information about the soil types present on PTA is presented in Section 4.1.4.2.4. The soil at this site consists of the Rockaway Rock Outcrop Association along with fine-grained sand with silt and clay overlain by poorly sorted sand and gravel.

4.3.4.2.5 Hydrogeology

General information about the hydrogeologic conditions at PTA is presented in Section 4.1.4.2.5. No site-specific information is available.

4.3.4.2.6 Hydrology

General information about hydrologic conditions at PTA is presented in Section 4.1.4.2.6. The western portion of the Former Munitions and Propellant Test Area crosses Green Pond Brook, as well as wetlands associated with the brook.

4.3.4.2.7 Vegetation

General information about vegetation at the installation is presented in Section 4.1.4.2.7. During the visual survey it was observed that vegetation at this site consists of wetlands and deciduous forest.

4.3.4.3 Land Use and Exposure Profile

4.3.4.3.1 Current Land Use/Activities

This site is currently used as a buffer zone between firing ranges. The majority of the site is unutilized and undeveloped.

4.3.4.3.2 Current Human Receptors

The current human receptors on the Former Munitions and Propellant Test Area MRS include authorized PTA personnel and contractors/visitors. While a locked gate controls access to the site, trespassers are considered an additional potential receptor population. Trespassers are individuals who have access to PTA but are not authorized to be present in specific areas of the MRS. The most likely "trespassers" would be PTA personnel, PTA residents, and contractors/visitors.

4.3.4.3.3 Potential Future Land Use

The Former Munitions and Propellant Test Area MRS is expected to be leased to the Navy and reactivated as a range at some point in the future.

4.3.4.3.4 Potential Future Human Receptors

The future human receptors include authorized installation personnel. Additional contractors would include future construction workers involved with reactivation of the MRS as a range.

4.3.4.3.5 Zoning/Land Use Restrictions

A locked gate controls access to the MRS. Access to this property is restricted during testing operations at nearby ranges.

4.3.4.3.6 Beneficial Resources

General information about the beneficial resources on PTA is presented in Section 4.1.4.3.6. Site-specific beneficial resources include wetlands and forested areas adjacent to the site.

4.3.4.3.7 Demographics/Zoning

General information about the demographics/zoning at PTA is presented in Section 4.1.4.3.7.

4.3.4.4 Ecological Profile

4.3.4.4.1 Habitat Type

General information on habitat types at PTA is provided in Section 4.1.4.4.1. Both wetlands and forested areas are present at this site.

4.3.4.4.2 Degree of Disturbance

The degree of disturbance is low and the majority of the site is undeveloped.

4.3.4.4.3 Ecological Receptors

General information about the ecological receptors at PTA is provided in Section 4.1.4.4.3. Although no site-specific ecological receptors were identified, according to NJDEP's i-Map Landscape Project layer, this site contains habitat with at least one occurrence of a state threatened species.

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4.3.4.5 Munitions/Release Profile

4.3.4.5.1 Munitions Types and Release Mechanisms

Table 4-7 presents a summary of the types of munitions debris and MEC that are expected to exist at the Former Munitions and Propellant Test Area based on information collected for the HRR. The mechanism by which the munitions, if present, could have been released into the environment is also presented in this table.

Table 4-7 Summary of Potential and Actual Munitions Debris and MEC for Former Munitions and Propellant Test Area

Munitions Debris / MEC Observed During SI Field Activities	Munitions Debris / MEC Identified During HRR	Primary Release Mechanism
None	▪ 57-mm M18 ▪ 75-mm M20 ▪ 90-mm M67 ▪ 105-mm M27 ▪ 106-mm M40	▪ Munitions firing ▪ Discarded or malfunctioned munitions

4.3.4.5.2 Maximum Probable Penetration Depth

The site was reportedly utilized as a munitions and propellant test area on which projectiles were fired from a firing point into a slug butt. The weapon would have been fired with munitions traveling in a near horizontal trajectory. The hills surrounding the target areas were both observed to consist largely of outcropping bedrock. Therefore, the standard calculation for the maximum probability penetration depth is not applicable. No information was available to indicate how often the sand in the slug butt was cleared of munitions or the disposition of this material.

4.3.4.5.3 MEC Density

No MEC was observed on the surface during the SI visual survey indicating that MEC density on the surface at the Former Munitions and Propellant Test area is likely negligible to low. MEC density is unknown in the subsurface.

4.3.4.5.4 Munitions Debris

No munitions debris was observed at the Former Munitions and Propellant Test Area during the SI visual survey.

4.3.4.5.5 Transport Mechanisms/Migration Routes

The primary transport mechanisms identified for the Former Munitions and Propellant Test Area include:

Erosion: Erosion of soil may uncover MEC.

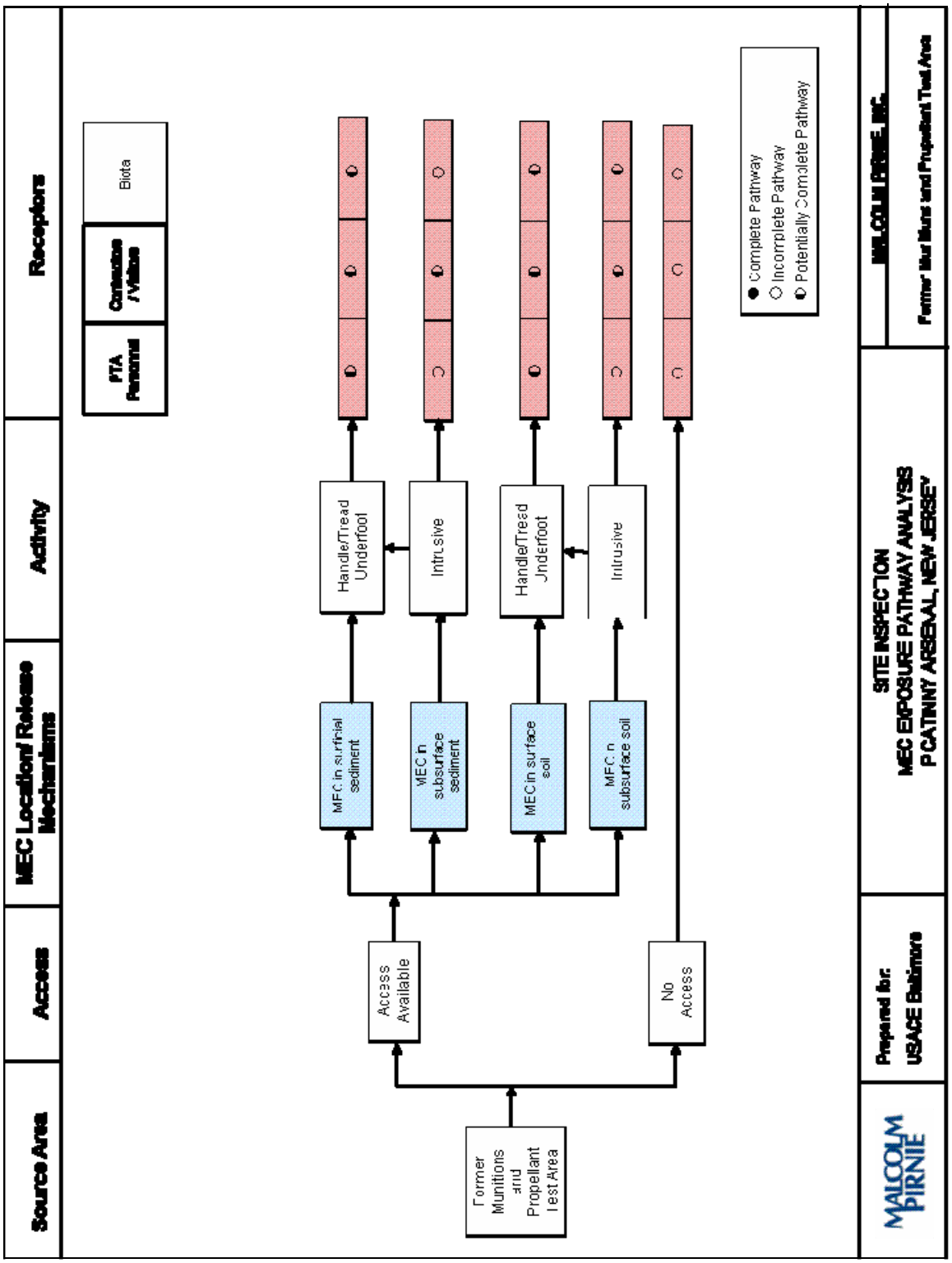
Soil Disturbance: Currently, the degree of soil disturbance is low. This is not anticipated to change while the adjacent ranges are operational, as the Former Munitions and Propellant Test Area is within the buffer zone for operational ranges. However, if this range is reactivated, any future soil disturbance at the Former Munitions and Propellant Test Area would create surface and subsurface soil disturbances that could cause both the transport and migration of MEC.

Frost Heave: Frost heave has the potential to move MEC to the surface, particularly during the winter and spring seasons. Frost heave is more likely to transport MEC to the surface in areas where MEC are buried close to the ground surface.

4.3.4.6 MEC Pathway Analysis

Figure 4-12 illustrates the MEC pathway analysis prepared for the Former Munitions and Propellant Test Area. As illustrated, potentially complete exposure pathways are identified for PTA personnel and contractors/visitors who may be exposed to MEC in surface soil or surficial sediment in Green Pond Brook. Potentially complete exposure pathways exist for contractors who may contact MEC in subsurface soil or subsurface sediment in the event that intrusive work is conducted on the site (*e.g.*, when the MRS is reactivated as a range in the future). Potentially complete exposure pathways exist for biota that may contact MEC in surface soil or surficial sediments and that may nest or burrow at the site and thereby contact MEC in subsurface soil.

Figure 4-12: MEC Exposure Pathway Analysis – Former Munitions & Propellant Test Area



4.3.5 Site Summary and Conclusions

4.3.5.1 MEC

A visual survey of approximately 2 acres of the undeveloped portions of the site was conducted to confirm if MEC are present at this MRS. No MEC or munitions debris were identified on the surface during the visual survey; however, MEC may be present in the subsurface.

Evidence of historical range activity was observed during the visual survey. A battleship gun turret was found at the firing point of the 900-yard range line of fire. Also, a slug butt was located in the target area.

4.3.5.2 MC

MC at the Former Munitions and Propellant Test Area are being addressed under the IRP and will not be included in the Active Army MMRP program.

4.3.6 Site Recommendations

As a result of observations made during the SI field activities and based on historical data, the Former Munitions and Propellant Area is recommended for an RI/FS for MEC. Due to observations made during the SI field work an accelerated response action is not recommended for this MRS.

4.4 Former Operational Areas (AEDB-R ID: PICA-006-R-01)

4.4.1 Site Description and Historical Overview

This MRS covers approximately 1,977 acres and consists of all areas of the installation south of Shinkle Road that are other than operational ranges, do not fall within an SDZ for operational ranges with the potential for ongoing releases of MEC, and have not already been identified as an MRS. Throughout the years there have been numerous UXO items found throughout the entire Former Operational Areas MRS. It is unknown why these items are present; however, according to an Installation Survey Report, in 1973 PTA had 2,036 acres used for R&D and testing. The allocation of the 2,036 R&D acres consisted of the following:

- Artillery firing (975 acres) – This area was located on the western portion of the installation and was used for artillery firing to determine ballistic, trajectory, velocity, and flight characteristics of shells up to 155 mm. Currently, there are several operational ranges located in this area.
- Rocket surveillance (624 acres) – This area was located on the eastern portion of the installation and was used for surveillance of rockets under climatic conditions and static firing. A portion of this area is still located in an operational range area.
- Testing areas (51 acres) – This area was located on the southern portion of the installation; it is likely that this area falls within an operational range area. These 51 acres were used for various activities including the testing of mines, bombs, and bomblets under simulated tropical rain conditions; burying explosives and devices to develop technology and equipment for determining size, quantity, and location; and testing fire pyrotechnics and flares.
- QA inspections and nuclear component testing (13 acres) – This area was located on the southern portion of the installation and was used for quality assurance (QA) inspections and testing of nuclear components used by DoD.
- Other (373 acres) – The remaining areas were located throughout the installation and contained computer centers, experimental projects for lead azide and other highly explosive components, and environmental testing of live ammunition.

A dredge pile and a former sanitary landfill, which cover approximately 13 acres, are located on the southern portion of this MRS. The dredge pile lies entirely within the limits of the landfill and both the dredge pile and landfill are reported MEC disposal areas. According to several reports, shells were disposed of in the sanitary landfill. In addition, dredge spoils from Green Pond Brook were reportedly placed at this location and Green Pond Brook was dredged due to the presence of shells. In interviews with PTA personnel and contractors, it was noted that MEC were identified during utility trenching operations in the landfill. An explosive, nitrocellulose, has been found in numerous soil and groundwater samples collected from both areas.

A waste burial area that covers approximately 8.5 acres is also located at the southern end of this MRS. The waste burial area was used as an unregulated disposal area and consists of undeveloped land in a low-lying wetland. The exact years of operation are unknown; however, it is believed that extensive landfilling activities occurred in the 1960s and 1970s. During a site walk in January 1998, munitions debris, identified as large projectiles, were observed in this area; no base plates or fuzes/nose plugs appeared to be installed on these projectiles. In addition, 40-mm grenades were found in trenches installed under the IRP.

4.4.2 Field Work Activities

4.4.2.1 MEC Activities and Purpose

The Former Operational Areas MRS has been recommended for further investigation during the RI/FS phase of the MMRP based on information collected during the HRR and SI Work Plan phases. Therefore, no MEC field activities were conducted at this site during the PTA SI.

4.4.2.2 MC Activities and Purpose

The Former Operational Area South has been recommended for further investigation during the RI/FS phase of the MMRP based on information collected during the HRR and SI Work Plan phases. Therefore, no MC field activities were conducted at this site during the PTA SI.

4.4.3 Field Work Results

4.4.3.1 MEC Results

No MEC field activities were conducted at the Former Operational Areas MRS during the PTA SI.

4.4.3.2 MC Results

No MC field activities were conducted at the Former Operational Areas MRS during the PTA SI.

4.4.4 Conceptual Site Model

4.4.4.1 MMRP Site Profile

4.4.4.1.1 Area and Layout

The Former Operational Area South MRS is 1,977 acres and consists of all areas of the installation south of Shinkle Road that are other than operational ranges, do not fall within an SDZ for operational ranges with the potential for ongoing releases of MEC, and have not already been identified as an MRS.

4.4.4.1.2 Structures

There are dozens of buildings located within the boundaries of this MRS. These buildings are used for manufacturing, storage, testing, R&D, administration, and recreation.

4.4.4.1.3 Utilities

The utilities servicing the buildings within this site are assumed to include electricity, drinking water, sewer and telephone/communications. Specific information on the location of utilities throughout the site is unknown.

4.4.4.1.4 Boundaries

The Former Operational Areas is bordered by the installation boundary to the south, west, southeast, and northeast, the 1926 Explosion Radius MRS to the east, and Shinkle Road to the north.

4.4.4.1.5 Security

Access to PTA is restricted by guards and surveillance at every entrance. However, access to the Former Operational Areas MRS is not restricted once on the installation.

4.4.4.2 Physical Profile

4.4.4.2.1 Climate

General climate information about PTA is presented in Section 4.1.4.2.1.

4.4.4.2.2 Geology

General geologic information about PTA is presented in Section 4.1.4.2.2. Due to the large area covered by the Former Operational Areas, general installation information is applicable.

4.4.4.2.3 Topography

General information about installation topography is presented in Section 4.1.4.2.3. The Former Operational Areas covers a large area with highly variable topography. In general, elevations are higher to the west and north.

4.4.4.2.4 Soil

General information about the soil types present on PTA is presented in Section 4.1.4.2.4. Soil within the Former Operational Areas MRS consists of sandy and silty loams, loam, silt, sand, clay, gravel, rock outcropping, and glacial till.

4.4.4.2.5 Hydrogeology

General information about the hydrogeologic conditions at PTA is presented in Section 4.1.4.2.5. Due to the large area covered by the Former Operational Area South, general installation information is applicable.

4.4.4.2.6 Hydrology

General information about hydrologic conditions at PTA is presented in Section 4.1.4.2.6. Waterbodies within this site include Stillwell Pond, 1400 Run, and Green Pond Brook. This site, which is largely undeveloped, also contains a significant amount of wetlands.

4.4.4.2.7 Vegetation

General information about vegetation at the installation is presented in Section 4.1.4.2.7. Due to the large area covered by this site, general installation information is applicable.

4.4.4.3 Land Use and Exposure Profile

4.4.4.3.1 Current Land Use/Activities

The Former Operational Areas MRS has dozens of buildings used for various purposes including manufacturing, storage, testing, R&D, administration, and recreation. This MRS also contains parking lots, recreational areas, including a large portion of the golf course, and a significant amount of undeveloped property. A portion of this site is also used for hunting.

4.4.4.3.2 Current Human Receptors

The current human receptors on the Former Operational Areas MRS include PTA personnel, PTA residents, contractors/visitors, recreationists (*e.g.*, hunters), and trespassers. Contractors/visitors include utility workers and visitors of PTA personnel and PTA residents. Recreationists are the PTA personnel and PTA residents who are permitted to hunt or recreate within the MRS. Since PTA is a fenced, guarded, and patrolled installation, it is not likely that trespassers from outside the installation would penetrate the perimeter of PTA and access the Former Operational Areas MRS. For the purpose of this CSM, trespassers are considered individuals who have access to PTA but are not authorized to be present in specific areas of the site. The most likely "trespassers" would therefore be PTA personnel, PTA residents, and contractors/visitors, and the potential exposure of trespassers is described by the potential exposure pathways for the latter receptor groups.

4.4.4.3.3 Potential Future Land Use

According to the Draft Real Property Master Plan: Short Range Component, February 2007, and the Draft Real Property Master Plan: Long Range Component, February 2007, under BRAC, it was recommended that PTA become an "integrated weapons and armaments specialty site for guns and ammunition." This will be accomplished by realigning six other DoD sites to PTA. As a result, a significant amount of development is planned for PTA in both the short-term (through FY 2012) and long-term. The majority of the development is planned for the downtown area, which does not fall within this site. However, several proposed development projects are planned within the Former Operational Areas including:

- Armament Integration Facility (projected start FY07) – a 100-meter range will be added to Bldg. 7 and an armaments integration laboratory will be built near the intersection of First Street and Phipps Road
- Fuze Engineering Complex (projected start FY08) – Bldg. 6, located near the intersection of Berkshire Hill Road and Phipps Road, will be renovated to include a fuze laboratory, an explosives research laboratory, and a fuze engineering and electromagnetic research laboratory
- Replacement of the service water distribution system - it is assumed that a portion of this system is located within the Former Operational Area South MRS

The proposed long-term development items are detailed below. Although it is assumed that the majority of this development will occur in the downtown area, dozens of buildings are located within this MRS; therefore, it is assumed that a portion of the proposed development will occur within the Former Operational Areas.

- Demolition of approximately 220 buildings throughout the installation
- Construction of numerous new buildings throughout the installation
- Some other general improvements (*e.g.*, pave roads, add curbs, improve parking lots)

4.4.4.3.4 Potential Future Human Receptors

The future human receptors are the same as the current human receptors (*i.e.*, PTA personnel, PTA residents, contractors/visitors). However, the number of receptors is expected to increase significantly. According to the Draft Real Property Master Plans for PTA, it is projected that approximately 650 additional personnel will be assigned to PTA by FY 2012 as a result of BRAC. Additional contractors would include future construction workers associated with the proposed development of the site.

4.4.4.3.5 Zoning/Land Use Restrictions

General information about zoning and land use restrictions at PTA is presented in Section 4.1.4.3.5.

4.4.4.3.6 Beneficial Resources

General information about the beneficial resources on PTA is presented in Section 4.1.4.3.6. Site-specific beneficial resources include the Forest and Wildlife Corridor, which incorporate dense forests and wetland areas. Several sensitive species, including the veery (*Catharus fuscescens*), barred owl (*Strix varia*), and American woodcock (*Scolopax minor*) are known to inhabit this area.

4.4.4.3.7 Demographics/Zoning

General information about the demographics/zoning at PTA is presented in Section 4.1.4.3.7.

4.4.4.4 Ecological Profile

4.4.4.4.1 Habitat Type

General information on habitat types at PTA is provided in Section 4.1.4.4.1. While a portion of the Former Operational Areas is developed, the majority of the site is undeveloped and consists of deciduous forests, ponds, streams, and wetlands.

4.4.4.4.2 Degree of Disturbance

A portion of the site is developed; however, the majority of the site is undeveloped. The degree of disturbance for the undeveloped areas is low.

4.4.4.4.3 Ecological Receptors

General information about the ecological receptors at PTA is provided in Section 4.1.4.4.3. Based on the habitats available, the undeveloped portions of the site likely have a diverse ecological community. Several sensitive species, including the veery (*Catharus fuscescens*), barred owl (*Strix varia*), and American woodcock (*Scolopax minor*) are known to inhabit this area. According to NJDEP's i-Map Landscape Project layer, this site contains habitat with at least one occurrence of a state threatened species.

4.4.4.5 Munitions/Release Profile

Table 4-8 presents a summary of the types of munitions that are known or expected to exist within the Former Operational Areas during research during the HRR and for the SI Work Plan. All the mechanisms by which the munitions could have been released into the environment are unknown; however, some potential release mechanisms are listed in the table.

Table 4-8: Summary of Potential Munitions Debris and MEC – Former Operational Areas

Munitions Debris / MEC Identified During HRR	Potential Release Mechanisms
▪ Any munitions or equipment that were used on, or passed through, PTA from the inception of the installation to September 2002. ▪ 8-inch projectiles ▪ 20-mm HE ▪ 37-mm cartridge ▪ 40-mm projectile/grenade ▪ 57-mm HE ▪ 66-mm projectile ▪ 81-mm projectile ▪ 90-mm HE ▪ 105-mm cartridge ▪ 120-mm projectile ▪ 122-mm cartridge ▪ 152-mm practice rounds ▪ 155-mm practice rounds ▪ 175-mm projectiles ▪ 3.5-inch practice rounds ▪ BLU-7A/S ▪ Fuzes ▪ Grenades ▪ Mines ▪ Pyrotechnics ▪ Rifle grenades ▪ Small arms ammunition	▪ Discarded or malfunctioned munitions ▪ Munitions testing activities ▪ Historical waste munitions disposal

4.4.4.5.1 Maximum Probable Penetration Depth

For portions of the Former Operational Area that might have been used as a range, calculated penetrations depths for fired munitions vary from a few inches up to 17 feet below ground surface depending on the weapons system. However, this maximum depth is unlikely at PTA

due to the shallowness of the bedrock throughout much of the installation and the manner in which items generally would have been utilized. Given the size of the installation and its mission, most items would have been fired on small ranges into targets that were nearby and therefore at nearly horizontal trajectories. Larger items would not have been fired at maximum range. As such, it is likely that most items that would have impacted the ground would be found shallower than the maximum penetration depth. At the dredge pile, sediments were placed to an estimated thickness of 15 to 20 feet; therefore, MEC may be buried up to 20 feet in depth. In addition, MEC at the waste burial area may be buried up to 10 feet in depth.

4.4.4.5.2 MEC Density

The density of MEC is unknown. However, the following items were found, and documented by PTA's safety office, within the Former Operational Areas MRS between 1986 and 1998. Note that records for other years are not available. No additional details regarding the types of MEC found are available. The quantity of each item found is given in parentheses.

- 20-mm HE (1)
- 37-mm cartridge (1)
- 40-mm projectile (1)
- empty 57-mm HE (1)
- empty 66-mm (1)
- 81-mm practice (1)
- empty 81-mm (1)
- 81-mm illumination (1)
- empty 90-mm HE (2)
- 90-mm practice round (1)
- expended 105-mm blanks (23)
- 105-mm cartridge (1)
- inert 120-mm (48)
- 122-mm cartridges (4)
- 152-mm practice (2)
- 155-mm practice (1)
- 3.5-inch practice rounds (30)
- 5-inch scrap (1)
- BLU-7A/S (2)
- inert fuze (1)
- scrap fuzes (7)
- empty grenades (5)
- practice grenade (1)
- empty mine (1)

- miscellaneous empty rounds (7)
- simulated pyrotechnic (1)
- small arms ammunition (123)

4.4.4.5.3 Munitions Debris

A visual survey was not conducted for the HRR or the SI. However, according to the UXO find safety map, munitions debris are present on this site.

4.4.4.5.4 Associated MC

Many IRP sites are located either wholly or partially within this MRS. As a result, extensive MC sampling has been conducted at this site as part of the IRP. Samples were collected from various media including soil, surface water, sediment, and groundwater, and have been analyzed for metals and explosives. As shown on Plates 1 and 2, metals and explosives were detected at concentrations greater than LOCs in soil, surface water, and sediment, at several locations throughout this site. As shown on Plate 3, no perchlorate samples were collected from this site.

No known MC sampling has occurred at this MRS outside of the IRP site locations. Therefore, the MC data collected at the IRP sites were extrapolated to the non-IRP portions of the Former Operational Areas MRS. It should be noted that it is unknown if the MC detected at the IRP sites are indicative of contamination directly related to operations related to the Former Operational Areas. Refer to Figure 2-2 for the locations of the IRP sites. Analysis of samples collected from IRP sites located within the Former Operational Areas MRS have indicated the presence of the following metals and explosives:

- Copper was detected at a maximum concentration of 13,000 mg/kg, which exceeds the PTA surface soil background concentration (11.3 mg/kg), the NJDEP Residential SCC (600 mg/kg), and the EPA Region 3 non-industrial RBC (3,100 mg/kg)
- Lead was detected at a maximum concentration of 2,400 mg/kg, which exceeds the PTA surface soil background concentration (25.8 mg/kg), the NJDEP Residential SCC (400 mg/kg), and the EPA Region 3 non-industrial RBC (400 mg/kg)

- Zinc was detected at a maximum concentration of 6,600 mg/kg, which exceeds the PTA surface soil background concentration (38.9 mg/kg) and the NJDEP Residential SCC (1,500 mg/kg); it does not exceed the EPA Region 3 non-industrial RBC (23,000 mg/kg)
- 2,4,6-TNT was detected at a maximum concentration of 2 mg/kg, which is below the EPA Region 3 non-industrial RBC (21 mg/kg); there is no NJDEP Residential SCC for this compound
- 2,4-DNT was detected at a maximum concentration of 2.5 mg/kg, which is above the NJDEP Residential SCC (1 mg/kg), but is below the EPA Region 3 non-industrial RBC (160 mg/kg)
- 2,6-DNT was detected at a maximum concentration of 2 mg/kg, which is above the NJDEP Residential SCC (1 mg/kg), but is below the EPA Region 3 non-industrial RBC (78 mg/kg)
- HMX was detected at a maximum concentration of 2 mg/kg, which is below the EPA Region 3 non-industrial RBC (3,900 mg/kg); there is no NJDEP Residential SCC for this compound
- NB was detected at a maximum concentration of 2.4 mg/kg, which is below the NJDEP Residential SCC (28 mg/kg) and the EPA Region 3 non-industrial RBC (39 mg/kg)
- Nitrocellulose was detected at a maximum concentration of 1,300,000 mg/kg; there are no NJDEP Residential SCC or EPA Region 3 non-industrial RBC for this compound
- Nitroglycerin was detected at a maximum concentration of 16.4 mg/kg, which is above the EPA Region 3 non-industrial RBC (7.8 mg/kg); there is no NJDEP Residential SCC for this compound
- Tetryl was detected at a maximum concentration of 2.1 mg/kg, which is below the EPA Region 3 non-industrial RBC (310 mg/kg); there is no NJDEP Residential SCC for this compound

4.4.4.5.5 Transport Mechanisms/Migration Routes

The primary transport mechanisms identified for the Former Operational Areas MRS include:

Soil Disturbance: The current degree of disturbance is relatively low as the majority of this site is undeveloped. However, future development is planned for PTA due to BRAC; these activities could uncover potential MEC or MC that are in the surface or subsurface. In addition, capping is suggested as a remedy for some of the IRP sites located within the boundaries of this site; cap installation could uncover MEC or MC that are buried beneath the surface.

Erosion: Erosion of soil may uncover MEC. MC adsorbed to soil particles may migrate in surface water runoff from surface soil to nearby water bodies. It should be noted that capping at the IRP sites would eliminate erosion as a primary transport/migration route for that portion of this site.

Frost Heave: Periodic, alternating freezing and thawing during the winter may cause MEC to rise from the soil subsurface to the soil surface.

Infiltration: Based on the soil types associated with the Former Operational Areas MRS, the potential exists for MC to migrate from one environmental medium to another (surface to subsurface soil to groundwater) through infiltration of percolating precipitation.

Recharge and Discharge: Groundwater may discharge to water bodies and surface water may recharge groundwater depending on time of year, rainfall/snowmelt amounts, and location within the Former Operational Areas MRS.

4.4.4.6 Pathway Analysis

4.4.4.6.1 MEC

Figure 4-13 illustrates the MEC pathway analysis prepared for the Former Operational Areas MRS. As described above, numerous MEC finds have been made within this site. The MEC Pathway Analysis shows that complete exposure pathways exist for PTA personnel/residents, recreationists, and contractors/visitors who may contact, via handling or treading underfoot, MEC in the surface soil and surficial sediment within the Former Operational Areas MRS. Complete exposure pathways also exist for contractors who may contact MEC in subsurface soil

or subsurface sediment while accessing underground utilities or performing intrusive work during future construction activities. It should be noted that clearance must be given by PTA's Safety Office prior to any subsurface activity. Complete exposure pathways exist for biota that may nest or burrow at the site and thereby come into contact with MEC in surface or subsurface soil. Potentially complete exposure pathways exist for aquatic organisms that may contact MEC in surficial sediments.

4.4.4.6.2 MC

Figure 4-14 illustrates the MC pathway analysis prepared for the Former Operational Areas MRS. As illustrated in the MC pathway analysis, soil and surface water/sediment impacted by MC are the primary source media for all human and ecological receptors.

Complete exposure pathways exist for PTA personnel/residents, recreationists, and contractors/visitors who may contact MC in surface soil or surface water and sediment. Complete exposure pathways also exist for contractors who may contact MC in subsurface soil or subsurface sediment while accessing underground utilities or performing intrusive work during future construction activities. Exposure routes include direct contact, ingestion, and inhalation of dust. Complete exposure pathways exist for biota that may contact MC in surface soil through feeding/preening activities and with subsurface soil through burrowing activities. Complete exposure pathways also exist for aquatic and semi-aquatic biota (*e.g.*, vegetation, invertebrates, fish, and waterfowl) that may be exposed to MC from directly ingested/assimilated surface water and sediment.

While the potable water supply at PTA, from groundwater wells, is monitored semiannually and treated for volatiles chemicals, potentially complete exposure pathways exist for potable water users. PTA personnel/residents may contact MC in potable water via ingestion and dermal contact.

Potentially complete exposure pathways through the food chain exist for assimilative/bioaccumulative MC to both human and ecological receptors. Recreationists may

ingest MC that have bioaccumulated in game animals hunted in the undeveloped portions of the Former Operational Areas. Although catch-and-release fishing is practiced by most anglers at PTA, some may consume their catch. Therefore, human consumption of fish is a potentially complete exposure pathway. Terrestrial, semi-aquatic, and aquatic wildlife may ingest MC assimilated in vegetation and bioaccumulated in prey species. These pathways are potentially complete due to the nature and variability of the process of assimilation into plants and bioaccumulation into wildlife. These processes are highly dependent on the particular MC and environmental conditions, as well as on the conditions of the individual plant or wildlife species.

Figure 4-13: MEC Exposure Pathway Analysis – Former Operational Areas

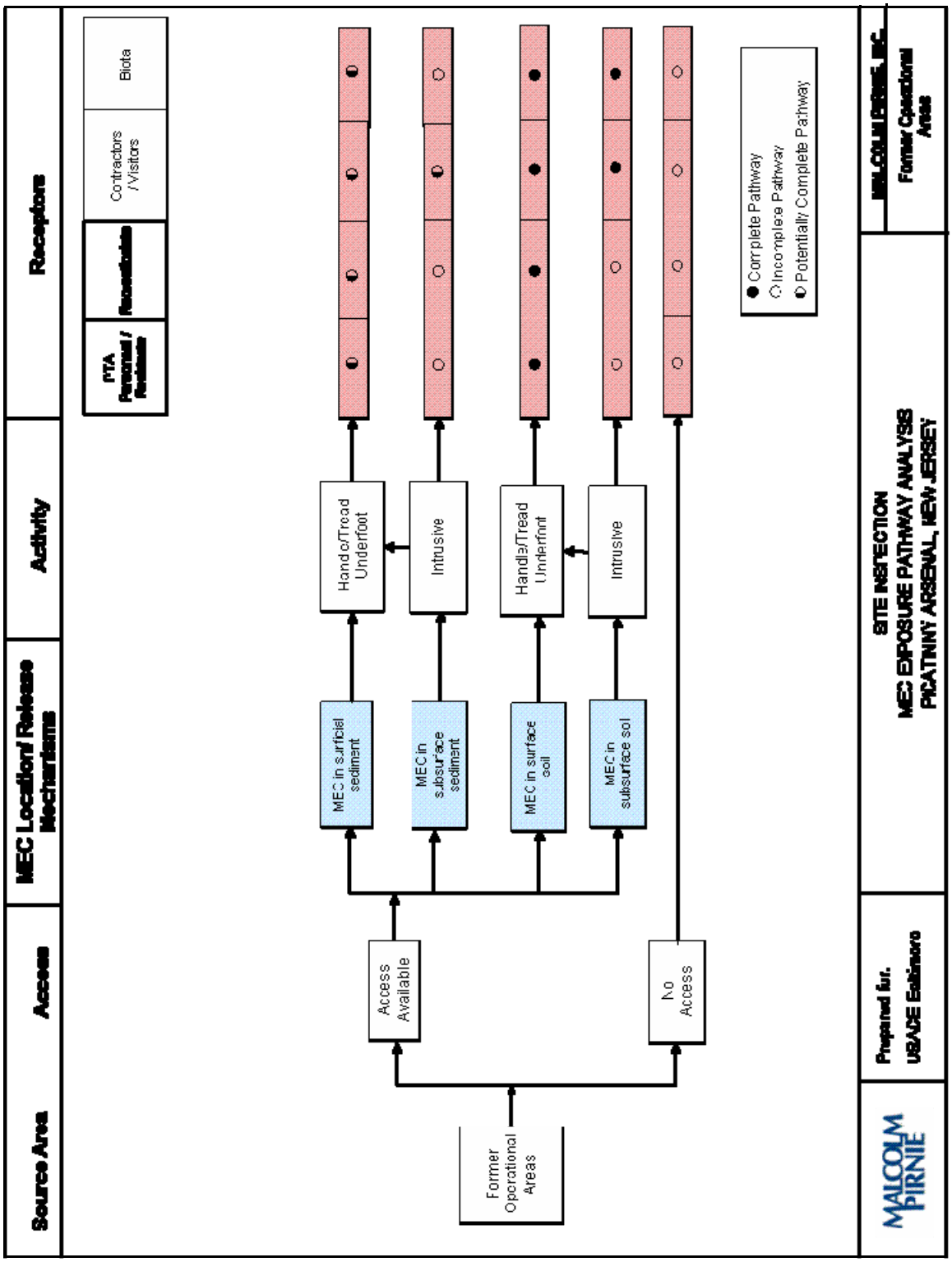
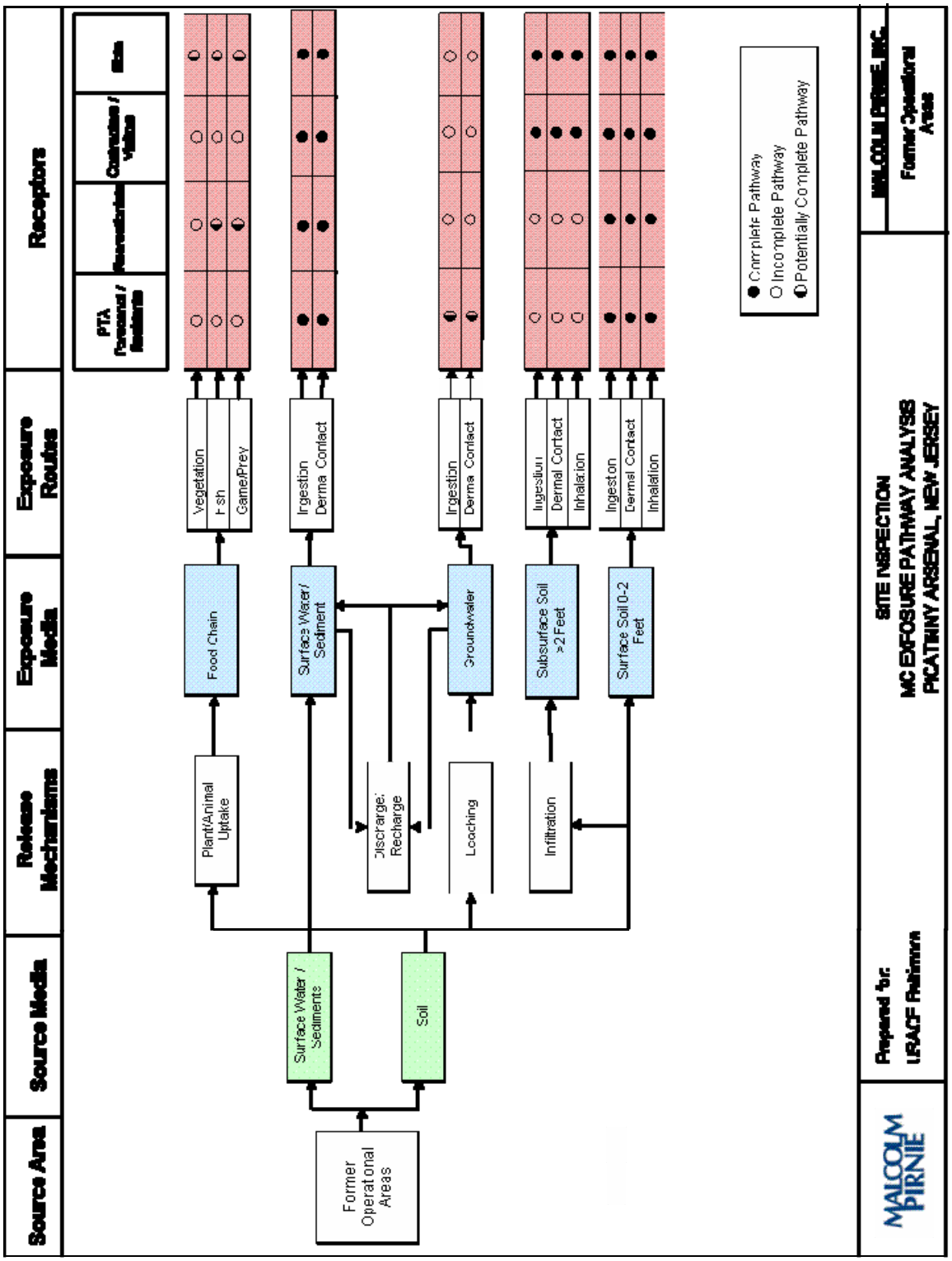


Figure 4-14: MC Exposure Pathway Analysis – Former Operational Areas



4.4.5 Site Summary and Conclusions

4.4.5.1 MEC

No MEC activities were conducted at the Former Operational Areas MRS during the SI. Sufficient information was obtained during research conducted for this SI to recommend this site proceed to an RI/FS under the MMRP.

4.4.5.2 MC

No MEC activities were conducted at the Former Operational Areas MRS during the SI. Sufficient information was obtained during research conducted for this SI to recommend this site proceed to an RI/FS under the MMRP.

It should be noted that many IRP sites are located within the radius of this MRS. As MC at these IRP sites are being addressed under the IRP, portions of this MRS will not require additional MC work under the Active Army MMRP program. Refer to Map 2-2 for the locations of the IRP Sites.

4.4.6 Site Summary and Conclusions

Sufficient information for the Former Operational Areas MRS was obtained during research conducted for this SI to recommend an RI/FS focused on MEC and MC.

4.5 Green Pond MRS (AEDB-R ID: PICA-005-R-01

4.5.1 Site Description and Historical Overview

The Green Pond MRS, which covers approximately 1.1 acres, consists of the portion of Green Pond Brook located south of the 9th Street bridge and north of the boundary of the former DRMO Yard. Since this MRS is a brook, it is possible that the stream channel and banks may be altered due to erosion and deposition. Therefore, this MRS extends from bank to bank, regardless of stream morphology, and includes a 15 foot buffer zone on each side of the banks. The Green Pond MRS lies entirely within the limits of the 1926 Explosion Radius MRS. Green Pond Brook, which is approximately 22,400 linear feet (6,828 meters), flows southwest from the outfall of Picatinny Lake through the center of the installation. MEC have been found protruding

from the banks and buried alongside the banks of Green Pond Brook, although the source of the MEC is unknown.

It should be noted that the size of the Green Pond MRS has increased since the HRR. During the HRR, the northern boundary of the site was the northern border of the former DRMO yard. However, documentation obtained from PTA's safety office shows a 66-mm shell was found in Green Pond Brook where the 9th Street Bridge crosses the brook. As a result, the northern boundary has been extended approximately 330 feet north.

4.5.2 Field Work Activities

4.5.2.1 MEC Activities and Purpose

The Green Pond MRS has been recommended for further investigation during the RI/FS phase of the MMRP based on information collected during the HRR. Therefore, no MEC field activities were conducted during the PTA SI.

4.5.2.2 MC Activities and Purpose

The Green Pond MRS has been recommended for NFA for MC during the RI/FS phase of the MMRP based on information collected during the HRR. According to the 2005 Final ROD prepared under the IRP, the selected remedy for MC in sediment includes chemical and biological monitoring, along with LUCs. Therefore, MC are being addressed under the IRP and will not be included in the Active Army MMRP program.

4.5.3 Field Work Results

4.5.3.1 MEC Results

No MEC field activities were conducted at Green Pond MRS during the PTA SI.

4.5.3.2 MC Results

No MC field activities were conducted at Green Pond MRS during the PTA SI.

4.5.4 Conceptual Site Model

4.5.4.1 MMRP Site Profile

4.5.4.1.1 Area and Layout

The Green Pond MRS covers approximately 1.1 acres and extends from 9th Street to the southern edge of the Former DRMO Yard and Former Burning Ground.

4.5.4.1.2 Structures

No buildings or structures are present since this is a brook.

4.5.4.1.3 Utilities

No utilities are present.

4.5.4.1.4 Boundaries

The Green Pond MRS is bordered to the north by 9th Street and to the west and south by the Former DRMO Yard boundary. There is no distinct boundary to the east.

4.5.4.1.5 Security

Access to PTA is restricted by guards and surveillance at every entrance. No site-specific security practices or controls are associated with the Green Pond MRS.

4.5.4.2 Physical Profile

4.5.4.2.1 Climate

General climate information is presented in Section 4.1.4.2.1.

4.5.4.2.2 Geology

General information about PTA geology is presented in Section 4.1.4.2.2. No specific geologic information pertaining to this area was available.

4.5.4.2.3 Topography

General information about installation topography is presented in Section 4.1.4.2.3. The Green Pond MRS elevation is approximately 700 feet amsl. The topography to the west of the brook is generally flat; to the east the land slopes gently.

4.5.4.2.4 Soil

General information about the soil types present on PTA is presented in Section 4.1.4.2.4.

4.5.4.2.5 Hydrogeology

General information about the hydrogeologic conditions at PTA is presented in Section 4.1.4.2.5. It is likely that shallow groundwater in this area discharges to Green Pond Brook.

4.5.4.2.6 Hydrology

General information about hydrologic conditions at PTA is presented in Section 4.1.4.2.6. This MRS is a waterbody located downstream of Picatinny Lake. Green Pond Brook generally has a wide, straight channel, with slow running, warm water, although there are seasonal variations in the flow due to fluctuations in precipitation. Portions of the brook are channelized and these portions have steep banks. The bottom of Green Pond Brook consists of fine sediment. The lower reach of the brook is considered a gaining stream.

4.5.4.2.7 Vegetation

General information about vegetation at the installation is presented in Section 4.1.4.2.7. Green Pond Brook has steep banks lined with herbaceous and small woody plants. Some reaches of the brook contain dense, submerged aquatic vegetation beds.

4.5.4.3 Land Use and Exposure Profile

4.5.4.3.1 Current Land Use/Activities

The Green Pond MRS is located in a heavily developed and utilized area of PTA.

4.5.4.3.2 Current Human Receptors

The current human receptors on the Green Pond MRS include PTA personnel, PTA residents, and contractors/visitors. Contractors/visitors include utility workers and visitors of PTA personnel and PTA residents.

4.5.4.3.3 Potential Future Land Use

No change in land use is known for the Green Pond MRS. The 2005 Final ROD for the IRP, prepared under the IRP, recommends LUCs for the site.

4.5.4.3.4 Potential Future Human Receptors

As no change in land use is known at this time, the future human receptors are the same as the current human receptors.

4.5.4.3.5 Zoning/Land Use Restrictions

There are no known zoning or land use restrictions at this MRS. The site is located in a heavily used portion of PTA.

4.5.4.3.6 Beneficial Resources

General information about the beneficial resources on PTA is presented in Section 4.1.4.3.6.

4.5.4.3.7 Demographics/Zoning

General information about the demographics/zoning for PTA is presented in Section 4.1.4.3.7.

4.5.4.4 Ecological Profile

4.5.4.4.1 Habitat Type

General information on habitat types at PTA is provided in Section 4.1.4.4.1. The majority of this site consists of aquatic warm bed habitat with little shade. There may be some submerged aquatic vegetation beds. Limited habitat is also present on the steeply sloped banks.

4.5.4.4.2 Degree of Disturbance

The current degree of disturbance is low and is expected to remain so due to the remedies proposed, which include chemical and biological monitoring and LUCs.

4.5.4.4.3 Ecological Receptors

General information on ecological receptors present at the installation is provided in Section 5.1.4.3. Since Green Pond Brook is a modified aquatic habitat due to channelization, expected ecological receptors would include those species tolerant of slow, warm water. According to NJDEP's i-Map Landscape Project layer, this site contains habitat with at least one occurrence of a state threatened species.

4.5.4.5 Munitions/Release Profile

4.5.4.5.1 Munitions Types and Release Mechanisms

Table 4-9 presents a summary of the types of munitions that are known or expected to exist at the Green Pond MRS based on information collected for the HRR. The mechanism by which the munitions, if present, could have been released into the environment is also presented in the table.

Table 4-9 Summary of Potential and Actual Munitions Debris and MEC – Green Pond MRS

Munitions Debris / MEC Identified During HRR	Primary Release Mechanism
▪ Any munitions or equipment that were used on, or passed through, PTA from approximately 1921 to 1980s ▪ 66-mm shell	Discarded or malfunctioned munitions

4.5.4.5.2 Maximum Probable Penetration Depth

There is no evidence to indicate that munitions were fired or tested in this area; therefore, the standard penetration depth calculation is not applicable. Any MEC expected to be located at this site would be due to disposal/burial activities. Since MEC has been found protruding from the

banks of Green Pond Brook it is possible that munitions may be found from the ground surface to a depth just below the bottom of the brook.

4.5.4.5.3 MEC Density

A visual survey to determine the density of MEC at the Green Pond MRS has not been conducted. Therefore, the density of discarded or malfunctioned munitions is not known.

4.5.4.5.4 Munitions Debris

A visual survey has not been conducted at this MRS; however, since MEC have been discovered at the site, it is possible that munitions debris is also present.

4.5.4.5.5 Transport Mechanisms/Migration Routes

The primary transport mechanisms identified for the Green Pond MRS include:

Erosion: Erosion of soil along the banks of Green Pond Brook may uncover MEC.

Soil Disturbance: The current degree of disturbance is low and is expected to remain so due to the remedies proposed, including chemical and biological monitoring and LUCs. However, any future soil disturbance could uncover MEC that are in the surface or subsurface.

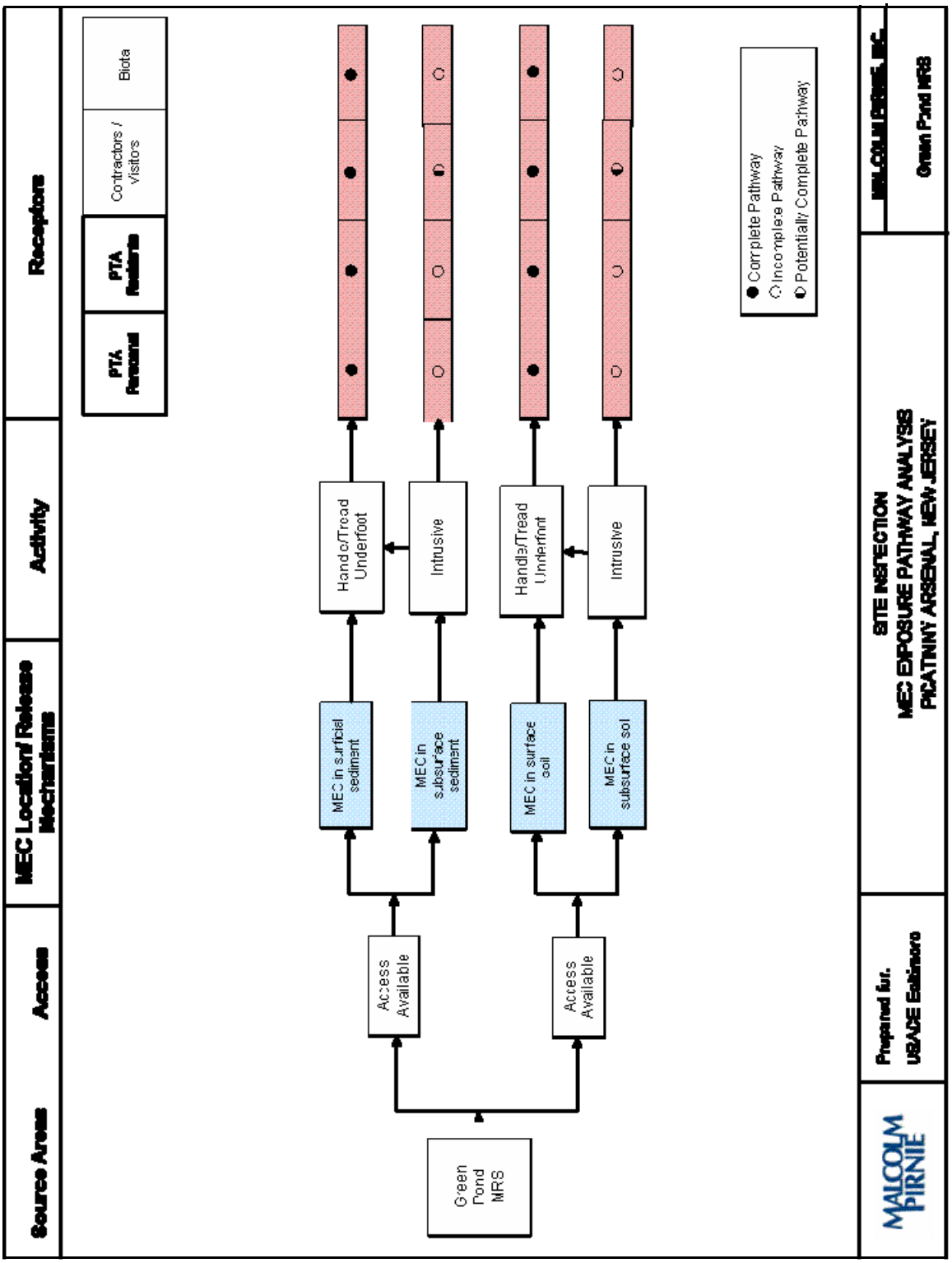
Frost Heave: Periodic, alternating freezing and thawing during the winter may cause MEC to rise from the soil subsurface to the soil surface.

4.5.4.5.6 MEC Pathway Analysis

Figure 4-15 illustrates the MEC pathway analysis prepared for the Green Pond MRS. Since MEC has been found protruding from the bank at the Green Pond MRS, and since more may be present, exposure pathways for surface soil and surficial sediment are identified as complete. Complete exposure pathways exist for PTA personnel, PTA residents, and contractors/visitors who may contact, via handling/treading underfoot, MEC in surface soil along the banks or in surficial sediments of Green Pond Brook. Potentially complete exposure pathways also exist for

contractors who may perform intrusive work on the MRS and thereby contact MEC in subsurface soil or subsurface sediment. Complete exposure pathways are identified for biota that may contact MEC in surface soil and/or surficial sediment.

Figure 4-15: MEC Exposure Pathway Analysis – Green Pond MRS



4.5.5 Site Summary and Conclusions

4.5.5.1 MEC

No MEC activities were conducted at the Green Pond MRS during the PTA SI. Sufficient information was obtained during the HRR to recommend the Green Pond MRS proceed to a RI/FS under the MMRP.

4.5.5.2 MC

MC at the Green Pond MRS are being addressed under the IRP and will not be included in the Active Army MMRP program.

4.5.6 Site Recommendations

Sufficient information for the Green Pond MRS was obtained during the HRR to recommend a RI/FS focused on MEC.

4.6 Inactive Munitions Waste Pit (AEDB-R ID: PICA-013-R-01)

4.6.1 Site Description and Historical Overview

This MRS, which covers approximately 94 acres, is located northwest of the northernmost end of Picatinny Lake, near the installation boundary. This site contains a range and the associated SDZ; a portion of the SDZ falls off post and is included in this report as the Inactive Munitions Waste Pit – Off-Post MRS. It was reported that this site was used from 1955 to the mid-1980s for the testing and storage of munitions and explosives. Based on information contained in the RI Concept Plan it appears the Inactive Munitions Waste Pit consisted of an open field with a burn cage, a gun turret, and a building (Bldg. 656). It is unknown whether all these structures were present throughout the site's operation. Although the site name suggests that materials may have been buried in pits, no site features or other evidence have been identified indicating that burial of munitions took place. In the 1980s, the site was covered with topsoil and sand, and in the late 1990s, the majority of the site was covered with fill and rock. A review of recent aerial photographs confirms that fill material up to 12 feet in thickness is present at the site.

4.6.2 Field Work Activities

4.6.2.1 MEC Activities and Purpose

The Inactive Munitions Waste Pit has been recommended for further investigation during the RI/FS phase of the MMRP based on information collected during the HRR. Although the presence of MEC cannot be confirmed, the presence of 12 feet of fill at the on-post portion of the MRS reduces the value of a magnetometer-assisted visual survey and intrusive work is not typically conducted during an SI. Therefore, no MEC field activities were proposed during the PTA SI. However, the visual survey conducted at the Munitions Waste Pit – Off-Post MRS overlapped a portion of this site. The overlap occurred since the boundary between the on and off-post sites was not well delineated (*i.e.*, there was no fence) and accurate locations could not be obtained from the GPS as satellite coverage was spotty due to the tree canopy.

4.6.2.2 MC Activities and Purpose

The Inactive Munitions Waste Pit has been recommended for further investigation during the RI/FS phase of the MMRP based on information collected during the HRR. Therefore, no MC field activities were conducted at this site during the PTA SI.

4.6.3 Field Work Results

4.6.3.1 MEC Results

No MEC items or munitions debris were observed during any of the survey at the Inactive Munitions Waste Pit – Off-Post MRS, including that portion of the survey inadvertently conducted on-post. See Map 4-4 for an illustration of the survey path.

4.6.3.2 MC Results

No MC field activities were conducted at the Inactive Munitions Waste Pit during the PTA SI.

4.6.4 Conceptual Site Model

4.6.4.1 MMRP Site Profile

4.6.4.1.1 Area and Layout

The former range is located on Green Pond Mountain in the northwestern portion of PTA. Surrounding the site is an SDZ consisting of a 1,250 foot radius from the center of the site. This area was used for munitions testing until 1965. Impact craters created during the testing were subsequently filled with gravel and sand.

4.6.4.1.2 Structures

According to the FY06 Installation Action Plan (IAP) for PTA, this site currently contains a gun turret, an elevated stand from which munitions were hung and/or fired, a metal cage in which munitions were detonated, three concrete bases with a cut projectile casing in each, several 8-inch gun barrels, one partial jet hull, two pieces of 18-inch long concrete storm sewer pipes, and several mounds of asphalt/concrete/brick debris. Historically, a control building (Bldg. 656), a guard shack, another elevated stand, two additional jet hulls, a steel test unit, and steel observation towers existed at the site.

4.6.4.1.3 Utilities

There is no information available regarding utilities that may be present at this site.

4.6.4.1.4 Boundaries

This MRS is bordered by the installation boundary to the northwest. There are no distinct boundaries to the south and east; the closest boundaries are Site 13 and Site 11, respectively.

4.6.4.1.5 Security

Access to PTA is restricted by guards and surveillance at every entrance. A locked gate controls access to the Inactive Munitions Waste Pit MRS and no personnel are allowed on site during testing operations at nearby ranges. It should be noted that portions of the MRS are located outside of the installation fence line. During the visual survey, the westernmost portion of the site was accessed from the west; no fenceline was encountered during field activities.

4.6.4.2 Physical Profile

4.6.4.2.1 Climate

General climate information for the installation is presented in Section 4.1.4.2.1.

4.6.4.2.2 Geology

General geologic information about PTA is presented in 4.1.4.2.2. This MRS is underlain by the Lower to Middle Silurian Green Pond Conglomerate, a reddish-brown to olive-gray quartzitic conglomerate that has been found at depths between two to four feet bgs. Unconsolidated material on top of this unit consists of glacial till.

4.6.4.2.3 Topography

General information about installation topography is presented in Section 4.1.4.2.3. This site is located approximately 1,175 feet amsl and is relatively flat to sloping.

4.6.4.2.4 Soil

General information about the soil types present on PTA is presented in Section 4.1.4.2.4. Soils at this site consist of the Rockaway and Rock Outcrop associations, which are deep, well to moderately well-drained, stony sandy loams.

4.6.4.2.5 Hydrogeology

General information about the hydrogeologic conditions at PTA is presented in Section 4.1.4.2.5. The depth to groundwater at the Inactive Munitions Waste Pit is approximately 6.5 to 7 feet bgs. Shallow groundwater flows to the east while groundwater flow in the bedrock complex depends on the fractures present.

4.6.4.2.6 Hydrology

General information about hydrologic conditions at PTA is presented in Section 4.1.4.2.6. No waterbodies are present on this MRS; however, a swampy area is located along the southern boundary.

4.6.4.2.7 Vegetation

General information about vegetation at the installation is presented in Section 4.1.4.2.7. This MRS, which mainly contains bare ground associated with fill areas, is also surrounded by deciduous forest.

4.6.4.3 Land Use and Exposure Profile

4.6.4.3.1 Current Land Use/Activities

The Inactive Munitions Waste Pit MRS is an other than operational area on the installation that acts as a buffer between active ranges. No information was provided on whether hunting occurs on this MRS; however, this CSM assumes that hunting may occur.

4.6.4.3.2 Current Human Receptors

The current human receptors on the Inactive Munitions Waste Pit MRS include authorized PTA personnel, PTA residents, contractors/visitors, recreationists (*e.g.*, hunters), and trespassers. Since PTA is a fenced, guarded, and patrolled installation, it is not likely that trespassers from outside the installation would penetrate the perimeter of PTA and access the MRS. However, for the purposes of this CSM, trespassers are considered individuals who have access to PTA but are not authorized to be present in specific areas of the MRS. The most likely "trespassers" would therefore be PTA personnel, PTA residents, and contractors/visitors, and the potential exposure of trespassers is described by the potential exposure pathways for the latter receptor groups.

4.6.4.3.3 Potential Future Land Use

Potential future land use for the Inactive Munitions Waste Pit is expected to remain the same as the current use.

4.6.4.3.4 Potential Future Human Receptors

As no change in land use is known at this time, the future human receptors remain the same as the current human receptors.

4.6.4.3.5 Zoning/Land Use Restrictions

No known site-specific land use restrictions are in place for the Inactive Munitions Waste Pit.

4.6.4.3.6 Beneficial Resources

General information about the beneficial resources on PTA is presented in Section 4.1.4.3.6. No site-specific beneficial resources have been identified.

4.6.4.3.7 Demographics/Zoning

General information about the demographics/zoning at PTA is presented in Section 4.1.4.3.7.

4.6.4.4 Ecological Profile

4.6.4.4.1 Habitat Type

General information on habitat types at PTA is provided in Section 4.1.10.4.1. The Inactive Munitions Waste Pit is surrounded by forested areas, including some shrubby habitat. In addition, a swampy area is located on the southern boundary.

4.6.4.4.2 Degree of Disturbance

The degree of disturbance at this site is low.

4.6.4.4.3 Ecological Receptors

General information about the ecological receptors at PTA is provided in Section 4.1.4.4.3. Site-specific information on ecological receptors is not available; however, an RI Report for this area suggested that an ecological risk assessment should be conducted due to the presence of wooded habitat (*i.e.*, forests). In addition, NJDEP's i-Map Landscape Project layer indicates this site contains habitat with at least one occurrence of a state threatened species.

4.6.4.5 Munitions/Release Profile

4.6.4.5.1 Munitions Types and Release Mechanisms

Table 4-10 presents a summary of the types of munitions debris and MEC that were identified during research conducted for the HRR. The mechanism by which the munitions, if present, could have been released into the environment is also presented in the table.

Table 4-10 Summary of Potential Debris and MEC for Inactive Munitions Waste Pit

Munitions Debris / MEC Identified During HRR	Primary Release Mechanism
Information on specific munitions types utilized at the site was not available.	▪ Munitions testing activities ▪ Munitions debris projected out from the site ▪ Possible historical waste munitions disposal

4.6.4.5.2 Maximum Probable Penetration Depth

Because no information was available regarding specific munitions utilized at the Inactive Munitions Waste Pit, a maximum probability penetration depth cannot be determined. However, based on the geology of the site, the maximum penetration depth is estimated to be 4 feet, which is the maximum depth to bedrock. It should be noted that the majority of this site is overlain with 12 feet of fill, which was placed after the site was no longer in use.

4.6.4.5.3 MEC Density

No MEC was observed on the surface during the visual survey. According to the HRR approximately 12 feet of fill material covers the surface of this MRS so MEC density on the surface is expected to be low. There is potential for MEC to exist in the subsurface.

4.6.4.5.4 Munitions Debris

No munitions debris was observed on the surface during the SI visual survey.

4.6.4.5.5 Associated MC

According to the HRR, four surface soil samples and two sediment samples were previously collected from this site. Analysis of these samples indicated the following:

- Copper was detected in all of the soil and sediment samples (12 to 1,400 mg/kg); however, only one soil sample had a concentration that exceeded both the site-specific background concentration (11.3 mg/kg for soil and 9.3 mg/kg for sediment) and the NJDEP SCC (600 mg/kg). None of the sample results exceeded the Region 3 RBC (3,100 mg/kg)
- Lead was detected in five of the soil and sediment samples (6.7 to 120 mg/kg); however, only three samples had concentrations that exceeded the site-specific background concentrations (25.8 mg/kg for soil and 11.6 mg/kg for sediment) and none of the results exceeded the NJDEP SCC or Region 3 RBC (400 mg/kg)
- Zinc was detected in all of the soil and sediment samples (36 to 427 mg/kg) and it exceeded the site-specific background concentrations (38.9 mg/kg for soil and 55.7 mg/kg for sediment) in five of the samples. However, none of the results exceeded the NJDEP SCC (1,500 mg/kg) or the Region 3 RBC (23,000 mg/kg)
- 1,3-DNB was detected in one soil sample (12.1 mg/kg) at a concentration that exceeded the Region 3 RBC (7.8 mg/kg); nitroglycerin was detected in three soil samples (13 to 97 mg/kg) at concentrations that exceeded the Region 3 RBC (7.8 mg/kg); and RDX was detected in one soil sample (11 mg/kg) at a concentration that exceeded the Region 3 RBC (5.8 mg/kg). None of these explosives have NJDEP SCC criteria
- 2,4-DNT was detected in one soil sample (11.7 mg/kg) at a concentration that exceeded that NJDEP SCC (1 mg/kg) but not the Region 3 RBC (160 mg/kg)
- 2,4,6-TNT was detected in one soil sample (8.8 mg/kg) at a concentration below the Region 3 RBC (21 mg/kg); there is no NJDEP SCC for this explosive
- Explosives were not detected in any of the sediment samples

4.6.4.5.6 Transport Mechanisms/Migration Routes

The primary transport mechanisms identified for the Inactive Munitions Waste Pit include:

Erosion: Although there are several structures located at the Inactive Munitions Waste Pit, the majority of the site consists of undeveloped land. Therefore, surface erosion at the site has the potential to transport soil impacted by MC.

Soil Disturbance: Although not currently planned, future construction within the Inactive Munitions Waste Pit would create surface and subsurface soil disturbances that could cause both the transport and migration of MEC or MC. Surface and subsurface disturbances can lead to the transport and migration of MC from one environmental medium to another (soil to surface or groundwater or both) through surface water runoff, infiltration, and erosion.

Infiltration: The potential for MC to migrate from one environmental medium to another through infiltration is moderate. The soils at the Inactive Munitions Waste Pit are characterized as having slow permeability; however, the majority of the site is undeveloped and not covered by an impermeable surface. Therefore, infiltration of percolating precipitation may cause MC in soil to migrate to shallow groundwater.

4.6.4.6 Pathway Analysis

4.6.4.6.1 MEC

The MEC Exposure Pathway Analysis is illustrated in Figure 4-16. Since no MEC have been found at the Inactive Munitions Waste Pit to date, no complete exposure pathways are identified. Potentially complete exposure pathways exist for PTA personnel/residents, recreationists, and contractors/visitors who may contact, via handling/treading underfoot, MEC in surface soil or surficial sediment of the swampy area. Potentially complete exposure pathways also exist for contractors who may contact MEC in subsurface soil or subsurface sediment while accessing underground utilities or performing intrusive work. It should be noted that clearance must be given by PTA's Safety Office prior to any subsurface activity. Potentially complete exposure pathways exist for biota that may contact MEC in surface soil or surficial sediment and that may nest or burrow at the site and thereby contact MEC in subsurface soil.

4.6.4.6.2 MC

The MC Exposure Pathway Analysis is illustrated in Figure 4-17. Because several chemical parameters were detected in environmental media, complete exposure pathways exist for

receptors with access to the Inactive Munitions Waste Pit MRS. Soil and sediment (in the swampy area) are the primary source media through which receptors may be exposed to MC.

Complete exposure pathways exist for PTA personnel/residents, recreationists, and contractors/visitors who may contact MC in surface soil or sediment at the site. Complete exposure pathways also exist for contractors who may contact MC in subsurface soil while performing intrusive work. Exposure routes include ingestion and dermal contact and, for soil, inhalation of dust. Complete exposure pathways exist for biota that may contact MC in surface and subsurface soil or sediment while feeding, nesting, or burrowing.

The nearest potable water production well is approximately two miles (3,219 meters) downgradient from the Inactive Munitions Waste Pit. Although the potable water supply at PTA is monitored semiannually and treated for volatile chemicals, potentially complete exposure pathways exist for potable water users. PTA personnel and PTA residents may contact MC in potable water via ingestion and dermal contact.

Potentially complete exposure pathways through the food chain exist for assimilative/bioaccumulative MC to both human and ecological receptors. No information was available regarding hunting at the Inactive Munitions Waste Pit, but this CSM assumes that hunting may occur on the MRS. Potentially complete exposure pathways exist for recreationists who may ingest MC that have bioaccumulated in game animals. Terrestrial wildlife may ingest MC assimilated in vegetation and bioaccumulated in prey species. These pathways are potentially complete due to the nature and variability of the process of assimilation into plants and bioaccumulation into wildlife. These processes are highly dependent on the particular MC and environmental conditions, as well as on the conditions of the individual plant or wildlife species.

Figure 4-16: MEC Exposure Pathway Analysis – Inactive Munitions Waste Pit

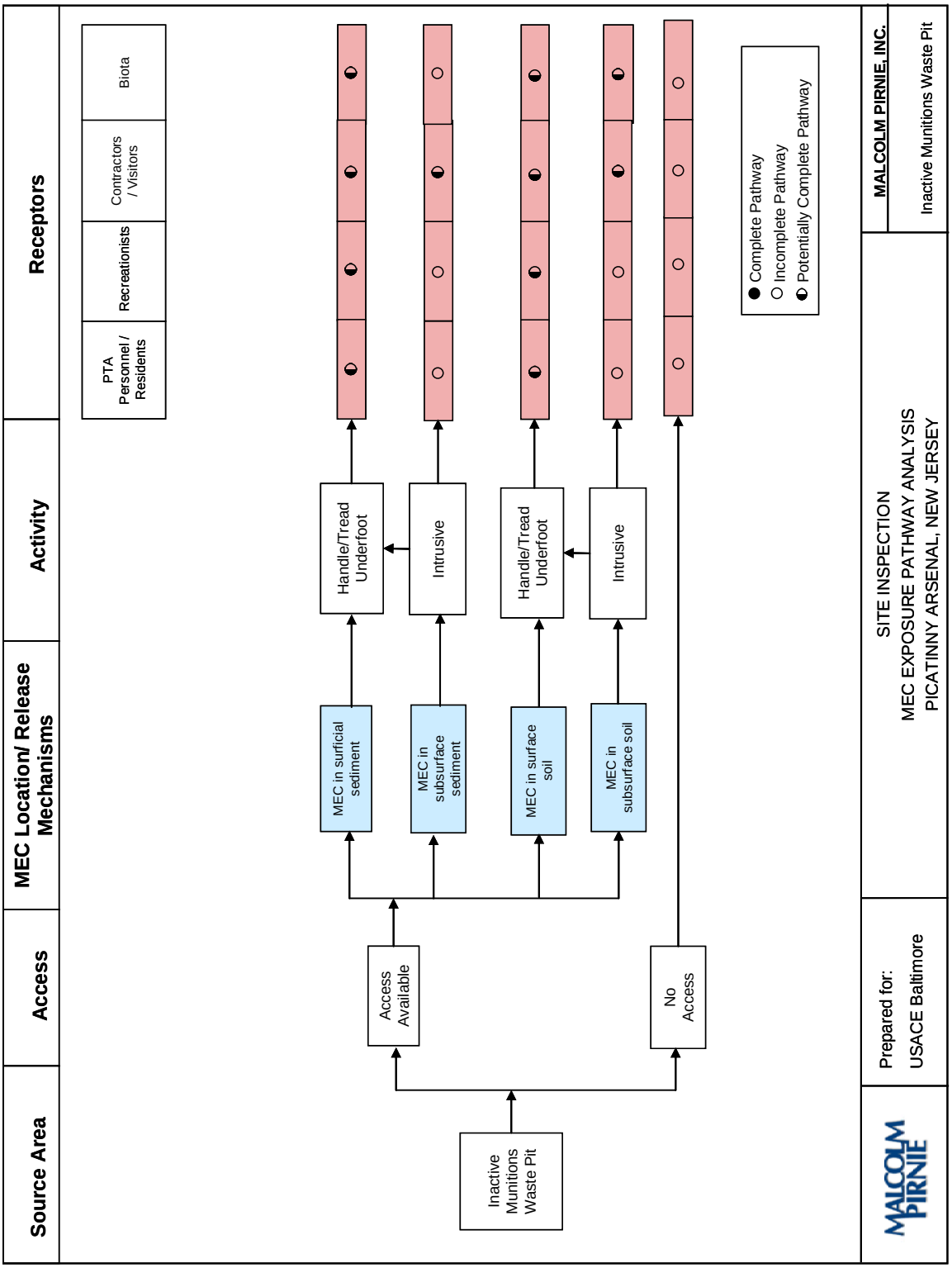
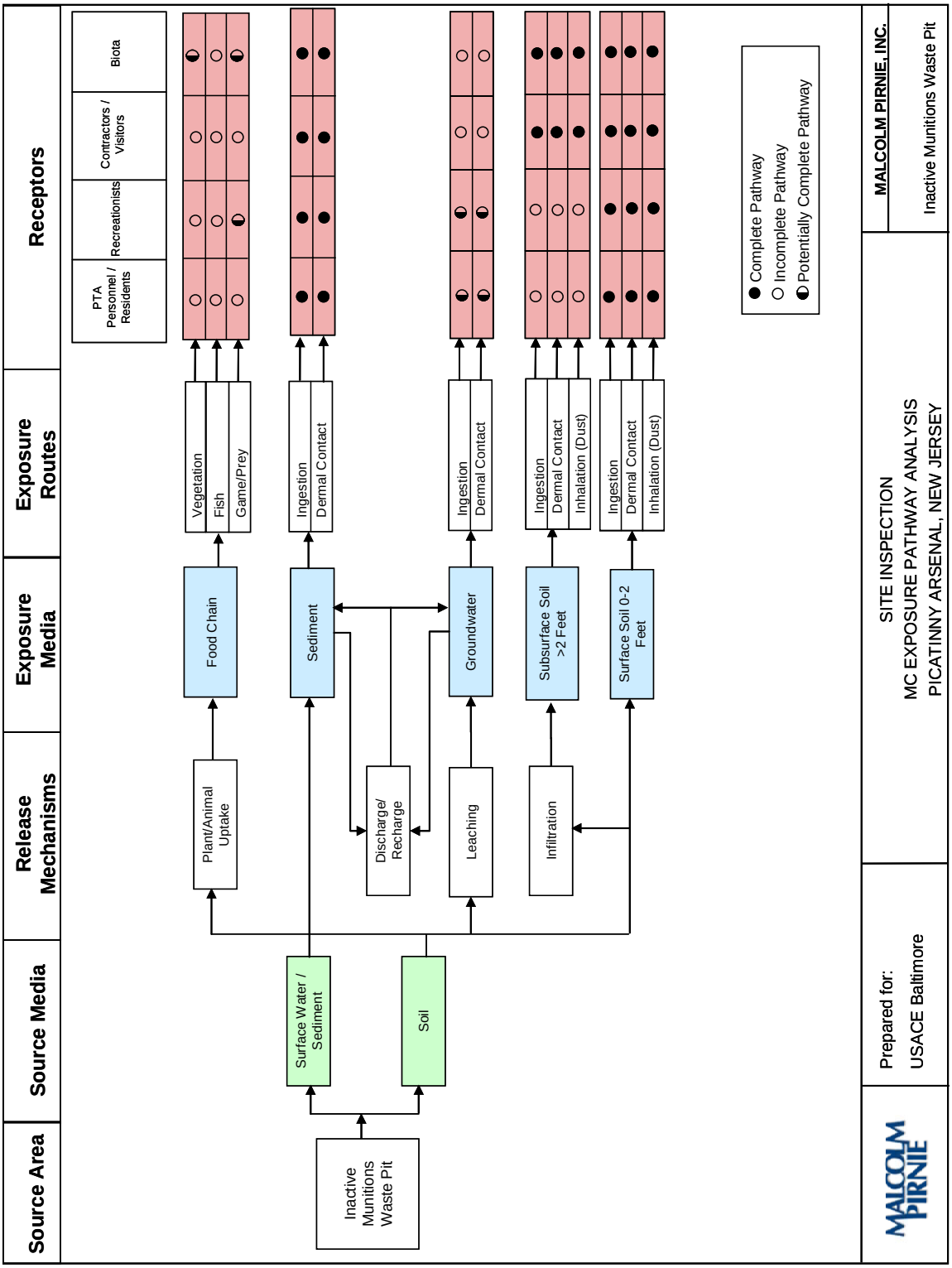


Figure 4-17: MC Exposure Pathway Analysis – Inactive Munitions Waste Pit



4.6.5 Site Summary and Conclusions

4.6.5.1 MEC

Sufficient information was obtained during the HRR to recommend the Inactive Munitions Waste Pit proceed to an RI/FS under the MMRP.

4.6.5.2 MC

Sufficient information was obtained during the HRR to recommend the Inactive Munitions Waste Pit proceed to an RI/FS under the MMRP.

4.6.6 Site Recommendations

Sufficient information was obtained for the Inactive Munitions Waste Pit during the HRR to recommend an RI/FS focused on MEC and MC.

4.7 Inactive Munitions Waste Pit – Off-Post (AEDB-R ID: PICA-014-R-01)

4.7.1 Site Description and Historical Overview

This MRS covers 7.5-acres and consists of all off-post property that falls within the SDZ (1,250 foot radius from the center of the Inactive Munitions Waste Pit MRS) of the Inactive Munitions Waste Pit MRS.

4.7.2 Field Work Activities

4.7.2.1 MEC Activities and Purpose

A visual survey was conducted during the SI to determine if MEC are present at the surface of this MRS. The purpose of the survey was to obtain sufficient information to support the Army CTC estimates and MRSPPs and to determine if an accelerated response is needed. The survey was conducted on approximately 2.25 acres using a transect approach. Due to the potential hazards associated with potential MEC, the UXO Technician escorted the field team members through this area using MEC avoidance techniques during the reconnaissance activities.

4.7.2.2 MC Activities and Purpose

The Inactive Munitions Waste Pit –Off-Post has been recommended for further investigation during the RI/FS phase of the MMRP based on information collected during the HRR. Therefore, no MC field activities were conducted at this site during the PTA SI.

4.7.3 Field Work Results

4.7.3.1 MEC Results

A visual survey was conducted over 2.25 acres and no MEC items or munitions debris were observed. In addition, no structures or surface features were identified during the visual survey. The visual survey path covered a portion of the Inactive Munitions Waste Pit On-Post property due to extremely spotty satellite coverage and the absence of a fence at the installation boundary. Map 4-4 shows the path of the visual survey at the Inactive Munitions Waste Pit - Off-Post MRS.

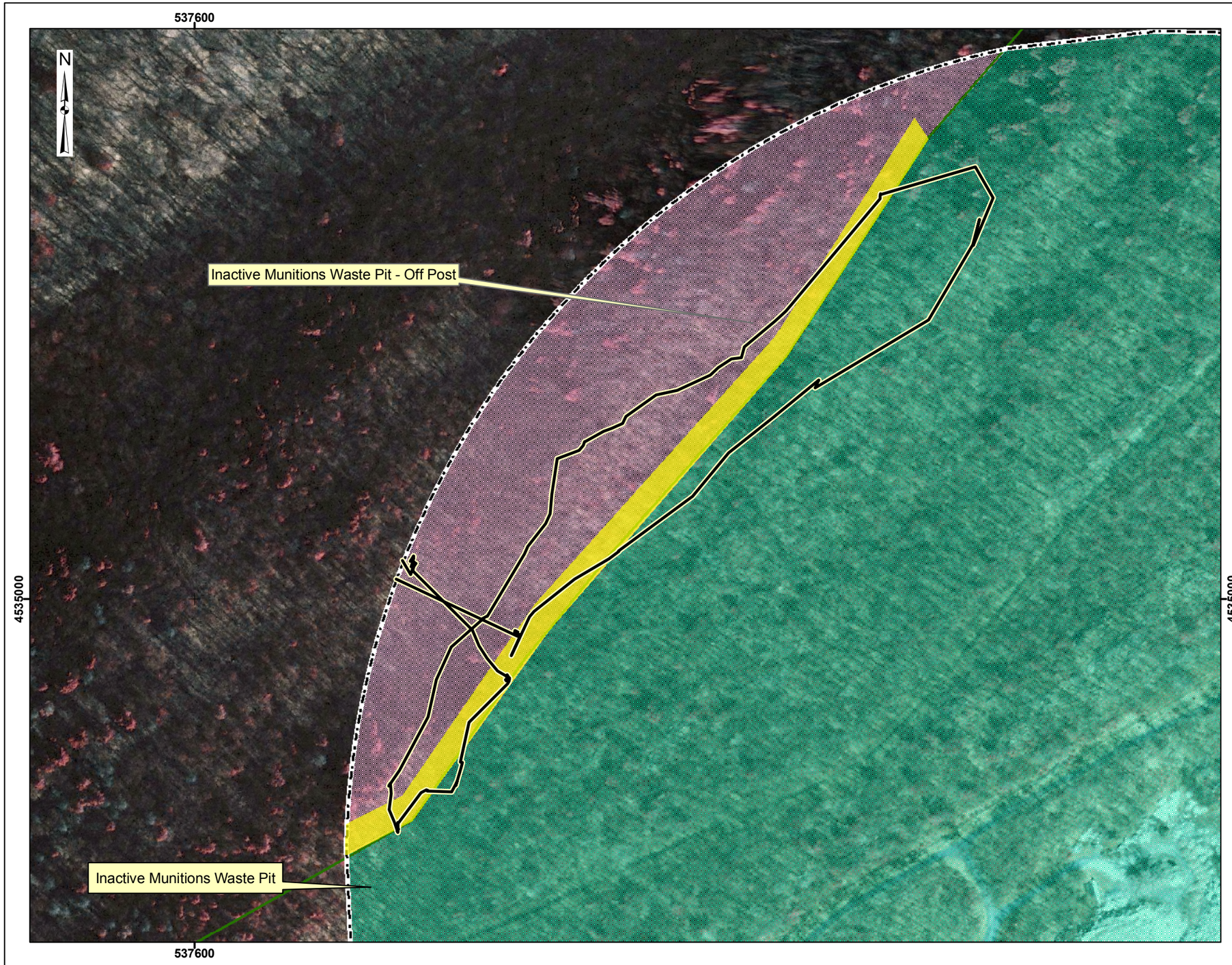
4.7.3.2 MC Results

No MC field activities were conducted at the Inactive Munitions Waste Pit - Off-Post MRS during the PTA SI.

Site Inspection
Picatinny Arsenal, NJ

MALCOLM PIRNIE

Map 4-4
SI Field Activities and Findings
Inactive Munitions Waste Pit - Off-Post



Legend

- Installation Boundary
- SI Work Plan Proposed Area for Visual Survey
- Site Survey

Military Range Area

- Inactive Munitions Waste Pit
- Inactive Munitions Waste Pit - Off-Post
- Surface Danger Zone

Notes: 1) A portion of the Inactive Munitions Waste Pit MRS was surveyed during the survey of the Inactive Munitions Waste Pit - Off-Post since the boundary between the on and off post sites is not well delineated and accurate locations could not be obtained from the GPS due to the tree canopy

2) Transects for the visual survey were not conducted in straight lines because of sporadic GIS satellite coverage, site topography and dense vegetation. GIS interference was caused by overhead tree canopy.

0 30 60 120 Meters

Data Source: Aerials: NJDEP, CIR Orthoimagery, 2002
CTT Data: AEC, CTT Range Inventory, 2005
SI Site Boundary: Remedial Investigation Concept Plan for Picatinny, March 1991

Coordinate System: UTM Zone 18N
Datum: NAD 83
Units: Meters

Contract: W912DR-05-D-0004
Edition: Final SI Report
Date: April 2008

4.7.4 Conceptual Site Model

4.7.4.1 MMRP Site Profile

4.7.4.1.1 Area and Layout

The Inactive Munitions Waste Pit - Off-Post is located on very hilly terrain in Jefferson Township, adjacent to the installation boundary. The site is vacant land.

4.7.4.1.2 Structures

There are no known structures on this property.

4.7.4.1.3 Utilities

There is no information available regarding utilities that may be present at this site; however, since the property is vacant it is unlikely that utilities are present.

4.7.4.1.4 Boundaries

This MRS is bordered by PTA's boundary to the south and east. There are no distinct boundaries to the north and west.

4.7.4.1.5 Security

No site-specific security practices or controls are associated with the Inactive Munitions Waste Pit - Off-Post, although access is extremely difficult due to the steep terrain.

4.7.4.2 Physical Profile

4.7.4.2.1 Climate

General climate information is presented in Section 4.1.4.2.1.

4.7.4.2.2 Geology

Due to the proximity to PTA, it is assumed that general information about PTA geology is applicable to this MRS. General geologic information about PTA is presented in 4.1.4.2.2. In addition, the Inactive Munitions Waste Pit MRS, which is located on the installation adjacent to this site, is underlain by the Lower to Middle Silurian Green Pond Conglomerate, a reddish-

brown to olive-gray quartzitic conglomerate that has been found at depths between 2 to 4 feet bgs. Unconsolidated material on top of this unit consists of glacial till.

4.7.4.2.3 Topography

This site consists of steep and mountainous terrain.

4.7.4.2.4 Soil

General information about the soil types present on PTA is presented in Section 4.1.4.2.4. Soils at this site consist of the Rockaway and Rock Outcrop associations, which are deep, well to moderately well-drained, stony sandy loams.

4.7.4.2.5 Hydrogeology

Due to the proximity to PTA, it is assumed that general information about PTA hydrogeology is applicable to this site. General information about the hydrogeologic conditions at PTA is presented in Section 4.1.4.2.5. In this area, it is assumed that shallow groundwater flows to the east while groundwater flow in the bedrock complex depends on the fractures present.

4.7.4.2.6 Hydrology

No waterbodies are present on this MRS.

4.7.4.2.7 Vegetation

Based on the site walk conducted for the SI, it was observed that this entire site contains a mix of deciduous and conifer forest.

4.7.4.3 Land Use and Exposure Profile

4.7.4.3.1 Current Land Use/Activities

This MRS is undeveloped and located on steep mountain terrain.

4.7.4.3.2 Current Human Receptors

The only possible current human receptors on the Inactive Munitions Waste Pit – Off-Post are recreationists (*e.g.*, hunters, hikers), but their presence is most likely limited by the steep and mountainous terrain.

4.7.4.3.3 Potential Future Land Use

Potential future land use for the Inactive Munitions Waste Pit – Off-Post is expected to remain the same as the current use since the entire site is located in a NJDEP Division of Fish & Wildlife designated Wildlife Management Area.

4.7.4.3.4 Potential Future Human Receptors

As no change in land use is known at this time, the future human receptors are the same as the current human receptors.

4.7.4.3.5 Zoning/Land Use Restrictions

The Inactive Munitions Waste Pit - Off-Post is located in a Highlands Preservation Area and a Wildlife Management Area.

4.7.4.3.6 Beneficial Resources

General information about the beneficial resources on PTA is presented in Section 4.1.4.3.6. Information concerning additional beneficial resources specific to this site was not available.

4.7.4.3.7 Demographics/Zoning

General information about the demographics/zoning near PTA is presented in Section 4.1.4.3.7. This site is located in a Highlands Preservation Area and a Wildlife Management Area.

4.7.4.4 Ecological Profile

4.7.4.4.1 Habitat Type

This site contains steep, mountainous terrain.

4.7.4.4.2 Degree of Disturbance

This site is undeveloped; therefore, the degree of disturbance is low.

4.7.4.4.3 Ecological Receptors

General information about the ecological receptors at PTA is provided in Section 4.1.4.4.3. According to NJDEP's i-Map Landscape Project layer, this site contains habitat with at least one occurrence of a state threatened species.

4.7.4.5 Munitions/Release Profile

4.7.4.5.1 Munitions Types and Release Mechanisms

Table 4-11 presents a summary of the types of munitions debris and MEC that were identified either during SI field activities or during research conducted for the HRR. The mechanism by which the munitions, if present, could have been released into the environment is also presented in the table.

Table 4-11 Summary of Potential and Actual Munitions Debris and MEC for Inactive Munitions Waste Pit – Off-Post

Munitions Debris / MEC Observed During SI Field Activities	Munitions Debris / MEC Identified During HRR	Primary Release Mechanism
None	Information on specific munitions types utilized at the site was not available.	▪ Munitions testing activities ▪ Munitions debris projected out from the site

4.7.4.5.2 Maximum Probable Penetration Depth

Because no information was available regarding specific munitions utilized at the Inactive Munitions Waste Pit, a maximum probability penetration depth cannot be determined. For the on-post area of the Inactive Munitions Waste Pit, the maximum penetration depth was estimated at four feet, which is the maximum depth to bedrock at the site. Assuming that the geology of the off - post portion of the site (extending approximately 1,000 feet (305 meters) from the PTA boundary) is similar, this estimated penetration depth can be applied to the off – post portion of the MRS as well.

4.7.4.5.3 MEC Density

No MEC was observed on the surface during the SI visual survey, indicating that MEC density at the surface of this MRS is likely negligible to low.

4.7.4.5.4 Munitions Debris

No munitions debris was observed during the SI visual survey.

4.7.4.5.5 Associated MC

Although no known sampling events have occurred outside of PTA's boundaries, as discussed in Section 4.6.4.5.5, four surface soil samples and two sediment samples were collected from the Inactive Munitions Waste Pit MRS. Both explosives and metals were detected in these samples; copper, 1,3-DNB, nitroglycerin, and RDX were all detected at concentrations that exceeded the comparison criteria.

4.7.4.5.6 Transport Mechanisms/Migration Routes

The primary transport mechanisms identified for the Inactive Munitions Waste Pit – Off-Post include:

Frost Heave: Periodic, alternating freezing and thawing during the winter may cause MEC to rise from the soil subsurface to the soil surface.

Erosion: Erosion of soil may uncover MEC. Surface erosion at the site has the potential to transport soil impacted by MC, especially since the site contains steeply sloping terrain.

Infiltration: The potential for MC to migrate from one environmental medium to another through infiltration is moderate. The soils at the Inactive Munitions Waste Pit – Off-Post are characterized as having slow permeability and runoff is expected to be high due to the terrain; however, the site is undeveloped and not covered by an impermeable surface. Therefore, infiltration of percolating precipitation may cause MC in soil to migrate to shallow groundwater.

4.7.4.6 Pathway Analysis

4.7.4.6.1 MEC

The MEC Exposure Pathway Analysis is illustrated in Figure 4-18. Munitions were used at the Inactive Munitions Waste Pit MRS, and this MRS falls within the SDZ of that site; however, to date no MEC have been found at the Inactive Munitions Waste Pit – Off-Post MRS. Therefore, potentially complete exposure pathways are shown for receptors that have access to the site. Specifically, potentially complete pathways exist for biota that may contact, via handling/treading underfoot, MEC in surface soil. Potentially complete pathways exist for biota that may contact MEC in subsurface soil while constructing burrows. Recreationists are not included as potential human receptors in the MEC Exposure Pathway Analysis because their presence on the MRS is most likely limited by the steep and mountainous terrain.

4.7.4.6.2 MC

The MC Exposure Pathway Analysis is illustrated in Figure 4-19. Soil impacted by MC is the primary source media for all receptors. Complete exposure pathways exist for biota that may contact MC in surface and subsurface soil while feeding, nesting, or burrowing.

However, potentially complete exposure pathways through the food chain exist for assimilative/bioaccumulative MC to both human and ecological receptors. Biota may ingest MC assimilated in vegetation and bioaccumulated in prey species. While recreationists (*i.e.*, hunters) are not expected to frequent the MRS, many game species have large home ranges. It is possible that game animals would frequent the MRS and that hunters would encounter these animals outside of the MRS. Therefore, potentially complete exposure pathways exist for recreationists who may be exposed to MC that have bioaccumulated in game animals. These pathways are potentially complete due to the nature and variability of the process of assimilation into plants and bioaccumulation into wildlife. These processes are highly dependent on the particular MC and environmental conditions, as well as on the conditions of the individual plant or wildlife species.

The source of potable water off-PTA is not known; therefore, potentially complete pathways for groundwater cannot be discounted.

Figure 4-18: MEC Exposure Pathway Analysis – Inactive Munitions Waste Pit – Off-Post

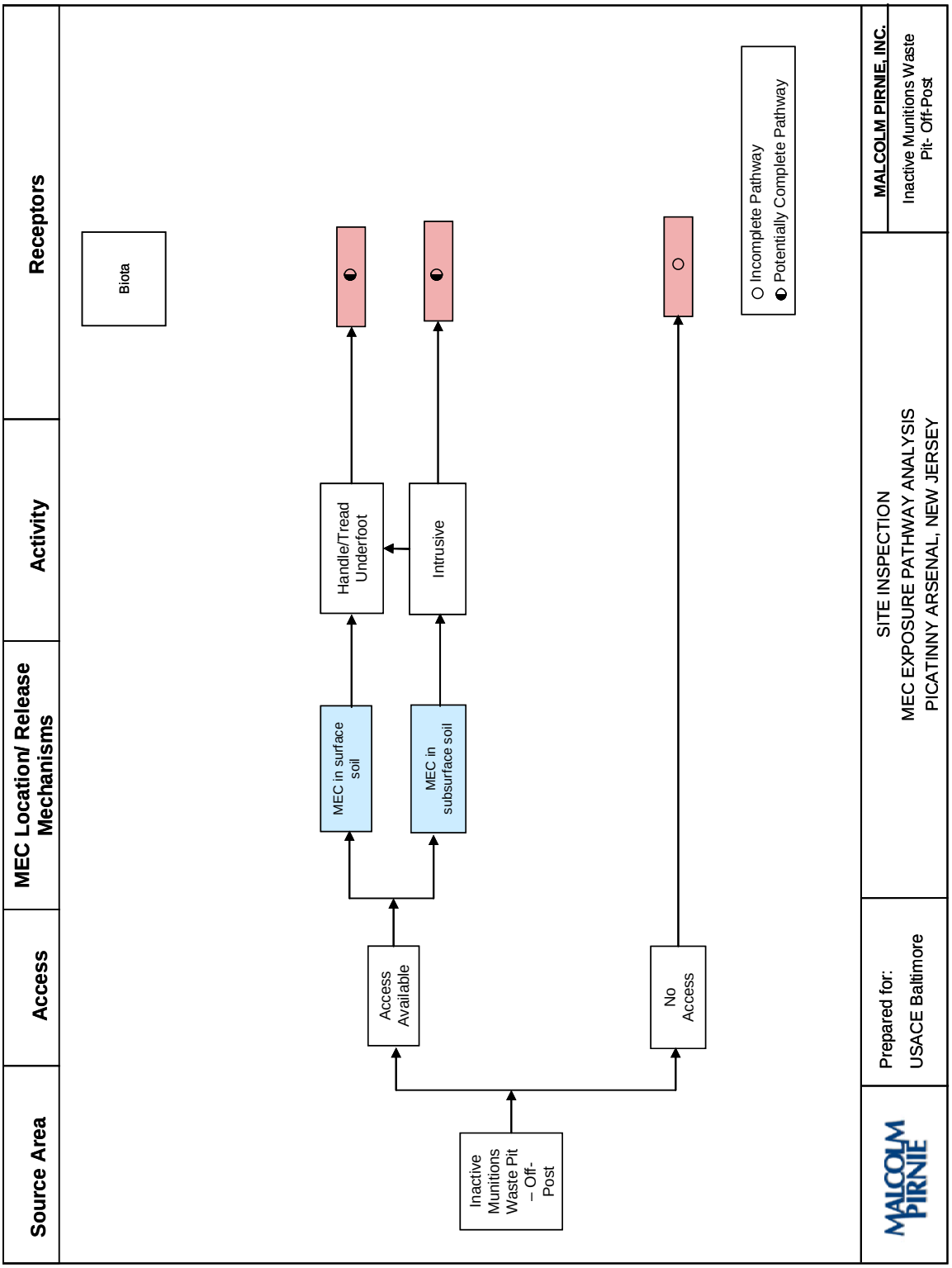
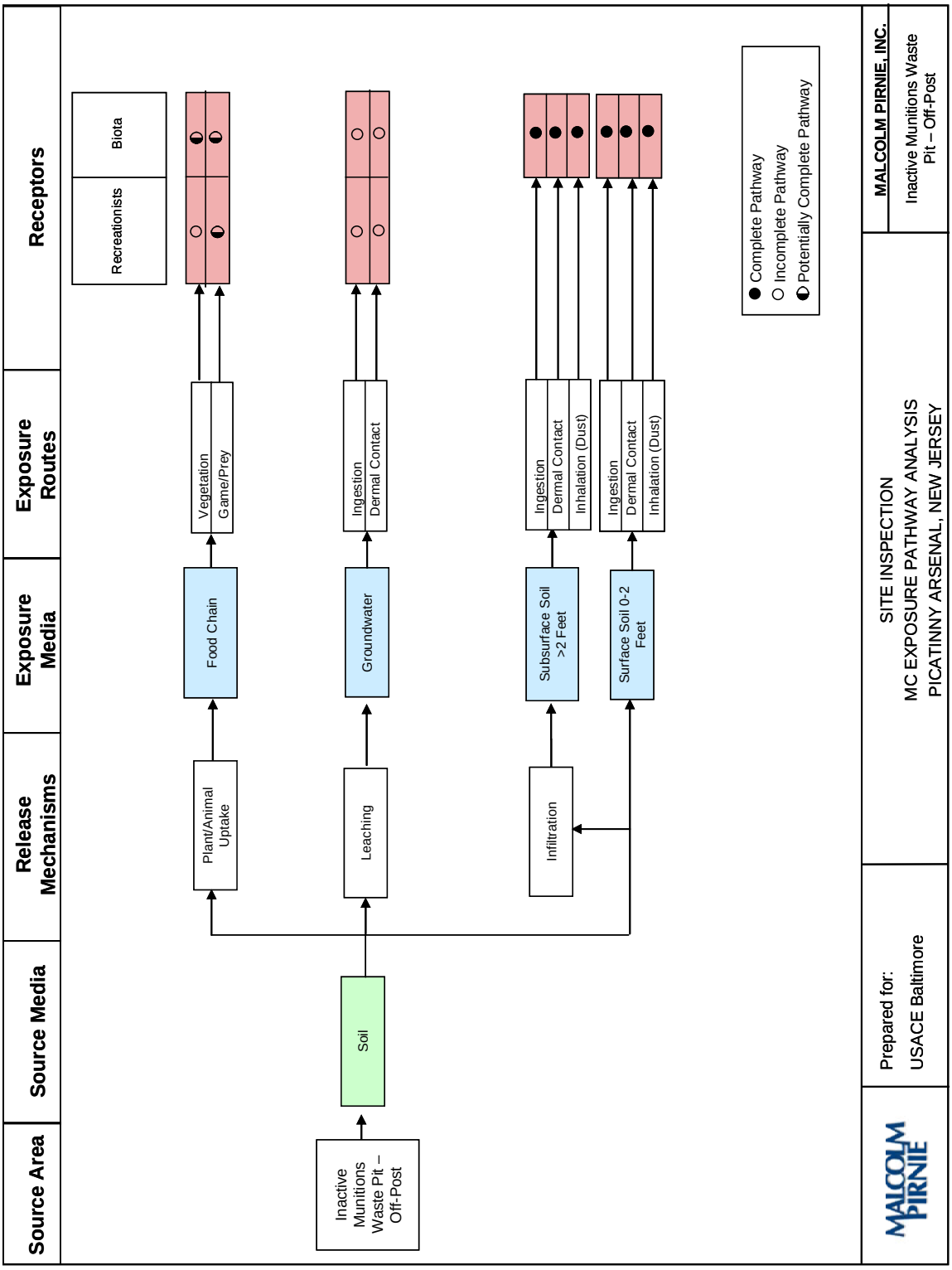


Figure 4-19: MC Exposure Pathway Analysis – Inactive Munitions Waste Pit – Off-Post



4.7.5 Site Summary and Conclusions

4.7.5.1 MEC

A visual survey was conducted over 2.25 acres of the 7.5 acre site. No MEC items or munitions debris were observed during the visual survey. Based on the activities that occurred at the Inactive Munitions Waste Pit, there is the potential for munitions debris items at the Inactive Munitions Waste Pit – Off-Post MRS.

4.7.5.2 MC

The Inactive Munitions Waste Pit – Off-Post has been recommended for further investigation during the RI/FS phase of the MMRP based on information collected during the HRR. Therefore, no MC field activities were conducted at this site during the PTA SI.

4.7.6 Site Recommendations

Based on information collected during the HRR, the Inactive Munitions Waste Pit – Off-Post is recommended for an RI/FS for both MEC and MC. Due to observations made during the SI field work an accelerated response action is not recommended for this MRS.

4.8 Lakes MRS (AEDB-R ID: PICA-008-R-01)

4.8.1 Site Description and Historical Overview

There are two large lakes on PTA; Lake Denmark and Picatinny Lake, that were historically used as ranges. Although they are not adjacent to each other (Refer to Map 2-1), these two lakes were consolidated into one MRS since the CSMs for both lakes are very similar. This MRS covers 758 acres and includes the lakes as well as the on-post land portions covered by the SDZs associated with the ranges.

Lake Denmark, which covers approximately 633 acres, is located on the northeastern portion of the installation. Lake Denmark is a man-made lake with an approximate surface area of 263 acres and an average depth of 6.5 feet. The lake is not used as a source of drinking water, but is

used for recreational boating and fishing. Swimming in Lake Denmark is banned and fish consumption advisories are in effect.

Previously, the lake was used as a mortar impact area and an experimental munitions testing range. Three ranges, 60-mm, 81-mm, and 4.2-inch inert projectile ranges, were identified. These ranges shared a single firing point on the southern end of the lake, but had several lines of fire. Several impact areas were located on the northern end of the lake. A 20-mm cannon range that fired across Lake Denmark toward an impact area near Bldg. 1221 was also identified.

According to a geophysical survey conducted in Lake Denmark, anomalous readings appear to be concentrated near the northern portion of the lake. It is also believed that UXO and munitions debris were discarded into Lake Denmark following the 1926 explosion of the Lake Denmark Powder Depot. Munitions dumping into the lake is thought to have occurred from the western shoreline.

On August 9, 2007, a 60-mm fuzed mortar was discovered near Bldg. 1204 during an archaeological study. This building is located within the safety fan of Lake Denmark. PTA's EOD unit removed and disposed of the mortar.

Picatinny Lake covers approximately 125 acres and is located in the central portion of the installation. Picatinny Lake is a man-made lake with an approximate surface area of 108 acres, a flat, featureless bottom, and a maximum depth of 20 feet, with more shallow depths at the northern end. Picatinny Lake is used for recreational boating and fishing; however, swimming is banned and fish consumption advisories are in effect. Picatinny Lake is also used as a source of non-potable water for production purposes and fire fighting.

There are two islands within Picatinny Lake; Flare Island[5], which is a man-made peninsula constructed of coal slag and Picnic Island, located in the southern portion of the lake. There is no historical evidence of former munitions testing conducted on Picnic Island.

5 In some reports, Flare Island is also referred to as Whiley's Island

Picatinny Lake has had several uses, including a range and a testing and storage area. A 3-inch Barbette gun firing range was previously located on the southeast shore of the lake; the impact area was located across the lake near Bldgs. 810 and 824. Flare Island, a man-made island, was formerly used to test flares and pyrotechnics. The lake was also used for the underwater storage of smokeless powder and explosives.

In addition, numerous production buildings were previously located along the eastern and western shores of Picatinny Lake. Many of these buildings, which are no longer in use, were investigated during the IRP. During test pit installation conducted as part of the IRP, MEC, including rocket motor housing sleeves, unattached fins, and base detonating fuzes were found. It was also reported that several explosive related accidents at one of these buildings, No. 800, may have dispersed explosives into the lake.

Bathymetric and magnetic surveys of the bottom of Picatinny Lake were conducted in 1995. Results of the bathymetric survey showed that the depth of the lake varies from five feet at its shallowest point on the northern end to a maximum depth of 12 feet near the dam at the southern end of the lake. Several anomalies that may represent DMM were identified along the shoreline and around Flare Island and Picnic Island.

4.8.2 Field Work Activities

4.8.2.1 MEC Activities and Purpose

The Lakes MRS has been recommended for further investigation during the RI/FS phase of the MMRP based on information collected during the HRR. Therefore, no MEC field activities were conducted at this site during the PTA SI.

4.8.2.2 MC Activities and Purpose

The Lakes MRS has been recommended for NFA for MC during the RI/FS phase of the MMRP based on information collected during the HRR. According to the 2006 IAP, institutional controls will be recommended for MC in Lake Denmark while MC in Picatinny Lake and the

near-shore areas will be evaluated in an FS. Therefore, MC are being addressed under the IRP and will not be included in the Active Army MMRP program.

4.8.3 Field Work Results

4.8.3.1 MEC Results

No MEC field activities were conducted at the Lakes MRS during the PTA SI.

4.8.3.2 MC Results

No MC field activities were conducted at the Lakes MRS during the PTA SI.

4.8.4 Conceptual Site Model

4.8.4.1 MMRP Site Profile

4.8.4.1.1 Area and Layout

This site, which covers approximately 758 acres, consists of Lake Denmark and Picatinny Lake, along with their associated on-post land areas that fall within the SDZs of the lakes. Lake Denmark is located in the northeast portion of the installation, near PTA's boundary. Lake Denmark is a man-made lake that covers approximately 263 acres. Land areas associated with Lake Denmark's SDZ include undeveloped wetlands, a softball field, an unnamed pond, magazines along 25th and 12th Avenues, and forested land immediately surrounding the lake.

Picatinny Lake is also a man-made lake that covers approximately 125 acres and is located in the central portion of the installation. Land areas associated with Picatinny Lake's SDZ include buildings located along the shoreline.

4.8.4.1.2 Structures

Structures associated with Lake Denmark include explosives storage magazines along the western shoreline and three Public Service Electric and Gas (PSE&G) utilities towers. Structures associated with Picatinny Lake include munitions production, testing, and storage buildings in the 500 and 800 series that surround the lake.

4.8.4.1.3 Utilities

A PSE&G utilities right-of-way traverses Lake Denmark from west-northwest to east-southeast. It is assumed that utilities exist for the buildings surrounding the lake.

No known utilities exist in Picatinny Lake or on Flare Island; however, a magnetic survey conducted in the lake revealed the presence of underwater linear features that may be pipelines. In addition, it is assumed that utilities exist for the 500 and 800 series building that surround the lake.

4.8.4.1.4 Boundaries

Lake Demark is bordered by scrub/shrub wetlands and Burnt Meadow Brook to the north, Gravel Cove Dam to the southwest, the 1200A and S-1200 buildings to the south, forested land and the installation boundary to the east, and the southern ridgeline of the Copperas Mountains to the west.

Picatinny Lake is bounded by scrub/shrub wetlands and Green Pond Brook to the north, an earthen dam with concrete spillway and numerous PTA R&D and production buildings as well as the steam and power generating plant for PTA (Bldg. 506) to the south, PTA munitions R&D, production, and storage buildings (500 and 900 series) to the east, and PTA munitions R&D and production buildings (700 to 900 series) as well as the steep slopes of the Green Pond Mountain ridgeline to the west.

4.8.4.1.5 Security

Access to PTA is restricted by guards and surveillance at every entrance. No site-specific security practices or controls are associated with Lake Denmark. Some parts of Picatinny Lake are fenced, limiting access to the shoreline.

4.8.4.2 Physical Profile

4.8.4.2.1 Climate

General climate information is presented in Section 4.1.4.2.1.

4.8.4.2.2 Geology

General geologic information about PTA is presented in Section 4.1.4.2.2. Lake Denmark is predominantly underlain by Middle Proterozoic hornblende granite overlain by Pleistocene glacial sediments and post-glacial alluvium. The majority of Picatinny Lake is underlain by Precambrian gneiss and Lower Cambrian Hardyston quartzite, overlain by Leithsville dolomite. Parts of Picatinny Lake are also underlain by the Green Pond Conglomerate.

4.8.4.2.3 Topography

General information about installation topography is presented in Section 4.1.4.2.3. Lake Denmark and the associated scrub/shrub wetlands are situated at the base of the southern ridgeline of Copperas Mountain at an elevation of approximately 850 feet amsl. The eastern slopes of this mountain are steep.

Picatinny Lake is situated at the base of the southeastern ridgeline of Green Pond Mountain. Topography of the area around the lake slopes sharply from ridges to the northwest and southeast into the valley floor where the lake is situated. Picatinny Lake is at an elevation of approximately 720 feet amsl.

4.8.4.2.4 Soil

General information about the soil types present on PTA is presented in Section 4.1.4.2.4. The thickness of surficial deposits on the western shore of Lake Denmark is expected to be less than 10 feet. Sediment at Lake Denmark and the associated scrub/shrub wetlands consists of post-glacial alluvium that contains silts and clay, muck, and peat.

It is unknown what type of soil is present around Picatinny Lake. Flare Island has very little soil on it since it was constructed from coal slag.

4.8.4.2.5 Hydrogeology

General information about the hydrogeologic conditions at PTA is presented in Section 4.1.4.2.5. At this MRS two aquifers are expected to be present; an unconfined glacial aquifer and a bedrock aquifer. It is assumed that groundwater flow in the glacial aquifer is toward the nearest large lake (*i.e.*, either Lake Denmark or Picatinny Lake). Bedrock groundwater flow is complex due to the fractured nature of the rock.

4.8.4.2.6 Hydrology

General information about hydrologic conditions at PTA is presented in Section 4.1.4.2.6. Lake Denmark is fed by Burnt Meadow Brook, which enters from the north. Scrub/shrub wetlands are present on the northern portion of the lake. The outfall from Lake Denmark flows southwest into Picatinny Lake.

Picatinny Lake receives water from Lake Denmark and Green Pond via Green Pond Brook. Picatinny Lake flows out over a spillway into Green Pond Brook.

4.8.4.2.7 Vegetation

General information about vegetation at the installation is presented in Section 4.1.4.2.7. It is assumed that Lake Denmark and the unnamed pond contain submerged and floating aquatic vegetation. Scrub/shrub wetlands are present on the northern end of Lake Denmark and mostly undeveloped, forested areas surround the lake. The dominant canopy forest species are in the red oak subgroup, which contains red oak (*Quercus rubra*), black oak (*Q. velutina*), and scarlet oak (*Q. coccinea*).

Picatinny Lake contains submerged aquatic vegetation. The areas around the lake consist of scrub/shrub wetlands to the north and tall trees along the southern shoreline.

4.8.4.3 Land Use and Exposure Profile

4.8.4.3.1 Current Land Use/Activities

Both Lake Denmark and Picatinny Lake are used for boating and fishing, but fish consumption advisories are in effect. No wading, swimming, or scuba diving is permitted. Picatinny Lake is also used as a source of non-potable water (*i.e.*, process water and fire protection). Surrounding both lakes are many active, inactive, and demolished buildings. Some of these buildings are used as chemical, betatron, and x-ray laboratories or are used for munitions R&D, production, and storage and steam and electric power generation.

4.8.4.3.2 Current Human Receptors

The current human receptors on the Lakes MRS include authorized PTA personnel, PTA residents, contractors/visitors, and recreationists (*e.g.*, hunters). Contractors/visitors include utility workers and visitors of PTA personnel and PTA residents.

4.8.4.3.3 Potential Future Land Use

There are no current plans to change the land use at the site. However, upgrades to the dam and spillways on both lakes are planned to begin in FY07. These upgrades will be conducted where the lakes flow into Green Pond Brook. The upgrades are planned in order to enable the dam to accommodate a 100-year flood and to armor the embankment to allow overtopping without breaching.

4.8.4.3.4 Potential Future Human Receptors

As no change in land use is known at this time, the future human receptors are the same as the current human receptors.

4.8.4.3.5 Zoning/Land Use Restrictions

General information about zoning/land use restrictions at PTA is presented in Section 4.1.4.3.7. Fish consumption advisories are in effect for both lakes, and swimming, wading, and scuba diving are banned.

4.8.4.3.6 Beneficial Resources

General information about the beneficial resources on PTA is presented in Section 4.1.4.3.6. Site-specific beneficial resources include the following:

- Scrub/shrub wetlands north of both lakes
- Undeveloped, forested areas surrounding Lake Denmark
- Game species including fish and waterfowl
- Lake Denmark and Picatinny Lake
- Gravel Dam Cove, which lies southeast of Lake Denmark, is a unique pond habitat that supports breeding populations of a rare damselfly (New England bluet – *Enallagma laterale*)
- It is assumed that both lakes function in groundwater recharge, storm water retention, and nutrient cycling

4.8.4.3.7 Demographics/Zoning

General information about the demographics/zoning at PTA is presented in Section 4.1.4.3.7

4.8.4.4 Ecological Profile

4.8.4.4.1 Habitat Type

General information on habitat types at PTA is provided in Section 4.1.4.4.1. A large part of the site consists of open water, including two aquatic lakes and two ponds. A scrub/shrub wetland, dominated by smooth alder *(Alnus serrulata*) and swamp azalea (*Rhododendron viscosum*) is located on the northern portion of Lake Denmark and north of Picatinny Lake, forested areas, dominated by members of the red oak subgroup are located around Lake Denmark.

4.8.4.4.2 Degree of Disturbance

Currently, the degree of disturbance for the lakes is low; however, upgrades to the dam and spillway are scheduled for FY07. Activities occurring at the site include recreational activities such as waterfowl hunting and fishing. The degree of disturbance for the land areas surrounding the lakes is moderate.

4.8.4.4.3 Ecological Receptors

General information about the ecological receptors at PTA is provided in Section 4.1.4.4.3. Ecological receptors known to be present at this site include fish, such as largemouth bass, chain pickerel (*Esox niger*), northern pike (*Esox lucius*), and yellow perch, birds, including waterfowl, wading birds, piscivorous birds, songbirds, and raptors, reptiles, amphibians, and small and large mammals. Four state-listed endangered aquatic plant species occur in Lake Denmark including featherfoil (*Hottonia inflata*), Robbin's pondweed (*Potamogeton robbinsii*), small bur (*Sparganium minimum*), and lesser bladderwort (*Utricularia minor*). Gravel Dam Cove is a unique pond habitat that supports breeding populations of the New England bluet, a rare damselfly. In addition, Lake Denmark is located adjacent to Area J, which is believed to be a summer roosting area for the Indiana bat, a federally endangered species.

4.8.4.5 Munitions/Release Profile

4.8.4.5.1 Munitions Types and Release Mechanisms

Table 4-12 presents a summary of the types of potential munitions that were identified during research conducted for the HRR. The mechanism by which the munitions, if present, could have been released into the environment is also presented in the table.

Table 4-12 Summary of Potential Munitions Debris and MEC for Lakes MRS

Munitions Debris / MEC Identified During HRR	Primary Release Mechanism
▪ Mortars: 60-mm, 81-mm, 4.2-inch inert ▪ 20-mm cannons ▪ Primary and secondary explosives ▪ Pyrotechnics ▪ Experimental munitions ▪ Large and medium ammunition	▪ Munitions firing and testing ▪ Discarded munitions and debris ▪ Underwater storage of smokeless powder and explosives ▪ Explosive related accidents in surrounding buildings ▪ Permitted discharges of process wastewater ▪ Discharge of explosives-contaminated groundwater from 800 series buildings area

4.8.4.5.2 Maximum Probable Penetration Depth

The largest munition fired at Lake Denmark was a 4.2-inch mortar. According to the USACE's Ordnance and Explosives Response Manual (EM1110-1-4009), June 2000, the maximum

probable penetration depth for a 4.2-inch mortar is 5.4 feet. No information was available regarding the specific caliber of munitions utilized at Picatinny Lake; therefore, a maximum probability penetration depth cannot be determined.

4.8.4.5.3 MEC Density

The density of MEC in Lake Denmark is unknown. A geophysical survey indicated several anomalous readings near the northern portion of the lake. The MEC density on the land portion of Lake Denmark is also unknown.

The MEC density in Picatinny Lake is unknown. However, based on previous land use and based on a geophysical survey conducted for the entire lake it appears that any MEC may be concentrated along the shoreline and around Flare Island and Picnic Island. In addition, in 1965 it was reported that cluster bombs exploded in a building adjacent to the lake, thereby spreading ordnance throughout the entire area, including the lake.

The MEC density on the land portion of Picatinny Lake is also unknown. However, during test pit installation conducted under the IRP, 11 rocket motor housing sleeves, unattached fins and an unknown quantity of base detonating fuzes were found.

4.8.4.5.4 Munitions Debris

Based on the activities that occurred at these lakes, there is the potential for munitions debris items. Two areas in Lake Denmark and one area in Gravel Dam Cove exhibited the potential for metallic deposits during a geophysical survey conducted in 1995. It was reported that munitions debris were projected into Picatinny Lake in 1965 by an explosion in Bldg. 808.

4.8.4.5.5 Transport Mechanisms/Migration Routes

The primary transport mechanisms identified for the Lakes MRS are:

Erosion: Erosion may uncover MEC in undeveloped, forested areas within the safety arcs of the former mortar and cannon ranges on Lake Demark and in the soil near the buildings surrounding Picatinny Lake.

Soil Disturbance: Current land use in areas immediately surrounding Lake Denmark and Picatinny Lake may result in disturbance to the soil surface. This may uncover MEC buried beneath the surface.

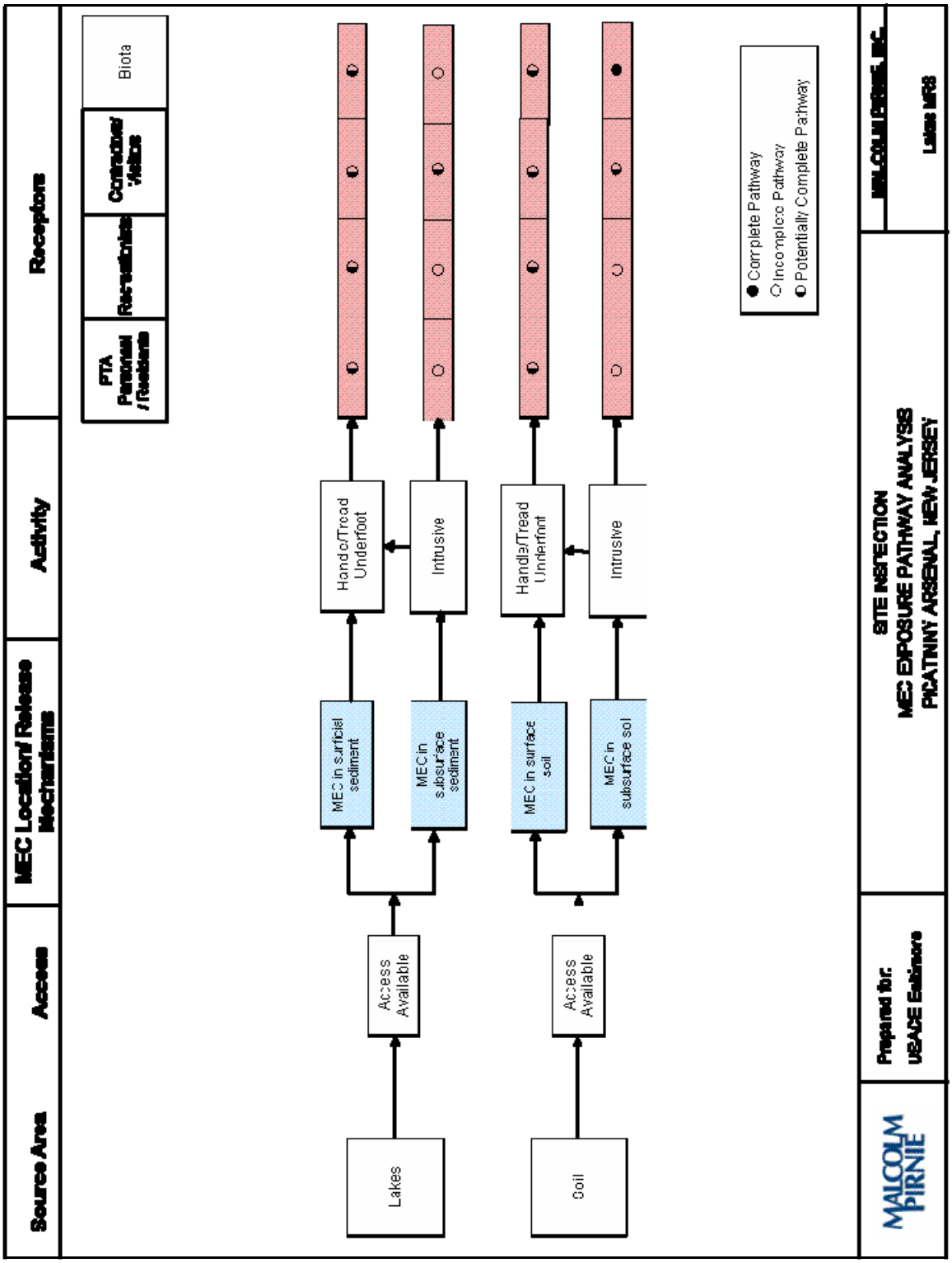
Frost Heave: Periodic, alternating freezing and thawing during the winter may cause MEC to rise from the soil subsurface to the soil surface.

Sedimentation: MEC that historically may have been stored, dumped or fired into the lakes are unlikely to resurface. Mixing of surface water caused by wind and seasonal lake turnovers may re-suspend silt and sediment, which may in turn re-settle and bury MEC.

4.8.4.6 MEC Pathway Analysis

As illustrated in Figure 4-20, potentially complete exposure pathways exist for PTA personnel/residents, recreationists, and contractors/visitors who may be exposed, via handling/treading underfoot, to MEC in surface soil or surficial sediment. While swimming is banned at PTA, it is possible that recreational users, primarily children or teenagers who are also PTA residents, might engage in swimming and may be exposed to MEC in surface sediment. Potentially complete exposure pathways also exist for contractors who may be exposed to MEC in subsurface soil or subsurface sediment, in the event of intrusive work on the site. A potentially complete exposure pathway exists from MEC in surface soil and surface sediment to biota (*i.e.*, terrestrial and aquatic vegetation and wildlife). There is a complete exposure pathway from MEC in subsurface soil to terrestrial wildlife that construct burrows.

Figure 4-20: MEC Exposure Pathway Analysis – Lakes MRS



4.8.5 Site Summary and Conclusions

4.8.5.1 MEC

No MEC activities were conducted at the Lakes MRS during the SI. Sufficient information was obtained during the HRR to recommend this site proceed to an RI/FS under the MMRP.

4.8.5.2 MC

MC at the Lakes MRS are being addressed under the IRP and will not be included in the Active Army MMRP program.

4.8.6 Site Recommendations

Sufficient information for the Lakes MRS was obtained during the HRR to recommend an RI/FS focused on MEC.

4.9 Lake Denmark Off-Post (AEDB-R ID: PICA-012-R-01)

4.9.1 Site Description and Historical Overview

This MRS covers approximately 96-acres and consists of all off-post property that falls within the safety fan of the Lake Denmark ranges. This site contains commercial/light industrial properties and vacant land; the largest property associated with the Lake Denmark Off-Post MRS is Radiation Technologies, Inc. (RTI), a Superfund Site.

According to the EPA's website, the RTI Superfund Site occupies 263 acres immediately adjacent to PTA's boundary near Lake Denmark. Past activities at RTI included testing and development of rocket engines and propellants. One of the contaminants of concern associated with the RTI site is perchlorate, which has been found in groundwater. Investigation and cleanup activities at this site are ongoing. Currently, the former RTI facility is leased by Sterigenics, a global company that provides sterilization and ionization services for the healthcare, food safety, and advanced applications industries. According to the Sterigenics website, the Sterigenics operation in Rockaway Township is a gamma facility.

4.9.2 Field Work Activities

4.9.2.1 MEC Activities and Purpose

A visual survey was conducted over approximately 4.75 acres of off-post property located adjacent to PTA. The purpose of the survey was to obtain sufficient information to support the Army CTC estimates and MRSPPs and to determine if an accelerated response is needed. The survey was conducted at biased locations where, based on the locations of the firing points on Lake Denmark, MEC was more likely to be encountered. In addition, prior to the survey, the field team met with EPA's Project Manager for the RTI Superfund Site and Sterigenics' General Manager. During this meeting, it was requested that the survey area also include a berm that covers a ten inch main water line from a pumphouse on Lake Denmark to Sterigenics' production area. Since EPA and Sterigenics were concerned about this area being actively walked by numerous personnel, this area was also visually surveyed during the SI field work.

4.9.2.2 MC Activities and Purpose

The Lake Denmark –Off-Post MRS has been recommended for further investigation during the RI/FS phase of the MMRP based on information collected during the HRR. Numerous samples have been collected from the on-post portion of this site; these samples have indicated the presence of metals at levels above LOCs. Therefore, no MC field activities were conducted at the Lake Denmark - Off-Post MRS during the PTA SI.

4.9.3 Field Work Results

4.9.3.1 MEC Results

No MEC items or munitions debris were observed during a visual survey of 4.75 acres of the site. However, several structures and surface features were identified on the Lake Denmark – Off-Post site during the survey. Information regarding the observations made during the survey is given in Table 4-13 and on Map 4-5.

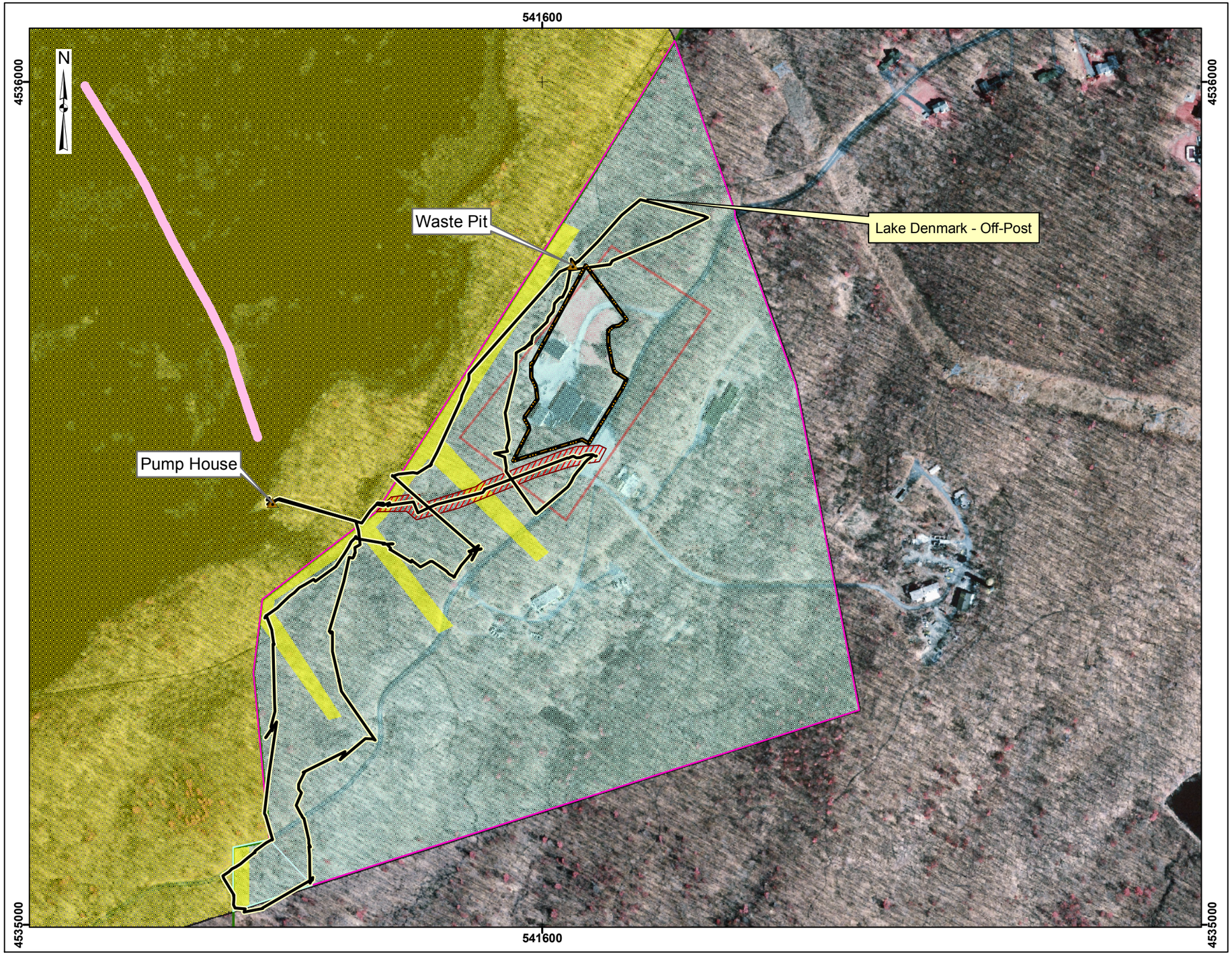
Table 4-13 Site Discoveries at the Lake Denmark – Off-Post MRS

Item ID	Description
MEC Item	
None	None
Munitions Debris	
None	None
Structures	
Pump House	A steel structure containing a pumping mechanism pumps water from Lake Denmark to Sterigenics' operations area. This water is only used for fire fighting purposes.
Fence	A fence encloses approximately four acres of the Sterigenics operations area
Buildings	Several concrete and metal buildings are located in the operations area
Surface Features	
Berm	A 5-foot berm runs west to east from the pump house identified above to Sterigenics' operations area. It appears that the berm protects a 10-inch water main coming from a pump house located on Lake Denmark.
Waste Pit	A waste pit, approximately six feet deep and littered with 55-gallon drums as well as other metal debris, is located just outside the northwest corner of Sterigenics' operations area.

4.9.3.2 MC Results Off-Post

No MC field activities were conducted at the Lake Denmark – Off-Post MRS during the PTA SI.

Site Inspection
Picatinny Arsenal, NJ



Map 4-5
SI Field Activities and Findings
Lake Denmark - Off-Post

Legend

- Installation Boundary
- Site Survey
- Approximate Furthest Extent of Mortar Impact Area
- SI Work Plan Proposed Area for Visual Survey
- Radiation Technology Superfund Site
- Berm
- Fenced Area

Military Range Area

- Lakes MRS
- Lake Denmark - Off-Post

Off-Post Owners*

- Rockaway Township
- Radiation Technology, Inc

*Notes: 1) Off-Post Owners areas are approximate
2) Transects for the visual survey were not conducted in straight lines because of sporadic GIS satellite coverage, site topography and dense vegetation. GIS interference was caused by overhead tree canopy.

0 90 180 360 Meters

Data Source: Aerials: NJDEP, CIR Orthoimagery, 2002
CTT Data: AEC, CTT Range Inventory, 2005

Coordinate System: UTM Zone 18N
Datum: NAD 83
Units: Meters

Contract: W912DR-05-D-0004
Edition: Final SI Report
Date: April 2008

4.9.4 Conceptual Site Model

4.9.4.1 MMRP Site Profile

4.9.4.1.1 Area and Layout

The Lake Denmark – Off-Post MRS covers approximately 96 acres and is primarily occupied by the RTI Superfund Site. The remainder of the area is vacant land.

4.9.4.1.2 Structures

Structures present include buildings associated with Sterigenics' operations, a fence that surrounds the operations area, and a pump house that supplies water to the operations area.

4.9.4.1.3 Utilities

The utilities servicing the buildings located within the Lake Denmark – Off-Post MRS are assumed to include electricity, drinking water, sewer, and telecommunications. The locations of these utilities are unknown. In addition, a 10-inch water main runs from a pump house on Lake Denmark to Sterigenics' operations area; this water is used for fire-fighting purposes only.

4.9.4.1.4 Boundaries

This site is bordered by PTA to the north and west. There are no distinct boundaries to the south and east.

4.9.4.1.5 Security

Sterigenics has a gate controlling access to their property. No other site-specific security practices or controls are associated with other areas of the Lake Denmark – Off-Post MRS.

4.9.4.2 Physical Profile

4.9.4.2.1 Climate

General climate information is presented in Section 4.1.4.2.1.

4.9.4.2.2 Geology

Due to the proximity to PTA, it is assumed that general information about PTA geology is applicable to this site. General geologic information about PTA is presented in Section 4.1.4.2.2.

4.9.4.2.3 Topography

General information about installation topography is presented in Section 4.1.4.2.3. Lake Denmark is situated at the base of the southern ridgeline of Copperas Mountain at an elevation of approximately 850 feet amsl. This site slopes gently westward toward Lake Denmark.

4.9.4.2.4 Soil

Soil present at this site includes the Byram Intrusive Suite, which is a medium to medium coarse grained hornblende granite.

4.9.4.2.5 Hydrogeology

Due to the proximity to PTA, it is assumed that general information about PTA hydrogeology is applicable to this site. General information about the hydrogeologic conditions at PTA is presented in Section 4.1.4.2.5. At this MRS two aquifers are expected to be present; an unconfined glacial aquifer and a bedrock aquifer. It is assumed that groundwater flow in the glacial aquifer is toward Lake Denmark. Bedrock groundwater flow is complex due to the fractured nature of the rock.

4.9.4.2.6 Hydrology

No waterbodies have been identified within this site; however, it is located adjacent to Lake Denmark. In addition, according to NJDEP's i-Map website, wetlands are present throughout this MRS.

4.9.4.2.7 Vegetation

General information about vegetation at the installation is presented in Section 4.1.4.2.7. Based on the site walk conducted for the SI, the vegetation at this site includes scrub/shrub wetlands on the northern end of Lake Denmark and mostly undeveloped, forested areas around the lake. The dominant canopy forest species are in the red oak subgroup, which contains red oak (*Quercus rubra*), black oak (*Q. velutina*), and scarlet oak (*Q. coccinea*).

4.9.4.3 Land Use and Exposure Profile

4.9.4.3.1 Current Land Use/Activities

This site is either forested or contains buildings associated with Sterigenics' operations. As mentioned previously, Sterigenics is located on the RTI Superfund Site, which has ongoing intrusive and non-intrusive investigations.

4.9.4.3.2 Current Human Receptors

The current human receptors on the Lake Denmark – Off-Post MRS include Sterigenics workers, other workers (including utility workers), contractors, visitors (*e.g.*, government personnel), recreationists (*e.g.*, hunters, hikers), and trespassers.

4.9.4.3.3 Potential Future Land Use

According to the existing property owner and/or tenant, there are no current plans to change the land use at the site. Therefore, the future land use remains the same as the current land use. The property owner and/or tenant have been notified about the potential presence of MEC on their property and have agreed to inform PTA personnel of any changes in land use or ownership.

4.9.4.3.4 Potential Future Human Receptors

As no change in land use is known at this time, the future human receptors are the same as the current human receptors.

4.9.4.3.5 Zoning/Land Use Restrictions

This MRS is located in a Highlands Preservation Area.

4.9.4.3.6 Beneficial Resources

General information about the beneficial resources is presented in Section 4.1.4.3.6. Site-specific beneficial resources include the following:

- Wetlands surrounding the RTI Superfund Site
- Undeveloped, forested areas
- Game species including fish and waterfowl
- The Highlands Preservation Area
- The federally-endangered Indiana bat nests in caves and mine shafts in this area of New Jersey; it is reported that nesting areas are located either on or near this MRS

4.9.4.3.7 Demographics/Zoning

General information about the demographics/zoning in Rockaway Township, near PTA, is presented in Section 4.1.4.3.7

4.9.4.4 Ecological Profile

4.9.4.4.1 Habitat Type

There are patches of forested areas, dominated by members of the red oak subgroup, and wetlands throughout this site. In addition, this site is located in a Highlands Preservation Area.

4.9.4.4.2 Degree of Disturbance

The degree of disturbance is moderate since a portion of this site is developed and since intrusive investigation activities are ongoing at the RTI Superfund Site.

4.9.4.4.3 Ecological Receptors

General information about the ecological receptors at PTA is provided in Section 4.1.4.4.3 and specific information regarding Lake Denmark is presented in Section 4.1.64.4.3. Due to the proximity of this site to the Lake Denmark MRS, it is assumed that the flora and fauna that inhabit the wetlands and forests of the Lake Denmark MRS also inhabit the wetlands and forests

of the Lake Denmark – Off-Post MRS. In addition, it is believed that Indiana bat nesting sites are either located on or near this MRS.

4.9.4.5 Munitions/Release Profile

4.9.4.5.1 Munitions Types and Release Mechanisms

Table 4-14 presents a summary of the types of potential munitions that were identified either during SI field activities or during research conducted for the HRR. The mechanism by which the munitions, if present, could have been released into the environment is also presented in the table.

Table 4-14 Summary of Potential and Actual Munitions Debris and MEC for Lake Denmark – Off-Post

Munitions Debris/MEC Observed During SI Field Activities	Munitions Debris / MEC Identified During HRR	Primary Release Mechanism
None	▪ Mortars: 60-mm, 81-mm, 4.2-inch inert ▪ 20-mm cannons ▪ Primary and secondary explosives ▪ Pyrotechnics ▪ Experimental munitions	▪ Munitions firing and testing ▪ Discarded UXO following the 1926 Lake Denmark Powder Depot explosion

4.9.4.5.2 Maximum Probable Penetration Depth

According to the USACE's Ordnance and Explosives Response Manual (EM1110-1-4009), June 2000, the maximum probable penetration depth for a 4.2-inch mortar is 5.4 feet.

4.9.4.5.3 MEC Density

No MEC was observed on the surface during the SI visual survey; therefore, the MEC density at this site is unknown.

4.9.4.5.4 Munitions Debris

No munitions debris was observed during the SI visual survey at the Lake Denmark - Off-Post MRS.

4.9.4.5.5 Associated MC

Surface water, sediment, and soil samples have been collected from Lake Denmark; analysis of these samples has indicated the presence of metals and explosives. Due to the proximity of this site to Lake Denmark, MC data will be extrapolated from the on-post property results. It should be noted that no perchlorate samples have been collected from Lake Denmark.

- Surface soil samples were collected in 1996 and analyzed for explosives and metals; the sample results did not indicate the presence of significant contamination. These samples were collected from the gunmount area of the former 20-mm cannon range (current location of softball fields), the impact area for the former 20-mm cannon range, and the western shore of Lake Denmark.
- Between 1998 to 1999 sediment and surface water samples were collected from numerous locations throughout the lake; the majority of the samples were collected from areas that exhibited anomalies during the geophysical investigation. Analysis of these samples indicated the following:
    - Copper, lead, and zinc were detected in the sediment samples (maximum concentrations – 175, 210, and 661 mg/kg, respectively) at concentrations that exceeded the site-specific background concentrations (9.3, 11.6, and 55.7 mg/kg, respectively) but not the comparison criteria.
    - Iron was detected in the sediment samples at a concentration (maximum concentration – 25,600 mg/kg) that exceeded the site-specific background concentration (14,500 mg/kg) but not the EPA Region 3 non-industrial RBC (55,000 mg/kg). Iron does not have a NJDEP Residential SCC.
    - Copper, iron, lead, and zinc were all detected in the surface water samples at concentrations (maximum concentrations – 7.2, 1200, 3.06, and 35 µg/L, respectively) that exceeded the site-specific background concentrations (non-detect, 389, 1.38, and 14.5 µg/L, respectively). However, only iron was detected at a concentration that exceeded the comparison criteria (EPA's Water Quality Criteria – 300 µg/L).

It should be noted that the majority of this MRS consists of the RTI Superfund Site. Various investigations conducted at this site have indicated the presence of volatile organics and perchlorate in the groundwater. Prior to 1972 RTI was involved in the testing and development of rocket engines and propellants. Therefore, it is expected that MC including metals and explosives would also be associated with RTI's operations.

4.9.4.5.6 Transport Mechanisms/Migration Routes

The primary transport mechanisms identified for Lake Denmark – Off-Post are:

Erosion: Erosion may uncover MEC in undeveloped, forested areas within the safety arcs of the former mortar and cannon ranges. MC adsorbed to soil particles may migrate from surface soil to surface water.

Soil Disturbance: The current degree of soil disturbance on Lake Denmark – Off-Post may be moderate due to ongoing groundwater investigations under CERCLA. Although future re-development of Lake Denmark – Off-Post could uncover MEC or MC that are potentially in the surface or subsurface soil, this site is located in a Highlands Preservation Area, which would limit future development..

Frost Heave: Periodic, alternating freezing and thawing during the winter may cause MEC to rise from the soil subsurface to the soil surface.

Infiltration and Groundwater Discharge: MC may migrate with percolating precipitation from surface soil to shallow groundwater. MC may be discharged with shallow groundwater to surface waters of Lake Denmark or it may percolate into the bedrock aquifer.

4.9.4.6 Pathway Analysis

4.9.4.6.1 MEC

Figure 4-21 illustrates the MEC pathway analysis prepared for the Lake Denmark – Off-Post MRS. The MEC Pathway Analysis shows potentially complete exposure pathways are identified for off-PTA workers, contractors/visitors, and recreationists/trespassers who may contact MEC in surface soil. It is assumed that recreationists and trespassers may access the undeveloped, forested portions of the Lake Denmark – Off-Post MRS for hiking or hunting. In the event of intrusive work on the site, off-PTA workers and contractors (*e.g.*, drillers installing borings for the RTI Superfund Site) may be exposed to MEC in subsurface soil. A potentially complete exposure pathway exists from MEC in surface soil to biota (*i.e.*, terrestrial vegetation and wildlife) and from MEC in subsurface soil to terrestrial wildlife that construct burrows.

4.9.4.6.2 MC

As illustrated in Figure 4-22, the MC Exposure Pathway Analysis, soil impacted by MC is the primary source media for all human and ecological receptors. Since no investigations for MC associated with PTA's operations have been conducted on the Lake Denmark – Off-Post MRS, none of the pathways are complete. Potentially complete exposure pathways exist for off-PTA workers, contractors/visitors, and recreationists/trespassers who may be exposed to MC in surface soil. Sterigenics workers, other workers, and contractors may also contact subsurface soil when accessing underground utilities or performing intrusive investigations associated with the RTI Superfund Site. Exposure routes include direct contact, ingestion, and inhalation of dust. Biota may also contact MC in surface soil through feeding/preening activities and MC in subsurface soil through burrowing activities.

The source of potable water off-PTA is not known; therefore, potentially complete pathways for off-PTA workers' exposure to MC in groundwater cannot be discounted.

Potentially complete exposure pathways through the food chain exist for assimilative/bioaccumulative MC to both human and ecological receptors. Recreationists or trespassers who engage in hunting in the area and consume their catch may ingest MC that have

bioaccumulated in game animals. Terrestrial wildlife may ingest MC assimilated in vegetation and bioaccumulated in prey species. These pathways are potentially complete due to the nature and variability of the process of assimilation into plants and bioaccumulation into wildlife. These processes are highly dependent on the particular MC and environmental conditions, as well as on the conditions of the individual plant or wildlife species.

Figure 4-21: MEC Exposure Pathway Analysis – Lake Denmark Off-Post

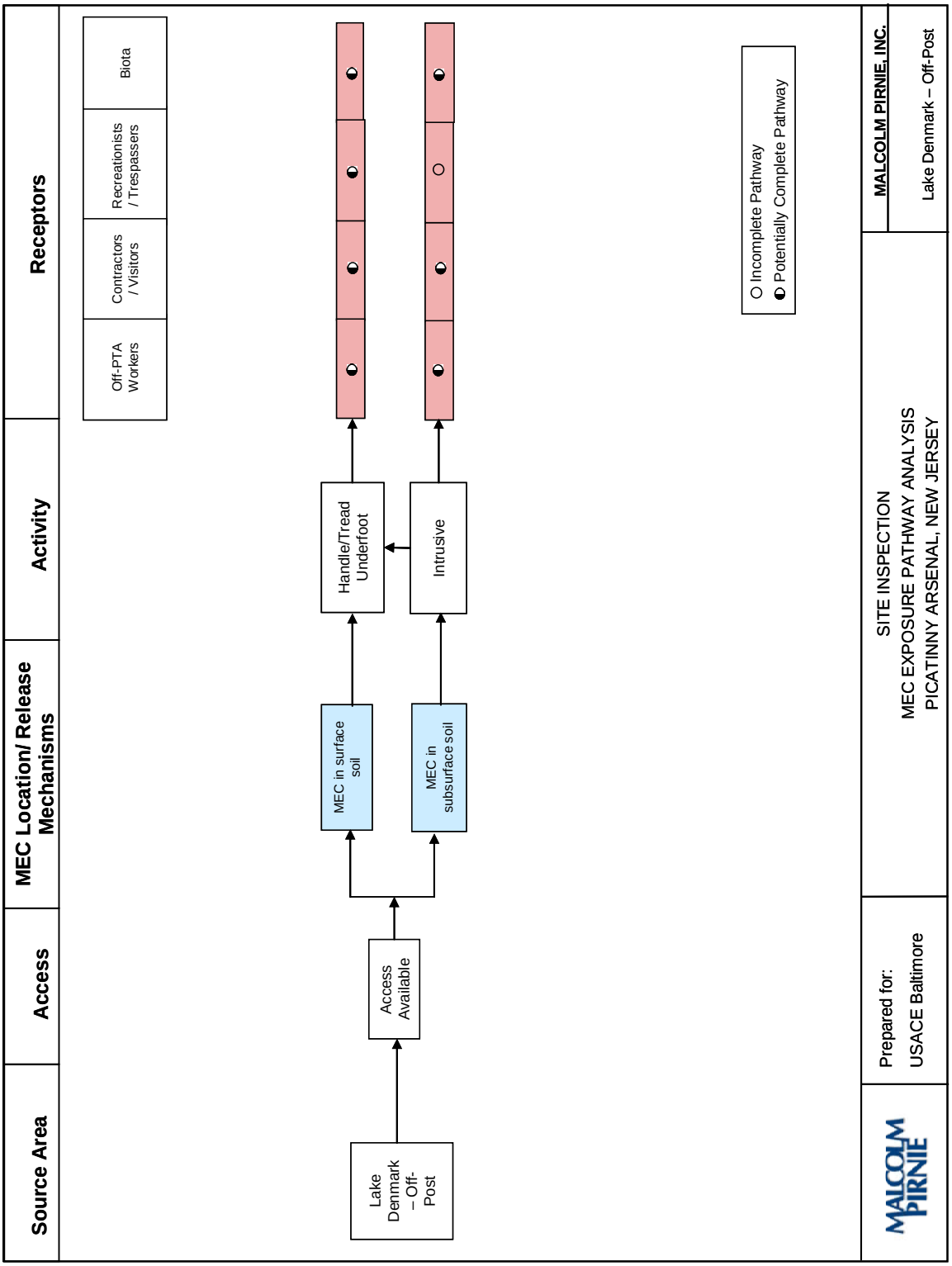
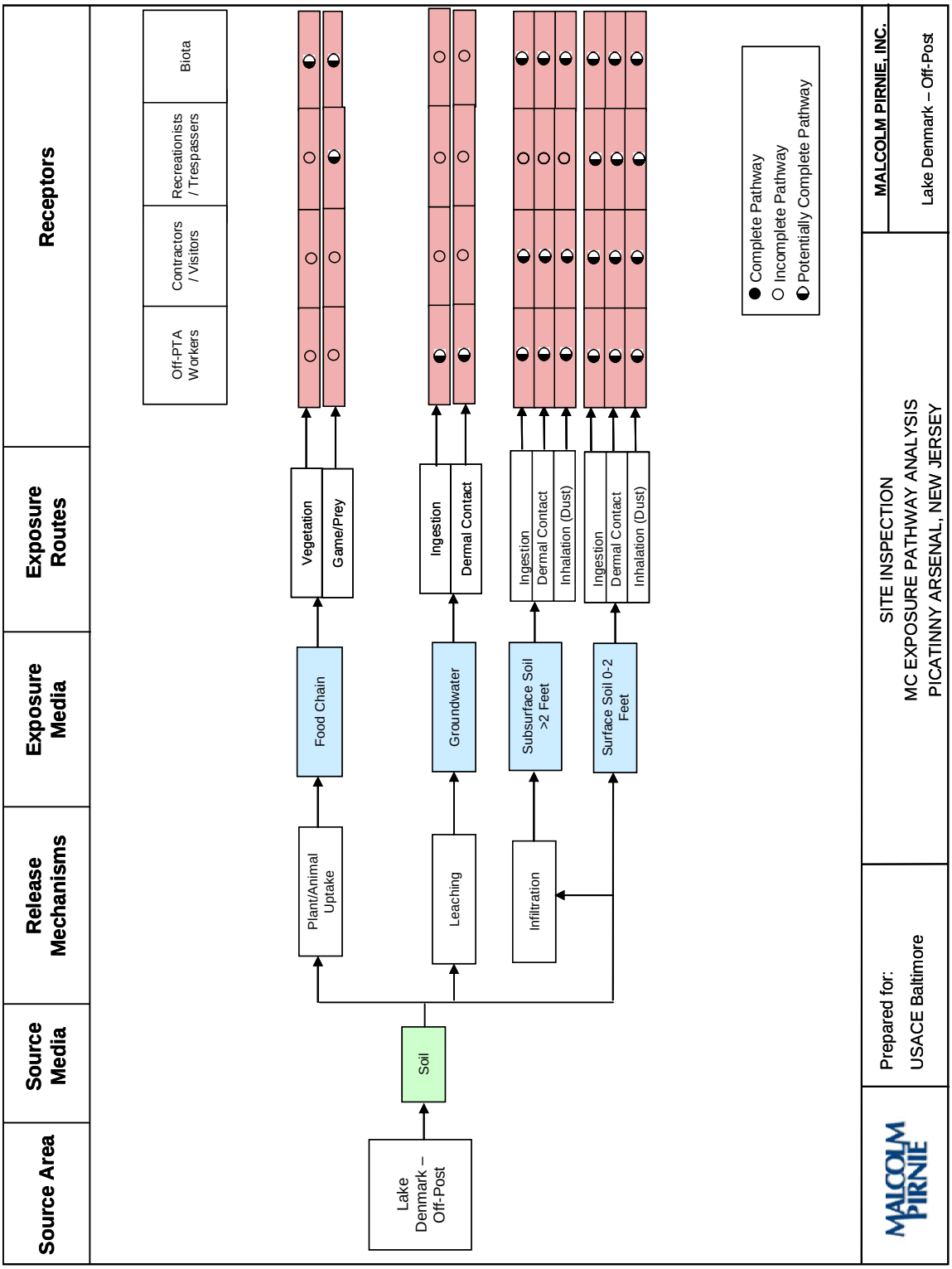


Figure 4-22: MC Exposure Pathway Analysis – Lake Denmark - Off-Post



4.9.5 Site Summary and Conclusions

4.9.5.1 MEC

A visual survey was conducted over 4.75 acres of the 96 acre site. No MEC items or munitions debris were observed during the visual survey. Based on the activities that occurred at the Lake Denmark MRS, there is the potential for munitions debris items at the Lake Denmark – Off-Post MRS.

4.9.5.2 MC

No MC activities were conducted at the Lake Denmark - Off-Post MRS during the SI. Sufficient information was obtained during the HRR to recommend this site proceed to RI/FS under the MMRP.

4.9.6 Site Recommendations

Based on existing data, the Lake Denmark – Off-Post is recommended for an RI/FS focused on MEC and MC. Since no MEC or munitions debris were observed on the surface during the SI field work, an accelerated response action is not recommended for this site.

4.10 Shell Burial Grounds

4.10.1 Site Description and Historical Overview

During the explosion in 1926, three craters, two which are adjacent to one another, were formed. These three craters formed two burial grounds (one on the southeastern portion of the installation near Bldg. 3150 and another on the southern portion of the installation near Bldg. 3100) that were used for the disposal of approximately 25 tons of explosives from the explosion. Although the two burial grounds are not adjacent to each other, they were consolidated into one MRS since their CSMs are the same.

The burial ground near Bldg. 3150 covers approximately 1.5 acres and is located near the southeastern installation boundary while the other burial ground near Bldg. 3100 covers approximately 4 acres and is located in the southern half of the installation. Materials that were

disposed of at these burial grounds include projectiles, mines, depth charges, fuzes, explosives, small arms ammunition, propellants, and, possibly, rocket fuels. It was also reported that the site potentially contains acids, pickling liquors, cyanide, and phenol. The Navy continued to use these areas for explosives disposal until 1945; no records of the types of material or amounts disposed of were kept. After the Navy discontinued its use of these areas, they were covered with 20 feet of fill. Currently, institutional controls exist for both burial grounds as they are fenced in and posted with warning signs.

4.10.2 Field Work Activities

4.10.2.1 MEC Activities and Purpose

The Shell Burial Grounds MRS has been recommended for further investigation during the RI/FS phase of the MMRP based on information collected during the HRR. Therefore, no MEC field activities were conducted during the PTA SI.

4.10.2.2 MC Activities and Purpose

According to the 2006 IAP, MC at these sites will be evaluated in an FS. Therefore, MC are being addressed under the IRP and will not be included in the Active Army MMRP program.

4.10.3 Field Work Results

4.10.3.1 MEC Results

No MEC field activities were conducted at the Shell Burial Grounds during the PTA SI.

4.10.3.2 MC Results

No MC field activities were conducted at the Shell Burial Grounds during the PTA SI.

4.10.4 Conceptual Site Model

4.10.4.1 MMRP Site Profile

4.10.4.1.1 Area and Layout

The burial ground near Bldg. 3150 covers approximately 1.5 acres and is located near the southeastern installation boundary while the burial ground near Bldg. 3100 covers approximately 4 acres and is located in the southern half of the installation. Currently, institutional controls exist for this MRS as both burial grounds are fenced in and posted with warning signs.

4.10.4.1.2 Structures

There are no known structures at this MRS.

4.10.4.1.3 Utilities

The RI report indicates that two water lines pass through the burial ground near Bldg. 3150 and a sanitary sewer line cuts through the burial ground near Bldg. 3100. No other information regarding these lines is available. No information is available to identify whether any other utilities pass through the burial grounds.

4.10.4.1.4 Boundaries

The entire MRS is fenced. The burial ground near Bldg. 3150 is bounded by Gately Road to the south and east and Shrader Road to the west. There is no distinct boundary to the north. The burial ground near Bldg. 3100 is bounded by vacant land to the north, 99th Road to the south, Bell Road and Main Road to the west, and Bldg. 3100 to the east.

4.10.4.1.5 Security

Access to PTA is restricted by guards and surveillance at every entrance. A fence, posted with warning signs, controls access to both burial grounds

4.10.4.2 Physical Profile

4.10.4.2.1 Climate

General climate information is presented in Section 4.1.4.2.1.

4.10.4.2.2 Geology

General geologic information for PTA is presented in Section 4.1.4.2.2. A well installed near the burial ground near Bldg. 3150 indicated the presence of bedrock (granitic gneiss) at 12 feet bgs; the bedrock was overlain by till (gravel mixed with silt, clay, and sand). The other burial ground has the same geology; however, the depth to bedrock is unknown.

4.10.4.2.3 Topography

General information about the topography of PTA is presented in Section 4.1.4.2.3. The burial ground near Bldg. 3150 is characterized by relatively flat land that slopes gently from east (at approximately 980 feet amsl) to west (at approximately 970 feet amsl). The burial ground near Bldg. 3100 is moderately sloped from the east (at approximately 830 feet amsl) toward the west-southwest (approximately 815 feet amsl).

4.10.4.2.4 Soil

General information about the soil types present on PTA is presented in Section 4.1.4.2.4. This site is covered with approximately 20 feet of fill. Native soils at the burial ground near Bldg. 3150 are acidic, somewhat poorly drained, loamy upland soils. Native soils at the burial ground near Bldg. 3100 are deep, moderately permeable, well-drained soil and gravelly loam to gravelly sandy loam subsoils over a fragipan.

4.10.4.2.5 Hydrogeology

General information about the hydrogeologic conditions at PTA is presented in Section 4.1.4.2.5. Bldg. 3150 - Groundwater measurements from monitoring wells associated with the burial ground near Bldg. 3150 showed groundwater between 5 and 15.5 feet bgs. The water table occurs in the bedrock aquifer over most of the site and in discontinuous smaller areas in the unconsolidated aquifer. Groundwater flow is northwest toward EOD Pond.

Bldg. 3100 - Groundwater measurements from monitoring wells associated with the burial ground near Bldg. 3100 showed groundwater between 10 and 60 feet bgs. Generally the water

table is associated with the bedrock aquifer; however, there are some localized areas with water in the unconsolidated aquifer. Water table groundwater flow is west toward Green Pond Brook.

4.10.4.2.6 Hydrology

General information about hydrologic conditions at PTA is presented in Section 4.1.4.2.6. No water bodies are on this MRS. Surface runoff at the burial ground near Bldg. 3150 is expected to flow west-northwest following topography. The EOD Pond is located approximately 500 feet (152 meters) northwest of the site.

Surface runoff at the burial ground near Bldg. 3100 is expected to flow west, following the topography. Green Pond Brook is approximately one-half mile (805 meters) west, and Picatinny Lake is located approximately 1,500 feet (457 meters) to the northwest.

4.10.4.2.7 Vegetation

General information about vegetation at the installation is presented in Section 4.1.4.2.7. Deciduous trees are the dominant vegetation on this MRS.

4.10.4.3 Land Use and Exposure Profile

4.10.4.3.1 Current Land Use/Activities

Currently there is no land use associated with this site as both burial grounds are fenced and posted with warning signs and access is restricted by the Safety Office.

4.10.4.3.2 Current Human Receptors

The current human receptors are PTA personnel, PTA residents, and contractors/visitors. However, the potential for these receptor populations to be present on the MRS is low, since the Safety Office restricts access to the site.

4.10.4.3.3 Potential Future Land Use

No change in land use is known for this MRS.

4.10.4.3.4 Potential Future Human Receptors

The potential future human receptors are the same as the current human receptors.

4.10.4.3.5 Zoning/Land Use Restrictions

This MRS is fenced and posted within warning signs and access is restricted by the Safety Office.

4.10.4.3.6 Beneficial Resources

There are no known site specific beneficial resources. General information about the beneficial resources on PTA is presented in Section 4.1.4.3.6.

4.10.4.3.7 Demographics/Zoning

General information about the demographics/zoning on PTA is presented in Section 4.1.4.3.7.

4.10.4.4 Ecological Profile

4.10.4.4.1 Habitat Type

General information on habitat types at PTA is provided in Section 4.1.4.4.1. The majority of the MRS is a deciduous forest.

4.10.4.4.2 Degree of Disturbance

The degree of disturbance for the Shell Burial Grounds is low. The MRS is fenced and can only be accessed with permission of the PTA Safety Office.

4.10.4.4.3 Ecological Receptors

General information about the ecological receptors on PTA is presented in Section 4.1.4.4.3. There are no known site-specific ecological receptors.

4.10.4.5 Munitions/Release Profile

4.10.4.5.1 Munitions Types and Release Mechanisms

Table 4-15 presents a summary of the types of potential munitions that were identified during research conducted for the HRR. The mechanisms by which the munitions, if present, could have been released into the environment are also presented in the table.

Table 4-15 Summary of Potential MEC Types – Shell Burning Grounds

Potential Munitions	Potential Primary Release Mechanism
▪ Mines ▪ Depth charges ▪ Fuzes ▪ Projectiles ▪ Explosives ▪ Small arms ammunition ▪ Propellants	Discarded munitions

4.10.4.5.2 Maximum Probable Penetration Depth

Munitions were not fired or tested in this area, so the standard penetration depth calculation is not applicable. It is reported that the area is covered with 20 feet of clean fill. The maximum depth of the craters is reported to be between 25 to 35 feet.

4.10.4.5.3 MEC Density

The MEC density of the Shell Burial Grounds is unknown. However, since this area was used for the disposal of many tons of material, it is expected that the density of MEC at the site is significant.

4.10.4.5.4 Munitions Debris

Since this area was used for the disposal of material from the 1926 explosion, it is likely that munitions debris items are present.

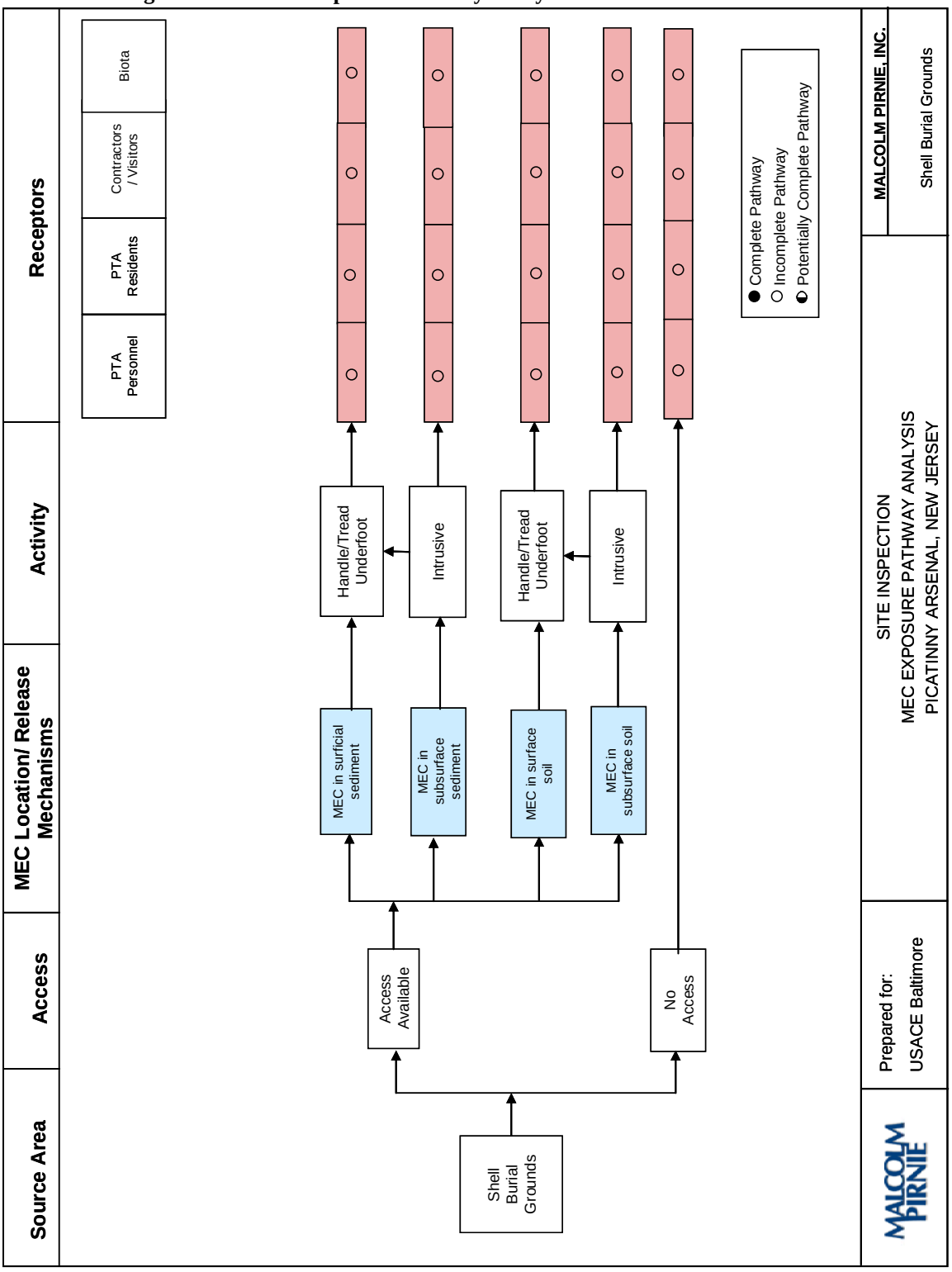
4.10.4.5.5 Transport Mechanisms/Migration Routes

No primary transport mechanisms were identified for MEC at this site.

4.10.4.6 MEC Pathway Analysis

Figure 4-23 illustrates the MEC exposure pathway analysis prepared for the Shell Burial Grounds MRS. The information available indicates that MEC are still present within the Shell Burial Grounds. However, no complete pathways for MEC were identified for either human or ecological receptors since the site is covered with 20 feet of fill (which is below the biologically active zone), the area is fenced and posted with warning signs, and the Safety Office does not allow any access to this site. It is not likely that MEC would move to the surface through frost heave since the disposed MEC are below the frost line. It is equally unlikely that MEC would be repositioned through soil disturbance since PTA's Safety Office restricts access to this area.

Figure 4-23: MEC Exposure Pathway Analysis – Shell Burial Grounds



4.10.5 Site Summary and Conclusions

4.10.5.1 MEC

No MEC activities were conducted at this MRS during the PTA SI. Sufficient information was obtained during the HRR to recommend the Shell Burial Grounds proceed to RI/FS under the MMRP.

4.10.5.2 MC

MC at the Shell Burial Grounds are being addressed under the IRP and will not be included in the Active Army MMRP program.

4.10.6 Site Recommendations

Sufficient information for the Shell Burial Grounds was obtained during the HRR to recommend an RI/FS focused on MEC.

Data Validation Results

The MC data were validated by a senior chemist at Malcolm Pirnie. Data review was performed in accordance with the procedures specified in the Quality Assurance Project Plan (QAPP, Malcolm Pirnie Inc., July 2004), EPA Functional Guidelines for Inorganic and Organic Data Review, and quality control (QC) parameters set forth by the project laboratory, Analytical Laboratory Services, Inc. (ALSI).

Sample results were subject to a Level III data review and included an evaluation of the following QC parameters:

- Sample condition upon receipt at laboratory
- Holding times
- Method blank contamination
- Surrogate recovery (for explosives analyses)
- Laboratory control sample (LCS) recovery
- MS/MSD recovery and RPD

- Field duplicates

The data quality for the sampling at PTA was also measured and evaluated in terms of the following specific indicators:

- Precision
- Accuracy
- Representativeness
- Comparability
- Completeness

The data validation concluded that iron and zinc in two samples required data qualification based on field duplicate RPDs that were outside of acceptance limits. Overall, the sample analyses were completed with quality assurance and control protocols met. The data set is considered usable and meets project data quality objectives.

5 RECOMMENDATIONS REVIEW

Summary of Site Investigation Recommendations

The recommendations for the MRSs at PTA are presented in this section. They are based on decisions made and agreed upon during the TPP session held on 11 October 2006, the data collected during the SI field activities, and the conclusions presented in Section 4 of this report. Refer to Appendix H for a copy of the TPP meeting minutes. The recommendations for the PTA MRSs are summarized in Table 5-1 and the final site acreages are presented in Section 5.2.

Table 5-1 Summary of SI Recommendations

MRS Acreage	SI Recommendation	Overall Priority Rating	Basis for Recommendation	
			MEC	MC
1926 Explosion Radius (PICA-003-R-01)				
1,562 acres	RI/FS – focus on MEC and MC. Note that those portions of the site where MC are being addressed under the IRP will not require additional MC work under the Active Army MMRP Program.	3	▪ Based on information obtained from PTA's safety office, numerous MEC items have been found within the boundary of this site including HE and AP projectiles and shells, small, medium, and large caliber ammunition, BLUs, and munitions debris ▪ During the visual survey conducted during the SI field work, munitions debris associated with trip flares was observed near the former projectile range	▪ Copper, iron, lead, and zinc were detected in surficial soil samples at levels greater than site-specific background levels and at levels that exceed the comparison criteria ▪ No explosives were detected in the surficial soil samples above laboratory reporting limits ▪ Many IRP sites are located either wholly or partially within the radius of this site. Extensive sampling, performed under the IRP, has indicated the presence of metals and explosives in soil, surface water and sediment at levels above LOCs at several locations throughout this site. Perchlorate was detected in groundwater samples at concentrations above the LOC.
1926 Explosion Site – Off-Post (PICA-004-R-01)				
833 acres	An accelerated response action for all areas of Mt. Hope Quarry that	3	▪ During a series of explosions at storage magazines on PTA, approximately 2.5	Although no known MC sampling has occurred at this site, metals and explosives have been detected in soil, surface water, and

MRS Acreage	SI Recommendation	Overall Priority Rating	Basis for Recommendation	
			MEC	MC
	will be mined in the future and were not included in the original TCRA RI/FS – focus on MEC and MC		million pounds of explosives detonated and were thrown out from the explosion center ▪ There have been numerous MEC finds at this MRS at Mt. Hope Quarry including nine finds between 2002 and 2007 ▪ During a TCRA performed at Mt. Hope Quarry between December 2006 and March 2007, 21 HE ordnance items and four inert ordnance items were found ▪ After the TCRA was completed, two munitions debris items were found at Mt. Hope Quarry outside the area where the TCRA was performed ▪ It should be noted that no MEC or munitions debris were observed on the surface during the visual survey, which was conducted on areas outside the quarry	sediment samples collected from the 1926 Explosion Radius MRS.
Former Munitions and Propellant Test Area (PICA-001-R-01)				
25 acres	RI/FS – focus on MEC	5	▪ This site was used as a recoilless rifle range for large diameter projectiles ▪ Although no MEC or munitions debris were observed at this site during the SI field work, evidence of historical range activity was observed; structures observed included a battleship	MC at this site are being addressed under the IRP and therefore, will not be included in the Active Army MMRP program

MRS Acreage	SI Recommendation	Overall Priority Rating	Basis for Recommendation	
			MEC	MC
			gun turret and slug butt	
Former Operational Areas (PICA-006-R-01)				
1,977 acres	RI/FS – focus on MEC and MC. Note that those portions of the site where MC are being addressed under the IRP will not require additional MC work under the Active Army MMRP Program.	3	▪ Based on information obtained from PTA's safety office, numerous MEC items have been found within the boundary of this site including HE projectiles and shells, small, medium, and large caliber ammunition, BLUs, and munitions debris ▪ A dredge pile and sanitary landfill located within the boundary of this MRS are both reported MEC disposal areas and MEC were found during utility trenching in the landfill ▪ Munitions debris and 40-mm grenades have been observed on a waste burial area near the southern portion of this MRS	Many IRP sites are located either wholly or partially within the radius of this site. Extensive sampling, performed under the IRP, has indicated the presence of metals and explosives in soil, surface water and sediment at levels above LOCs at several locations throughout this site. No perchlorate samples were collected within this site.
Green Pond MRS (PICA-005-R-01)				
1.1 acres	RI/FS – focus on MEC	4	▪ MEC have been observed protruding from, and buried alongside, the banks of the brook; the source of the MEC is unknown ▪ Based on information obtained from PTA's safety office, a 66-mm shell was found in Green Pond Brook where the 9th Street Bridge crosses the brook	MC at this site are being addressed under the IRP and therefore, will not be included in the Active Army MMRP program

MRS Acreage	SI Recommendation	Overall Priority Rating	Basis for Recommendation	
			MEC	MC
Inactive Munitions Waste Pit (PICA-013-R-01)				
94 acres	RI/FS – focus on MEC and MC	4	▪ It was reported that this site was used for the testing and storage of munitions and explosives ▪ Although no MEC or munitions debris were observed at this site during the SI field work, evidence of historical range activity was observed; structures observed included a burn cage and gun turret	Four surface soil samples and two sediment samples were collected from this site. Both explosives and metals were detected in the samples; some of the parameters exceeded the comparison criteria.
Inactive Munitions Waste Pit – Off-Post (PICA-014-R-01)				
7.5 acres	RI/FS – focus on MEC and MC	4	▪ This site falls within the safety fan for a historic on-post range used for the testing and storage of munitions and explosives ▪ No MEC or munitions debris were observed on the surface of this site during the SI visual survey	Although no known MC sampling has occurred at this site, metals and explosives have been detected in soil and sediment samples collected from the Inactive Munitions Waste Pit MRS.
Lakes MRS (PICA-008-R-01)				
758 acres	RI/FS focus on MEC	4	▪ This site had several ranges on it including 60-mm, 81-mm, and 4.2-inch inert projectile ranges, a 20-mm cannon range, and a 3-inch Barbette gun firing range ▪ Geophysical surveys conducted at this site have indicated anomalous readings in the lakes ▪ It is believed that UXO and munitions debris were discarded	MC at this site are being addressed under the IRP and therefore, will not be included in the Active Army MMRP program

MRS Acreage	SI Recommendation	Overall Priority Rating	Basis for Recommendation	
			MEC	MC
			into Picatinny Lake following the 1926 explosion ▪ Several MEC items have been found on land within the safety fans of the ranges including a 60-mm fuzed mortar, rocket motor housing sleeves, unattached fins, and base detonating fuzes ▪ An island within this site was used to test flares and pyrotechnics ▪ Picatinny Lake was used for the underwater storage of smokeless powder and explosives ▪ It was reported that an explosive related accident at one of the buildings within this site may have dispersed explosives into Picatinny Lake	
Lake Denmark – Off-Post (PICA-012-R-01)				
96 acres	RI/FS – focus on MEC and MC	5	▪ This site is located within the safety fan of some of the ranges associated with Lake Denmark, which is included in the Lakes MRS	Although no known MC sampling has occurred at this site, metals have been detected in sediment samples collected from the Lake MRS.
Shell Burial Grounds (PICA-010-R-01)				
5.7 acres	RI/FS – focus on MEC	5	▪ This site was used for the disposal of approximately 25 tons of explosives from the 1926 explosion. Material disposed of includes projectiles, mines, depth charges, fuzes, explosives, small arms ammunition,	MC at this site are being addressed under the IRP and therefore, will not be included in the Active Army MMRP program

MRS Acreage	SI Recommendation	Overall Priority Rating	Basis for Recommendation	
			MEC	MC
			propellants, and possibly rocket fuels. ▪ This site was also used for explosives disposal by the Navy until 1945	

Rationale for Final Acreage

As previously discussed, the HRR, dated November 2006, identified 14 MRSs at PTA. However, for this SI Report the number of MRSs identified is ten. This occurred since a portion of the Former Operational Area was changed from an Area of Interest to an MRS for the SI Work Plan (Former Operational Area South) and since some of the MRSs identified in the HRR and SI Work Plan have been separated while others have been consolidated. Listed below are the MRSs identified in the HRR, the MRSs identified in this SI Report, and the reason for the acreage changes.

Table 5-2 Summary of SI Report MRS Acreages

SI MRS	SI MRS Acreage	MRSs Consolidated in SI MRS[1]	Phase 3 Inventory Acreage	HRR MRS Acreage	Comments
1926 Explosion Radius (PICA-003-R-01)	1,562	1926 Explosion Site (PICA-003-R-01)	1,028	1,552	<u>Rationale for Acreage Change Between Phase 3 Inventory Report and HRR Report</u> 1) 1926 Explosion Site - the arc of influence around the explosion center increased from ¾-mile to 1 mile based on information contained in historic reports. In addition, the operational range footprint of PTA decreased between the Phase 3 Inventory and the HRR. 2) Former DRMO Yard and Former Burning Ground - the former burning ground was discovered during the HRR and was not originally included in the Former DRMO Yard MRS. 3) Former Projectile Range – this range was identified during the HRR <u>Rationale for Acreage Change Between HRR Report and SI Report</u> Due to site consolidation, acreage for this MRS equals the acreage of all the MRSs consolidated into the new site
		Former DRMO Yard and Former Burning Ground (formerly PICA-007-R-01)	2	9.5	
		Former Projectile Range (formerly no AEDB-R number assigned)	NA	< 1	

SI MRS	SI MRS Acreage	MRSs Consolidated in SI MRS[1]	Phase 3 Inventory Acreage	HRR MRS Acreage	Comments
1926 Explosion Site – Off-Post (PICA-004-R-01)	833	1926 Explosion Site – Off-Post (PICA-004-R-01)	472	833	Rationale for Acreage Change Between Phase 3 Inventory Report and HRR Report The arc of influence around the explosion center changed from ¾-mile to 1 mile based on historic reports. Rationale for Acreage Change Between HRR Report and SI Report No change from HRR
Former Munitions and Propellant Test Area (PICA-001-R-01)	25	1000-Meter Impact Range (formerly PICA-001-R-01)	0.2	25	Rationale for Acreage Change Between Phase 3 Inventory Report and HRR Report In the Phase 3 Inventory, the Former Munitions and Propellant Test Area was two separate MRSs; the 1000-Meter Impact Range and the 1000-Meter Range, since the area between the firing point and the impact area was deemed operational range, and therefore, was not MMRP-eligible. Due to the subsequent change to PTA's operational range footprint, this area is now designated other than operational range and is included in the MRS. Rationale for Acreage Change Between HRR Report and SI Report No change from HRR
		1000-Meter Range (formerly PICA-002-R-01)	0.3		
Former Operational Areas (PICA-006-R-01)	1,977	Former Operational Area South (formerly no AEDB-R number assigned)	NA	NA	Rationale for Acreage Change Between Phase 3 Inventory Report and HRR Report 1) Former Operational Area South – this MRS was not identified in the Phase 3 Inventory and was an Area of Interest in the HRR. 2) The limits of the landfill shown in the July 2006 Draft Final ROD are slightly larger than the boundaries shown in the Phase 3 Inventory Report. The larger boundary was used in the HRR. 3) Waste Burial Area Near Sites 19 & 34 – this MRS was identified during the HRR Rationale for Acreage Change Between HRR Report and SI Report The Former Operational Areas MRS was an area of interest in the HRR, not an MRS.
		Dredge Pile and Former Sanitary Landfill (formerly PICA-006-R-01)	9	13	
		Waste Burial Area Near Sites 19 & 34 (formerly no	NA	8.5	

SI MRS	SI MRS Acreage	MRSs Consolidated in SI MRS[1]	Phase 3 Inventory Acreage	HRR MRS Acreage	Comments
		AEDB-R number assigned)			Based on subsequent information obtained from PTA, this site was changed to an MRS in the SI Work Plan. It has now been consolidated with the Dredge Pile and Former Sanitary Landfill and the Waste Burial Area Near Sites 19 & 34.
Green Pond MRS (PICA-005-R-01)	1.1	Green Pond Site (PICA-005-R-01)	8	1.4	<u>Rationale for Acreage Change Between Phase 3 Inventory Report and HRR Report</u> This MRS originally also included Bear Swamp Brook. However, Bear Swamp Brook was removed in the HRR since there is no documentation that MEC is present in the brook. <u>Rationale for Acreage Change Between HRR Report and SI Report</u> The length of this site was increased in the SI Report since documentation obtained from PTA's safety office shows a 66-mm shell was found 330 feet north of the northern boundary identified in the HRR. However, the width of the site was decreased in the SI Report since the width now consists of a standard 15-foot buffer from each bank. It is unknown how the width of the site was determined for the CTT; this width was carried into the HRR.
Inactive Munitions Waste Pit (PICA-013-R-01)	94	The on-site portion of the Inactive Munitions Waste Pit (formerly no AEDB-R number assigned)	NA	101.5	<u>Rationale for Acreage Change Between Phase 3 Inventory Report and HRR Report</u> This MRS was identified in the HRR <u>Rationale for Acreage Change Between HRR Report and SI Report</u> This site was separated into on and off-post portions for the SI Report.
Inactive Munitions Waste Pit – Off-Post (PICA-014-R-01)	7.5	The off-post portion of the Inactive Munitions Waste Pit (formerly no AEDB-R number assigned)	NA	101.5	<u>Rationale for Acreage Change Between Phase 3 Inventory Report and HRR Report</u> This MRS was identified in the HRR <u>Rationale for Acreage Change Between HRR Report and SI Report</u> This site was separated into on and off-post portions for the SI Report.

SI MRS	SI MRS Acreage	MRSs Consolidated in SI MRS[1]	Phase 3 Inventory Acreage	HRR MRS Acreage	Comments
Lakes MRS (PICA-008-R-01)	758	The on-post portion of Lake Denmark (formerly PICA-008-R-01)	327 (note: includes on and off-post acreage)	729	<u>Rationale for Acreage Change Between Phase 3 Inventory Report and HRR Report</u> 1) Lake Denmark – A mortar testing range and cannon testing range were identified during the HRR. Due to the inclusion of these ranges, along with their SDZs, the acreage of the site expanded. 2) Picatinny Lake – The acreage for this MRS increased since a 3-inch projectile testing range was identified during research conducted for the HRR and since some land portions adjacent to the lake were added due to the discovery of munitions debris. <u>Rationale for Acreage Change Between HRR Report and SI Report</u> Lake Denmark was split into on and off-post portions in the SI Report. The on-post portion was consolidated with Picatinny Lake. Therefore, the acreage for this MRS equals the acreage of all MRSs consolidated into this new site.
		Picatinny Lake Site (formerly PICA-009-R-01)	108	125	
Lake Denmark – Off-Post (PICA-012-R-01)	96	The off-post portion of Lake Denmark (formerly PICA-008-R-01)	327 (note: includes on and off-post acreage)	729	<u>Rationale for Acreage Change Between Phase 3 Inventory Report and HRR Report</u> The acreage associated with the off-post portion of this MRS was not calculated for the Phase 3 Inventory. However, it is likely that the acreage increased between the Phase 3 Inventory and the HRR Report due to the inclusion of additional ranges and their SDZs that were discovered during the HRR. <u>Rationale for Acreage Change Between HRR Report and SI Report</u> This site was separated into on and off-post portions for the SI Report.
Shell Burial Grounds (PICA-010-R-01)	5.5	Shell Burial Ground Near Bldg. 3150 (formerly PICA-010-R-01)	3	1.5	<u>Rationale for Acreage Change Between Phase 3 Inventory Report and HRR Report</u> During a review of historic maps, it was determined that the shape of the Shell Burial Ground Near Bldg. 3150 was incorrect in the Phase 3 Inventory. <u>Rationale for Acreage Change Between</u>
		Shell Burial Ground Near	4	4	

SI MRS	SI MRS Acreage	MRSs Consolidated in SI MRS[1]	Phase 3 Inventory Acreage	HRR MRS Acreage	Comments
		Bldg. 3100 (formerly PICA-011-R-01)			HRR Report and SI Report Due to site consolidation, acreage for this MRS equals acreage of all MRSs consolidated into new site

Note:

1 – With the exception of the Former Munitions and Propellant Test Area, the MRS names in this column are from the HRR. The MRS names in this column for the Former Munitions and Propellant Test Area are from the Phase 3 Inventory.

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Appendix A: Field Notes

Appendix B: Field Forms and Photographic Log

Appendix C: Geographic Information Systems Data

Appendix D: Ordnance Data Sheets

Appendix E: Analytical Results and the Quality Control Summary Report

Appendix F: Prioritization Protocol

Appendix G: Cost To Complete Data Extraction Tables

Appendix H: TPP Meeting Minutes

Appendix I: UXO Find Map