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**FINAL**  
**HISTORICAL RECORDS REVIEW**  
**PICATINNY ARSENAL, NEW JERSEY**

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November 2006

Prepared for:

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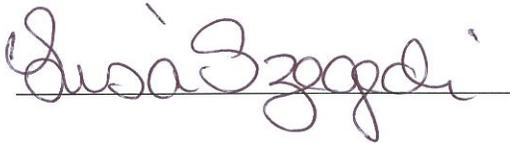
**FINAL**  
**HISTORICAL RECORDS REVIEW**  
**PICATINNY ARSENAL, NEW JERSEY**

**DOD CONTRACT NUMBER: W912DR-05-D-0004**

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**November 2006**

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## TABLE OF ACRONYMS

Acronym	Definition
°F	Degrees Fahrenheit
AEC	Army Environmental Center
AEDB-R	Army Environmental Database - Restoration
A/I	Active/Inactive
amsl	Above Mean Sea Level
AOC	Area of Concern
AP	Armor Piercing
ARDEC	Armament Research, Development and Engineering Center
ARS	Advance Range Survey
ASR	Archives Search Report
bgs	Below ground surface
Bldg.	Building
BRAC	Base Realignment and Closure
BRG	Ballistic Rail Gun
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CSM	Conceptual Site Model
CTC	Cost to Complete
CTT	Closed, Transferring, and Transferred
DERP	Defense Environmental Restoration Program
DL	Detection Level
DMM	Discarded Military Munitions
DNT	Dinitrotoluene
DoD	Department of Defense
DRMO	Defense Reutilization & Marketing Office
DSERTS	Defense Site Environmental Restoration Tracking System
EM	Engineer Manual
EOD	Explosive Ordnance Disposal

## TABLE OF ACRONYMS

Acronym	Definition
EPIC	Environmental Photographic Interpretation Center
ERA	Ecological Risk Assessment
EUL	Enhanced Use Lease
FS	Feasibility Study
FY	Fiscal Year
GIS	Geographic Information Systems
HE	High Explosive
HMX	Cyclotetramethylene-tetranitramine
HRR	Historical Records Review
IAP	Installation Action Plan
IC	Institutional Control
ID	Identification
INRMP	Integrated Natural Resources management Plan
IRP	Installation Restoration Program
ITRC	Interstate Technology and Regulatory Council
JATO	Jet Assisted Take-Off
Lbs.	Pounds
LOC	Level of Concern
LUC	Land Use Control
MC	Munitions Constituents
MD	Maryland
MEC	Munitions and Explosives of Concern
mg/kg	Milligrams per Kilogram
mm	Millimeter
MMRP	Military Munitions Response Program
MRS	Military Response Site
NAD	North America Datum
NARA	National Archives and Records Administration

## TABLE OF ACRONYMS

Acronym	Definition
NCP	National Contingency Plan
NFA	No Further Action
NJ	New Jersey
NJDEP	New Jersey Department of Environmental Protection
PA	Preliminary Assessment
PAH	Polycyclic Aromatic Hydrocarbon
PBX	Polymer Bonded Explosive
PCB	Polychlorinated Biphenyls
PETN	Pentaerythrite Tetranitrate
POC	Point of Contact
PSE&G	Public Service Electric and Gas
PTA	Picatinny Arsenal
R&D	Research and Development
RAB	Restoration Advisory Board
RBC	Risk Based Concentration
RC	Response Complete
RDX	Cyclotrimethylenetrinitramine
RG	Record Group
RI	Remedial Investigation
RMD	Reaction Motors Division
ROD	Record of Decision
RTI	Radiation Technology, Inc.
SARA	Superfund Amendment and Reauthorization Act
SDZ	Surface Danger Zone
SI	Site Inspection
SLERA	Screening Level Ecological Risk Assessment
SVOC	Semi-Volatile Organic Compound
TCE	Trichloroethylene

## TABLE OF ACRONYMS

Acronym	Definition
TD	Transferred
TNT	Trinitrotoluene
µg/g	Microgram per Gram
U.S.	United States
USACE	United States Army Corps of Engineers
U.S.C	United States Code
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
UXO	Unexploded Ordnance
VOC	Volatile Organic Compound
WWI	World War I
WWII	World War II

## **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** – All 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 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, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of consistent with applicable environmental laws and regulations.

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

**Explosives Safety** – A condition where operational capability and readiness, personnel, property, and the environment are protected from the unacceptable effects of an ammunition or explosives mishap.

**Military Range** – A designated land or water area set aside, managed, and used for range activities of the DoD. Ranges include 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, and airspace areas designated for military used in accordance

with regulations and procedures prescribed by the Administrator of the Federal Aviation Administration.

**Munitions and Explosives of Concern (MEC)** – This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks, means unexploded ordnance, DMM or munitions constituents (*e.g.*, trinitrotoluene or royal detonating explosive) present in high enough concentrations to pose an explosive hazard.

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

**Operational Range** – A military 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.

**Other Than Operational Range** – Encompasses closed, transferred and transferring ranges.

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

## **EXECUTIVE SUMMARY**

The Department of Defense (DoD) has established the Military Munitions Response Program (MMRP) under the Defense Environmental Restoration Program (DERP) to address defense sites with munitions and explosives of concern (which include unexploded ordnance [UXO] and discarded military munitions [DMM]) and munitions constituents (MC). MMRP eligible sites include other than operational ranges where UXO, DMM, and/or MC are known or suspected and the release occurred prior to September 30, 2002. Properties classified as operational ranges, operating storage or manufacturing facilities, or facilities that are used or were permitted for the treatment or disposal of military munitions are not eligible and, therefore, are excluded from the MMRP program. This report presents the results of the MMRP Historical Records Review (HRR) conducted at Picatinny Arsenal (PTA), New Jersey (NJ).

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. 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 trinitrotoluene (TNT) and amatol into bombs and projectiles.

In 1926, a series of explosions occurred on the eastern portion of PTA, on property that was 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 were 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 the BRAC, DoD has determined that PTA will remain open and be realigned, gaining new missions. Currently, PTA's mission includes R&D and pilot plant production of armament items, life-cycle engineering, and the support of other military weapons and weapon systems. To facilitate this mission, PTA has 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.

The Phase 3 Closed, Transferring, and Transferred (CTT) Range Inventory Report was completed for PTA in December 2003 and the following 11 MMRP-eligible sites were identified:

- 1000-Meter Impact Range
- 1000-Meter Range
- 1926 Explosion Site
- 1926 Explosion Site-Off-Post
- Bear Swamp/Green Pond Site
- Dredge Pile/Landfill
- DRMO Yard

- Lake Denmark
- Picatinny Lake Site
- Shell Burial Ground #1
- Shell Burial Ground #2

During research performed for this HRR, the following new sites were identified:

- Former Projectile Range
- Inactive Munitions Waste Pit
- UXO Find (Berkshire Trail)
- Waste Burial Area Near Sites 19 & 34

Between the Phase 3 Inventory Report and the HRR, approximately 4,200 acres of PTA changed from operational range to other than operational range. Due to this, the 1000-meter range and 1000-meter impact range were combined and given a new name (Former Munitions and Propellant Test Area). For many of the sites identified in the Phase 3 Inventory, the increase in the other than operational range area of PTA also resulted in an increase in the size of the MRS.

In addition to the new MRSs, the following four areas of interest were identified during the research performed for the HRR. The areas of interest were identified as potential sites on historical maps or in documents; however, they were determined to be MMRP ineligible or lacked sufficient information to identify the area as an MMRP eligible range.

- Baseball Fields
- Former Operational Area
- Former Motors/Rocket Fuel Test Area
- Inactive Rocket Fuel Test Areas

As a result of the HRR, there are a total of 14 MMRP eligible sites identified at PTA. The changes to the Phase 3 Inventory ranges and identification of the new ranges are summarized in Table ES-1.

**Table ES-1: Summary of HRR Acreage Changes and AEDB-R IDs\***

MRS Name	Phase 3 Inventory Acreage	HRR Acreage	MMRP AEDB-R ID	Munitions Use	Known MEC/MC	Rationale for Acreage Change	MEC/MC Addressed in MMRP
1926 Explosion Site	1,028	1552	PICA-003-R-01	Magazine and storage building explosion; mines, depth charges, fuzes, projectiles, explosives, small arms ammunition, and propellants	Known MEC/Suspected MC (metals, explosives and perchlorate)	1) Arc of influence around explosion center changed from ¾-mile to 1-mile (1,207 to 1,609 meters) radius based on historic reports 2) Operational range footprint of base changed between Phase 3 Inventory and HRR	MEC for entire site (except excluded areas); MC for entire site except excluded areas and areas where MC is addressed for a collocated IRP site
1926 Explosion Site – Off-Post	472	833	PICA-004-R-01	Magazine and storage building explosion; mines, depth charges, fuzes, projectiles, explosives, small arms ammunition, and propellants	Known MEC/ Unknown MC	Arc of influence around explosion center changed from ¾-mile to 1-mile (1,207 to 1,609 meters) radius based on historic reports	MEC & MC for entire site
Dredge Pile and Former Sanitary Landfill	9	13	PICA-006-R-01	Disposal site for munitions such as rifle grenades, and large and medium caliber ammunition, and for dredging materials containing small caliber ammunition	Known MEC/known MC (explosives and metals)	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.	MEC for entire site

MRS Name	Phase 3 Inventory Acreage	HRR Acreage	MMRP AEDB-R ID	Munitions Use	Known MEC/MC	Rationale for Acreage Change	MEC/MC Addressed in MMRP
Former DRMO Yard and Former Burning Ground	2	9.5	PICA-007-R-01	Storage and disposal of munitions which include primary explosives, secondary explosives, and pyrotechnics. The timeframe of use and the types of material burned in the Former Burning Ground are unknown.	Suspect MEC/Known MC (metals)	A former burning ground was discovered adjacent to the Former DRMO Yard. These two sites were combined for this HRR.	MEC for entire site
Former Munitions And Propellant Test Area	0.4	25	PICA-001-R-01	Range for recoilless rifles, such as the 57-mm M18, 75-mm M20, 90-mm M67, 105-mm M27, and the 106-mm M40.	Suspect MEC/All MC less than levels of concern (LOC)	In the Phase 3 Inventory, the area between the firing point and impact area was deemed operational range, and therefore, was not MMRP-eligible. Due to the subsequent change to the installation's operational range footprint, this area is now designated other than operational range.	MEC for entire site
Former Projectile Range	NA	< 1	NA	Used as a projectile range for unknown munitions and also for testing smaller diameter projectiles, such as 20-mm, 37-mm, and 40-mm. May contain fuzes and spotting charges.	Suspect MEC/Unknown MC	This range was identified during the HRR.	MEC &MC for entire site

MRS Name	Phase 3 Inventory Acreage	HRR Acreage	MMRP AEDB-R ID	Munitions Use	Known MEC/MC	Rationale for Acreage Change	MEC/MC Addressed in MMRP
Green Pond Site	8	1.4	PICA-005-R-01	Munitions types might include rifle grenades and large and medium caliber ammunition.	Known MEC/Known MC (metals)	Bear Swamp Brook is no longer part of this site since no documentation that MEC exists in the brook was discovered.	MEC for entire site
Inactive Munitions Waste Pit (includes an Off-Post portion)	NA	On-Post – 94	NA	Activities included the testing and storage of munitions and explosives.	On-Post - Suspect MEC/Known MC (metals and explosives). The explosives were not reported to be detected at elevated concentrations	This site was identified during the HRR; it lies within a portion of the installation recently characterized as closed range area. A portion of this site falls outside the installation boundary.	MEC & MC for entire site
		Off-Post – 7.5			Off-Post – Suspect MEC/Suspect MC		
Lake Denmark	327	On-Post – 633	PICA-008-R-01	Munition types include 60-mm, 81-mm, and 4.2-inch inert mortars, and 20-mm cannon mortars. Possibility of DMM in the lake.	On-Post - Known MEC/Known MC (metals)	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. It should also be noted that a portion of the SDZs associated with these ranges falls outside the installation boundary.	MEC for entire site
		Off-Post – 96			Off-Post – Suspect MEC/Unknown MC		MEC & MC for entire site

MRS Name	Phase 3 Inventory Acreage	HRR Acreage	MMRP AEDB-R ID	Munitions Use	Known MEC/MC	Rationale for Acreage Change	MEC/MC Addressed in MMRP
Picatunny Lake Site	108	125	PICA-009-R-01	Munition types include phosphorous grenades, experimental pyrotechnics, cluster bombs, and 3-inch projectiles. The lake was also used for storage of smokeless powder and other explosives.	Known MEC/Known MC (explosives and metals)	1) A 3-inch projectile testing range was identified during research conducted for the HRR. 2) DMM was discovered in test pits installed near Bldgs. 565 and 823, which are adjacent to Picatunny Lake. These areas have been added to the site.	MEC for entire site
Shell Burial Ground Near Bldg. 3150	3	1.5	PICA-010-R-01	Ordnance includes mines, depth charges, fuzes, projectiles, explosives, small arms ammunition, propellants and possibly rocket fuels.	Known MEC/Suspect MC	Based on a review of historic maps, the original CTT shape was found to be incorrect	MEC for entire site
Shell Burial Ground Near Bldg. 3100	4	4	PICA-011-R-01	Ordnance includes mines, depth charges, fuzes, projectiles, explosives, small arms ammunition, propellants and possibly rocket fuels	Known MEC/Suspect MC	None	MEC for entire site

MRS Name	Phase 3 Inventory Acreage	HRR Acreage	MMRP AEDB-R ID	Munitions Use	Known MEC/MC	Rationale for Acreage Change	MEC/MC Addressed in MMRP
UXO Find (Berkshire Trail)	NA	< 1	NA	81-mm HE mortar find. Unknown origin, possible kick-out from open detonation	Known MEC/Unknown MC	This site was identified during the HRR	MEC & MC for entire site
Waste Burial Area Near Sites 19 & 34	NA	8.5	NA	Large projectiles including 175-mm or 8-inch projectiles, 40-mm grenades	Known MEC/Known MC (metals)	This range was identified during the HRR.	MEC for entire site

\* Sites that were not identified in the Phase 3 Inventory, but were identified during research conducted for this HRR, do not have an AEDB-R ID.

## 1 INTRODUCTION

The Department of Defense (DoD) has established the Military Munitions Response Program (MMRP) under the Defense Environmental Restoration Program (DERP) to address defense sites with munitions and explosives of concern (MEC) (which include unexploded ordnance [UXO] and discarded military munitions [DMM]) and munitions constituents (MC). The United States (U.S.) Army's inventory of closed, transferring and transferred (CTT) military ranges and sites has identified sites eligible for action under the MMRP. The MMRP eligible sites include other than operational ranges where UXO, DMM, and/or MC are known or suspected and the release occurred prior to September 30, 2002. Properties classified as operational ranges, operating storage or manufacturing facilities, or facilities that are used or were permitted for the treatment or disposal of military munitions are not eligible and, therefore, are excluded from the MMRP program. This report presents the results of the MMRP Historical Records Review (HRR) conducted at Picatinny Arsenal (PTA), 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 Amendment and Reauthorization Act of 1986 (SARA), 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 Site Inspection (SI) report is part of the CERCLA process and will complete the PA/SI requirement for MMRP eligible sites.

## **1.1 PURPOSE/SCOPE**

The purpose of the HRR is to perform a detailed records search to document historical and other known information for MRSs at PTA to supplement the inventory information. It will also support the Technical Project Planning process designed to facilitate decisions on those areas where more information is needed to determine the next steps in the CERCLA process.

## **1.2 PROJECT DRIVERS**

The regulatory structure for managing MRSs at PTA is guided by a mixture of federal, state, and local laws, as well as DoD and Army regulations and guidance. Key legislative and administrative precedents to date will undoubtedly influence the final regulatory framework for the MMRP. The key legislative and administrative precedents include:

### **Defense Environmental Restoration Program (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 the SARA of 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.*

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

Sections 311-312 of the National Defense Authorization Act of FY02 reinforced and modified 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 MEC 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 DERP Management Guidance and the National Defense Authorization Act of 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.

### **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 (IRP), 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 Restoration Program. The guidance document was provided to implement the Army's DERP in accordance with the DoD DERP Management Guidance (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).

## **1.3 BACKGROUND**

As stated above, the Phase 3 Inventory for PTA is considered to mark the completion of the PA phase of work under CERCLA. The SI is the next phase in the CERCLA process and will complete the PA/SI requirement for the MMRP eligible sites. The following paragraphs summarize the results of the Range Inventory at PTA and present the primary goals of performing an SI.

### **1.3.1 Inventory**

The Army Range Inventory program was conducted in three phases. The first phase (Phase 1) involved a data call issued through the Army Environmental Center (AEC) requesting general information about ranges on various installations under each U.S. Army Major

Command. The Phase 1 Inventory was conducted using a questionnaire called the Advance Range Survey (ARS). The ARS allowed the Army to meet the short-term data goal of supporting the DoD preparation of Senate Report 106-50.

Mr. John Lyons, a Realty Specialist with the Public Works Department of PTA, was listed as the point of contact (POC) in the ARS for CTT ranges. The ARS Phase 1 Inventory survey for PTA was completed in November 2000. Three records for CTT ranges were found in the ARS; however, all of the records appear to refer to indoor firing ranges, which were not included in the Phase 3 Inventory (PICA00204)<sup>1</sup>.

The ARS allowed the Army to meet its short-term needs; however, the Army's long-term needs required a more detailed inventory of its ranges that was not achievable based on the information in the ARS. For management and budgetary reasons, the Army divided the detailed follow-on inventory into two phases. The Phase 2 Inventory addressed operational ranges, while Phase 3 covered CTT ranges and sites with MEC and/or MC.

The Phase 2 Inventory for PTA was conducted in the winter of 2002 by AEC. The Phase 2 Inventory report includes maps that delineate the operational range boundary. The remainder of the property within the installation boundary is designated as other than operational range by default.

The Phase 3 Inventory for PTA was completed by Malcolm Pirnie, Inc. The site visit was conducted on December 10, 2002, and the *Final Closed, Transferring, Transferred Range/Site Inventory Report for Picatinny Arsenal* was submitted to AEC on December 9, 2003. This report identified the following 11 MMRP eligible sites at PTA:

- 1000-Meter Impact Range
- 1000-Meter Range
- 1926 Explosion Site

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<sup>1</sup> The references obtained for this HRR were numbered sequentially starting with PICA00001. Whenever the PICA number refers to a reference, the number will start immediately after the letters. Whenever PICA and a number are used to refer to an IRP or AEDB-R site number there will be a dash (e.g., PICA-204)

- 1926 Explosion Site-Off-Post<sup>2</sup>
- Bear Swamp/Green Pond Site
- Dredge Pile/Landfill
- Defense Reutilization & Marketing Office (DRMO) Yard
- Lake Denmark
- Picatinny Lake Site
- Shell Burial Ground #1
- Shell Burial Ground #2

An additional potential MRS, the Former Pistol Range, was identified during the Phase 3 Inventory. However, it was determined that this site is not MMRP eligible since it was used as a small arms testing range and there is no documentation that any other munitions were used at the site. In addition, MC contamination associated with this site is being addressed under the IRP (PICA00204; PICA00205). Additional information on the results of the Phase 3 Inventory is discussed in Section 4.

### **1.3.2 Site Inspection**

The primary goal of the MMRP SI is to collect sufficient information to make one of the following decisions: 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). The installation-wide SI at PTA will address the explosive safety threat posed both by MEC and MC contamination at the MMRP eligible sites. The secondary goal of the SI is to collect information for building the MMRP program,

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<sup>2</sup> The Phase 3 Inventory defines the term TD at the end of the Range/Site name as referring to "...a transferred portion of a site. If a site extends past the installation boundary and is therefore identified as transferred, that transferred portion is given the same name as the site within the installation boundary and a TD is added to the end to indicate that it has been identified as transferred." However, a transferred range is defined as "...a military range that is no longer under military control, but that was once used by the Army." Since none of the off-post portions of MRS identified in the HRR were ever under Army control, the use of TD is misleading. Therefore, for this HRR, any off-post portions of an MRS that were never under Army control will be referred to as off-post (e.g., 1926 Explosion Site – Off-Post).

to include Cost to Complete (CTC) estimates and data needed to apply the Munitions Response Site Prioritization Protocol for the MMRP eligible sites.

#### **1.4 REPORT ORGANIZATION**

This HRR has the following sections:

- Section 1 – Introduction
- Section 2 – Site Description
- Section 3 – Data Collection and Document Review Process
- Section 4 – Historical Records Review Findings
- Section 5 – Conceptual Site Model (CSM)
- Section 6 – Conclusions

The following supporting information and analyses are appended to this HRR:

- Archives Searched/Data Sources (Appendix A)
- Bibliography (Relevant Historical Documents) (Appendix B)
- Interview Records (Appendix C)
- EOD Incident Reports (Appendix D)
- Munitions Technical Data Sheets (Appendix E)

## **2 SITE DESCRIPTION**

### **2.1 DETAILED INSTALLATION DESCRIPTION/HISTORY**

PTA, which covers 6,491 acres, is located in Morris County, NJ, approximately 4 miles (6,437 meters) northwest of Dover, in Rockaway Township, and 45 miles (72,420 meters) west of New York City (PTA.D&M.0001; PTA.D&M.0003; PICA00096; PICA00115). PTA is bordered by numerous major highways including State Route 15 on the southern end of the installation, Interstate 80, which is located approximately 1 mile (1,609 meters) to the southeast, and U.S. Route 46, located approximately 2.5 miles (4,023 meters) southeast of the main entrance (PTA.D&M.0001; PICA00115).

PTA has a long history, dating back to the late 1800s. After the Civil War, Congress determined that the need existed for a depot near New York City where large quantities of powder and explosives could be stored. In March 1880, the PTA site was chosen and funds were appropriated for its establishment. Between June 1880 and March 1881, the War Department purchased 1,866 acres of land in the valley where PTA is currently located. The reservation has had several names over the years including the Dover Powder Depot, the Picatinny Powder Depot, and the U.S. Powder Depot, before becoming known by its current name of Picatinny Arsenal in October 1907 (PTA.D&M.0001; PTA.D&M.0003; PICA00096; PICA00115).

For more than a decade, PTA remained a storage and powder depot; five magazines, officers' quarters, service buildings, and stables were built at the installation in the 1880s and 1900s (PTA.D&M.0001; PICA00115). Cartridge bag manufacture and loading of charges at PTA began in 1897. The first production activity, assembly of powder charges for cannons, began several years before the Spanish-American War, which started in 1898. In 1902, PTA also began loading armor-piercing (AP) projectiles. During the early 1900s, the following activities occurred (PTA.D&M.0003; PICA00115):

- 1903 – Six projectile sheds were built.
- 1904 – A plant used for filling projectiles with explosive “D” (ammonium picrate) was constructed.
- 1906 – Buildings and machinery used for capping, grooving, tapping, and banding fixed ammunition were installed. One of the buildings constructed for assembly of fixed ammunition was temporarily used as a chemical laboratory and then later as an HE plant.
- 1908 – A factory used for the manufacture of powder for large munitions began operations. This factory was later expanded to include the manufacture of .30-caliber small arms powder. By 1909, this factory had a capacity of approximately 2.7 million pounds (lbs.) of powder per year.
- 1913 – A factory with a capacity of 1,000 lbs. of explosive “D” per day was built.

PTA’s operations continued to expand; by World War I (WWI), they had increased their capacity to manufacture smokeless powder and were producing munitions of all sizes, including .30-caliber rifle ammunition to 16-inch shells. During WWI, PTA also expanded their storage capacity for powder, explosives, and other components. By the end of WWI, the manufacture of smokeless powder was discontinued due to the large amount already in storage. However, PTA had begun new operations including the melt-loading of projectiles and the manufacture of pyrotechnic signals and flares. They were also involved in the experimental manufacture of modern propellants, HE, fuzes, and metal components, as well as the loading of trinitrotoluene (TNT) and amatol into bombs and projectiles (PTA.D&M.0003; PICA00115).

From the late 1800s to 1960, the Navy owned a portion of property adjacent to PTA (PICA00096; PICA00111; PICA00214). The Lake Denmark Naval Ammunition Depot property, which consisted of approximately 450 acres, was located on what is currently the eastern portion of PTA near Picatinny Lake. From 1890 to 1945, this property was used

mainly for storage of explosives, powder, and projectiles (PICA00080; PICA00081; PICA00082; PICA00096; PICA00111; PICA00159; PICA00208). From 1946 to 1960 the Navy operated an Air Rocket Test Station on this property. After the property was transferred back to the Army in 1960, the Army continued to operate the test station until 1972 (PICA00208).

On July 10, 1926, lightning from an electrical storm struck a tree at the southwest end of the Lake Denmark Naval Ammunition Depot, setting off a series of explosions. Minor explosions continued at the installation for five days (PTA.D&M.0003; PICA00096; PICA00111).

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 also 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 (1,207 meters) from the explosion center, while shell fragments were found up to 1 mile (1,609 meters) away (PICA00006; PICA00096). Eighteen people were killed (PTA.D&M.0003; PICA00096; PICA00115). The total amount of explosives detonated in the explosions was approximately 2.4 million lbs. (PTA.D&M.0003; PICA00096).

After the explosion, PTA was cleaned up and rebuilt; by 1931, the following operations were occurring there: loading of bombs and projectiles; the manufacture and loading of pyrotechnics and smokeless powder; the assembly of all fixed ammunition larger than .50-caliber; and the performance of chemical laboratory services for the ordnance department. By World War II (WWII), PTA was the only facility in the United States capable of producing the large amounts of ordnance needed for the war. During WWII, PTA was producing thousands of pounds of smokeless powder, tetryl, ethylenedinitramine, boosters, primers, and detonators. To accomplish this work, PTA employed 17,000 personnel; the work was conducted 24 hours a day, seven days a week (PTA.D&M.0003; PICA00115).

PTA also produced thousands of pounds of explosives for the Korean and Vietnam Wars; smokeless powder, C-4 composition, T-9 composition, igniters, 60-millimeter (mm) mortar propellant powder, solvent powder, and nitroglycerin were produced for the Korean War, while nitroglycerin and experimental high explosives (HE) including polymer bonded explosives (PBX), cyclotetramethylene-tetranitramine (HMX), pentaerythrite tetranitrate (PETN), tetryl, Composition B, and TNT were produced for the Vietnam War. For the Vietnam War, PTA also developed Beehive ammunition of various calibers, single and double base propellants, mines that were dispersed from low-flying helicopters, and unique explosive systems used for destroying tunnel networks (PTA.D&M.0003; PICA00115; PICA00208).

In the years between the Korean and Vietnam Wars, PTA produced mines, shells, fuses, HE casings and rockets, flash smokeheads for rockets, wafer bombs, nitroglycerin, and Jet-Assisted Take-Off (JATO) units. PTA also contributed to the development of some nuclear weapons, including artillery shells and the Davy Crocket, and was involved in the design and development of the following warheads: the Nike family, the Hawk, Redstone, Corporal, Sergeant, Littlejohn, Honest John, Surface to Air Missile-D, Lance, and Safeguard (PTA.D&M.0003).

After the Vietnam War, PTA continued research and development (R&D) work on nuclear and non-nuclear weapons. The R&D applications included artillery, infantry, vehicle and aircraft weapons, demolition munitions, mines, bombs, grenades, pyrotechnic systems, rocket-assisted projectiles, flares, chemical systems/materials, and fuses (PTA.D&M.0003; PICA00115).

Under BRAC, DoD has determined that PTA will remain open and be realigned, gaining new missions (PICA00205). 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 system. Currently, PTA's mission includes R&D and pilot plant production of armament items, life-cycle engineering, and the support of other military weapons and weapon systems. (PICA0205; <http://www.globalsecurity.org/military/facility/picatinnny.htm>). To

facilitate this mission, PTA has established several partnerships with academia and industry and has involved them in the R&D process (<http://www.pica.army.mil>).

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. A timeline of significant events in the history of PTA is summarized in Table 2-1.

*Table 2 -1: Timeline of Significant Events*

Time Period	Significant Events
1880 - circa 1914	<ul style="list-style-type: none"> <li>○ Congress appropriated funds for the establishment of PTA (originally named the Dover Powder Depot).</li> <li>○ For over a decade, PTA operated as a storage and powder depot.</li> <li>○ Assembly of powder charges for cannons began several years before the Spanish-American War (1898).</li> <li>○ In 1902 PTA began loading AP projectiles.</li> <li>○ In October 1907 the installation was renamed Picatinny Arsenal.</li> <li>○ By WWI, PTA was manufacturing smokeless powder and propellants of all sizes.</li> </ul>
Circa 1914 - 1926	<ul style="list-style-type: none"> <li>○ During WWI, PTA expanded their storage capacity for powder, explosives, and other components.</li> <li>○ During WWI, PTA began to melt-load projectiles, load TNT into bombs, manufacture pyrotechnic signals and flares, and they began experimental manufacture of modern propellants, HE, fuzes, and metal components.</li> <li>○ Lightning from an electrical storm ignited a magazine on the arsenal, setting off a series of explosions that destroyed much of the installation.</li> </ul>
1926-mid 1970s	<ul style="list-style-type: none"> <li>○ After the explosion, PTA was cleaned up, rebuilt, and expanded.</li> <li>○ By 1931, PTA was involved in loading bombs and manufacturing explosives and ammunition.</li> <li>○ PTA produced thousands of pounds of explosives, boosters, primers, and detonators in support of WWII.</li> <li>○ PTA also produced thousands of pounds of explosives for the Korean and Vietnam Wars.</li> <li>○ Production continued in between the wars, along with some R&amp;D.</li> </ul>
Mid-1970s - present	<ul style="list-style-type: none"> <li>○ After the end of the Vietnam War, PTA continued R&amp;D on nuclear and non-nuclear weapons.</li> <li>○ Currently, PTA's mission includes R&amp;D and pilot plant production of armament items, life-cycle engineering, and the support of other military weapons and weapon systems.</li> </ul>

## 2.2 PHASE 3 INVENTORY MUNITIONS RESPONSE SITES

The following 11 MMRP eligible sites were identified at PTA during the 2003 Phase 3 Inventory:

- 1000-Meter Impact Range
- 1000-Meter Range
- 1926 Explosion Site
- 1926 Explosion Site - Off-Post
- Bear Swamp/Green Pond Site
- Dredge Pile/Landfill
- DRMO Yard
- Lake Denmark
- Picatinny Lake Site
- Shell Burial Ground #1
- Shell Burial Ground #2

Each of the 11 inventory sites is displayed on Map 2-1. The information obtained and descriptions of the sites that resulted from the Phase 3 Inventory are presented in Section 4. New information pertaining to the ranges as a result of research conducted for this HRR is also presented in Section 4.

**Historical Records Review  
Picatinny Army Arsenal, NJ**



**MALCOLM  
PIRNIE**

**Map 2-1  
Overview of Munitions Response Sites  
from the Phase 3 Inventory**

**Legend**

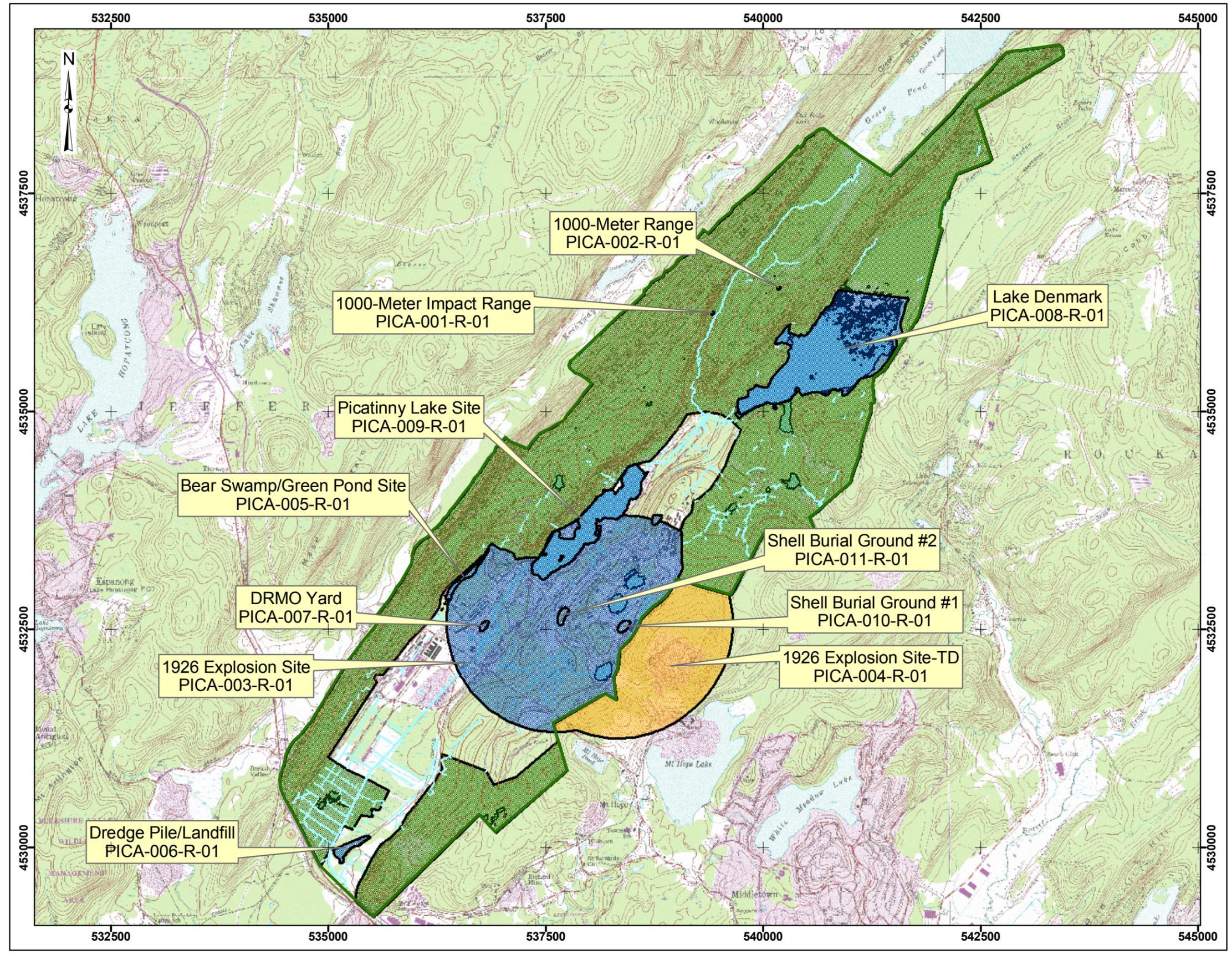
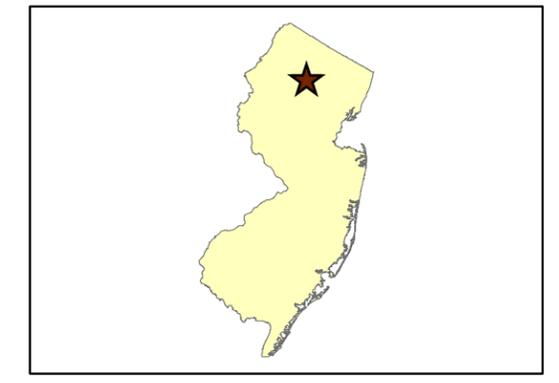
- Installation Boundary
- CTT Range/Site Inventory**
- Operational Range Area in 2003
- Closed MRS
- Off-Post MRS



Data Source: Topo: Microsoft Terraserver,  
USGS Digital Raster Graphic, 2006  
CTT Data: AEC, CTT Range Inventory, 2005

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

Contract: W912DR-05-D-0004  
Edition: Final Historical Records Review  
Date: November 2006



### **3 DATA COLLECTION AND DOCUMENT REVIEW PROCESS**

Numerous primary sources of information were researched as part of the data collection effort for the HRR. The sources of data included:

- 1) National and regional archives record groups (RGs) search
- 2) Installation data collection visit
- 3) Web search
- 4) Technical Information Center
- 5) U.S. Army Research, Development, and Engineering Command
- 6) Interviews

Each of the information sources are described below.

Note that it is recognized that not all data types are of the same quality; for the purpose of this report, general data quality designations have been made. A verifiable data source (such as a document or map) is designated as high quality. Handwritten records and maps supported by verifiable data or personal accounts from interviews that either are corroborated by numerous interviewee accounts or are supported by verifiable data are considered medium quality. Examples of low quality data include formerly verifiable, but no longer available, data (for example, recollections of lost documents and maps) or personal interviews without backup documentation or with contradictory documentation.

#### **3.1 NATIONAL AND REGIONAL ARCHIVES**

Relevant archival record repositories and RGs were selected based on guidance set forth in the *Technical/Regulatory Guideline for Munitions Response Historical Records Review*, prepared by the Interstate Technology and Regulatory Council (ITRC) UXO Team and based on the process developed by the USACE for performing Archive Search Reports (ASRs) (guidance provided at <http://www.mvs.usace.army.mil/engr/ed-p/asr.htm>). Only the record repositories that historically have proved to be most useful were searched. A complete listing of the archival repositories and RGs searched are provided in Appendix A. Relevant archival documents are provided in Appendix B. The following archival repositories were

searched for this HRR. Approximately 130 archive research person hours were spent on this installation.

- National Archives, National Archives and Record Administration (NARA), College Park, Maryland (MD)
- Regional Archives, NARA Northeast Region (New York, New York)

### **3.2 WEB SEARCH**

In addition to the repositories listed above, and in order to supplement the archive data and information received from the installation, Malcolm Pirnie has conducted Internet research. The list below presents the web sites that were searched for information on PTA. With the exception of installation history and utility information, only a small amount of relevant information was identified during the web search.

- PTA: <http://www.pica.army.mil/>
- U.S. Army Center of Military History: <http://www.army.mil/cmh-pg/>
- Environmental Restoration Information System: <http://aero.apgea.army.mil/pls/eris/eris.pmain.erishome>
- Global Security: <http://www.globalsecurity.org/military/facility/fort-meade.htm>
- U.S. Army Knowledge Online: <https://www.us.army.mil/suite/authenticate.do>
- Geographic Information System (GIS) Repository: <https://gis.hqda.pentagon.mil/>

### **3.3 INSTALLATION DATA COLLECTION VISIT**

Several site visits for PTA were conducted from April 3, 2006, through April 6, 2006, from April 12, 2006, through April 14, 2006, and on May 17, 2006 (PICA00208 through PICA00215; PICA0225). A site visit with one of the owners of off-post property, Tilcon, operator of the adjacent Mt. Hope Quarry, was conducted on April 25, 2006 (PICA00206). The purpose of these visits was to collect the information needed to complete the HRR and

develop CSMs for the site. While on-site, Lisa Szegedi, Janis Karn, and Larry Jordan reviewed environmental reports and historical documents/maps for PTA, including available MEC and MC data. Interviews with relevant personnel were also conducted. In addition, several follow-up phone interviews have been conducted.

The PTA Explosive Ordnance Disposal (EOD) Division was contacted several times; both during and after the site visits. Numerous EOD incident reports for the past four years were obtained. The majority of the incidents occurred off the installation at Mt. Hope Quarry. Copies of the EOD incident reports are provided in Appendix E.

### **3.4 USAEC TECHNICAL INFORMATION CENTER**

Malcolm Pirnie personnel conducted research at the Technical Information Center in Edgewood, MD, to obtain technical and historical documents that may have not been available through the other information sources researched. Several relevant documents were received from the Technical Information Center. They are detailed in Appendix B.

### **3.5 U.S. ARMY RESEARCH, DEVELOPMENT AND ENGINEERING COMMAND**

Malcolm Pirnie personnel conducted research at the U.S. Army Research, Development, and Engineering Command in Edgewood, MD, to obtain any potential documents/information concerning any activities involving chemical warfare material that may have not been available through the other information sources researched. No relevant documents were received from the U.S. Army Research, Development and Engineering Command.

### **3.6 INTERVIEWS**

Interview records are included in Appendix C. Information gathered during the discussions has been incorporated throughout the HRR. The following on-post interviews were conducted for PTA:

- Mr. Christopher Berkowitz (Real Property)

- Mr. John Bostonian (Range Control/Weapons)
- Mr. Robert Canning (Real Property)
- Mr. Joseph Clark (Environmental Division, Deputy Environmental Manager)
- Mr. Ted Gabel (Environmental Division, Environmental Program Manager)
- Mr. Vinnie Kapoor (Former Master Planner)
- Mr. Donald Lane (Director of Explosives Safety)
- Mr. Frank Langenecker (Directorate of Public Works [DPW]/GIS)
- Mr. Jack Lyons (Real Property)
- Mr. Frank Misurelli (Public Relations Office)
- Mr. Saleem Mithwani (Current Master Planner)
- Dr. Patrick Owen (Installation Historian)
- Sergeant Owens (EOD Division)
- Mr. Edward Pinson (Safety)
- Mr. Paul Reibel (Environmental Division)
- Mr. Alan Richwald (EOD Division)
- Sergeant Eric Soto (EOD Division)
- Mr. Jon VandeVentor (Natural Resources)
- Mr. Joseph Wu (EOD Division)
- Mr. Bruce Zimmerman (POC, Army Residential Communities Initiative)
- Township of Jefferson Police Department
- Rockaway Township Police Department

During the site visit, the following off-post personnel were also interviewed:

- Mr. Douglas Schicho (Senior Project Manager, Shaw)
- Mr. William Aspinall, IV (Operations Manager, Tilcon, Mt. Hope Quarry)
- Ms. Joyce Watson (Public Relations Director, Tilcon, Mt. Hope Quarry)

In addition, a request for information from people knowledgeable about potential MRSs was placed in the Spring of 2006 (Volume 3, Issue 2), PTA Restoration Advisory Board's (RAB) Newsletter. No answers to this request for information were obtained.

## 4 HISTORICAL RECORDS REVIEW FINDINGS

Eleven MMRP eligible sites were identified at PTA during the 2003 Phase 3 Inventory; due to the change in PTA's operational range footprint, as detailed below, two of these sites have subsequently been combined into one site. During the HRR process, four additional sites were identified through the archive records search and interviews with installation personnel. Each of these sites is included in this HRR. One of these, UXO Find Near Berkshire Trail, was identified due to a live mortar find at the installation in August 2006. The other three sites, the Former Projectile Range, the Inactive Munitions Waste Pit, and the Waste Burial Area Near Sites 19 & 34, were not identified during the Phase 3 Inventory because, at that time, they were located in the operational range footprint of the installation. However, since the Phase 3 Inventory report was completed, approximately 4,200 acres of PTA changed from operational range to other than operational range (PICA00096; PICA00220). Comparing Map 2-1 and Map 4-1 illustrates this significant change in the operational range footprint. For many of the sites identified in the Phase 3 Inventory, the increase in the other than operational range area of PTA also resulted in an increase in the size of the MRS.

The 14 sites are presented in alphabetical order in the following sections. As applicable, the following information is provided for each site:

- Description of the site that resulted from the Phase 3 Inventory (presented verbatim)
- New information pertaining to the site as a result of research conducted for this HRR
- Summary of changes based on the research conducted for this HRR

Additionally, four areas of interest were identified during research performed for the HRR. These areas are not MMRP eligible since the historical uses of these sites do not indicate the presence of MEC or sufficient documentation is not available to substantiate the presence of MEC. For three sites (Baseball Fields, Inactive Rocket Fuel Test Areas, and the Former Motors/Rocket Fuel Test Area) this conclusion is substantiated by the IRP investigations. In addition, any chemical contamination present at these three sites is being addressed by the

IRP. The fourth area of interest is not an IRP site, although it is collocated with numerous IRP sites, since it consists of all areas of the installation that are other than operational ranges, do not fall within operational SDZs for ranges with the potential for ongoing releases of MEC, and have not already been identified as an MRS. Brief descriptions of the areas of interest are provided in Section 4.15.

**Map 4 - 1: Overview of HRR Munitions Response Sites**

## **4.1 1926 EXPLOSION SITE (PICA-003-R-01)**

### **4.1.1 PHASE 3 INVENTORY SITE DESCRIPTION**

The description of the 1926 Explosion Site contained in the Phase 3 Inventory report states:

*This site includes the area affected by the explosion of the Lake Denmark Powder Depot – the Navy facility that was located next to the arsenal. The site is 1,028 acres. The site is centered at the explosion location, where the two Shell Burial sites are located, and spreads in both east and western directions from there inside the installation boundaries. The explosion occurred in 1926 but continues to have an impact on the arsenal since there are digging restrictions in place all over the arsenal due to potential UXO. The site includes the explosion center and a ¾-mile radius around it on all sides, minus the areas that fall on operational range acreage. As a result of the explosion, numerous types of munitions, including mines, depth charges, fuzes, projectiles, explosives, small arms ammunition, and propellants were thrown over the installation area and beyond. Current uses for this area include office buildings, recreational areas, and industrial/manufacturing facilities. While UXO investigations and/or responses have been performed on parts of the site, no documentation was found indicating that a UXO investigation and/or response of the whole site has been performed (PICA00204).*

### **4.1.2 HRR Site Findings**

As described below, this site includes the area affected by the explosion of the Lake Denmark Naval Ammunition Depot. From the late 1800s to the 1960s, the Navy owned a portion of property, called the Lake Denmark Naval Ammunition Depot, adjacent to PTA (PICA00096; PICA00111; PICA00214). The Lake Denmark Naval Ammunition Depot property was located on what is currently the eastern portion of PTA, near Picatinny Lake (PICA00080; PICA00081; PICA00082; PICA00159). Refer to Figures 4-1<sup>3</sup> and 4-2 for historic maps showing the Lake Denmark Naval Ammunition Depot.

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<sup>3</sup> It should be noted that the figures contained in this report were obtained, as-is, from historic reports. Therefore, the majority of these figures do not contain directional arrows or scales. The purpose of these maps is to assist the reader with understanding the information contained in the report. For the official map of each HRS, the reading should refer to the maps referenced for each site.

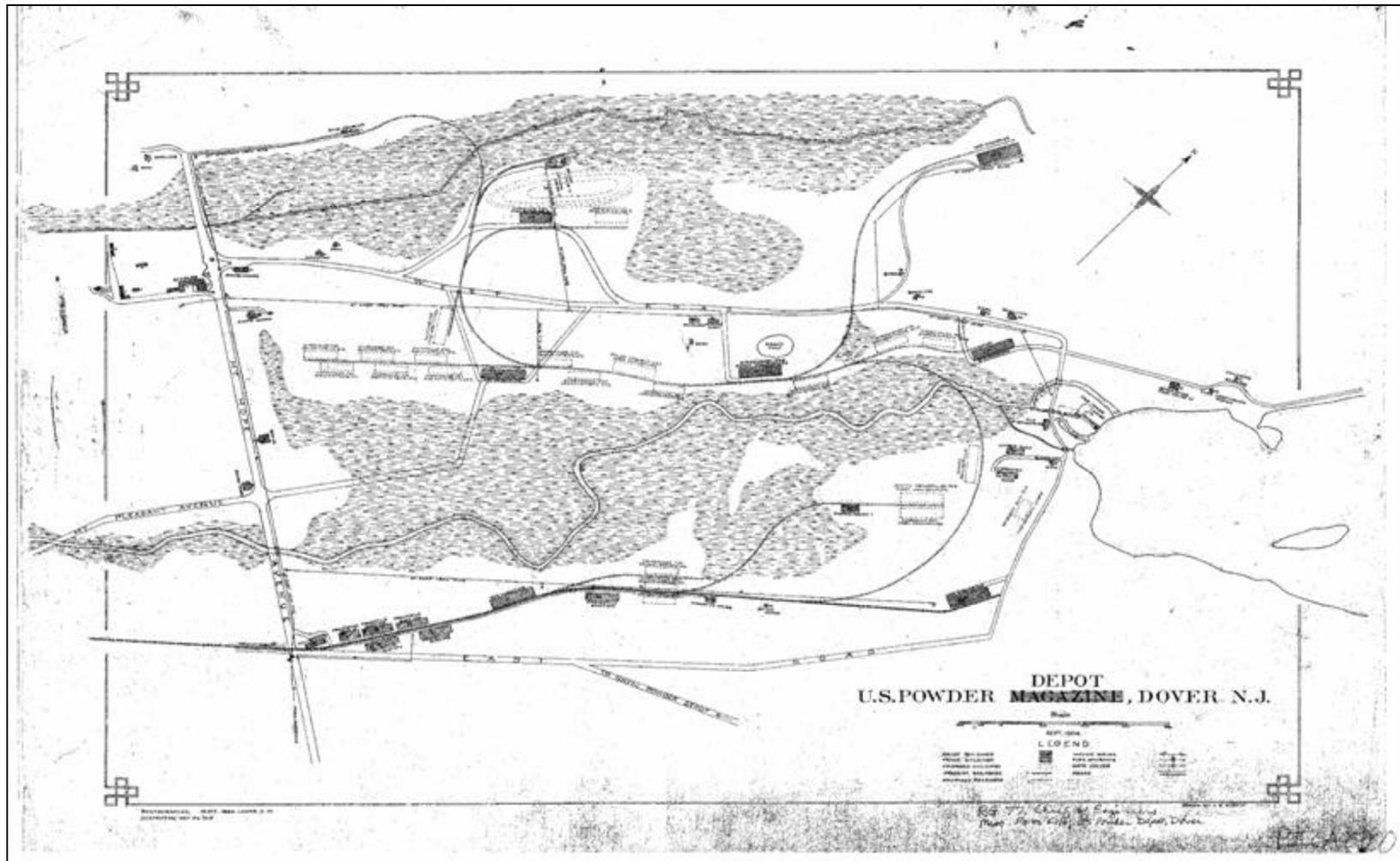
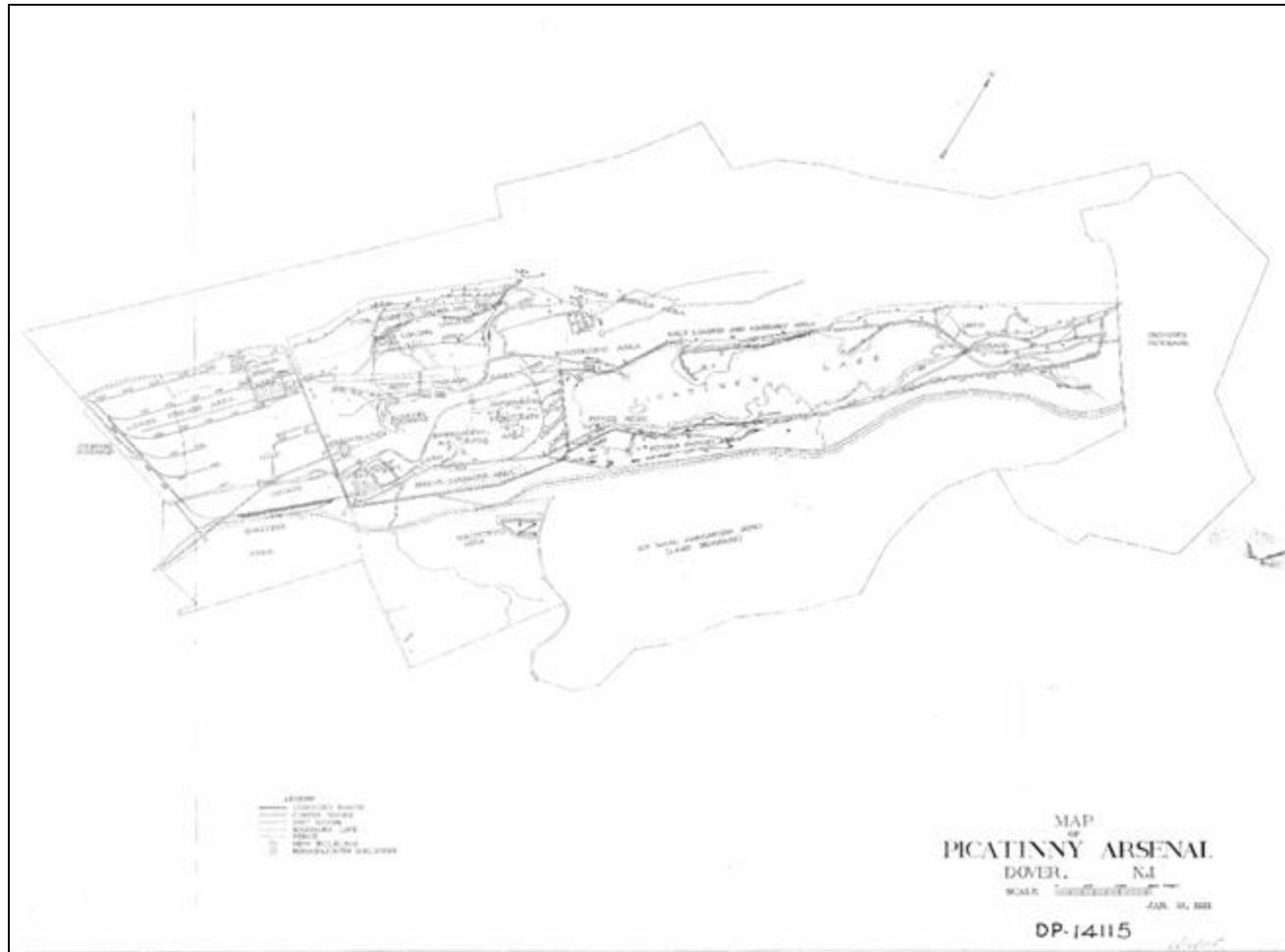


Figure 4-1: 1904 map showing Lake Denmark Naval Ammunition Depot



**Figure 4-2: 1931 map showing Lake Denmark Naval Ammunition Depot**

On June 9, 1891, 315 acres of land were transferred from the War Department to the Navy Department (PICA00096; PICA00111). This area was added to twice in subsequent years; 75 acres of land were added in 1902 and 64 acres were added in 1918 (PICA00111). This land, referred to as the Lake Denmark Naval Ammunition Depot, the U.S. Naval Ammunition Depot, or the Lake Denmark Powder Depot<sup>4</sup>, was used by the Navy mainly for storage of materials in magazines or storehouses (PICA00096; PICA00111). This entire property was transferred from the Navy to the Army in 1960 (PICA00214).

On July 10, 1926, at approximately 1715 hours, lightning from an electrical storm struck the southwest end of the Lake Denmark Naval Ammunition Depot, ultimately causing a series of explosions. At the time of the explosions, the Navy property contained between 160 and 200 buildings; approximately 40 to 50 of these were used for the storage of the HE, smokeless powder, projectiles, and black powder (PICA00096; PICA00111). Shortly after the lightning strike, black smoke was observed issuing from Temporary Magazine No. 8. At approximately 1820 hours, while fire-fighting attempts were ongoing, the first explosion occurred at the magazine. A second explosion, in Temporary Storehouse No. 9, followed about five minutes later. Two large craters, referred to as the Shell Burial Ground Near Building (Bldg.) 3100 in this report and discussed in Section 4.12, resulted from these explosions. The explosions damaged the surrounding magazines, shellhouses and buildings, exposing their contents to flying missiles and fire (PICA00096; PICA00111). Another crater, referred to as the Shell Burial Ground Near Bldg. 3150 and discussed in Section 4.11, was created when Shell Store House No. 22 exploded (PICA00096; PICA00111). Minor explosions continued at the installation for five days (PICA00111).

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

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<sup>4</sup> In the HRR, this property is referred to as the Lake Denmark Naval Ammunition Depot.

shell fragments were found up to 1 mile away (1,207 to 1,609 meters) (PICA00006; PICA00096).

According to a historical report, the following materials were stored in the main buildings that exploded (PICA00096):

Temporary Storehouse No. 8 – It was estimated that 670,000 lbs. of explosives were stored in this building, including:

- 50 lbs. TNT
- 1600 – 300 lb. depth charges TNT
- 100 – 25 lb. Navy Mark I bombs, loaded and plugged
- Bomb accessories (*e.g.*, fins, tails)
- 850 aerial bombs, TNT center section

Temporary Storehouse No. 9 – It was estimated that over 1.6 million lbs of TNT were stored in this building, including:

- 250,000 lbs. grade “A” flake TNT
- 350,000 lbs. grade “A” TNT
- 150 to 160 Mark IV aircraft bombs; approximately 250 lbs. of TNT in each bomb

Shell Store House No. 22 – It was estimated that 180,000 lbs. of explosives were stored in this building, including:

- 40 – 14-inch Class “B”; loaded and fused
- 80 – 14-inch AP rounds; loaded and fused
- 360 Mark I bombs, each containing 50 lbs. TNT
- 1,000 Mark II bombs, each containing 50 lbs. TNT
- 300 to 400 Mark III bombs, each loaded with TNT
- 200 Mark IV bombs, each loaded with TNT
- 500 Mark V bombs, each loaded with TNT

- 10,000 – 8-inch shells, loaded and fused
- 1,000 – 5-inch shells, loaded and fused

It was also reported that the following explosives burned but did not detonate (PICA00006; PICA00096):

- 3.1 million lbs. Explosives “D”
- 20,000 lbs. of picric acid
- 510,000 lbs. of TNT

Due to the explosion, MEC removal actions are required prior to intrusive activities for many areas at the installation. A determination regarding where MEC removal actions are required at the installation is conducted on a case-by-case basis by the Safety Office (PICA00209; PICA00213). Since 1926, there have been numerous MEC finds at the installation that are associated with the explosion; several documented finds include the following: (PICA00208; PICA00209). Refer to Map 4-2 for the locations of these finds.

October 1967 - During installation of a parking lot for Bldg. 3002, located approximately 150 yards above the Marine Corps (aka Navy) hill gate, Navy shells were found. In total, 180 rounds of 3-, 4-, and 5-inch Navy shells were recovered, some up to 4 feet below ground surface (bgs). Analysis of the shells indicated that they were manufactured between 1898 and 1925. It was determined that some of the shells were live (PICA00014).

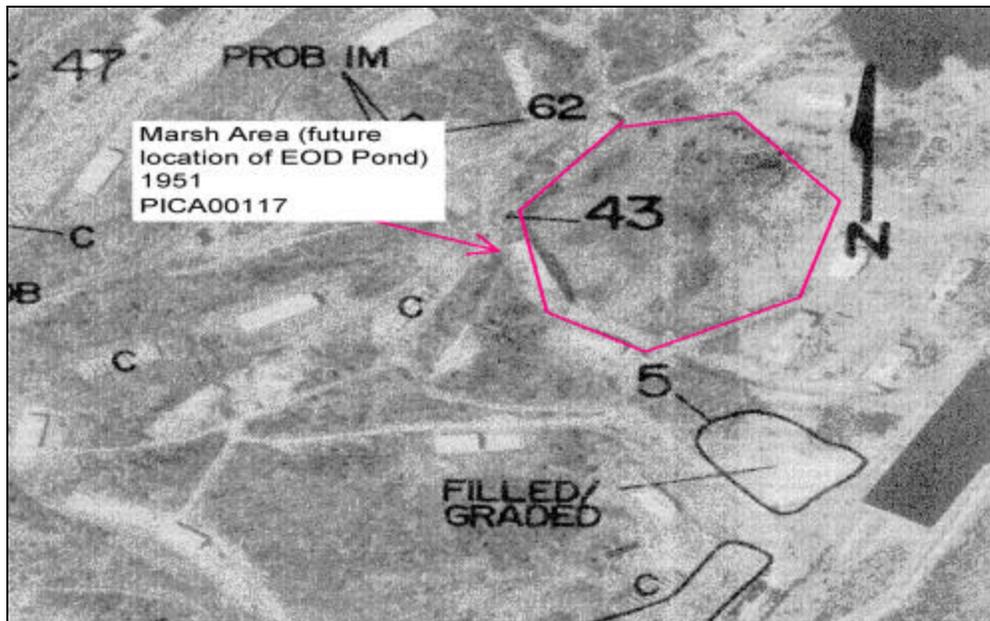
1995 – During widening of a parking lot between Bldgs. 3022 and 3028, a 14-inch AP projectile was uncovered (PICA00107).

Date Unknown – While replacing the floor in the gymnasium (Bldg. 3150), numerous MEC items were found underneath the floor. It was reported that the MEC were likely from the 1926 explosion (PICA00209).

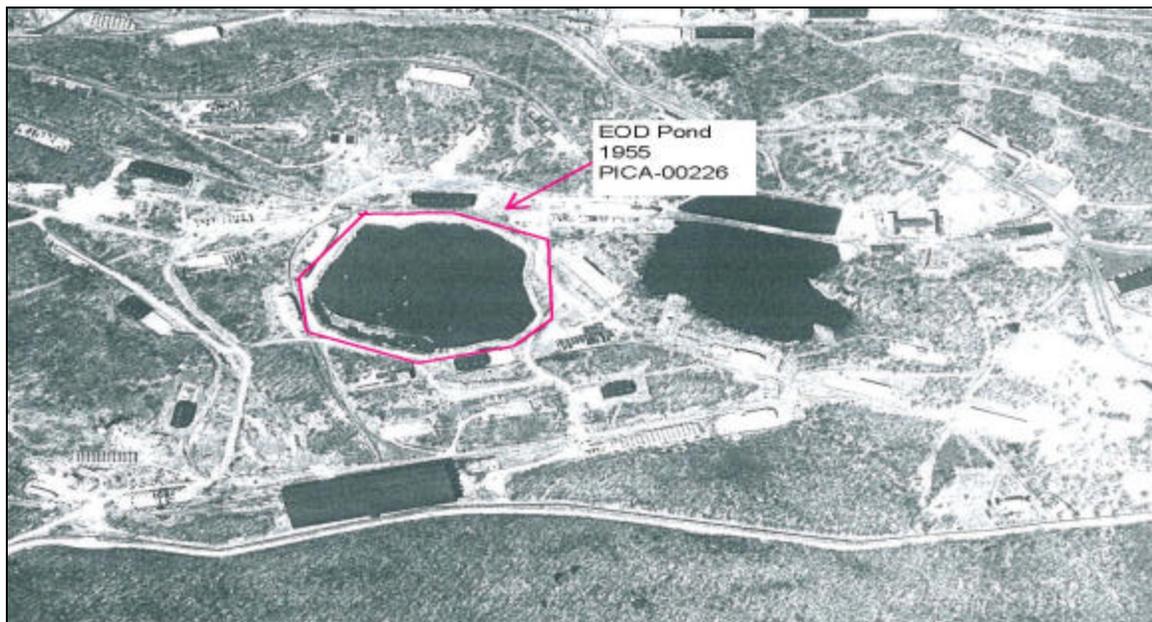
Two other areas of interest were identified during HRR research, including the Little League Fields and EOD Pond. Since both of these areas fall within the 1926 Explosion Site, they are described below (PICA00210; PICA00214). These two sites are shown on Map 4-2.

Little League Fields – This is an IRP Site listed under PICA-176. According to the IAP, unknown material may have been disposed of in pits at this site. In addition, material dredged from Green Pond Brook was reportedly spread on the baseball fields at an unknown date. The dredge material was likely placed in right and center fields. According to the RI Concept Plan, PTA personnel reported that munitions were found in the dredge material from Green Pond Brook. Surface soil samples were collected from this site during the 1996 SI and analyzed for various parameters including explosives and metals; no parameters were found at concentrations that exceeded the LOCs. In addition, three subsurface soil samples (between 2 to 4 feet bgs) were collected during the Phase III RI. These samples were also analyzed for metals, and explosives and no parameters were found at concentrations that exceeded the levels of concern (LOC) (PTA.D&M.0004; PTA.T017.0056O; PICA00205). A geophysical survey was conducted for this property and anomalous readings were found. A contractor either excavated or drilled at the anomaly locations and no MEC was encountered (PICA00225). According to the IAP, an NFA recommendation will be made for this site (PICA00205).

EOD Pond – This site is listed as an IRP Site under PICA-164. According to historical maps, the 16 million-gallon reservoir (EOD Pond) was constructed between 1951 and 1955. Prior to its construction, the EOD Pond was an undeveloped marsh (Figure 4-3). The earliest document that shows EOD Pond as a reservoir is an aerial photo dated 1955 (Figure 4-4). The reservoir, which is approximately 9 acres in size, is located near Building 3159 and is approximately 500 feet (152 meters) west of the Shell Burial Ground Near Bldg. 3150 (PTA.T017.0100B). A berm, ranging in height from 1 foot to at least 10 feet, surrounds the reservoir. According to the IAP, the reservoir has an inlet from a stream on the southeast side and a formal outlet to a culvert on the north side that is controlled by an overflow valve. A second overflow valve is located on the east side. EOD Pond is a designated fishing area open to permitted fisherman (PTA.T017.0048U; PTA.T017.0100B).



**Figure 4-3: 1951 aerial photo showing undeveloped marsh at future site of EOD Pond**



**Figure 4-4: 1955 aerial photo showing EOD Pond**

EOD Pond is surrounded by Buildings 3137, 3155, 3157, and 3159 (Figure 4-4). Prior to construction of the reservoir, magazines surrounded the marsh area, but were destroyed by the 1926 explosion (PTA.T017.0048U; PTA.T017.0100B; PICA00164). There is no documentation of any spills or discharges from the four buildings into the reservoir; however, there is an internal memo from an ARDEC employee stating that it was rumored that at one time a 16-inch shell may have been pulled from the marshy area (PTA.T017.0048U; PTA.T017.0100B). Due to its proximity to one of the explosion centers, it is possible that MEC either landed or were dumped in the marsh during the 1926 explosion (PICA00214).

Previous investigations were conducted at EOD Pond between 1984 and 2000 and included the collection of surface soil, surface water and sediment samples for various parameters, including metals and explosives. One surface water sample contained aluminum at a concentration above the LOC. The source of the aluminum is unknown (PTA.T017.0048U). One metal, beryllium, was detected in surface soil at a concentration greater than the LOC; however, this metal is not typically associated with MEC. Elevated levels of copper were detected in sediment samples collected from the reservoir.

Based on these results, a geophysical survey was conducted and additional surface water and sediment samples were collected. Results of the geophysical survey indicated a large number of ferrous anomalies throughout the reservoir, with the largest located within 100 feet (30.5 meters) of the shoreline. The source of these anomalies was not identified; however, as described below, no explosives have been detected in surface water or sediment samples collected from EOD Pond (PTA.T017.0048U; PICA00205).

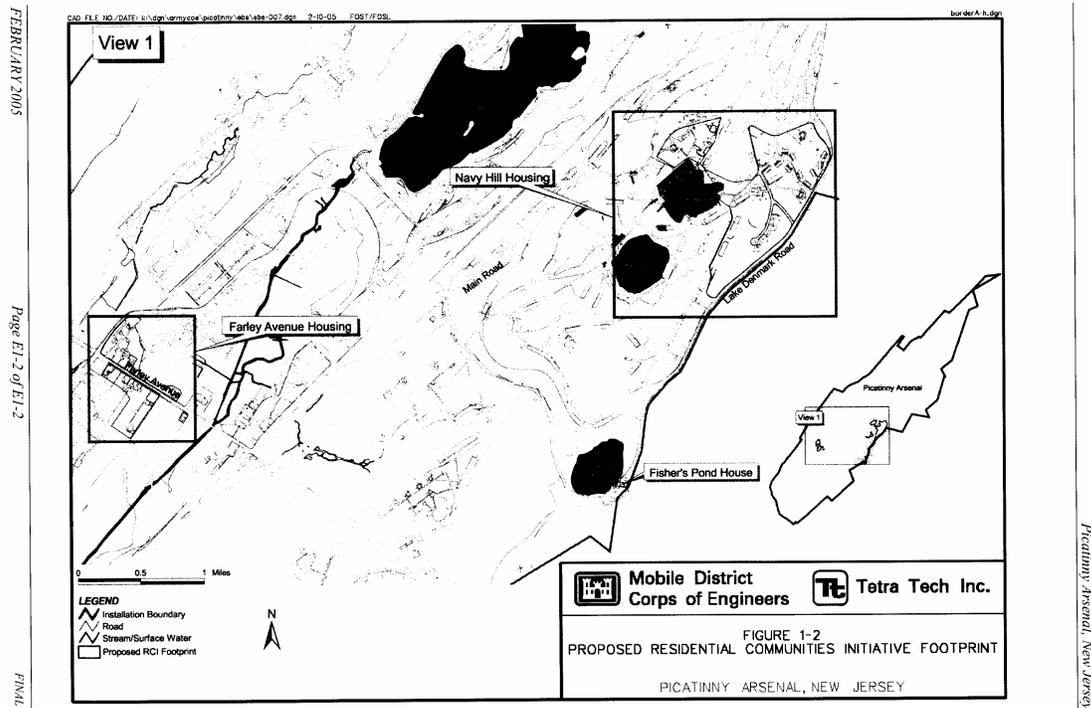
Surface water and sediment samples were collected throughout the pond, with many being collected at locations where ferrous anomalies were found. Explosives were not found in any of the surface water or sediment samples. Several metals, including lead, copper, and zinc, were found in the sediment, and several metals, including aluminum and zinc, were found in the surface water at concentrations that exceeded the LOCs. The source of the metals is unknown (PTA.T017.0048U; PICA00205).

As described above, numerous types of munitions and bulk explosives were thrown over the installation as a result of the explosion, including mines, depth charges, fuzes, projectiles, explosives, small arms ammunition, and propellants (PICA00096; PICA00204). For this HRR, the 1926 Explosion Site consists of the explosion center and the area within a 1-mile radius (1,609 meters), minus the following:

- 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. This includes SDZs associated with operational ranges in the 600 area (located on the western side of the 1926 Explosion Site) and an SDZ associated with the 1500 Area (located on the northern side of the 1926 Explosion Site) where open detonation is still ongoing.

The site also overlaps numerous other Munitions Response Sites (MRSs) that are discussed in this HRR, including Picatinny Lake, the Former DRMO Yard and Former Burning Ground, Green Pond Brook, and the Shell Burial Areas. These MRSs potentially represent areas where MEC may be more concentrated due to site activities that took place at them; therefore, they are considered their own sites and are not included in the 1926 Explosion Site acreage. Thus, the 1926 Explosion Site consists of 1,552 acres (Map 4-2).

It should be noted that a portion of this site falls on leased property. A 50-year Enhanced Use Lease (EUL) for two parcels of property on PTA was signed on May 1, 2006 (Figure 4-5) (PICA00207). The lease, which is with GMH Military Housing LLC, is for 113 houses located on Farley Avenue and Navy Hill (PICA00118; PICA00207).



**Figure 4-5: Map showing housing EUL locations.**

#### 4.1.3 Summary of HRR Changes

The only change that has been made to this site in the HRR is the area of the site. In the Phase 3 Inventory, this site was 1,028 acres (PICA00204). The size of the site has changed to 1,552 acres for this HRR due the following:

**Radius** – For the Phase 3 Inventory, the site was identified as including the explosion center and the area within a three-quarter-mile radius (1,207 meters), minus the areas that fall on operational range acreage (PICA00204). Several historical reports of the explosion indicate that shell fragments were found up to 1 mile (1,609 meters) away from the explosion center (PICA00006; PICA00096; PICA00208; PICA00213). Therefore, the site was expanded to include the explosion center and the area within a 1-mile (1,609 meters) radius, minus off-post property, areas that fall on operational ranges and the SDZs for operational ranges where there is the potential for on-going releases of MEC, and areas that overlap other MRSs.

Operational Range – Subsequent to the Phase 3 Inventory, the operational range area was reduced from approximately 4,500 acres to 330 acres. This change was requested in a 2004 memorandum (subject: Range Reclassification for Picatinny) from the Brigadier General to the Commander, HDQA, Pentagon (PICA00220). Therefore, a larger portion of the land within the radius surrounding the explosion is MMRP eligible.

## **Map 4-2: 1926 Explosion Site and 1926 Explosion Site – Off-Post**

## **4.2 1926 EXPLOSION SITE – OFF-POST (PICA-004-R-01)**

### **4.2.1 Phase 3 Inventory Site Description**

The description of the 1926 Explosion Site – Off-Post contained in the Phase 3 Inventory report states:

*This site is the transferred area affected by the 1926 explosion of the Lake Denmark Powder Depot – the Navy facility that was located next to the arsenal. This site is located outside the central eastern boundary of the installation. The site is 472 acres. As a result of the explosion, numerous types of munitions, including mines, depth charges, fuzes, projectiles, explosives, small arms ammunition, and propellants were thrown over the installation area and beyond. Current uses for this area include housing facilities and recreational areas. No evidence was found to suggest there are digging restrictions in this area. No documents were found to indicate any UXO investigations and/or responses were performed on the site.*

### **4.2.2 HRR Site Findings**

As described in Section 4.1.2, in 1926, lightning from an electrical storm struck near a Naval magazine, setting off a series of explosions. As a result of the explosion, numerous types of munitions, including mines, depth charges, fuzes, projectiles, explosives, small arms ammunition, and propellants, were thrown over the installation and beyond (PICA00096; PICA00111; PICA00204). Unexploded shells were initially reported to have been found up to three-quarters of a mile from the explosion center, while shell fragments were found up to 1 mile away (1,207 to 1,609 meters) (PICA00006; PICA00096).

For the HRR, the 1926 Explosion Site – Off Post consists of all off-post properties that fall within a 1-mile (1,609 meters) radius of the explosion center. Therefore, this site consists of 833 acres (Map 4-2). The 1926 Explosion Site – Off-Post consists of residential 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 which 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 (PICA00206). According to the Phase 3 Inventory report, the 1926 Explosion Site – Off-Post consisted of housing facilities and recreational areas; the quarry was not mentioned in the Phase 3 report. However during the HRR, Mt. Hope Quarry was identified as occupying a large portion of area of the 1926 Explosion – Off-Post MRS. Over the past four years, which is how long EOD incident reports are kept before being disposed of, there have been 7 documented MEC finds at the quarry to which PTA's EOD Division responded (PICA00090; PICA00175; PICA00212; PICA00224). These finds are detailed below:

May 26, 2006 – A 6-inch common round containing explosives was found on the quarry's conveyor belt. The round was picked up by the magnet prior to going through the stone crusher.

May 23, 2006 – A 4-inch common round containing explosives was found on the quarry's conveyor belt. The round was picked up by the magnet prior to going through the stone crusher.

April 8, 2006 – A 6-inch common round was found on the quarry's conveyor belt. The round had made it through the stone crusher and had been flattened. It is unknown if this round was live.

September 6, 2005 – A 5-inch AP projectile was found. It is unknown where this was found and if it was live.

November 9, 2004 – A 6-inch common round was found on the quarry's conveyor belt. It is unknown if this round was live.

August 14, 2002 – A 5-inch inert AP round was found at an unknown location on the quarry. The EOD report indicates the projectile was likely from the 1920s explosion on the arsenal.

Unknown – A 5-inch projectile was found at the quarry. It is unknown where this was found and if it was live.

No other off-post EOD records were found. A visit to view the quarry's processes was made in April 2006. During this site visit, it was observed that the quarry operations are moving

closer to PTA. The quarry's process for preparing the rock to be detonated, along with the process for crushing the rock, includes the following (PICA00206):

- The tree cover and all loose material are removed and bulldozed
- To the extent possible, the soil layer is scraped from the rock and placed into wind rows (berms). The berms ultimately get seeded and remain in place.
- The soil layer on top of the rock is typically between a few inches to several feet deep. Since it is not possible to remove all of the overburden, a very thin layer of soil, in addition to deeper pockets of soil, will remain after the top soil layer is scraped.
- The rock is then prepared to be removed by detonation. After detonation, large front end loaders load the rock into the back of dump trucks which take the rock over to the processing area.
- In the processing area, the rocks go through the following. Note that this does not include the entire process. Primary crusher – conveyor – screen – surge pile – conveyor belt and electro magnet – secondary crusher. The purpose of the electro magnet, which is located several inches above the conveyor belt, is to remove metal from the belt.
- This second rock crusher has a screen that allows 6-8 inch size rocks through before being crushed. Rocks larger than 6- 8 inches bypass this rock crusher and are carried away to a different pile of rock, which is sent through the process again.

Typically, MEC are being found by the electromagnet (Figure 4-6) (PICA00206).



**Figure 4-6: Photograph of electromagnet at Mt. Hope Quarry**

#### **4.2.3 Summary of HRR Changes**

The only change that has been made to this site in the HRR is the area of the site. In the Phase 3 Inventory, this site was 472 acres (PICA00204). The size of the site has changed to 833 acres for this HRR since the radius of the area influenced by the explosion was increased in the HRR. For the Phase 3 Inventory, the site was identified as all off-post property that falls within a three-quarter-mile (1,207 meters) radius of the explosion center (PICA00204). Several historical reports of the explosion indicate that shell fragments were found up to 1 mile (1,609 meters) away from the explosion center (PICA00006; PICA00096). Therefore, the site was expanded to all off-post property that falls within a 1-mile (1,609 meters) radius of the explosion center.

### **4.3 DREDGE PILE AND FORMER SANITARY LANDFILL (PICA-006-R-01)**

#### **4.3.1 Phase 3 Inventory Site Description**

For the purposes of this HRR, the site name has been changed from “Dredge Pile/Landfill” to “Dredge Pile and Former Sanitary Landfill” to be more consistent with the IRP site name. The site is co-located with two IRP sites. The description of the Dredge Pile and Former Sanitary Landfill contained in the Phase 3 Inventory report states:

*These are two sites that have been combined for administrative purposes. Both sites have unexploded munition [MEC] concerns resulting from disposal. The Dredge Pile contains all the dredging materials from the Bear Swamp/Green Pond Site. Munitions that might be found in this site include rifle grenades, and large and medium caliber ammunition. The dredging took place in order to deepen the channel and because the site is prone to flooding. During the dredging event, munitions were found, mostly small caliber ammunition. The Dredge Pile is an irregular shaped pile of sediments and is located inside the Spice Landfill. The height of the pile varies between 15 and 20 feet and covers an area of one acre. The disposal area is unlined and uncapped. The landfill area was a disposal site for munitions and other wastes, such as sludge, from 1940 to 1982. The site, composed of the dredge pile and the landfill, is considered a closed site and occupies nine acres. Unexploded munition clearance must be performed prior to any excavation. No documents were found to indicate any UXO investigations and/or responses were performed on the site.*

*The site is associated with two Defense Site Environmental Restoration Tracking System (DSERT) sites [now termed AEDB-R sites], PICA-068 and PICA-067. PICA-068 was closed and any issues arising from the site addressed under PICA-067. The cost to complete (CTC) does not cover all MEC and MC for all the phases. Previous investigations have determined that the contaminants of concern are metals, Semi-Volatile Organic Compounds (SVOCs), pesticides and Polycyclic Aromatic Hydrocarbons (PAHs). Contaminated soil will be removed from the site and potential groundwater concerns addressed under PICA-206. It is unknown whether the metals are linked to MC.*

#### **4.3.2 HRR Site Findings**

The Dredge Pile and Former Sanitary Landfill sites are located in the southernmost portion of the installation. The sites lie between Parker Road and Spicer Avenue, north and northwest of the main entrance to the installation on Parker Road off of Route 15. The July 2006 Draft Final Record of Decision (ROD) for the sites states that the Former Sanitary Landfill covers

an area of approximately 9 acres (PTA.TO17.0113B). The Dredge Pile covers approximately 1.8 acres, but lies entirely within the limits of the Former Sanitary Landfill as shown in Figure 4-7. Together, the sites cover a total of approximately 9 acres. A detailed aerial photograph showing the site boundaries and surrounding area is shown on Map 4-3. As indicated in Figure 4-7 and Map 4-3, the limits of the Sanitary Landfill shown in the July 2006 Draft Final ROD cover a slightly larger area than the boundaries included in the Phase 3 Inventory report. As shown, the area covered by the landfill has expanded to 13 acres.



**Figure 4-7: Map of Former Sanitary Landfill (Site 25) and Dredge Pile sites (Site 26)**

As shown in Map 4-3, the site is partially collocated with the SDZ for an operational range. As such, the portion of the site that is overlain by the SDZ normally would not be eligible for inclusion in the MMRP if a release of MEC or MC occurred after September 2002.

However, the SDZ is associated with a burning ground and as documented in numerous discussions with PTA personnel (PICA00211, PICA0023, PICA00225), the activities conducted at the burning ground since September 2002 reportedly present no potential for releases of MEC and/or MC to the SDZ. Engineering controls are reported to be utilized at the site boundary to prevent the release of MEC and/or MC outside of the operational burning ground boundary. Additionally, the burning ground is reportedly utilized to burn bulk explosives and to remove explosives contamination from equipment; all burning activities reportedly take place on pans. Therefore, the portion of the Dredge Pile and Former Sanitary Landfill site collocated with the SDZ for the burning ground will be evaluated further within the MMRP.

As indicated in the Phase 3 Inventory report, no range activities were identified to have occurred at the Dredge Pile or Former Sanitary Landfill sites. However, both sites have been documented as areas in which MEC were reportedly disposed (PTA.D&M.0037; PTA.TO17.0113B). An in-depth history of these sites has been presented in various documents as the sites progressed through the IRP (*e.g.*, PTA.D&M.0001, PTA.D&M.0003, PTA.D&M0035, PTA.D&M.0037; PTA.TO17.0053C, PTA.TO17.0086D, PTA.TO17.0113B). A summary of this history of site use is presented here.

The 2006 Draft Final ROD for the sites states that various types of waste were disposed of in the landfill from the 1940s through the early 1970s (PTA.TO17.0113B). The landfill did not appear on any of the historical maps available for review. The landfill is shown on maps enclosed in the various reports in which it is discussed. The wastes disposed of in the landfill were reported to include rubbish, industrial wastes, sewage treatment plant sludge, and MEC. In interviews conducted with PTA personnel and contractors, it was noted that MEC were identified during trenching operations while excavating through the landfill site in order to place a utility line (PTA.D&M.0037; PICA00225). No other information was available to suggest how, when, or what types of MEC were disposed. However, an explosive, nitrocellulose, was found in several samples from soil and groundwater collected from the sanitary landfill (PTA.D&M.0037). The 1989 SI Report states that the landfill was closed in

1972 and capped (PTA.D&M.0001). None of the documents reviewed show or discuss the limits of the cap reportedly installed at the landfill in 1972.

The 2006 Draft Final ROD states that the Dredge Pile “consists of an irregularly shaped pile of sediments dredged from portions of GPB [*Green Pond Brook*].” The 2006 IAP reports that material was dredged from a stretch of GPB adjacent to the Former DRMO Yard (This is the Green Pond site which is discussed further in Section 4.7) and from a stretch of stream in the Lower Burning Ground (which is an operational range area) (PICA00205). The Phase 3 Inventory report stated that material was also dredged from Bear Swamp Brook and may have contained MEC. The Draft Final Phase I RI Report for Study Area C states that the dredging was conducted to remove shells found in Green Pond Brook. In addition, nitrocellulose was found in soil samples collected from the dredge pile (PTA.D&M.0037). Material was piled to a height of 15 to 20 feet above the surrounding grade at the site, and the terrain is hummocky. It is estimated in the 2006 Draft Final ROD that the Dredge Pile contains approximately 12,000 cubic yards of sediment removed from Green Pond Brook.

It should be noted that although it has been indicated that MEC was present in the dredge spoils from Green Pond Brook, there is no evidence that MEC was present in the dredge spoils from Bear Swamp Brook. The PTA personnel and PTA contractors that oversaw this dredging operation did not recall there being any MEC present in the materials removed from Bear Swamp Brook (PICA00214, PICA00225).

Given the use of the site as a landfill, numerous investigations of the area have been completed. These investigations are summarized in the 1998 Phase 1 RI report (PTA.D&M.0037). Additionally, numerous studies have been completed as part of the IRP. A selection of the various investigations is summarized in Table 4-1.

**Table 4-1. Selected Previous Investigations Conducted at the Former Sanitary Landfill Site**

Year	Type of Investigation	Results*
1981-1984	Groundwater sampling	Metals were detected in groundwater.
1986	Geophysical survey (including seismic-refraction, electric resistivity, and electromagnetic conductivity)	Top of bedrock surface was identified at 375 to 450 feet above mean sea level. Elevated conductivity values were interpreted as conductive sediments or contaminated groundwater near the ground surface. The landfill area was identified as an anomalous area.
1988	SI (groundwater, surface water/sediment)	<b>Groundwater:</b> Explosives and metals were detected. <b>Surface water:</b> Metals detected (may be due to upstream sources). No explosives detected. <b>Sediment:</b> Metals detected. No explosives detected.
1998	RI (geophysical survey, ground-water, surface and subsurface soil)	<b>Groundwater:</b> Explosives and metals detected in the upper and lower aquifers. <b>Surface soil:</b> Explosives and metals detected. <b>Subsurface soil:</b> Explosives and metals detected. <b>Geophysical:</b> Numerous ferrous anomalies were identified throughout the landfill. Seven areas were excavated. Metal items consisted of refuse (no munitions were identified).

\* - The analytical results discussed are limited to those applicable to the MMRP (i.e., metals, explosives, and propellants). In most cases, a number of other analytes were also investigated.

Numerous investigations have also been conducted that focused specifically on the Dredge Pile. These studies are summarized in Table 4-2.

**Table 4-2: Selected Previous Investigations Conducted at the Dredge Pile Site**

Year	Type of Investigation	Results*
1984	Soil sampling	Metals detected (explosives were not analyzed).
1988	SI (groundwater, surface soil, surface water/sediment)	Surface soil: Metals were detected. No explosives detected. Surface water: Metals detected (may be due to upstream sources). No explosives detected. Sediment: Metals detected. No explosives detected.
1991	RI (surface and subsurface soil)	Explosives were detected in one sample. The depth at which the sample was collected was not available. Metals were detected in numerous samples.
1998	RI (geophysical survey, ground-water, surface and	<b>Groundwater:</b> Explosives and metals detected in the upper and lower aquifers.

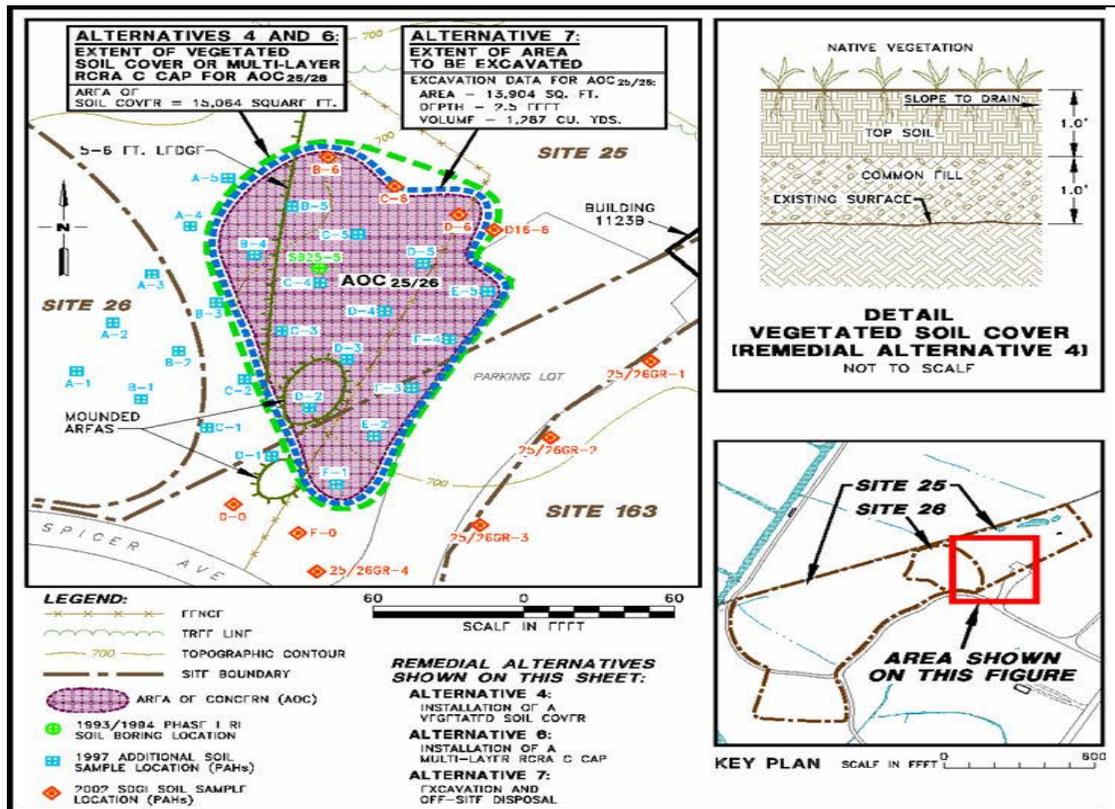
Year	Type of Investigation	Results*
	subsurface soil)	<p><b>Surface soil:</b> Explosives and metals detected.</p> <p><b>Subsurface soil:</b> Explosives and metals detected.</p> <p><b>Geophysical:</b> Numerous ferrous anomalies were identified throughout the landfill. Seven areas were excavated. Metal items consisted of refuse (no munitions were identified).</p>

\* - The analytical results discussed are limited to those applicable to the MMRP (i.e., metals, explosives, and propellants). In most cases, a number of other analytes were also investigated.

A number of additional studies have been completed at the sites subsequent to the completion of the 1998 RI report. All of these studies focused on evaluating the final disposition of the Former Sanitary Landfill and Dredge Pile sites within the IRP. As of the 1988 SI report, the landfill has been referred to as “Site 25,” while the Dredge Pile has been referred to as “Site 26.” Within the 2006 Installation Action Plan (IAP), Sites 25 and 26 are referred to as PICA-067 and PICA-068, respectively. Given that the Dredge Pile is located completely within the limits of the Former Sanitary Landfill, the sites were combined and evaluated together. The studies include the *Feasibility Study for Site 25/26* completed in March 2003, the *Proposed Plan for Site 25/26 Soil* completed in November 2004, and the Draft Final ROD report completed in July 2006 (PTA.TO17.0053C; PTA.TO17.0086D). It should be noted that the Dredge Pile site (Site 26, PICA-068) is considered Response Complete under the IRP because the site has been combined with the landfill site (Site 25, PICA-067) and therefore will be addressed with the landfill.

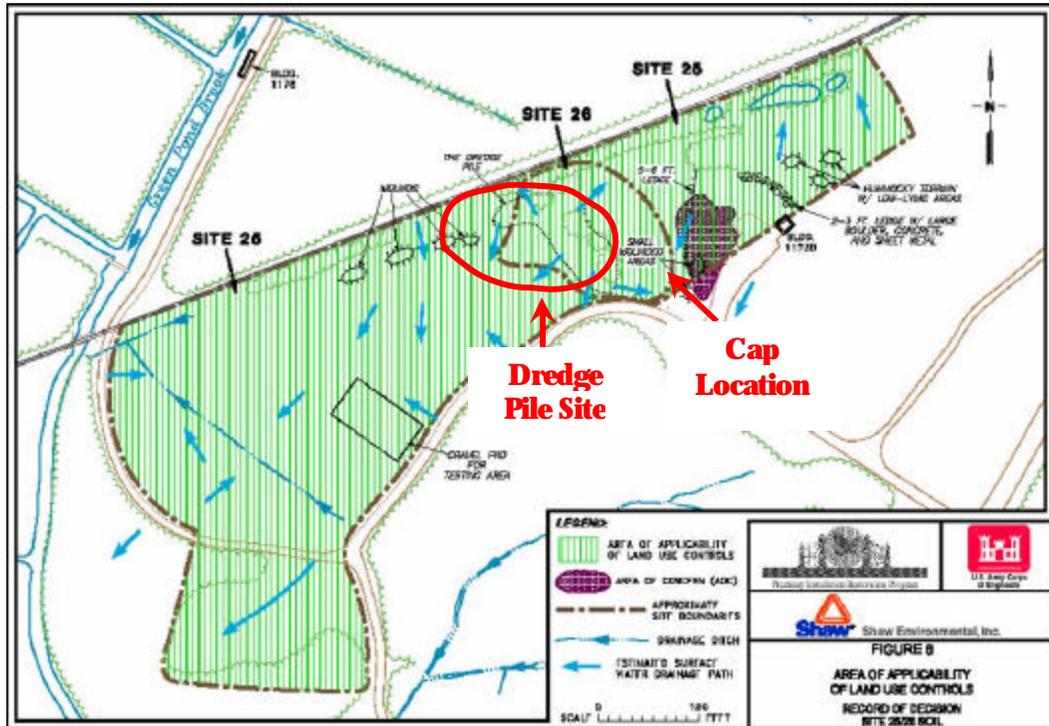
As discussed in the 2006 Draft Final ROD, the chosen remedy for MC in soils at the Dredge Pile and Former Sanitary Landfill site includes placing a vegetative cover over a small portion of the landfill where impacted surface soils were identified. As shown in Figure 4-8 and Map 4-3, the area over which a vegetative cover will be placed covers approximately one acre of the total 13 acre Sanitary Landfill and Dredge Pile site and lies to the east of the limits of the Dredge Pile site. The chosen remedy for this site also includes land use

controls<sup>5</sup> over the entire site (Figure 4-9). As previously stated, the landfill was closed and capped in 1972. The dredge pile is reported to have been placed on top of the landfill, some time after the cap was installed, and piled 15 to 20 feet above the surrounding grade. Maps contained in the Draft Final ROD show the area as a localized topographic high. The long-term operation and maintenance of the entire site, along with the performance of five-year reviews (in accordance with CERCLA and the NCP) are included as part of the July 2006 Draft Final ROD. The 2006 Draft Final ROD specifically indicates that hazards associated with “UXO will be addressed by [the] Military Munitions Response Program under a separate ROD.” As such, the entire Dredge Pile and Former Sanitary Landfill Site will be carried through the MMRP.



**Figure 4-8: Map from the July 2006 Draft Final ROD showing the location and design of the vegetative cover**

<sup>5</sup> Note that whenever institutional controls are referenced, the enforcing authority is the installation commander.



**Figure 4-9: Map from the Draft Final ROD (July 2006) showing the area in which land use controls are the chosen remedy.**

### 4.3.3 Summary of HRR Changes

The Dredge Pile and Former Sanitary Landfill site was originally included in the Phase 3 Inventory and covered an area of approximately 9 acres. Based on information obtained during research for this HRR, the acreage of the Dredge Pile and Former Sanitary Landfill has increased to 13 acres. Research conducted as part of the HRR indicates that the landfill was active from the 1940's to 1972. No specific information was available to indicate when munitions might have been disposed. The dredge pile was put in place in 1982. No information was available to indicate which specific munitions types might be encountered at the Dredge Pile site. According to the 2006 Draft Final ROD, the selected remedy for MC in soils at the Dredge Pile and Former Sanitary Landfill site includes placing a vegetative cover over a small portion of the landfill where impacted surface soils were identified. Therefore,

MC is covered under the IRP. MEC is not; however, and the total area to be carried forward for MEC and included in the MMRP for this MRS is 13 acres.

**Map 4-3: Dredge Pile and Former Sanitary Landfill**

#### **4.4 FORMER DRMO YARD AND FORMER BURNING GROUND (PICA-007-R-01)**

##### **4.4.1 Phase 3 Inventory Site Description**

This site was presented in the Phase 3 Inventory report under the name DRMO Yard. The designation “former” was added to the DRMO Yard, and the site was combined with a collocated former burning ground that was identified during the HRR. The description of the Former DRMO Yard contained in the Phase 3 Inventory report states:

*This site is believed to be associated with the storage and disposal of munitions. The yard is a closed site that contains five buildings and occupies two acres. It is located on the southwestern portion of the installation, just southwest of Picatinny Lake. The site was used as a storage yard for disposal, salvage and sale of excess materials. It is not known for how long the site was used. Materials used in the manufacture and testing of explosives, pyrotechnics and munitions were stored in this area, as well as scrap metal, used batteries, and motor vehicles. Munition types that might be found in this site include primary explosives, secondary explosives, and pyrotechnics. No documents were found to indicate any UXO investigations and/or responses were performed on the site.*

*The site is associated with a DSERT site, PICA-072. The CTC does not cover all MEC and MC for all the phases. Previous investigations have detected metals, Polychlorinated Biphenyls (PCBs) and PAHs in concentration above levels of concern in the soil. Metals were also detected in concentrations above levels of concern in the groundwater. It is unknown whether the metals are linked to MC.*

##### **4.4.2 HRR Site Findings**

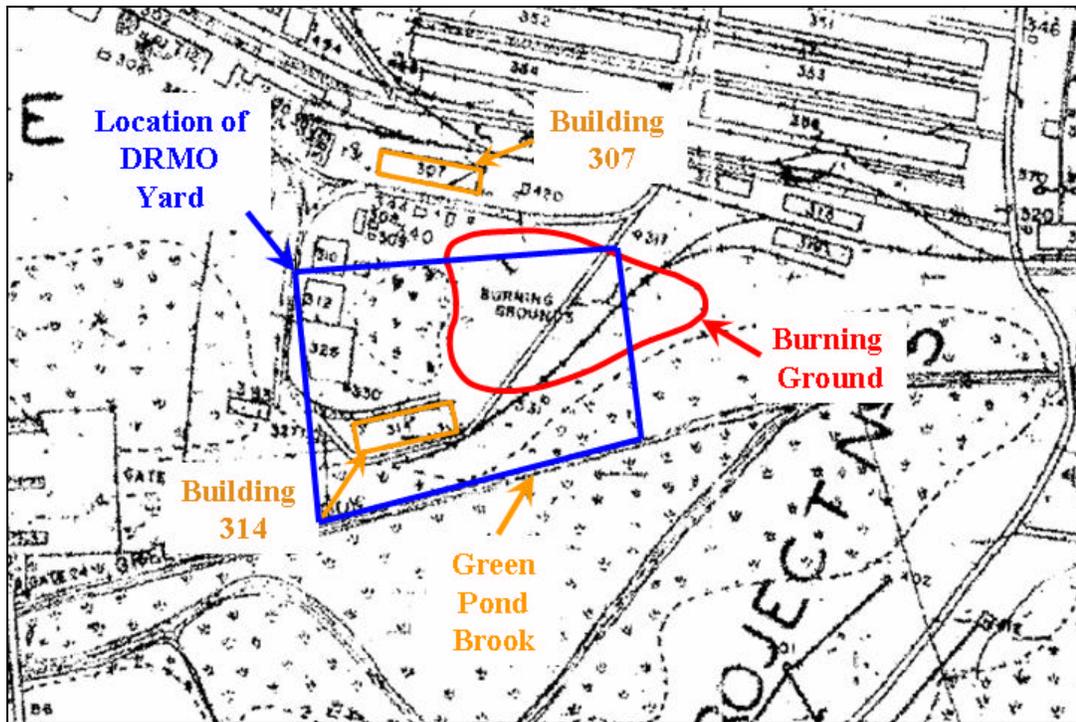
This site, which consists of the collocated Former DRMO Yard and Former Burning Ground, is located southwest of Picatinny Lake on the southern portion of the installation. It is bordered by Green Pond Brook to the east and Building 307 to the west (Figure 4-10). The site lies entirely within the limits of the 1926 Explosion Site 1-mile (1,609 meters) radius as shown on Map 6-1. During the 1989 SI at PTA, it was reported that the Former DRMO Yard was paved with asphalt; a portion of the property was surrounded by deteriorating berms (PTA.D&M.0001). The RI Concept Plan indicates that operation of the DRMO Yard began in 1955 (PTA.D&M.0004). According to maps from the 1930s and 1940s, this area was a low-lying marsh, as much of the lower portion of the installation was during this period. It is believed that the former DRMO Yard area was filled in with debris related to the 1926

explosion; however no documents were available to confirm this belief. The DRMO Yard was closed in the mid-1990s (PTA.TO17.0105D).

The Former DRMO Yard was used for the storage of unwanted materials at the installation. Various types of materials were stored there, including materials used in the manufacturing and testing of explosives, pyrotechnics and munitions; potential PCB-containing transformers; vehicles; scrap metal; batteries; and office equipment. A waste pile, containing plastic, wood, metal, and insulation debris, is located on the western portion of the site. Three buildings, Buildings 314, 314D, and 314E, are still located within the site boundaries (PTA.TO17.0105D). In addition, dumpsters that contained flashed and unflashed shells were reportedly located behind Building 314 (PTA.D&M.0040). At the time of the Phase I RI report (April 1998), the Former DRMO Yard contained tons of iron, copper wire, aluminum, and brass (PTA.D&M.0040).

In 1993, Picatinny personnel discovered buried UXO while installing a fence post in the Former DRMO Yard (PICA00099). The subsequent investigation included excavation of 14 test pits, including two adjacent to Green Pond Brook approximately 75 feet (23 meters) from Building 314. Nitrocellulose was detected in soil samples collected from these two test pits adjacent to the brook (PTA.D&M.0040). It has also been reported that in 1993 during a site walk of the Former DRMO Yard, MEC was found protruding from the banks of Green Pond Brook in the area adjacent to Building 314 (PICA00099). None of the maps reviewed during preparation of this report, or the reports in which the MEC items were discussed, showed or contained detailed locations for these items.

During research conducted for the HRR, maps showing a former burning ground near the Former DRMO Yard were obtained from PTA's historian, Dr. Owens. The Former Burning Ground is depicted on maps from 1931, 1940 and July 1944 (PICA00083; PICA00079; PICA00066). Figure 4-10 shows the location of the Former Burning Ground in reference to the Former DRMO Yard. The majority of the Former Burning Ground is collocated with the Former DRMO Yard with the exception of two small areas that fall outside the limits of the Former DRMO Yard.



**Figure 4-10: 1944 Historical Map showing the Former Burning Ground (PICA-00066)**

According to a 1921 report of a fire in the Former Burning Ground (PICA-00002), boxes of smokeless powder and TNT were typically burned in a single pit. According to an interview with the installation historian, the Former Burning Ground was probably moved to its current location near the southern end of the installation around WWII (PICA00208). The latest map depicting the Former Burning Ground is dated July 1944 (PICA00066).

Typically, a 1250-foot radius (381 meters) SDZ would be associated with a former burning ground. However during research conducted for this HRR, it was discovered that only boxes of smokeless powder and TNT were burned at the former burning ground and thus such an SDZ would not be applicable.

The Former DRMO Yard is listed under the IRP as PICA-072. Although not listed under the IRP name, the Former Burning Ground was also investigated as part of IRP PICA-072 since it is co-located with the Former DRMO Yard. Several investigations have been conducted

under the IRP to determine potential for contamination in soil and groundwater from several parameters including metals and explosives. During the 1989 SI, 10 shallow soil samples were collected from the Former DRMO Yard, five along the eastern site boundary and five along the western site boundary. The samples were collected from areas at the edges of the pavement with visible discoloration; metal fragments were also visible at many of the sample locations. The samples were analyzed for various parameters, including nitrocellulose, explosives, and metals. Analysis of these samples indicated the presence of numerous metals, including antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, and zinc, at levels exceeding the LOCs. It is likely there are numerous sources for the metal contamination since many types of waste materials, including scrap metal and batteries, were stored here. Nitroglycerine was found in one sample at a level slightly above the detection level (DL) (0.699 microgram per gram ( $\mu\text{g/g}$ ); the DL is 0.573  $\mu\text{g/g}$ ). No other explosives were detected in any of the samples (PTA.D&M.0001).

Surface water/sediment samples were also collected during the 1989 SI, including a sediment sample from the drainage ditch (which was dry at the time of sampling) and two surface water/sediment samples from Green Pond Brook. One of the samples from Green Pond Brook was an upstream sample. Analysis of these samples indicated the presence of copper in surface water at a concentration slightly above the LOC. It was noted in the SI report that numerous metals were detected upstream of this site. No explosives were found in these samples except for nitrocellulose, which was found in the upstream sediment sample only (PTA.D&M.0001).

The November 2005 FS for the Former DRMO Yard recommends a combination of three remedial alternatives (Figure 4-11) (PTA.TO17.0105D):

- Alternative S-3B: Excavation and off-site disposal of soil with PCB concentrations greater than 100 milligrams per kilogram (mg/kg)
- Alternative S-4B: Excavation and off-site disposal of lead-contaminated soil adjacent to Green Pond Brook
- Alternative S-7: Installation of an improved asphalt cap



discovered to have been located in the same area as the Former DRMO Yard. According to historic records, the Former Burning Ground was in operation up until the mid-1940s. Due to the potential presence of MEC, the Former Burning Ground has been added to this MRS. The Former DRMO Yard was in operation from the 1950s through the mid-1990s. Based on research conducted during the HRR, the area of the Former DRMO Yard was expanded to encompass Buildings 314D and 314E. According to the 2005 FS, the preferred alternative for MC at the Former DRMO Yard and Former Burning Ground involves hot spot excavation and the installation of an improved asphalt cap over six acres. Therefore, MC is covered under the IRP. MEC is not; however, and the total area to be carried forward for MEC and included in the MMRP for this MRS is 9.5 acres. Map 4-4 shows the new boundary of this MRS. As shown on Map 6-1, the site lies entirely within the limits of the 1926 Explosion Site 1-mile (1,609 meters) radius.

**Map 4-4: Former DRMO Yard and Former Burning Ground**

#### **4.5 FORMER MUNITIONS AND PROPELLANT TEST AREA (PICA-001-R-01)**

For the purposes of this HRR, the name of this site has been changed to be more consistent with the IRP site name. This site was presented in the Phase 3 Inventory report as two closed ranges, the 1000-Meter Range and the 1000-Meter Impact Range.

##### **4.5.1 Phase 3 Inventory Site Description**

The description of the 1000-Meter Impact Range contained in the Phase 3 Inventory report states:

*The 1000-Meter Impact Range is located on the upper northwest corner of the installation, across from Lake Demark. The 0.2-acre closed range was the impact area for the 1000-meter range below. The two areas are 1000 meters apart. The range is completely surrounded by A/I range area on all sides. It was used until 1975. It was probably constructed during WWII. It was used to test recoilless rifle type munitions. The munitions used at the range would have been large caliber projectiles. The area is currently undeveloped and acts as buffer area for another range nearby. No personnel are allowed on the site during testing operation at the nearby ranges B.1222 and B.670 since the site acts as a buffer zone for these ranges. No documents were found to indicate any UXO investigations and/or responses were performed on the site.*

The description of the 1000-Meter Range contained in the Phase 3 Inventory report states:

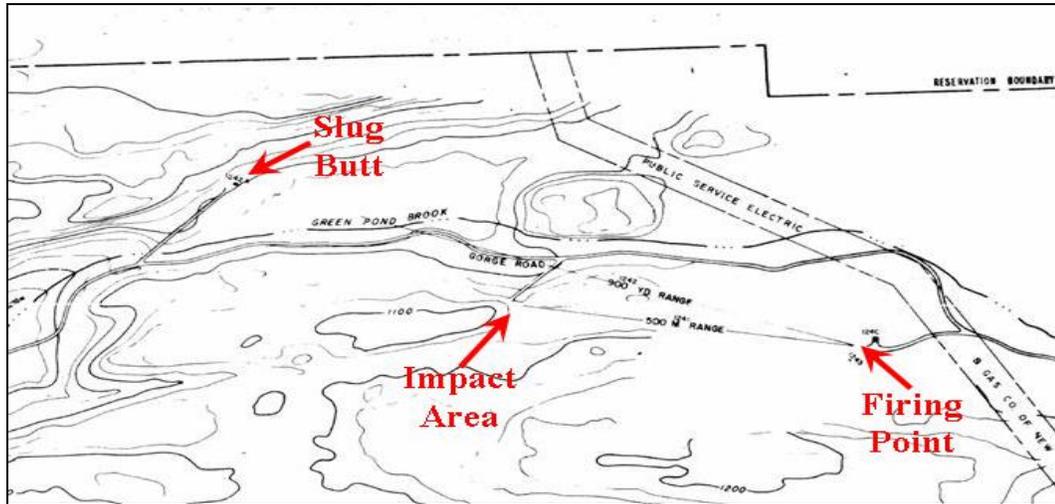
*The 1000-Meter Range is located on the upper north-central portion of the installation, across from Lake Demark. The 0.3-acre closed range was the firing point for the 1000-meter impact range above. The range is completely surrounded by active/inactive (A/I) range area on all sides. It was used until 1975. It was probably constructed during WWII. It was used to test recoilless rifle type munitions. The munitions used at the range would have been large caliber projectiles. The area is currently undeveloped and acts as buffer area for another range nearby. No personnel are allowed on the site during testing operation at the nearby ranges B.1222 and B.670 since the site acts as a buffer zone for these ranges. No documents were found to indicate any UXO investigations and/or responses were performed on the site.*

As previously discussed, at the time the Phase 3 Inventory report was completed, approximately 4,200 acres of PTA that are currently designated as other than operational range area were considered operational range areas (PICA00096; PICA00220). The firing

point and one impact area were separated by operational range and so were evaluated as two separate MRSs. Throughout the rest of this HRR and through the remainder of the MMRP, the two sites will be treated as one MRS.

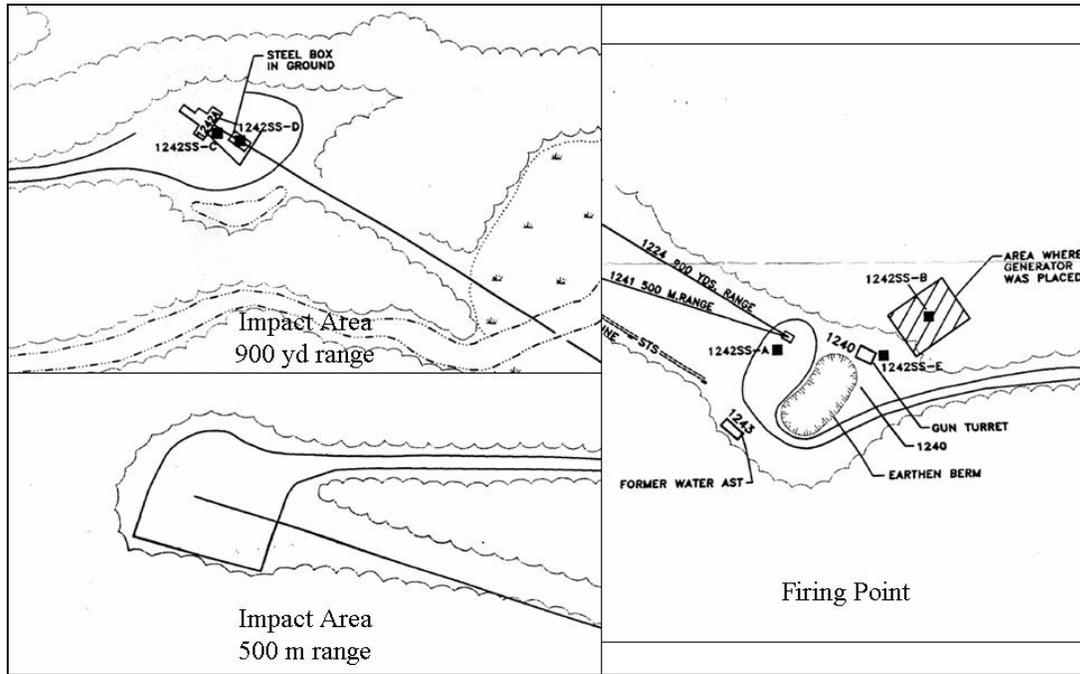
#### **4.5.2 HRR Site Findings**

The Former Munitions and Propellant Test Area is located northwest of Lake Denmark in the northern half of the installation. The range is shown on a 1972 map (Figure 4-12) and on Map 4-5 to consist of one firing point with two firing lines termed the 900-yard and 500-meter ranges (PICA00072). The firing point and impact area for the 900-yard range represent the “1000-Meter Range” and “1000-Meter Impact Range” from the Phase 3 Inventory report. The 500-meter range was not identified in the Phase 3 Inventory report because it was located within the installation’s former operational range footprint. The 500-meter range was identified to be part of the Former Munitions and Propellant Test Area during research conducted as part of this HRR. The new site boundary encompasses the firing point and both of the impact areas. Map 4-5 also shows the site to overlap a portion of the Lake Denmark MRS. The portion of the Lake Denmark MRS which is overlapped is an SDZ for a 20-mm cannon range. Since the overlapping portion of the Former Munitions and Propellant Test Area is a firing point, the overlapping portion is attributed to the Former Munitions and Propellant Test Area.



**Figure 4-12: 1972 map showing the location of the former 1000-Meter Range**

As shown in Figure 4-13 and in Map 4-5, the Former Munitions and Propellant Test Area consisted of two firing lines with buildings located at the firing point (Buildings 1240 and 1243) and at the impact area (Building 1242A) of the 900-yard range. There were no buildings shown to be associated with the impact area for the 500-meter range. At the firing point, a berm is shown along with a gun turret (Building 1240), both of which are reportedly still in place. Both of these reportedly were utilized to protect personnel during test firing operations. The RI Concept Plan, dated 1991, reported that the area was utilized as a recoilless rifle range on which large diameter projectiles were fired (PTA.D&M.0003 & 0004). An example of a recoilless rifle is shown in Figure 4-14. No additional information was available to indicate which specific weapons systems were utilized on site; however, the 57-mm M18, 75-mm M20, 90-mm M67, 105-mm M27, and 106-mm M40 recoilless rifles were all in use over the timeframe in which the Former Munitions and Propellant Test Area was reportedly in use. None of the documents reviewed discussed how the range was used (*e.g.*, for testing fuzes or propellant), the specific munitions types which were fired on the range, or how the munitions were configured (*e.g.*, high explosive or inert).

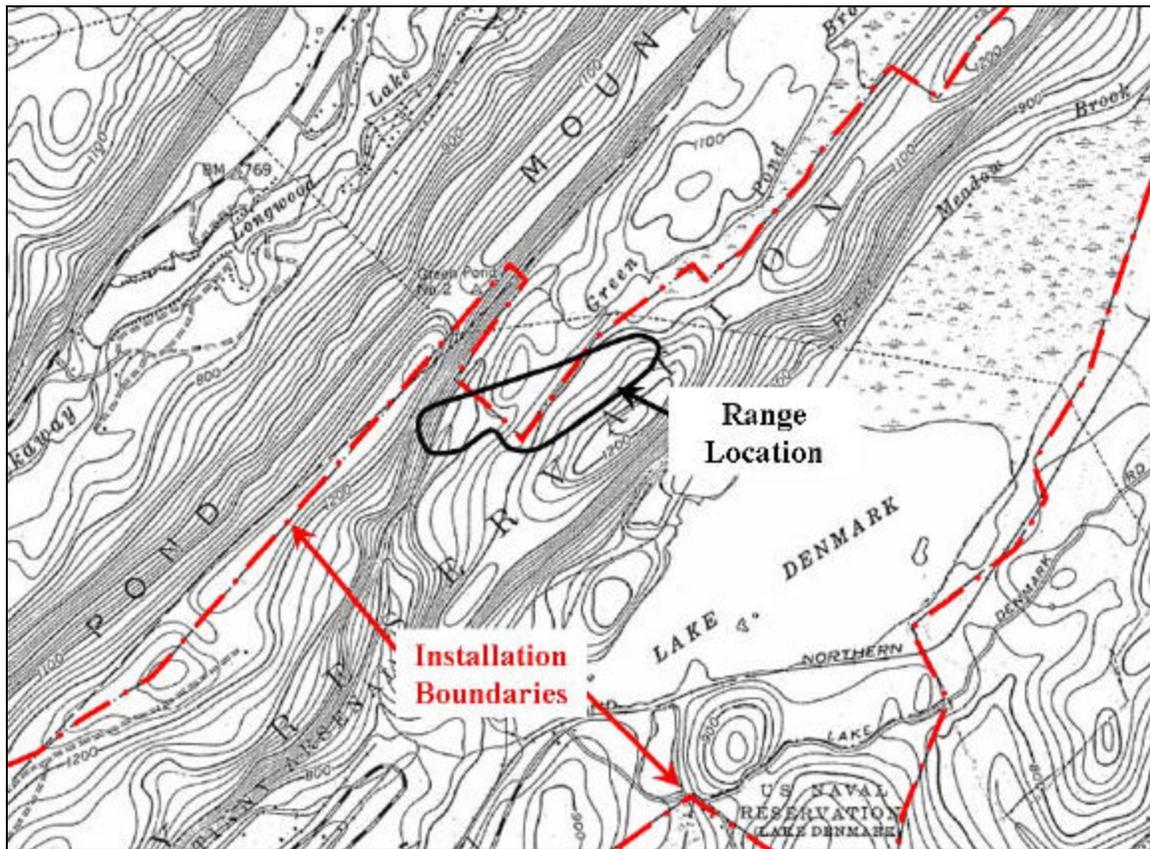


**Figure 4-13: Layout of the Former Munitions and Propellant Test Area (PTA.TO01.0013)**



**Figure 4-14: Photograph of a 75-mm recoilless rifle.**

The exact timeframe over which the range was utilized is unknown since the documents and maps available for review either do not identify the dates of use or provide contradictory dates. According to the IAP, the Former Munitions and Propellant Test Area was constructed in 1964 (PICA00205). Review of available maps and aerial photographs confirms that the range was constructed sometime between 1954 and 1970. As shown on a 1954 map (Figure 4-15), the land area occupied by the Former Munitions and Propellant Test Area had not yet been acquired by PTA. Review of aerial photos from a 1989 Environmental Photographic Interpretation Center (EPIC) study shows the area as completely undeveloped and heavily wooded in 1940 and 1951 (PICA00117). The 900-yard and 500-meter ranges are both present in a 1970 aerial photo from the EPIC study.



**Figure 4-15: 1954 map showing the approximate location of the Former Munitions and Propellant Test Area (PICA00122)**

The Phase 3 Inventory report indicates that the installation stopped utilizing the range in 1975; the 1998 PA/SI states that the range was closed in the early 1970s (PTA.TO01.0013). However, the 1989 SI report stated that as of submittal of that report, the range was still in operation and the site was not visited by the contractor because the range was in use and access was prohibited (PTA.D&M.0001 & 0002). The 1991 RI Concept Plan indicates that, as of submittal of that report, the range was no longer in operation (PTA.D&M.0003 & 0004). If the range was operational in 1989, then test firing on the range ended between 1989 and 1991.

Numerous investigations have been completed at the Former Munitions and Propellant Test Area as part of the IRP. The 2006 IAP states that the IRP site covers 37 acres (PICA00205). The limits of the IRP site are shown on Map 4-5 and are coincident with the limits of the MMRP MRS. However, as calculated using ESRI GIS software, the site covers approximately 25 acres. As stated in the 2006 IAP and discussed in the 1998 PA/SI, five surface soil samples were collected throughout the site for the 1998 investigation (PTA.TO01.0003). Three of these samples were collected from the firing point. Figure 4-13 also shows that two samples were collected from the impact area for the 900-yard range, but that none were collected from the impact area for the 500-meter range. The 500-meter impact area was not sampled because it could not be located. All samples were analyzed for explosives, volatile organic compounds (VOCs), SVOCs, pesticides/PCBs, anions, and metals. Only cadmium was detected above the NJDEP residential soil cleanup criteria (at location 1242SS-B at a concentration of 1.2 mg/kg, location 1242SS-D at a concentration of 1.2 mg/kg, and location 1242SS-E at a concentration of 1.3 mg/kg). These concentrations did not exceed the NJDEP industrial criteria. No other metals or any anions were detected at concentrations that exceeded any of the applicable criteria to which they were compared. Explosives, VOCs, SVOCs, and pesticides/PCBs were not present in detectable concentrations in any of the remaining samples analyzed. The 1998 PA/SI recommended no further action for the site. However, there was no discussion of whether the area was ever investigated for MEC.

Additionally, a Screening Level Ecological Risk Assessment (SLERA) was completed for the site (PTA.TO17.0100B). The report stated, “Though a potential risk should be acknowledged within the RI report, based on the limited amount of contamination and the relatively low concentrations, additional Ecological Risk Assessment investigations are not warranted for Site 7.” U.S. Environmental Protection Agency (USEPA) comments on the SLERA indicated that “if...*[there were no exceedances of residential LOCs]*...the site would be appropriate for NFA for unrestricted use” (PTA.TO17.0104B). Again, this report does not discuss whether the area was ever investigated for MEC.

None of the PTA personnel interviewed that were familiar with MEC finds at the installation were aware of any MEC being identified in the area of the Former Munitions and Propellants Test Area (PICA00209, PICA00210, PICA00211, and PICA00212). None of the EOD incident reports available for review discussed the area. There has been no development in the area and it is reported to be remote and difficult to reach.

#### **4.5.3 Summary of HRR Changes**

The Former Munitions and Propellants Test Area was included in the Phase 3 Inventory report as two separate ranges (1000-Meter Range and 1000-Meter Impact Range). At the time the Phase 3 Inventory report was prepared, these two ranges were separated by operational range area. Due to the subsequent change to the installation’s operational range footprint, the entire area encompassed by range activities could be consolidated into one MRS. The two former ranges have been combined and included as the Former Munitions and Propellants Test Area under the Army Environmental Database – Restoration (AEDB-R) ID PICA-001-R-01 (formerly the 1000-Meter Impact Range). The 1000-Meter Range (AEDB-R ID PICA-002-R-01) is considered RC under the MMRP. Due to the change in the operational range footprint, the site has expanded from the 0.4 acres included in the Phase 3 Inventory to 25 acres which encompasses PICA-001-R-01 and PICA-002-R-01. Research conducted as part of the HRR indicates that the range was utilized from 1964 to sometime between 1989 and 1991 for firing recoilless rifles. No information was available to indicate the specific weapons systems utilized, but the recoilless rifles available for use over the timeframe in which the range was reportedly in use include the 57-mm M18, 75-mm M20,

90-mm M67, 105-mm M27, and 106-mm M40 recoilless rifles. As detailed in the PA/SI, no further action for MC was recommended for this site. Therefore, this site will be carried forward in the MMRP for MEC only.

**Map 4-5: Former Munitions and Propellant Test Area**

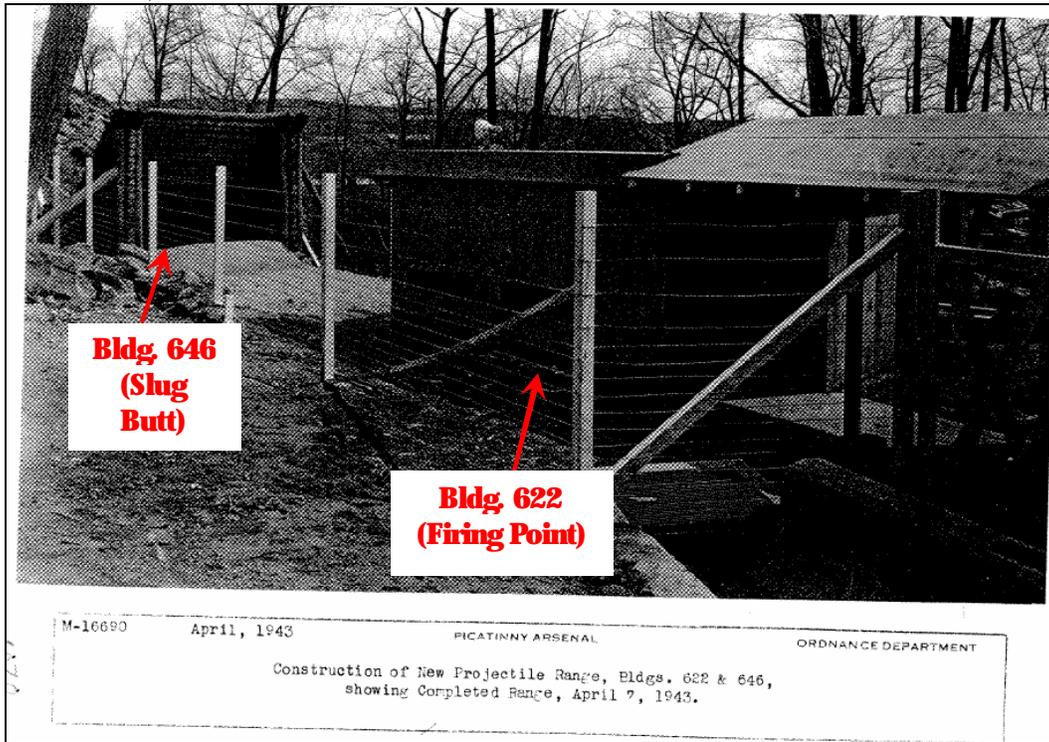
## **4.6 FORMER PROJECTILE RANGE**

### **4.6.1 Phase 3 Inventory Site Description**

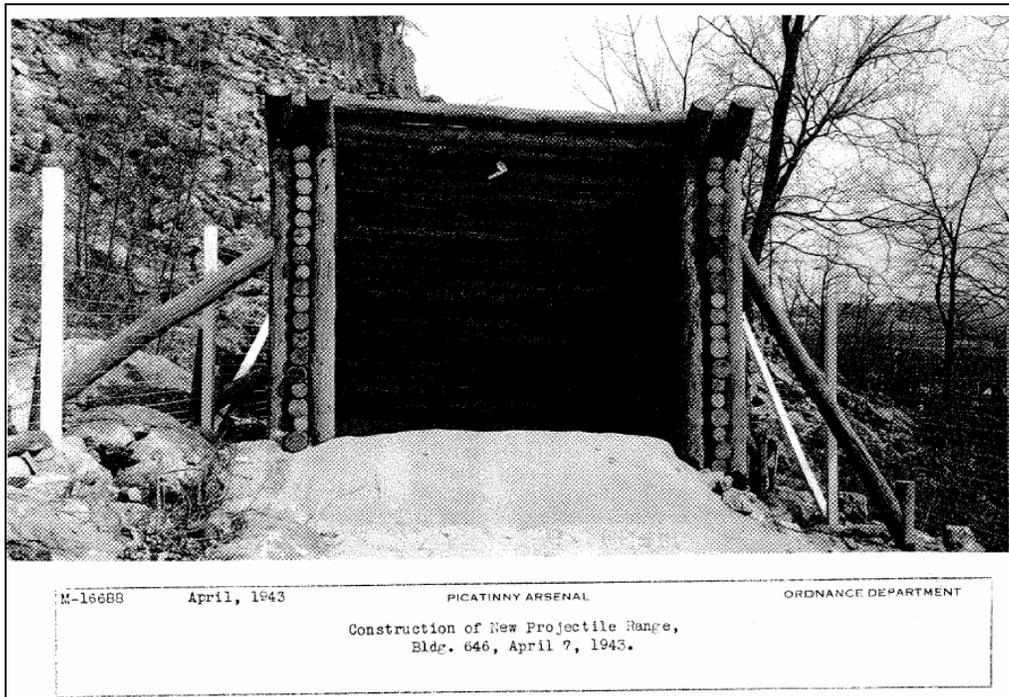
As previously discussed, almost 4,200 acres of previously operational range area were re-categorized as other than operational range area. The Former Projectile Range was located within operational range area at the time of completion of the Phase 3 Inventory report and so was not included as part of the Inventory report. The site was identified through research conducted while preparing this HRR report and lies within a portion of the installation newly characterized as closed range area.

### **4.6.2 HRR Site Findings**

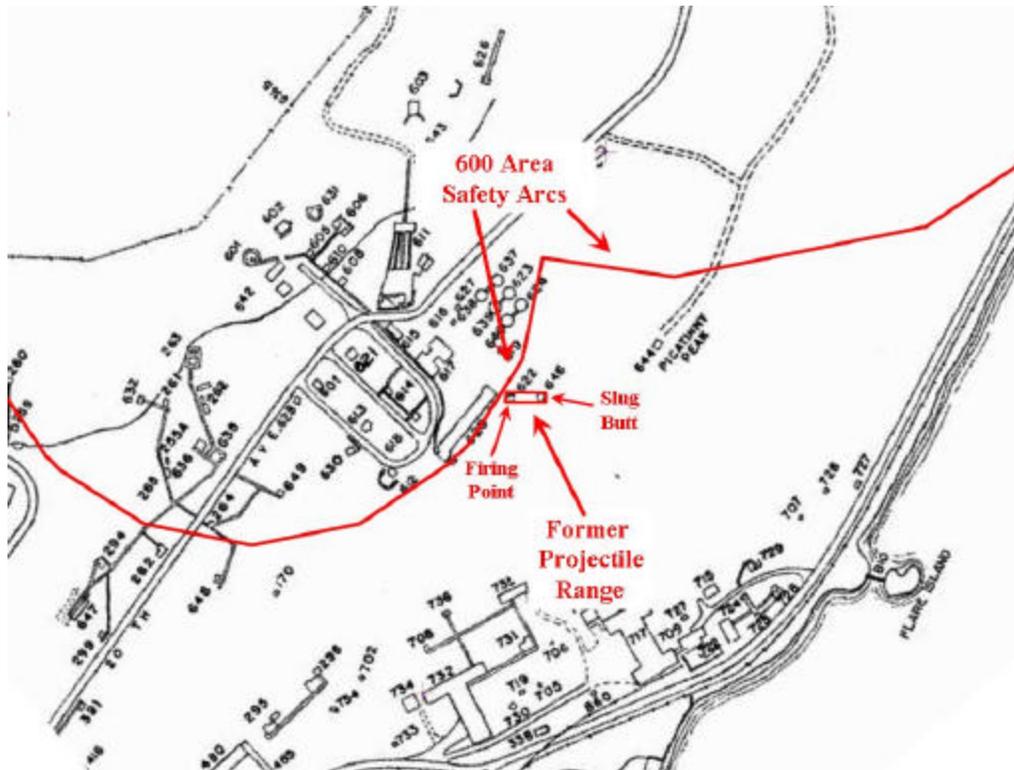
As shown on Map 4-6, the Former Projectile Range is located west of Picatinny Lake and just west of Picatinny Peak in the 600 Area of the installation. The site lies entirely within the limits of the 1926 Explosion Site 1-mile (1,609 meters) radius as shown on Map 6-1. The range was first identified in a 1943 memorandum documenting construction activities that took place on the installation between January 1, 1942, and April 1, 1943 (PICA00139). As shown in Figure 4-16 and Figure 4-17, the range consisted of a covered firing point (Building 622) and a slug butt (Building 646), with firing on the range directed from west to east. Construction of the range was reportedly completed by April 1943 (PICA00139). As shown on Figure 4-18, the range is located just outside of the current SDZ associated with the Building 604F operational range. The former range encompasses less than an acre. 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.



**Figure 4-16: Photograph of the completed projectile range showing the firing point and slug butt**



**Figure 4-17: Photograph of Building 646, which was the slug butt for the Former Projectile Range**



**Figure 4-18: 1946 map of the 600 Area showing the Former Projectile Range (Buildings 622 and 646) (PICA00082)**

As previously indicated, the range was constructed in 1943 for use as a projectile range. No documents were identified to indicate the specific munitions types that were utilized on the range. However, the presence of the slug butt, its type of construction, and its proximity to the firing point (less than 100 feet (30.5 meters) downrange), suggest that larger diameter projectiles would not have been fired. Additionally, the apparent height of the structure in which the firing point was located would have limited the types of weapons that could have been used on the range. The memorandum in which the range was first identified notes the use of a 155-mm Howitzer, a 40-mm anti-aircraft gun, and a 3-inch anti-aircraft gun on surrounding ranges (PICA00139). Given the height limitation of the building the firing point was located in, and the short distance between the firing point and the target butt, it is assumed that the range would have been utilized for testing smaller diameter projectiles, such as 20-mm, 37-mm, and 40-mm (as opposed to 155-mm or 175-mm projectiles).

A document discussing activities that took place on the installation from October 1, 1944, to December 31, 1944, refers to the site numerous times as a rocket range and describes flame

proofing timbers in the "...rocket range, Building No. 622" (PICA00060). No documents were available that discuss specific munitions utilized on the range or the manner in which the range was utilized for test firing rockets. It is assumed that rockets would have been fired into the slug butt since, as shown in Figure 4-18, the slug butt is located at the base of Picatinny Peak. If the range was used to test fire rockets in this manner, the items would not have been explosively configured or they would have risked destroying the target butt. Thus the items would have been completely inert or configured with a fuze and spotting charge. If the items had been explosively configured, they could have destroyed the slug butt after one or a few test firings. The other alternative is that the range was used for static testing of rockets, in which case items would have been locked in place and fired in order to test the propellant without actually firing the item.

Buildings 622 and 646 are shown on numerous historical maps, but were not discussed in any of the other documents reviewed. The buildings are present on maps dated 1944 and 1949 and on an aerial photo from 1951 (PICA00066; PICA00070; PICA00117). The next available document that shows the area is an aerial photo dated 1963 (PICA00117). This photo shows that the buildings are no longer present and that the area is overgrown with trees or underbrush, indicating that the range was last utilized sometime between 1951 and 1963.

The Former Projectile Range is shown to be within the limits of RI Concept Site 155 on Plate 1, included as part of the 1991 RI Concept Plan, Volume 2 within the limits of Area M (PTA.D&M.0004). However, the 2006 IAP states that the area of concern was limited to Building 620 (shown in Figure 4-18) (due to activities which take place within the building), which is still utilized (PICA00205). The original site boundary appears to have been arbitrarily drawn to encompass too large an area. Therefore, although Building 620 was determined to be ineligible for the IRP based on activities which occur within the building, the Former Projectile Range was determined to be an MRS within the MMRP.

None of the PTA personnel interviewed that were familiar with MEC finds at the installation were aware of any MEC being identified in the area of the Former Projectile Range (PICA00209, PICA00210, PICA00211, and PICA00212). None of the EOD incident reports

available for review discussed the area. There has been no development in the area since the buildings were removed from the site. The date these buildings were removed is unknown.

#### **4.6.3 Summary of HRR Changes**

The Former Projectile Range was identified during research conducted while preparing this HRR and was not included in the Phase 3 Inventory report. The site covers less than one acre and was constructed in 1943. The range may have been utilized as late as 1963, but a specific date for closing the range was not identified. Information on specific munitions types utilized on the range was not available. However, the range was described as both a projectile and a rocket range. Munitions potentially utilized could include various smaller diameter projectiles (20-mm to 40-mm) and rockets that may have been tested statically. Given that the slug butt was constructed with timber, it is unlikely that the items fired would have been explosively configured, but they may have contained a fuze and spotting charge. This site is being carried forward for MC and MEC in the MMRP.

### Map 4-6: Former Projectile Range

## **4.7 GREEN POND SITE (PICA-005-R-01)**

### **4.7.1 Phase 3 Inventory Site Description**

This site is listed in the Phase 3 Inventory report as the Bear Swamp/Green Pond Site. However, as described below, there is no evidence that Bear Swamp should be considered part of this site; therefore, the name has been changed in the HRR to the Green Pond Site. The description of the Bear Swamp/Green Pond Site contained in the Phase 3 Inventory report states:

*These are two connected sites where unexploded munitions have been found. They are treated as one site for administrative purposes. The site is located on the southwestern corner of the installation, to the west of the DRMO yard. The site occupies eight acres. Munitions types that might be in the site or have been found there include rifle grenades, and large and medium caliber ammunition. Unexploded munitions have been found in both areas during site investigations. It is not clear why munitions would be found there; it could have been a range, a disposal area or a storage area. The period of use is also unknown, but it is suspected to have been used during WWII. UXO clearance is required before dredging and sampling events. The areas are not being currently used except for a southern corner of Green Pond Brook near Picatinny Lake that is used for fishing. No documents were found to indicate any UXO responses were performed on the site.*

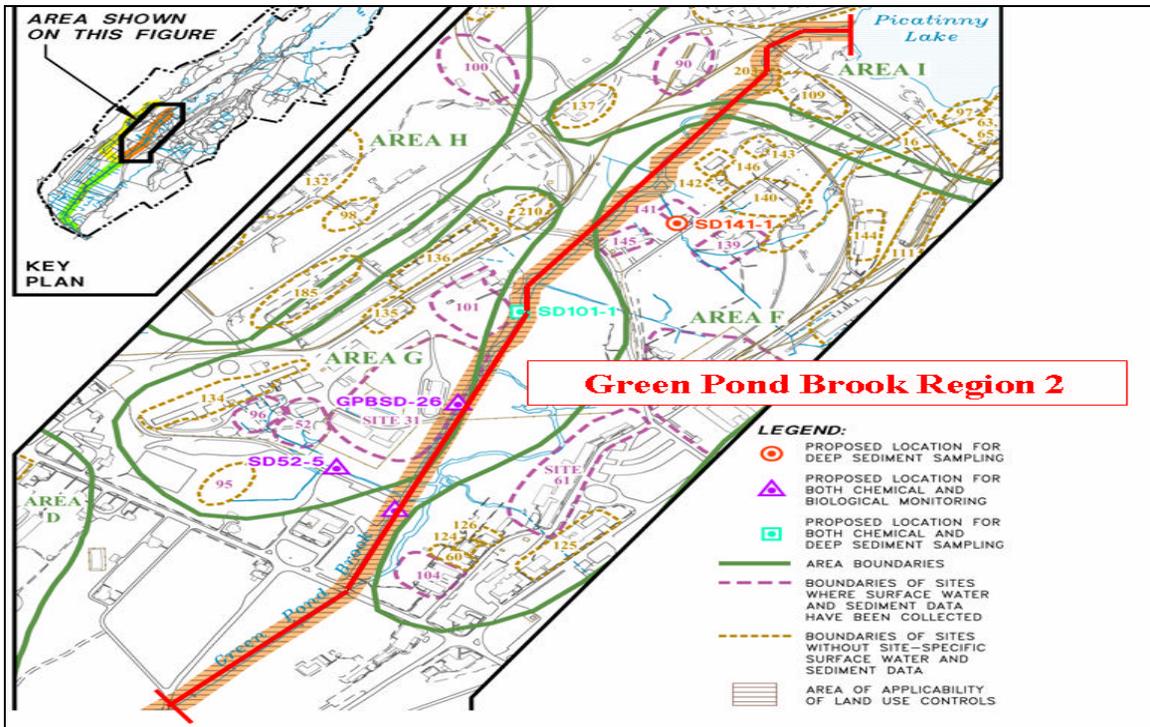
*The site is associated with two DSERT sites, PICA-193 and PICA-194. PICA-194 was combined with PICA-193 and both are being addressed under PICA-193. The cost to complete (CTC) does not cover all UXO, DMM, and MC for all the phases. Various investigations have taken place at the site since 1983. During the last investigation in 1999, the concentrations of VOCs, pesticides, SVOCs, PCBs, explosives, and metals exceeded levels of concern for surface waters. The concentrations of VOCs, SVOCs, PCBs, pesticides and metals exceeded the levels of concern for sediments. Contaminated sediments are to be dredged. It is unknown whether the metals are linked to MC.*

### **4.7.2 HRR Site Findings**

Note that in Section 4.7.1 it is incorrectly stated that Green Pond is located west of the Former DRMO Yard; it is actually located to the east. In the Phase 3 Inventory report, Bear Swamp Brook was also included as part of this site since it was reported that dredged material from both brooks was used to create the Dredge Pile. However, no documentation

was found to indicate that Bear Swamp Brook has ever been dredged. Additionally, the site was visited on a windshield tour of the installation by Malcolm Pirnie. The area reportedly dredged is a heavily vegetated swampy area with mature trees that does not show any signs of being dredged. Bear Swamp Brook has no evidence of MEC being present, so will not be included in this site and is removed from further discussion in this HRR.

Green Pond Brook is an IRP Site listed under PICA-193. It was combined with Bear Swamp Brook for the purpose of the IRP. Green Pond Brook is approximately 22,400 linear feet (6,828 meters) and flows from the outfall of Picatinny Lake through the center of the installation in a southwest direction (PTA.TO17.0089C). The site lies entirely within the limits of the 1926 Explosion Site 1-mile (1,609 meters) radius as shown on Map 6-1. The upper and lower reaches were divided into two study areas under the IRP. The Green Pond MRS falls within Region 2 of the IRP site and is located immediately adjacent to the Former DRMO Yard. As shown on Figure 4-19, Region 2 of Green Pond Brook runs from the outfall of Picatinny Lake to the confluence of Bear Swamp Brook.

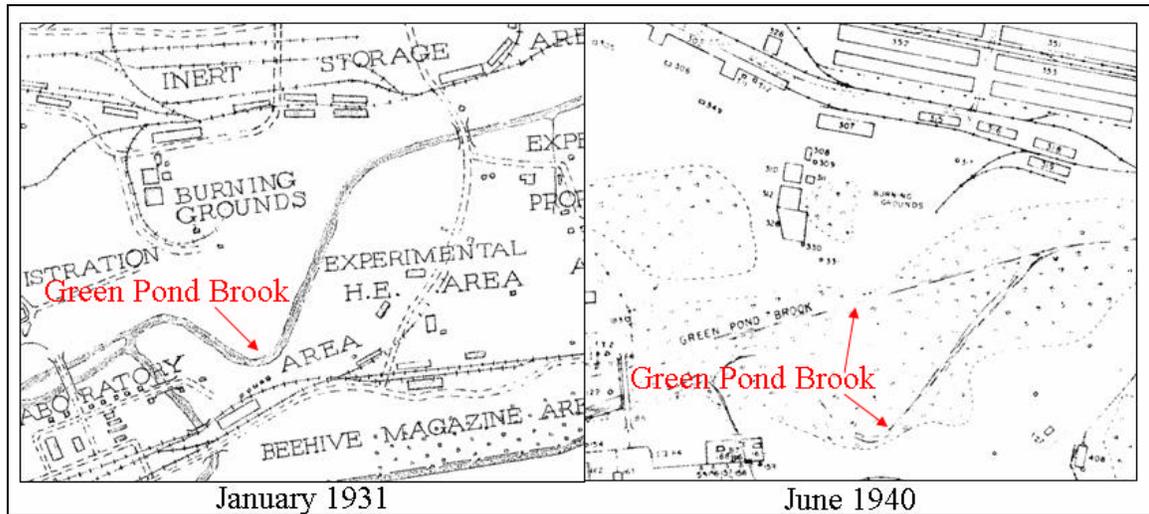


**Figure 4-19: Map of Green Pond Brook Region 2 from the 2005 Final ROD (PTA.TO17.0089C)**

As stated in Section 4.4.2, Picatinny personnel discovered buried UXO while installing a fence post in the Former DRMO Yard (PICA00099). The subsequent investigation included the excavation of two test pits adjacent to Green Pond Brook. Nitrocellulose was detected in soil samples collected from these two test pits adjacent to the brook (PTA.D&M.0040). It has also been reported that in 1993 during a site walk of the Former DRMO Yard, MEC was found protruding from the banks of Green Pond Brook in the area adjacent to Building 314 (PICA00099).

According to IRP documents, Green Pond Brook in Region 2 has been altered through channelization to alleviate sedimentation and drainage problems in this area of the installation (PTA.TO17.0089C). A 1931 map shows Green Pond Brook in its original

configuration in the area adjacent to the Former DRMO Yard and Former Burning Ground (PICA00083). In contrast, a 1940 map shows the straight channel of Green Pond Brook in this same area (PICA00079). The exact year of the channelization of Green Pond Brook is unknown. Figure 4-20 shows the 1931 and 1940 maps of Green Pond Brook.



**Figure 4-20: 1931 and 1940 Maps of Green Pond Brook (PICA00079 and PICA00083)**

Dredging of Green Pond Brook took place in the winter of 1982. Approximately 17,300 square yards of Green Pond Brook's stream bed was removed to alleviate drainage problems in the areas below Picatinny Lake (PICA00103). According to the RI Concept Plan, PTA personnel reported that the Dredge Pile was material from the dredging of Green Pond Brook (PTA.D&M.0004; PICA00205).

Numerous investigations conducted under the IRP indicate the presence of copper in sediments of Green Pond Brook in the vicinity north of the Former DRMO Yard. No explosive compounds were detected above LOCs in surface water and sediment samples in this same region.

According to the 2005 Final ROD for Green Pond Brook, the IRP remedies selected for Region 2 are chemical and biological monitoring, as well as land use controls (PTA.TO17.0089C).

### **4.7.3 Summary of HRR Changes**

The acreage of the Green Pond MRS has changed from 8 acres to 1.4 acres. There is no evidence that Bear Swamp Brook has any MEC or MC issues associated with it thus the acreage for this site has been removed from the MRS. MC for Green Pond is addressed under the IRP. However, MEC is not and will be carried forward in the MMRP. Map 4-7 depicts the new boundary of the Green Pond MRS.

## Map 4-7: Green Pond Site

## **4.8 INACTIVE MUNITIONS WASTE PIT**

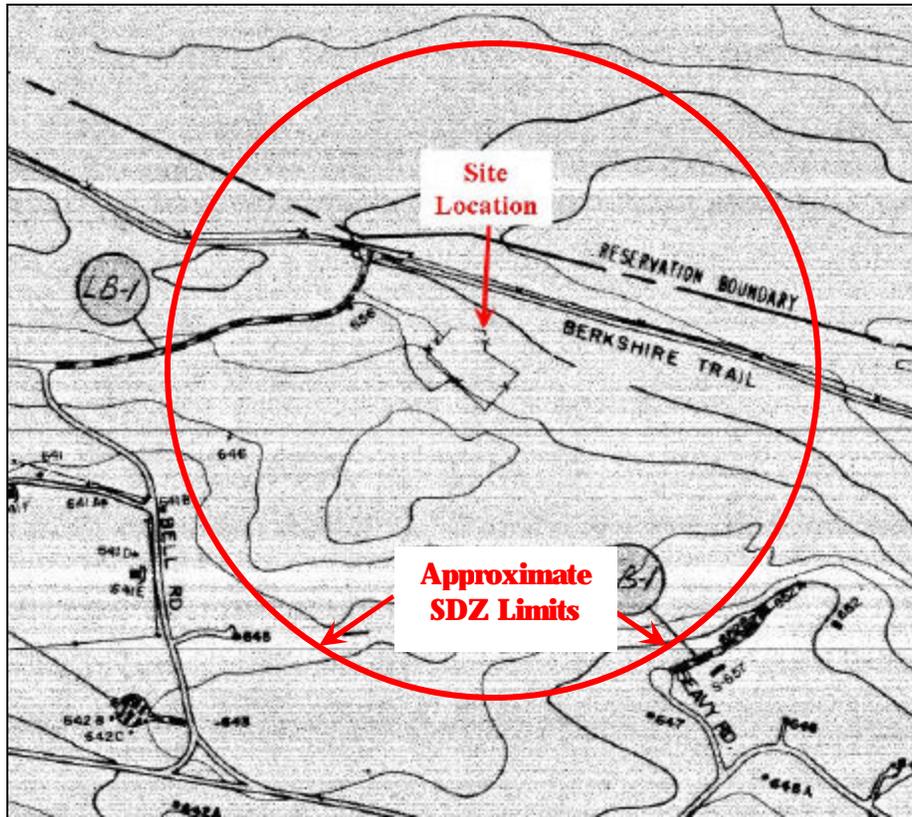
### **4.8.1 Phase 3 Inventory Site Description**

The majority of the Inactive Munitions Waste Pit was located within operational range area at the time of completion of the Phase 3 Inventory report and so was not included as part of the Inventory report. A portion also extends off-installation. The site was identified through research conducted while preparing this HRR report and lies within a portion of the installation recently characterized as closed range area.

### **4.8.2 HRR Site Findings**

As shown on Map 4-8, the Inactive Munitions Waste Pit is located approximately 2,000 feet (610 meters) northwest of the northernmost end of Picatinny Lake, within a few hundred feet of the northwestern installation boundary. Figure 4-21 shows the site to lie southeast of the intersection of Berkshire Trail and 20<sup>th</sup> Avenue. As shown on Map 4-8, the Inactive Munitions Waste Pit MRS is broken up into two MR areas. The first area consists of the portion of the range area and SDZ that lie within the limits of the installation. The area covers approximately 94 acres. The second MR area is termed Inactive Munitions Waste Pit – Off-Post and consists of the portion of the SDZ that lies outside of the limits of the installation. This off-post portion covers approximately 7.5 acres.

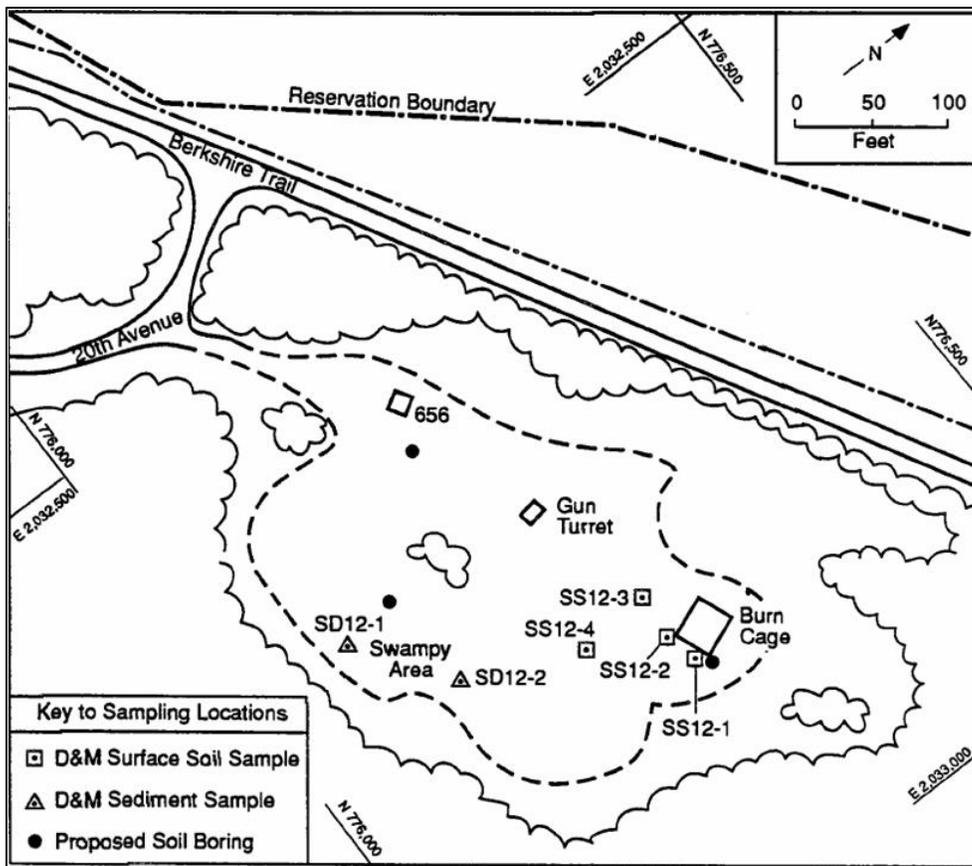
None of the documents available for review serve as a primary source to indicate the types of activities that took place at the site. However, the 1991 RI Concept Plan documents interviews conducted as part of the study conducted under the IRP (PTA.D&M.0004). The contractor conducted interviews with unnamed former PTA personnel with first hand knowledge of activities conducted at the site, including the testing and storage of munitions and explosives.



**Figure 4-21: 1973 map showing the Inactive Munitions Waste Pit (PICA00077)**

The 2006 IAP describes the site as being operated from 1955 to the mid-1980s (PICA00205). As shown in Figure 4-22 the site appears to have consisted of an open field with a burn cage, a gun turret, and Building 656, although it is unclear whether all of these structures were present throughout the site's history. The portion of the installation in which the Inactive Munitions Waste Area lies is shown on maps from 1931 and 1944 (PICA00083; PICA00066). The area is shown on both maps to be within the limits of the installation boundary, but no roads or other improvements to the area are shown on the map. The area is shown on maps from 1946 and 1949, by which time both 20<sup>th</sup> Avenue and Berkshire Trail had been constructed (PICA00082; PICA00071). However, no buildings are shown to have been present on the site as of 1949. The next maps available for review are dated 1972 and 1973 (PICA00072; PICA00080). On these maps, Building 656 is present along with a fence that apparently surrounded the site. The 1973 map is shown in Figure 4-21. Review of these

maps indicates that the area was developed sometime between 1949 and 1972. There is no additional information to verify the 1955 construction date indicated in the 2006 IAP. Also, the 2006 IAP is the only document reviewed that discusses a site closure date.



**Figure 4-22: Map of the Inactive Munitions Waste Pit from the 1991 RI Concept Plan (PTA.D&M.0004)**

The 2006 IAP report states that the site was utilized for evaluating munitions, while the 1989 SI report states that the area was used for static testing of explosives and propellants (PTA.D&M.0001). The manner in which the burn cage was utilized is not discussed in either document, however, they are usually utilized to control or prevent the ejection of fragments from items that might detonate when burned. Both documents report that, although the site name suggests that materials may have been buried in pits, there were no site features or other evidence indicating that burial of munitions took place. Both reports also indicate that

metal objects were found partially buried at the site, but none of the objects identified constituted MEC or munitions debris. The 2006 IAP goes on to state that:

*Historical practices consisted of testing munitions, and then filling the resulting crater with fill material, typically gravel and sand. Many ammunition fragments [munitions debris] were projected out from the site and were never recovered. According to Picatinny personnel, from 1965 to the present, no munitions were disposed of at the site. Since that time, all material associated with munitions testing was taken to the Picatinny Burning Ground.*

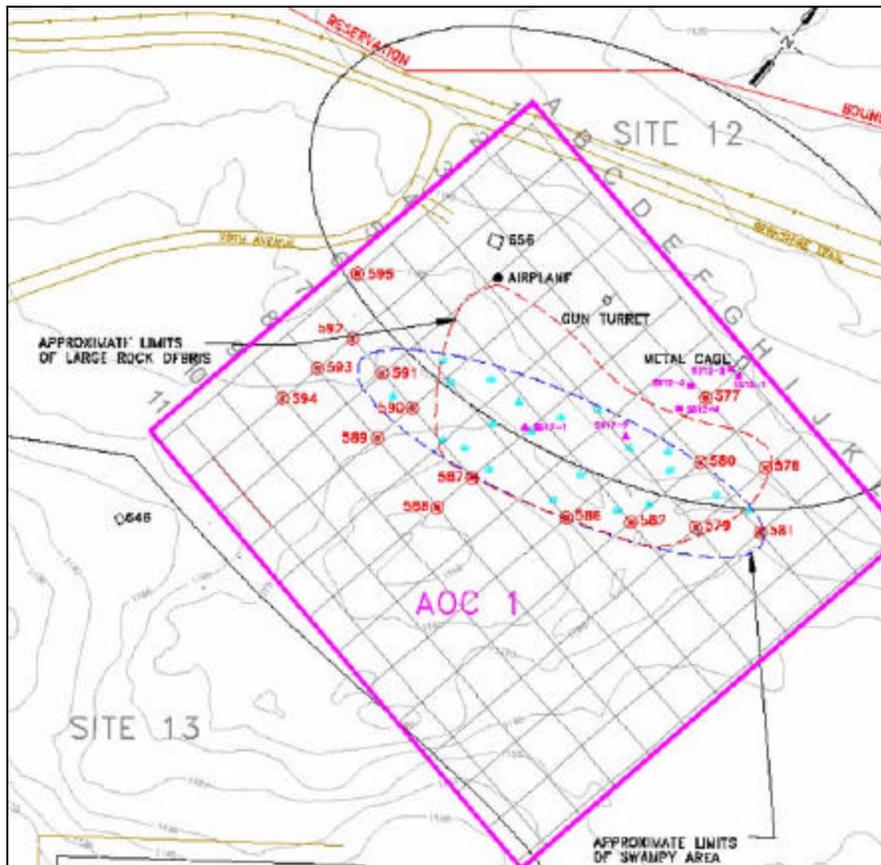
This appears to indicate that the range was still utilized for testing after 1965, but that the standard operating procedure included policing the area to remove munitions debris and MEC. However, as reported in the 1991 RI Concept Plan, interviews with unnamed PTA personnel familiar with the area indicate that MEC may be present at the site due to historical activities (PTA.D&M.0004). As stated above, the site apparently was used to detonate explosives and, possibly, munitions. Given the documented evidence of munitions debris being ejected from the site during testing operations, an SDZ must also be included as part of the site. Since no specific discussion of munitions tested at the site was available, a minimum SDZ radius of 1,250 feet (381 meters) will be used. This minimum number was chosen due to the large number of buildings surrounding the site. It is unlikely that larger munitions would have been detonated at the site, given the increased likelihood of damaging the surrounding buildings that this would have presented. As shown in Map 4-8 the SDZ encompasses much of the surrounding area and extends off installation.

An SI of the Inactive Munitions Waste Pit was conducted under the IRP as documented in the 1989 SI report (PTA.D&M.0001). As shown in Figure 4-23, four surface soil samples (indicated by an SS12-X label) and two sediment samples (indicated by an SD12-X label) were collected from the site. The investigation completed at the site focused on the immediate range area and did not include the SDZ. The sediment samples were collected from a swampy area located along the southern site boundary. All samples were analyzed for propellants, metals, and explosives. Numerous explosives and metals were detected at elevated concentrations in the surface soil samples. However, metals were found to exceed the applicable criteria at only one location near the burn cage. Explosives were not present in

detectable concentrations in either of the sediment samples. All metals concentrations in sediment samples fell within the ranges observed for regional soils.

As detailed in PICA00225, during a May 17, 2006, interview, Mr. Gabel and Mr. Schicho indicated that, at the request of the installation, the site had not been investigated further until 2004 because the site was being considered for use in connection with range activities. As indicated in the 2004 600 Area Groundwater RI Work Plan, the site was in the RI/FS stage of investigation (PTA.TO17.0088C). The work plan detailed a proposed groundwater investigation focused on identifying a source area for trichloroethylene (TCE) contamination in groundwater detected in a potable water well located adjacent to the site that was installed to serve Building 660. As shown in Figure 4-23, the plan proposed to collect numerous soil gas samples (in red) to identify the presence of VOCs in soils. The plan also proposed to install numerous groundwater wells. The 2006 IAP states that the investigation was completed and that trichloroethylene (TCE) was detected in groundwater underlying the site, resulting in groundwater beneath the site falling within the IRP. Additional investigation of groundwater underlying and adjacent to the site is planned.

MEC avoidance procedures were followed during the IRP groundwater investigation; however, the report does not mention that MEC or munitions debris were encountered at the site. Review of the available EOD incident reports does not indicate that any responses to the area occurred.



**Figure 4-23: Figure from the 2004 Groundwater Investigation Work Plan Showing Proposed Soil Gas Sample Locations**

It is important to note that during the May 17, 2006, interview, Mr. Schicho indicated that much of the Inactive Munitions Waste Pit site had been covered with fill material and rock in the late 1990s, well after use of the site for munitions testing had ended. Additionally, the 2006 IAP also states that much of the site was covered with topsoil and sand in 1980. Review of recent aerial photographs confirms that much of the area over which surficial soils might have been contaminated by range activities is currently covered with fill material up to 12 feet in thickness. The approximate limits of the rock debris are shown on Figure 4-23.

### 4.8.3 Summary of HRR Changes

The Inactive Munitions Waste Pit and Inactive Munitions Waste Pit – Off-Post was identified during research conducted while preparing this HRR and was not included in the Phase 3

Inventory report. The Inactive Munitions Waste Pit MR area covers 94 acres, while the Inactive Munitions Waste Pit – Off-Post MR area covers 7.5 acres. The range area was reportedly constructed in 1955 and was reportedly closed in the mid-1980s, but a specific date for closing the range was not identified. Information on specific munitions types utilized on the range was not available. Both MC and MEC are carried forward in the MMRP for this MRS.

**Map 4-8: Inactive Munitions Waste Pit and Inactive Munitions Waste Pit – Off-Post**

## **4.9 LAKE DENMARK (PICA-008-R-01)**

### **4.9.1 Phase 3 Inventory Site Description**

The description of Lake Denmark contained in the Phase 3 Inventory report states:

*This site is located on the northeastern corner of the installation near its boundary. Lake Denmark is a man-made, 327-acre lake located on the northeastern portion of the arsenal. The lake is a closed range, but it is completely surrounded by A/I range area on all sides. The lake has an average depth of 6.5 feet. The lake has a long history as a disposal area for munitions and their associated wastes. It is not known for how long the lake was in use for military purposes, but it is believed to have been from 1926 to the 1970s. In 1926, after the Lake Denmark Powder Depot explosion, unexploded munitions were dumped into the lake. The lake was also used as an impact area for experimental mortar rounds, and other explosive and pyrotechnic munitions. The firing point for the range was the dam located at the southern end of the lake. No record exists on the type and quantity of munitions fired into Lake Denmark over the years. Munition types that could be found in the lake include mortars, primary explosives, secondary explosives, pyrotechnics, and experimental munitions. Prior site investigations indicate the possibility of unexploded munitions on the bottom of the lake. The site is currently used for recreational boating and fishing, but both swimming and scuba diving are prohibited on the site. No documents were found to indicate any UXO responses were performed on the site.*

*The site is associated with a DSERT site, PICA-015. The CTC does not cover all MEC and MC for all the phases. Previous investigations on surface waters and sediments indicated the presence of metals in concentrations above levels of concern. The DSERT description sheet indicated that institutional controls would be recommended for this site. It is unknown whether the metals are linked to MC.*

### **4.9.2 HRR Site Findings**

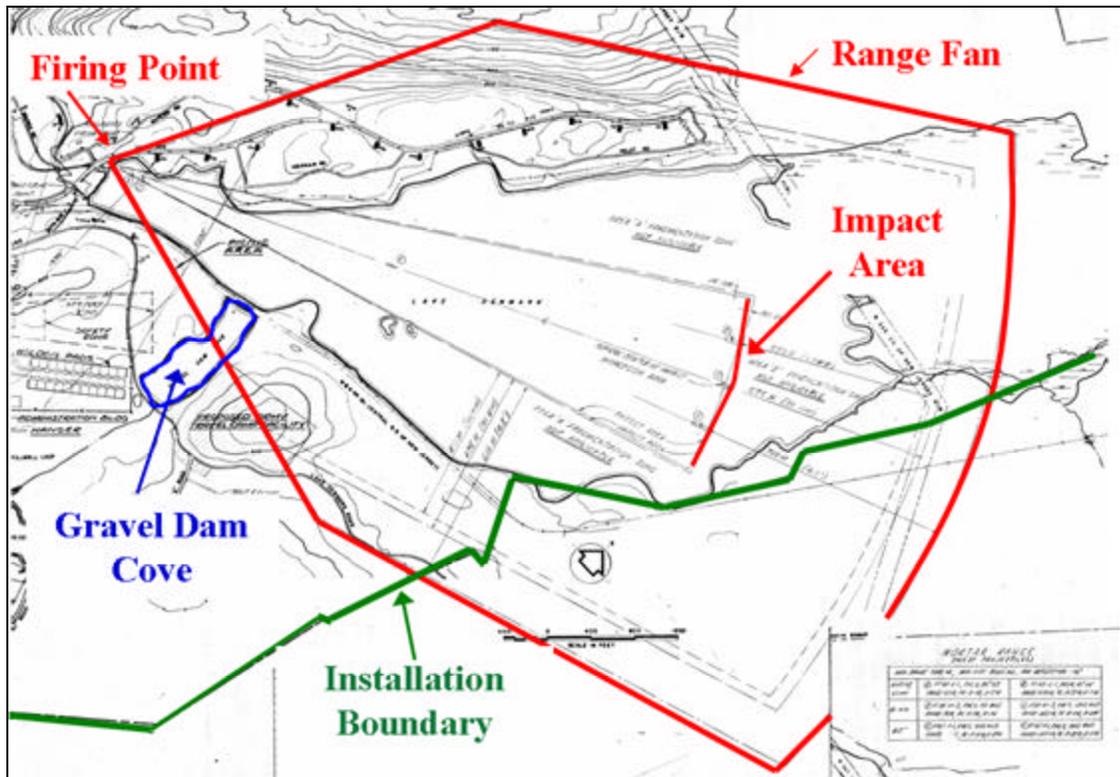
Lake Denmark is a man-made lake that has an approximate surface area of 263 acres. The lake has an average depth of 6.5 feet and holds approximately 331 million gallons of water (PTA.TO17.0014D). This lake is not used as a source of drinking water since all potable water on the installation is supplied by groundwater wells (PICA00205; PICA00226). However, water from Lake Denmark is reportedly used as service water for the 1500 area of the installation. The lake is used for recreational boating and fishing. The following institutional controls are in effect for Lake Denmark:

- Fish consumption advisories are in effect for Lake Denmark in order to prevent depletion of the fish populations and in accordance with NJDEP advisories due to elevated contaminant levels in fish tissue. The advisories recommend, by species, the maximum number of meals a person should ingest per week (PICA00228).
- Swimming in the lake is banned (PICA00210; PICA00228).

At the time the Phase 3 Inventory was completed, the Lake Denmark closed range was completely surrounded by A/I range area. Due to a change in the operational range footprint of the installation, the area surrounding the lake is now considered other than operational range.

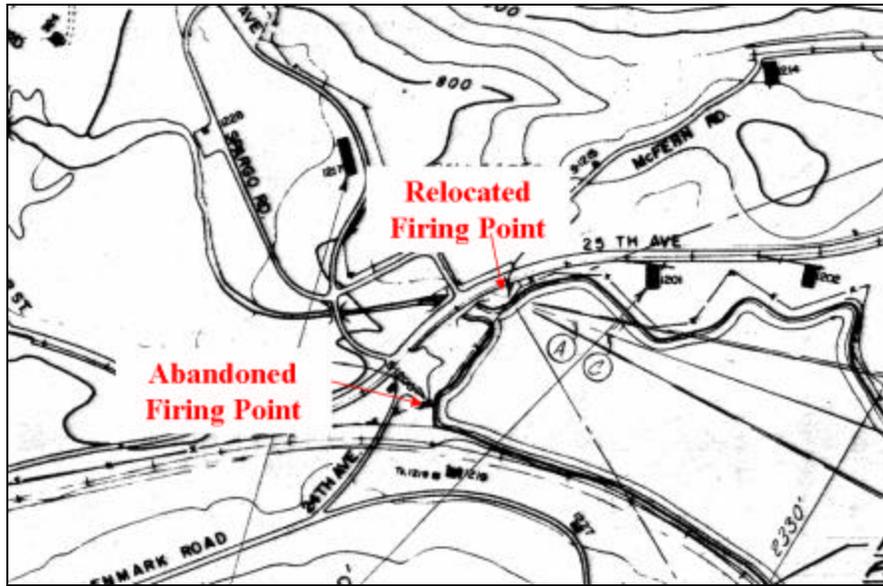
The Phase 3 Inventory report described Lake Denmark as an impact area for mortar and experimental munition testing range; however, at that time, the exact types and sizes of munitions fired into the lake were unknown. During research conducted for the HRR, more detailed information was obtained from historic maps and reports on the mortar and experimental testing ranges. Details of these ranges are described below.

An experimental mortar testing range was laid out on Lake Denmark in 1944 to test the stability of 60-mm and 81-mm mortars. The firing point was located on the southern end of the lake (PICA00143). The earliest map depicting the mortar range is dated 1974 (PICA00069). This map shows three mortar ranges composed of a single firing point with several firing lines along the axis of the lake (Figure 4-24). The three ranges are listed as 60-mm, 81-mm, and 4.2-inch inert projectile ranges with a maximum distance of 2,000 yards. Several impact areas are also shown on the map at the northern end of the lake. Safety fans for each of the three ranges are drawn on the map, with the largest one associated with the 4.2-inch projectile range.



**Figure 4-24: 1974 map showing the 60-mm, 81-mm, and 4.2-inch mortar ranges (PICA-00069).**

As shown on Figure 4-24, a portion of Gravel Dam Cove falls within the Lake Denmark MRS since it has been expanded to include the SDZs of the mortar and cannon testing ranges. Gravel Dam Cove lies southeast of Lake Denmark near the present day softball fields and is separated from the lake by an abandoned railroad track bed (PTA.TO17.0014D). As shown on Figure 4-25, the firing point for these ranges is labeled “Relocated Firing Point” and appears to be located near the dam at the southern end of the lake. A former firing point, labeled “Abandoned Firing Point” is also shown on the map and is located 400 feet (122 meters) south of the dam along the shoreline. It is assumed that the same impact area shown above on Figure 4-24 was utilized for the abandoned firing point, as well.



**Figure 4-25: 1974 map showing the abandoned and relocated firing points**

According to the 2005 RI report completed for Lake Denmark (PTA.TO17.0048W), a 20-mm rifle testing range was depicted on a 1947 PTA Division of Engineering drawing. The RI report states that this “drawing indicated that a 20-mm Rifle Testing Range fired across Lake Denmark toward an impact area located northeast of Building 1211 along the western shore of the lake. The firing point of the range was located on the southwestern side of Lake Denmark, near the present day softball fields.” (Figure 4-26).



**Figure 4-26: Location of former 20-mm rifle range (PTA.TO17.0048W)**

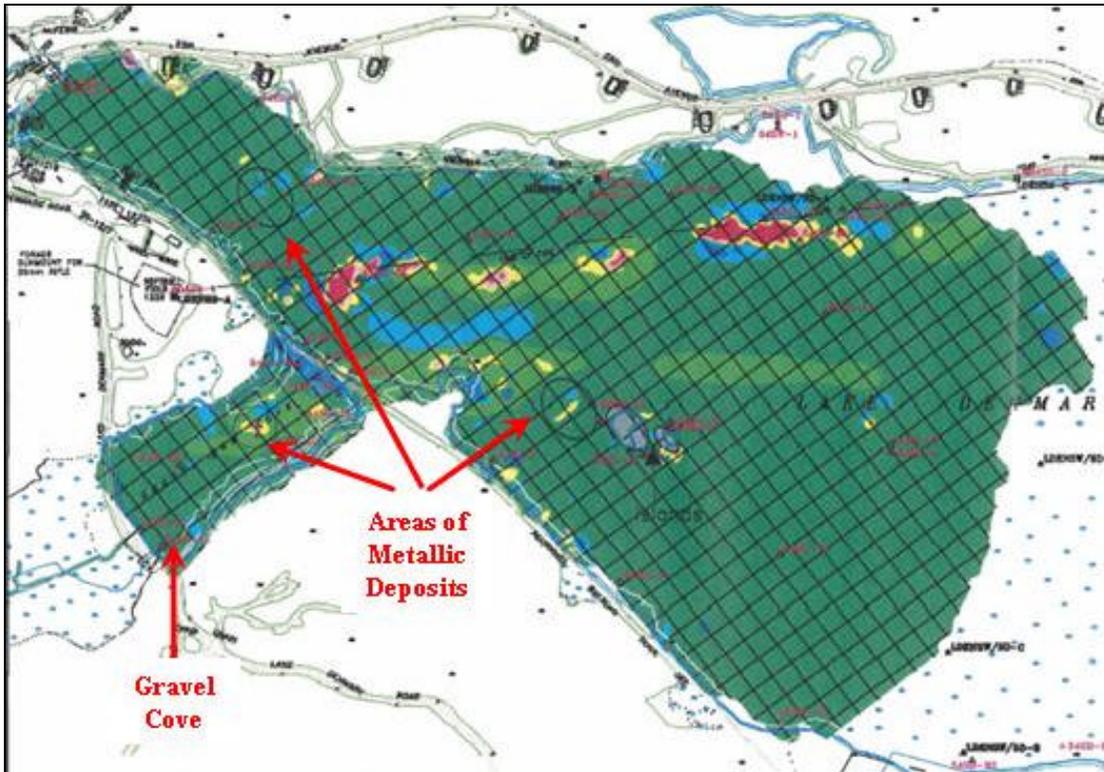
A copy of the 1947 Department of Engineering drawing could not be obtained from PTA DPW, and no other historical documentation of the existence of this range was found during the HRR research. Upon review of Army Ordnance Guidance, it was discovered that a rifle utilizing 20-mm ammunition has never existed. Instead, this rifle testing range was most likely a 20-mm cannon range and is referred to as such for the remainder of this report. As shown on Map 4-9, a portion of the Lake Denmark MRS falls within the boundary of current operational range footprint. This area is not MMRP eligible and was excluded from the MRS. In addition, the northwest corner of the new MRS boundary overlaps the Former Munitions and Propellant Test Area MRS and was also excluded from the Lake Denmark MRS. As described in Section 4.5.2, the firing point for the Former Munitions and Propellant Test Area is considered to have a higher likelihood of containing MEC and/or MC than the edge of the Lake Denmark MRS.

As shown on Map 4-9, a portion of the Lake Denmark MRS also extends over the installation boundary northeast of the lake. Thus, the site was divided into two MR areas - Lake Denmark and Lake Denmark – Off-Post. The Lake Denmark MR area includes the portion

of the MRS that falls inside the limits of the installation. The area covers approximately 633 acres. The Lake Denmark – Off-Post MR area is that portion of the MRS that lies outside the limits of the installation. This off-post portion covers approximately 96 acres and includes the Radiation Technology, Inc. (RTI), Superfund Site, which covers the largest area of the Lake Denmark – Off-Post MR area.

According to the USEPA's website (<http://www.epa.gov/region02/superfund/>), the RTI Superfund Site occupies 263 acres immediately adjacent to PTA's boundary near Lake Denmark. Present land use at the RTI site is predominantly light industrial. The area around the site is generally undeveloped with some residential and industrial development. Past activities included testing and development of rocket engines and propellants.

Previous investigations conducted at Lake Denmark include a geophysical survey and surface soil, surface water, and sediment sampling. The results of these investigations are presented in the 1995 RI report (PTA.TO17.0048W). A geophysical survey was conducted on Lake Denmark and Gravel Dam Cove to determine the presence of ferrous anomalies. As shown on Figure 4-27, two areas within Lake Denmark and one within Gravel Dam Cove exhibited the potential for metallic deposits.



**Figure 4-27: Magnetic anomalies within Lake Denmark and Gravel Dam Cove (PTA.T017.0048W)**

Sediment samples were collected throughout the lake, including near the ferrous anomalies identified by the geophysical survey. Explosives were not found in any of the surface water or sediment samples. Several metals, including arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, silver, and zinc, were detected above their LOCs in the sediment throughout the entire lake (PTA.T017.0048W). Aluminum and mercury were detected above their LOCs in several surface water samples. According to the 2006 IAP, institutional controls will be recommended for MC contamination at the site under the IRP.

#### **4.9.3 Summary of HRR Changes**

The Phase 3 Inventory report described Lake Denmark as an impact area for mortar and experimental munition testing range; however, at that time, the exact types and sizes of munitions fired into the lake were unknown. During research conducted for the HRR,

detailed information was obtained from historic maps and reports on the testing ranges over the lake. These ranges were identified as a 60-mm and 81-mm mortar range, a 4.2-inch inert projectile range, and a 20-mm cannon range. In addition, the exact locations of firing points and impact areas for these ranges were identified from historic maps during the HRR. The boundary of the Lake Denmark MRS was expanded to include the safety fans of the mortar and cannon ranges. The new boundary included a portion of the current operational range footprint and also overlapped the firing point of the Former Munitions and Propellant Test Area MRS. These two areas were excluded from the Lake Denmark MRS. The site was subdivided into two MR areas because a portion of the MRS is outside the installation boundary. This portion represents the northeast corner of the SDZ of the 4.2-inch projectile testing range. The acreage of the Lake Denmark MRS has increased from 327 acres to 633 and now includes a portion of Gravel Dam Cove. The acreage of the Lake Denmark – Off-Post MRS is 96 acres. The timeframe of use has not changed. Since MC for the on-post portion is covered under the IRP, only MC for the off-post portion will be carried forward in the MMRP. MEC for the entire site will be carried forward in the MMRP.

## Map 4-9: Lake Denmark

## **4.10 PICATINNY LAKE SITE (PICA-009-R-01)**

### **4.10.1 Phase 3 Inventory Site Description**

The description of Picatinny Lake Site contained in the Phase 3 Range Inventory report states:

*The 108-acre lake was formed in the 1880s when a dam was built on part of Green Pond Brook. It has a maximum depth of 20 feet. It is located in the center of the installation. The hill above the lake was used as an impact area for experimental mortar rounds from 1940 to 1970 and the shortfalls fell into the lake. Smokeless powder and explosives were also stored underwater in the lake from 1910 to 1960. Tests performed on this powder indicated it retained full explosive strength after removal from the lake and subsequent drying. Explosives and related debris were discharged or disposed of in the lake. It is no longer used for range purposes. The island on the lake, Flare Island, was used for pyrotechnic testing. Munition types that could be in the range include mortars, primary explosives, secondary explosives, pyrotechnics, experimental munitions, and large and medium ammunition. The lake is currently used for recreational boating, but no swimming, wading, or scuba diving is allowed. It is used as a source of non-potable water for manufacturing and firefighting-relating purposes. Fishing in the lake is permitted, but fish consumption is discouraged. Some parts of the lake are fenced and no digging or sampling is allowed without permission. No documents were found to indicate any UXO investigations and/or responses were performed on the site.*

*The site is associated with a DSERT site, PICA-057. The cost to complete (CTC) does not cover all MEC and MC for all the phases. Previous investigations on surface waters and sediments indicated VOCs, SVOCs, explosives, and metals contamination. The DSERT description sheet indicated that institutional controls would be recommended for this site. It is unknown whether the metals are linked to MC.*

### **4.10.2 HRR Site Findings**

Picatinny Lake has an approximate surface water area of 108 acres and is located in the center of the installation (Map 4-1). The majority of this site lies entirely within the limits of the 1926 Explosion Site 1-mile (1,609 meters) radius as shown on Map 6-1. The lake contains approximately 165 million gallons of water (PTA.TO17.0060M) and is used as a source of non-potable water for production purposes and fire fighting. The lake is currently

used for recreational boating and fishing (PTA.TO17.0060M). The following institutional controls are in effect for Picatinny Lake:

- Fish consumption advisories are in effect for Picatinny Lake in order to prevent depletion of the fish populations and in accordance with NJDEP advisories due to elevated contaminant levels in fish tissue. The advisories recommend, by species, the maximum number of meals a person should ingest per week (PICA00210; PICA00228).
- Swimming in the lake is banned (PTA.TO17.0060M)

As shown on Map 4-10, there are two islands within Picatinny Lake. The smaller island, Flare Island<sup>6</sup>, is a man-made peninsula constructed of coal slag. It has been previously reported that Flare Island was used to test flares and other pyrotechnics from World War II through the 1970's (PTA.TO17.0060M). However, a 1924 report of a fire caused by "phosphorous grenades" from the testing on Flare Island was obtained during research conducted as part of the HRR. (PICA00004). The report states that upon examination of the scene of the fire "the remains of a burster and thimble of the Phosphorous Grenade MK 1" was discovered on the shore of Picatinny Lake. The larger island, Picnic Island, is located in the southern end of the lake. There was no historical evidence of former munitions testing conducted on this island.

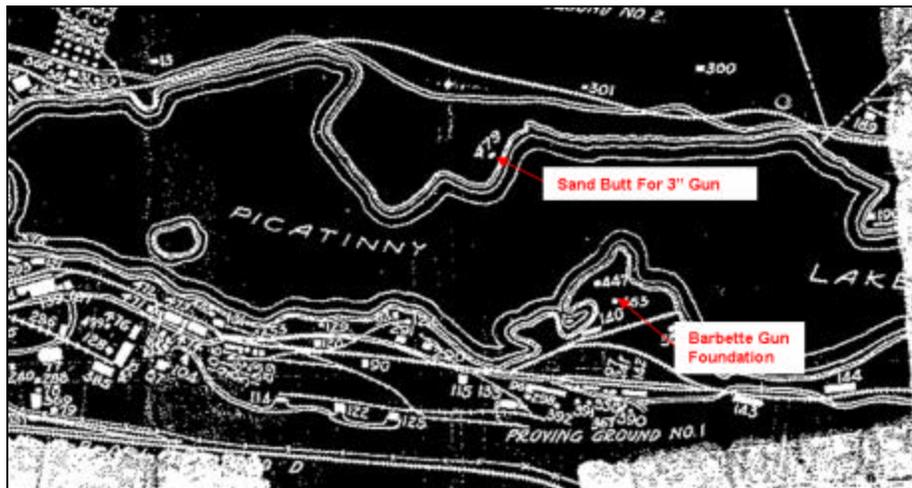
Throughout PTA's history, numerous production buildings have been located along the eastern and western edges of Picatinny Lake. Many of these buildings, which are no longer in use and/or have been demolished, are part of the current IRP for PTA. Map 4-10 shows the locations of some of these buildings. As seen on the map, many of these sites are considered separate sites in the IRP.

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<sup>6</sup> In some reports, Flare Island is also referred to as Whiley's Island

From 1910 to 1960, smokeless powder<sup>7</sup> and explosives were stored underwater in the lake. As reported in a 1942 newspaper article, some of the smokeless powder, an explosive that was formerly manufactured in the 500 building area, had been stored underwater for 16 years and still possessed full explosive strength (PTA.TO17.0060M). This statement is also supported by tests performed on the powder, which indicated that it retained full explosive strength after removal from the lake and subsequent to drying. Underwater storage protected the powder from lightning, spontaneous ignition, and heat. In addition, standard ammunition boxes of the powder were sunk in the lake.

During the HRR, a former 3-inch Barbette Gun firing range was found on a map dated 1922 (Figure 4-28) (PICA00172). The map depicts the Barbette Gun foundation on the southeast shore of the lake and an impact area located across the lake on the northwest shore near current Buildings 810 and 824.



**Figure 4-28: 1922 map showing the 3-inch projectile firing range over Picatinny Lake**

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<sup>7</sup> As defined in TM 60A 1-1-9, 29 May 1998, "smokeless powder is composed of pyrocellulose containing approximately 13 percent nitrogen which is colloidized with ether-alcohol. It is manufactured in the form of small flakes, strips, sheets, or perforated cylindrical grains. Smokeless powder..is used as gun propellants...solid propellants for rockets, as bursters in some types of chemical or pyrotechnic ammunition, and as impulse charges for mortars.

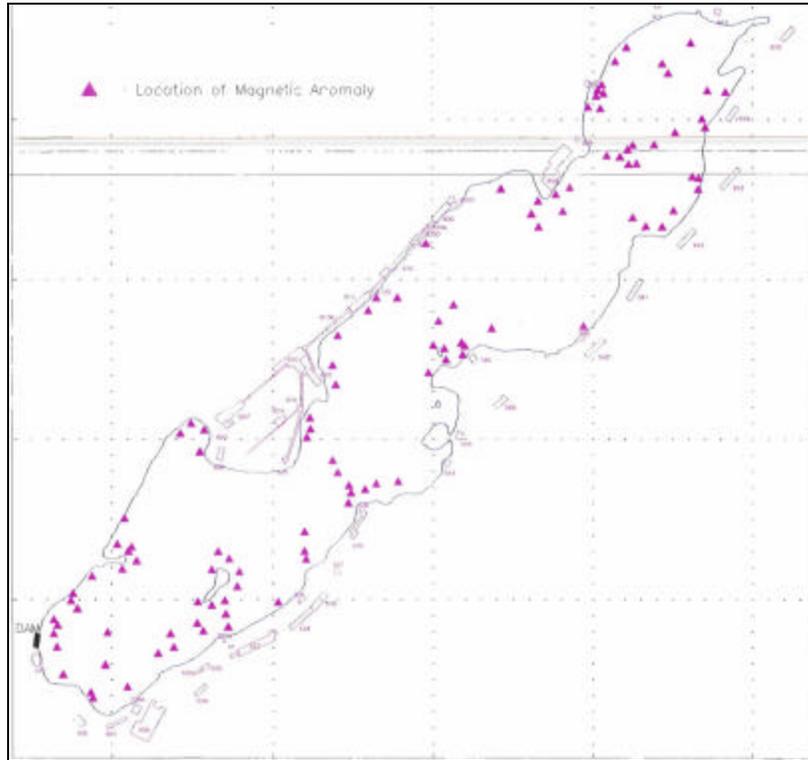
For the purpose of the HRR, the Picatinny Lake Site has been expanded to encompass this former 3-inch firing range. A map from April 1919 does not depict the Barbette Gun firing point or its impact area across the lake. In 1919, the eastern peninsula was occupied by a 3-inch fragmentation test chamber and jolting machinery building. According to historical documents, the 3-inch firing range was moved from the shores of Picatinny Lake in 1931 (PICA00086). During the rehabilitation of PTA in the years following the 1926 explosion, the firing range was moved to the testing area west of Picatinny Peak. In 1931, a new melt loading plant was constructed on the western shore of the lake near the former impact area (PICA00086). Around the same time, a new Cannon Blending Unit was constructed on the east shore of the lake near the former firing point location (PICA00130).

Other potential sources of contamination in Picatinny Lake include reported dumping of explosives and propellants into the lake (PICA00205). Releases and discharges from buildings located near Picatinny Lake have also contributed to debris or potential contamination in the lake. The following information highlights reported releases of MEC in and around Picatinny Lake (PTA.TO17.0060M):

*There may have been up to four explosive-related accidents in the back room of Building 800 ( Site 93), located on the southwestern portion of the lake. The back room faces the lake, so it is possible that explosives may have been dispersed into the lake as a result of the accidents. During a March 1965 accident in Building 800, submissiles (cluster bombs) exploded, killing two people and causing a fire. The explosion did not destroy the building but spread ordnance around the area near the building, including the lake.*

Bathymetric and magnetic surveys of the lake bottom 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 (PTA.TEPS.0008). The magnetometer survey was conducted across the entire lake, along lines positioned about 30 feet (9 meters) apart, and along the lake perimeter (PTA.TEPS.0008). Figure 4-29 is a plot of magnetic anomalies in Picatinny Lake, mapped during the survey. Two linear features that may represent pipelines appear to cross the lake in distinct locations (PTA.TO17.0060M). Several anomalies that may represent DMM were

identified at locations along the shoreline. The areas around Flare Island and Picnic Island also showed high concentrations of metallic anomalies attributed to DMM.



**Figure 4-29: 1995 Map showing geophysical anomalies within Picatinny Lake**

As discussed above, many production buildings have historically been located along the shores of Picatinny Lake. Many of these former production buildings were investigated under the IRP. As part of these investigations, intrusive activities were conducted, including the installation of test pits. MEC have been found in these test pits at the following locations:

- At the former location of Building 565 (Test Pit 178-TP-6), 11 rocket motor housing sleeves and unattached fins were uncovered (PTA.TO17.0060M).
- South of Building 823 near a former loading dock (Test Pit 93-TP), base detonating fuzes and other possible MEC were uncovered (PTA.T005.002A).

Several investigations of Picatinny Lake surface water and sediment have been conducted under IRP PICA-057. Twenty-three surface water and twenty-three sediment samples were collected from Picatinny Lake biased towards the geophysical anomalies within the lake. Sample analyses included metals and explosives. Detected concentrations of cadmium, copper, lead, manganese, mercury, nickel, silver, and zinc exceeded their corresponding LOCs in 15 of the 23 sediment samples (PTA.TO17.0060M). The maximum concentrations of six metals were detected around Flare Island. Smokeless black powder was detected in one near-shore sediment sample collected 100 feet (30.5 meters) from the southeastern shore of the lake, near the boat dock. Detected concentrations of 2,6-DNT, HMX, PETN, and cyclotrimethylenetrinitramine (RDX) were compared to the Region 3 RBCs; no explosives concentrations exceeded their RBC. Five of the 23 surface water samples contained chromium above its LOC. No other compounds were reported above LOCs (PTA.TO17.0060M).

Sixteen surface water and sixteen sediment samples were collected near the banks of Picatinny Lake, under the Phase I RI for sites located along the shores of the lake. Twelve metals (e.g., copper, lead, mercury) were detected at concentrations in sediment greater than LOCs (PTA.TO17.0060M). Chromium and lead were detected at concentrations in surface water greater than LOCs. Explosives were detected in sediments at concentrations greater than LOCs near the 800 Building area (PTA.TO17.0060M).

According to the IAP, MC in Picatinny Lake and near-shore areas will be evaluated in an FS. MEC will not be addressed under the IRP.

#### **4.10.3 Summary of HRR Changes**

Research conducted during the HRR showed that Picatinny Lake was not only used for underwater storage of smokeless powder and other explosives, but was also used as a testing range and burial site for DMM. From 1922 to 1931, one range was utilized to test 3-inch projectiles shot from a Barbette Gun from the southeastern shore to a slug butt across the lake on the southwestern shore. This range was not identified in the Phase 3 Report. Flare Island was used as a grenade and pyrotechnic testing range from 1924 through the mid-1970s. The

presence of MEC near some of the former production buildings that border Picatinny Lake was discovered during research conducted for this HRR. Due to the identification of the 3-inch projectile testing range and the potential for MEC in the Building 800 series and Building 500 series areas, the acreage of this MRS has increased from 108 to 125 acres with 18 acres of the site overlying land and 107 acres covering the water. Since MC is being addressed under the IRP only MEC will be carried forward in the MMRP.

**Map 4-10: Picatinny Lake Site**

## **4.11 SHELL BURIAL GROUND NEAR BLDG. 3150 (PICA-010-R-01)**

### **4.11.1 Phase 3 Inventory Site Description**

The Shell Burial Ground near Bldg. 3150 was termed “Shell Burial Ground #1” in the Phase 3 Inventory Report. The range name was changed at the request of the installation. The site will be referred to as the Shell Burial Ground near Bldg. 3150 throughout the rest of this report. The description of the Shell Burial Ground near Bldg. 3150 contained in the Phase 3 Inventory report states:

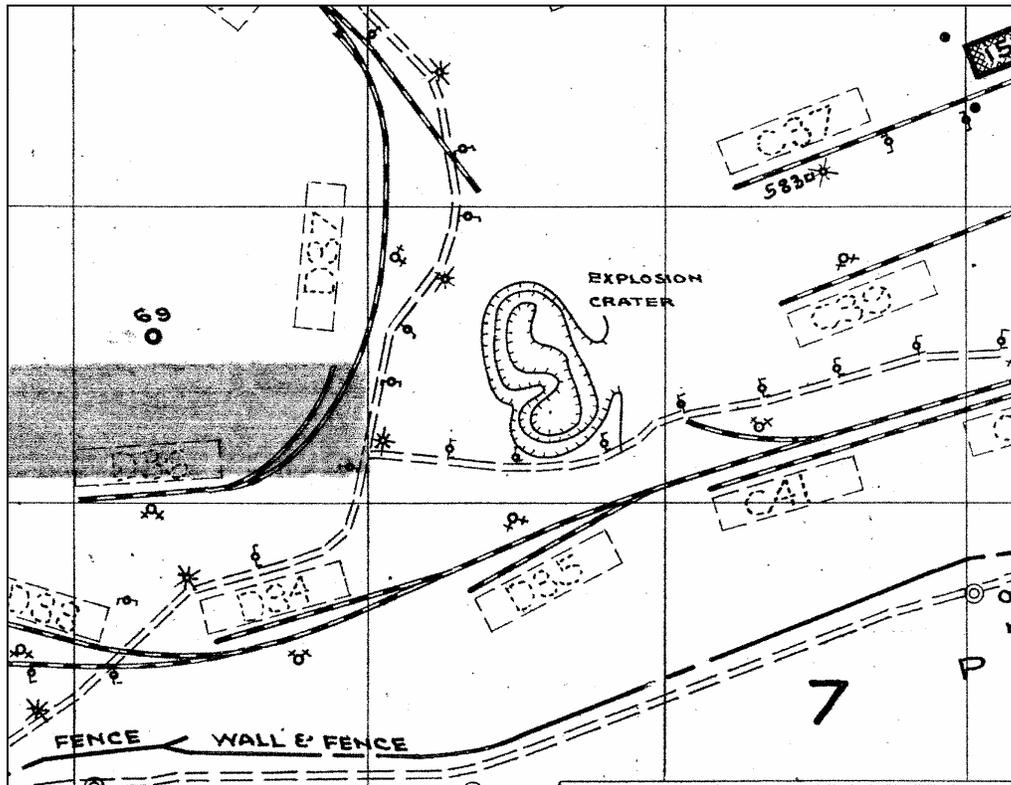
*This site is one of two burial areas that resulted from the 1926 explosion at the Lake Denmark Powder Depot. This site is located towards the center of the installation, on the eastern side of Picatinny. Originally, the site was one of the craters caused by the explosion, where unexploded ordnance, ordnance scrap, as well as debris from the explosion were deposited. The crater is three acres. The crater was also used by the Navy Depot as an ordnance dumping area from 1926 to 1945. The site was then covered with about 20 feet of fill material, fenced and marked with warning signs. There are approximately 25 tons of debris and ordnance deposited between both shell burial areas. Ordnance that may be found inside the craters includes mines, depth charges, fuzes, projectiles, explosives, small arms ammunition, propellants and possibly rocket fuels. The crater is located northwest of Building 3150. No excavation is allowed at this site. The site is not currently being used for anything as it is fenced off and posted with warning signs. No documents were found to indicate any UXO investigations and/or responses were performed on the site.*

*The site is associated with a DSERT site, PICA-162. Previous investigations conducted from 1998 to 2000 indicated that cyanide and VOCs were detected in the groundwater at concentrations exceeding levels of concern. It is unknown whether the metals are linked to MC.*

### **4.11.2 HRR Site Findings**

As described in Section 4.1, on July 10, 1926, lightning from an electrical storm struck the southwest end of the Lake Denmark Naval Ammunition Depot, setting off a series of explosions. One of the major explosions occurred when Shell Storehouse No. 22 exploded. This explosion created a large crater on the eastern portion of the property near Bldg. 3150 (currently a gymnasium) and near what is currently EOD Pond (also known as the Reservoir near Bldg. 3159, PICA-164 in the IAP), but was a marsh at the time of the explosion (Map 4-

11) (PICA00080; PICA00081; PICA00096; PICA00111; PICA00158; PICA00159; PICA00216). It was reported that the crater was between 25 and 35 feet deep (PICA00007). This crater was contoured into three sub-craters, which appeared to correspond to the three main piles of explosive material stored in the building (PICA00129). Figure 4-30 shows a 1932 map depicting the crater. The site lies entirely within the limits of the 1926 Explosion Site 1-mile (1,609 meters) radius as shown on Map 6-1.



**Figure 4-30: 1932 map showing explosion crater**

This Shell Burial Area, along with the Shell Burial Ground Near Bldg. 3100, was used for the disposal of approximately 25 tons of explosives from the 1926 explosion. Materials that were disposed of in the burial area included projectiles, mines, depth charges, fuzes, explosives, small arms ammunition, propellants, and possibly rocket fuels. The 1981 IAP also reported that the site contains acids, pickling liquors, cyanide, and phenol. The burial depth is unknown, but is estimated to be approximately 20 feet (PTA.D&M.0004; PTA.TO17.0048T; PICA00096; PICA00115; PICA00204). The Navy continued to use this

area for explosives disposal until 1945; no records of the types of material or amounts disposed of were kept (PTA.D&M.0004; PICA00115; PICA00204). After the Navy discontinued its use of this area, it was covered with 20 feet of fill (PTA.TO17.0048T).

During the 1998-2000 RI for this site, one surface soil and three subsurface soil samples were collected and analyzed for VOCs, SVOCs, explosives, metals, and cyanide. No contaminants were found at levels that exceeded the LOCs. It should be noted that, due to safety restrictions, these samples were collected from areas surrounding the shell burial area and not the site itself (PTA.TO17.0048T).

During the 1989 SI and the 1998-2000 RI, groundwater was also sampled and analyzed for VOCs, SVOCs, explosives, metals, and cyanide. Five of the RI wells were screened in the bedrock aquifer, and five were screened in the unconsolidated overburden. During three rounds of sampling of these wells, only cyanide and a VOC (tetrachloroethylene) were detected at levels above the LOCs (PTA.TO17.0048T; PICA00205). Currently, institutional controls exist for this site as it is fenced in and posted with warning signs. The area is heavily wooded without a lot of undergrowth (PICA00214).

#### **4.11.3 Summary of HRR Changes**

The size and shape of the Shell Burial Ground near Bldg. 3150 were changed based on historical mapping obtained during the HRR that better defined the area of this site. It appears the this historic maps outline is more accurate since the Phase 3 outline cross two roadways. The acreage of this MRS has decreased to 1.5 acres. There were no changes to the dates of use or munitions types suspected to be present at the site that resulted from completion of this HRR.

**Map 4-11: Shell Burial Ground Near Bldg. 3150**

## **4.12 SHELL BURIAL GROUND NEAR BLDG. 3100 (PICA-011-R-01)**

### **4.12.1 Phase 3 Inventory Site Description**

The Shell Burial Ground Near Bldg. 3100 was termed “Shell Burial Ground #2” in the Phase 3 Inventory Report. The range name was changed at the request of the installation. The site will be referred to as the Shell Burial Ground near Bldg. 3100 throughout the rest of this report. The description of the Shell Burial Ground near Bldg. 3100 contained in the Phase 3 Inventory report states:

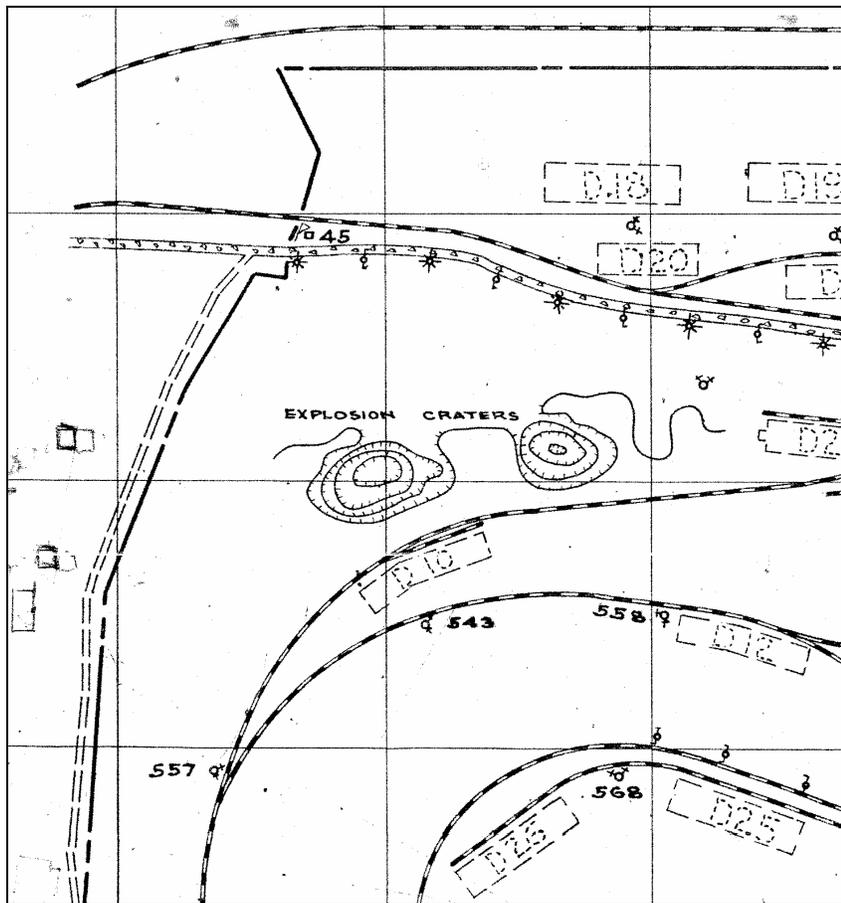
*This site is one of two burial areas that resulted from the 1926 explosion at the Lake Denmark Powder Depot. The site is located in the center of the installation, towards the south of Picatinny. Originally, the site was one of the craters caused by the explosion, where unexploded ordnance, ordnance scrap, as well as debris from the explosion were deposited. The crater is four acres. The crater was also used by the Navy depot as an ordnance dumping area from 1926 to 1945. The site was then covered with about 20 feet of fill material, fenced, and marked with warning signs. There are approximately 25 tons of debris and ordnance deposited between both shell burial areas. Ordnance that may be found inside the craters includes mines, depth charges, fuzes, projectiles, explosives, small arms ammunition, propellants and possibly rocket fuels. The crater is located northwest of Building 3100. No excavation is allowed at this site. The site is not currently being used for anything as it is fenced off and posted with warning signs. No documents were found to indicate any UXO investigations and/or responses were performed on the site.*

*The site is also associated with DSERT site PICA-162. Previous investigations performed under another DSERT site, PICA-052, conducted from 1998 to 2000 indicated that metals, VOCs and SVOCs were detected in the groundwater at concentrations exceeding levels of concern. It is unknown whether the metals are linked to MC.*

### **4.12.2 HRR Site Findings**

As described in Section 4.1, on July 10, 1926, lightning from an electrical storm struck the southwest end of the Lake Denmark Naval Ammunition Depot, setting off a series of explosions. The first two explosions, which occurred in Temporary Storehouse Nos. 8 and 9, respectively, created two large craters located near the central portion of PTA, approximately 1,500 feet (457 meters) east of the southern outlet of Picatinny Lake (PICA00080;

PICA00081; PICA00096; PICA00111; PICA00158; PICA00159; PICA00216). It was reported that these craters were between 25 and 35 feet deep, with the crater caused by the explosion of Temporary Storehouse No. 9 being the deepest (PICA00007). Figure 4-31 shows a 1932 map depicting the explosion craters. The site lies entirely within the limits of the 1926 Explosion Site 1-mile (1,609 meters) radius as shown on Map 6-1.



**Figure 4-31: 1932 map showing explosion craters**

This Shell Burial Area, along with the Shell Burial Ground near Bldg. 3150, were used for the disposal of approximately 25 tons of explosives from the 1926 explosion. Materials that were disposed of in the burial area included projectiles, mines, depth charges, fuzes, explosives, small arms ammunition, propellants, and possibly rocket fuels. The 1981 IAP also reported that the site contains acids, pickling liquors, cyanide, and phenol. The burial

depth is unknown, but is estimated to be approximately 20 feet (PTA.D&M.0004; PTA.TO17.0048T; PICA00096; PICA00115; PICA00204). The Navy continued to use this area for explosives disposal until 1945; no records of the types of material or amounts disposed of were kept (PTA.D&M.0004; PICA00115; PICA00204). After the Navy discontinued its use of this area, it was covered with 20 feet of fill (PTA.TO17.0048T).

During the 2005 RI for this site, one surface soil sample and two subsurface soil samples were collected from areas adjacent to the site. Soil samples could not be collected from within the site boundaries since PTA's Safety Office does not allow work to occur in this area. As shown on Plate 1, none of the soil samples collected in the vicinity of the site had metals concentrations greater than the LOCs (PTA.TO17.0048S; PTA.TO17.0048T). Plate 2 indicates perchlorate has not been detected at this site. Plate 3 indicates no explosives have been detected at concentrations greater than LOCs in soil samples from locations adjacent to the site.

Groundwater samples were collected during several sampling events. Between 1981 and 1984, one well was sampled several times for inorganics and purgeable organics. Lead was found at a level slightly above the current LOC. Explosives were analyzed for, but were not detected. During a 1988 sampling event 2,4-DNT was found in one well at 0.3 µg/L, which is below the current LOC (PTA.D&M.0004). During the RI, six groundwater samples were collected; four samples were collected from wells screened in the overburden (between 12 and 35 feet bgs) and two samples were collected from wells screened in bedrock. Analysis of these samples indicates the presence of lead in one sample (collected from a bedrock well) at a concentration slightly above the LOC (PTA.TO17.0048T).

Currently, institutional controls exist for this site as it is fenced in and posted with warning signs. The area is heavily wooded without a lot of undergrowth (PICA00214). Refer to Map 4-12 for a map of the Shell Burial Ground near Bldg. 3100.

#### **4.12.3 Summary of HRR Changes**

There were no changes to the size, dates of use, or munitions types suspected to be present at the site that resulted from completion of this HRR.

**Map 4-12: Shell Burial Ground Near Bldg. 3100**

## **4.13 UXO FIND NEAR BERKSHIRE TRAIL**

### **4.13.1 Phase 3 Inventory Site Description**

The UXO Find Near Berkshire Trail was identified when the Department of the Army Police located a 81-mm mortar round In August 2006 while patrolling the wooded area outside the western fence line near Berkshire Trail. Since it was discovered after 2003, this site was not included in the Phase 3 Inventory Report. In addition, this area of the installation was categorized as operational range area at the time of completion of the Phase 3 Inventory report. The site now lies within a portion of the installation newly characterized as other than operational.

### **4.13.2 HRR Site Findings**

As shown on Map 4-13, the UXO Find Near Berkshire Trail MRS is located west of Picatinny Lake along the western ridge line of the installation. This site lies entirely within the limits of the 1926 Explosion Site 1-mile (1,609 meters) radius as shown on Map 6-1. As previously indicated, this MRS was identified after the PTA Police discovered an 81-mm mortar round while patrolling the woods outside the fence line west of the 600 Area. Members of the EOD Office were called to identify and dispose of the item. As reported in the EOD Incident Report (PICA00229), the mortar was identified as a M374A2 81-mm HE mortar. The report also states that the mortar was detonated in place. According to Sergeant First Class (SFC) Owens of the EOD office, who responded to the incident, the year inscribed on the mortar was 1975 (PICA00230).

The UXO Find Near Berkshire Trail is not listed as an IRP site in the 2006 IAP and thus no previous investigations for MC or MEC were conducted in the area. None of the PTA personnel interviewed indicated that a former testing range occupied this area of the installation. The August EOD incident reports available for review discussed the area.

### **4.13.3 Summary of HRR Changes**

The UXO Find Near Berkshire Trail was identified when the Department of the Army Police located a 81-mm mortar round while patrolling the wooded area outside the western fence line near Berkshire Trail. This MRS is < 1 acre in size. This MRS was not included in the Phase 3 Inventory report.

**Map 4-13: UXO Find Near Berkshire Trail**

#### **4.14 WASTE BURIAL AREA NEAR SITES 19 & 34**

##### **4.14.1 Phase 3 Inventory Site Description**

The Waste Burial Area was located within operational range area at the time of completion of the Phase 3 Inventory report and so was not included as part of the report. The site was identified through research conducted while preparing this HRR report and lies within a portion of the installation recently characterized as other than operational range.

##### **4.14.2 HRR Site Findings**

The Waste Burial Area Near Sites 19 & 34 is located at the southern end of PTA on the east side of Green Pond Brook (Map 4-14) (PTA.T019.0032B). This undeveloped site is situated in a low-lying wetland area bounded on the east and south by dense woods, on the north by the Skeet Range, and on the west by the Lower Burning Ground (Site 34) (PTA.T019.0032B). Due to its proximity to the Lower Burning Ground, the site became a prime location to dispose of items that could not be burned or that did not require burning (PTA.D&M.0037). Due to it being an unregulated site, the exact years of operation are unknown; however, it is believed that extensive landfilling activities took place in the 1960s and 1970s (PTA.T019.0032B).

Under the IRP, the original area for the Waste Burial Area included only part of the current site. It was defined as a 300-foot x 300-foot area located within the Waste Burial Ground area used for waste disposal and landfilling (PTA.T019.0032B). The original area was expanded after additional waste piles were discovered outside of its boundaries. Currently, the IRP site is 8.5 acres and incorporates all known waste piles determined through a site inspection and analysis of historical aerial photography (PTA.T019.0032B).

As shown on Map 4-14, the Waste Burial Area is partially collocated with the SDZ for an operational range. As such, the portion of the site that is overlain by the SDZ normally would not be eligible for inclusion in the MMRP. However, the SDZ is associated with a burning ground. As documented in numerous discussions with PTA personnel (PICA00211,

PICA0023, PICA00225), the activities that take place at the burning ground reportedly present no potential for ongoing contamination of the area with MEC and/or MC. Engineering controls are reported to be utilized to prevent the release of MEC and/or MC. Therefore, the portion of the Waste Burial Area that falls within the SDZ of the Lower Burning Ground will be included in the MRS.

As part of the IRP Phase I RI in 1994, a geophysical survey was conducted; however, swampy conditions prevented data collection at some points. Results did not reveal any locations of buried metal or potential burial pits. Anomalies detected correlated to surface debris piles. Test pit locations were correlated to surface debris piles identified from the geophysical survey. No metals or explosives were detected above the LOCs in surface and subsurface soil samples (PTA.D&M.0037).

During a site walk in January 1998, munitions debris was visibly present and identified as large projectiles. The projectiles were estimated to be 175-mm or 8-inch projectiles and were all identified as ejection type. There were no base plates or fuzes/nose plugs installed in any of the visible projectiles (PTA.T019.0016C).

Under the IRP, a trenching investigation was conducted in 1998 to further investigate the expanded site areas that were not investigated during the Phase I RI (PTA.T019.0032B). MEC were identified in exploratory trench 1, one of five trenches that were excavated. The maximum depth of 5 feet was reduced to 2 feet when the initial MEC was identified below the surface soil. The EOD Team identified the MEC as 40-mm grenades that were potentially live. Map 4-14 shows the location of trench 1. After the initial destruction of the grenades, four additional 40-mm grenades were located and destroyed by the EOD Team. Due to the discovery of MEC at the site, EOD personnel recommended that no further activities occur in the area where the grenades were discovered (PTA.T019.0032B).

A Proposed Plan was completed under the IRP in April 2005. The recommended remedial alternative chosen, "Implementation of Institutional Controls and Land-use Restrictions," satisfies all requirements of the Remedial Action Objectives (RAOs) and is believed by the

Army to meet the threshold criteria and provide the best balance of trade-offs among the other alternatives (PTA.T017.0098B).

This recommended remedial alternative involves implementing permanent ICs and LUCs to protect any land users from potential exposure above the 10-6 risk-based level. This alternative addresses MC contamination in the subsurface at the Waste Burial Area.

LUCs are required because, under this remedial alternative, contamination would remain in place (PTA.T017.0098B). Land use would be restricted to five days per year for the hunter or other authorized personnel without protective equipment. A MEC assessment would be performed to implement and maintain ICs, in accordance with the Army requirements for the proposed land use (PTA.T017.0098B).

Separate from the recommended alternative, an ultra-low permeability asphalt cap will be constructed over the southern portion of the Waste Burial Area. The cap was selected as a remedy for MC for the Lower Burning Ground (Site 34), which is adjacent to the site (PTA.T017.0098B).

#### **4.14.3 Summary of HRR Changes**

The Waste Burial Area was identified during research conducted while preparing this HRR and was not included in the Phase 3 Inventory report. The exact years of operation at the Waste Burial Area are unknown; however, it is believed that landfilling took place in the 1960s and 1970s. To date the investigation identified several 40-mm grenades on site. Since MC at this site is covered under the IRP, only MEC will be carried forward in the MMRP. The total acreage of the Waste Burial Area MRS is 8.5 acres.

**Map 4-14: Waste Burial Area Near Sites 19 & 34**

#### 4.15 AREAS OF INTEREST

In addition to the new MRSs, four areas of interest were identified during the research performed for the HRR. The areas of interest were identified as potential sites on historical maps or in documents; however, they were determined to be MMRP ineligible or lacked sufficient information to identify the area as an MMRP eligible range. The following areas of interest were identified at PTA, and their approximate locations are shown on Map 4-15:

Baseball Fields – This is an IRP Site listed under PICA-092. According to the IAP, unknown material may have been disposed of in pits at this site. In addition, material dredged from Green Pond Brook was spread on the baseball fields at an unknown date. As detailed in the RI Concept Plan, PTA personnel reported that munitions were found in the dredge material (PTA.D&M.0004; PICA00205). A geophysical survey was conducted for this property and anomalous readings were found. A contractor either excavated or drilled at the anomaly locations and no MEC was encountered (PICA00225). According to the IAP, two investigations of the soil have been conducted at this site; one in 1991 and one in 1995. Several contaminants were detected in the soil samples; however, all were present at levels below the LOCs. The list of parameters analyzed for is not detailed in the IAP. A ROD recommending LUCs for this site was submitted to the regulatory agencies in July 2001; the ROD has not yet been approved due to the release of new EPA guidance on the use of LUCs. This site is considered RC in the IRP (PICA00205). Based on the historical use of this site and the IRP investigation results, both which did not indicate the presence of MC or MEC, this site is not MMRP eligible.

Former Operational Area – This area of interest consists of all areas of the installation that are other than operational ranges, do not fall within an SDZ for operational ranges with the potential for ongoing releases of MEC, have not already been identified as an MRS, and have not already been classified as another Area of Interest. This Area of Interest is not an IRP site, although it is collocated with numerous IRP sites.

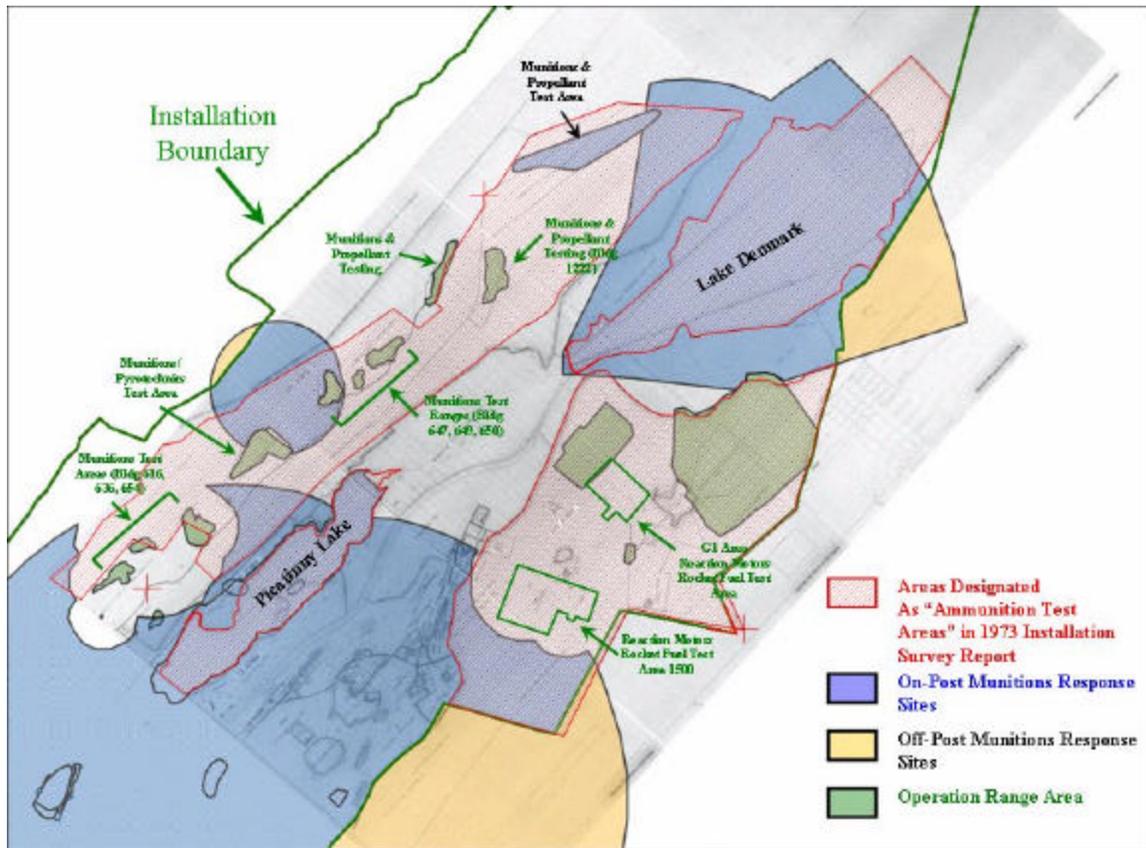
According to a 1973 Installation Survey Report, in 1973 PTA was developed as follows<sup>8</sup> (PTA00015):

- 513 acres for maintenance and munition production and facilities
- 679 acres for supply facilities
- 286 acres for housing and community facilities
- 249 acres for utilities and ground improvements
- 1,398 acres unimproved land
- 648 acres for operational and training facilities - It was reported that the operational and training areas were mainly located on the southern and western portions of the installation; it is likely much of these areas are still located within the operational range areas of the installation.
- 2,036 acres for R&D and testing.

The allocation of the 2,036 R&D acres consisted of the following. Refer to Figure 4-32 for a map showing these areas.

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<sup>8</sup> Note that this equals 5,848 acres; according to the report PTA consisted of 6,491 acres. It is unknown what the remaining acres were used for.



**Figure 4-32 – Map from 1973 Installation Report showing Locations of Areas designated as Ammunition Test Areas**

Artillery Firing (975 acres) – This area is 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 including a ballistics demonstration area, a test range for small and large caliber weapons, ammunitions, and various explosive devices, a test area for small metal projectiles, a short firing range, and a test range for munitions under development. One of the sites is also used for the open detonation of waste ordnance and explosives (PTA.D&M.0001; PICA00015; PICA00205). Refer to Map 4-15 for the approximate location of this area.

Rocket Surveillance (624 acres) – This area is 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 and currently

consists of the 1500 series buildings. The operational area is divided into the Western Explosives Area and the Eastern Pyrotechnics Area. From the early 1950's to 1958, liquid fuel missiles were tested in the Eastern Pyrotechnics Area. The Western Explosives Area was constructed in the late 1940s and used for static testing of rocket engines along with the testing of pyrotechnics, explosives, and solid rocket propellants. The IAP indicates that the Eastern and Western Explosives Areas are currently used for storage, assembly, research, development, and testing of high explosives, propellants, and projectiles (PICA00015; PICA00205). Refer to Map 4-15 for the approximate location of this area.

Testing Areas (51 acres) – This area is located on the southern portion of the installation; it appears 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 (PICA00015). Due to insufficient information in the report, this area cannot be located on a map.

QA Inspections and Nuclear Component Testing (13 acres) – This area is located on the southern portion of the installation and was used for quality assurance inspections and testing of nuclear components used by DoD (PICA00015). Refer to Map 4-15 for the approximate location of this area.

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 (PICA00015). Due to insufficient information in the report, these areas cannot be located on a map.

Although the 1973 report indicates the presence of 2,036 acres of R&D and test areas, actual locations of test ranges and their associated SDZs are not given in the report (PICA00015). Furthermore, in a memo to the Commander of the AEC regarding the February 2002 Active/Inactive Range Inventory Report for PTA, it is indicated that many areas on the

installation listed as inactive training/maneuver areas were actually natural buffers between operational ranges and surrounding communities (PICA00220).

Therefore, sufficient documentation is not available to classify this Area of Interest as an MRS. However, during interviews with various PTA personnel, it was indicated that MEC finds have been made throughout the installation, even in locations not known to be associated with a historic range. As a result, PTA's Safety Office must be contacted prior to conducting any intrusive activities to determine if a MEC removal investigation is required. Since EOD keeps incident reports for 3 years, the locations of most of the MEC finds are unknown (PICA00209; PICA00212; PICA00213). However, it should be noted that on August 28, 2006, a live mortar was found in the woods near Berkshire Trail. It is unknown why the mortar, which was manufactured in 1975, was present at that location since it was not located within any known historic or operational range, or within the SDZ of any known historic or operational range (PICA00229; PICA00230).

Metals and explosive data have been collected for numerous IRP sites located within this Area of Interest. As shown on Plates 1 and 3, both metals and explosives have been found at various locations throughout this site at levels that exceed the LOCs (PICA00205).

Former Motors/Rocket Fuel Test Area (RI Concept Plan Site 4, PICA-157) - The Former Motors/Rocket Fuel Test Area is located within other than operational range area that was characterized as operational at the time of completion of the Phase 3 Inventory report. As such, the site was not previously evaluated for inclusion in the MMRP. The 2001 Final RI report states that the 23-acre site was operated by the NARTS division of the Navy from 1951 to 1968 under a lease from the Department of the Army (PTA.TO17.0047C). Various areas within the site boundary were used for testing rocket engines and their related components and/or testing and developing highly volatile rocket fuels and rocket propulsion systems.

The 2001 Final RI report also states that small mines were reportedly tested after 1968 for an unknown period of time within the area termed Test Area D (PTA.TO17.0047C). However,

none of the reports or maps reviewed discussed or identified a location for this testing. Test Area D has also been documented as containing a range for testing various hand guns; however, the existence of this range could not be verified during previous investigations, and none of the maps reviewed identified a small arms range. In 1975, a Ballistic Rail Gun (BRG) was constructed in Test Area D. The BRG consisted of a trough filled with water or anti-freeze, which allowed the soft recovery of conventional shells fired from a 115-mm Howitzer cannon. The BRG area currently lies within operational range area.

An area termed Test Area E occupies 14 acres at the top of the ridge that overlooks Test Area D (PTA.TO17.0047C). This area consists of five structures and two test stands. The presence of rubble and steel supports indicate additional structures may have existed but were demolished. Rocket engine testing occurred over a rectangular pit located behind Building 3618. Before the exhaust pit was lined with gunnite in 1965 or 1966, materials in the exhaust pit most likely leached into the ground. No documents were found to indicate any MEC investigations and/or responses were performed on the site.

Although the Test Area E has been inactive since 1968, numerous M-16 rifle blanks found during a 1992 site visit indicate that this area was used as a training area. It was reported that about 100 tests in which bullets were fired into cans filled with a gallon of hydrazine occurred behind Building 3601. Building 3601 is not shown on any of the maps reviewed. However, Buildings 3600 and 3602 lie within the area. Also, no documents were identified to indicate the type of guns or bullets utilized for the testing (PTAD&M0004).

The Former Motors/Rocket Fuel Test Area lies within an area of the installation in which a MEC survey must be completed prior to any intrusive activities taking place (PTA.TO17.0063E). However, as discussed, little evidence was identified to show that MEC were used in the area, and none of the documents that discuss the use of MEC identify specific locations at which these items would have been used. Additionally, geophysical surveys were conducted over large sections of the site (PTA.TEPS.0008). The reports identify metal anomalies in various areas of the site, but all of these are attributed to

identifiable site features. Surface clearances and down-hole geophysical surveys were reportedly conducted during soil sampling and drilling activities at the site, but none of the reports discuss identifying MEC (PTA.TO17.0047A). Additionally, the contractor that conducted the work did not indicate that any MEC were identified during completion of the various studies (PICA00225).

The 2005 FS and the 2006 IAP both indicate that chemical contaminants were identified at the site during the numerous investigations (PTA.TO17.0063E; PICA00205). The IAP states, and review of the FS confirms, that all media were covered under the FS and remedial alternatives have been identified to address site contamination. As such, chemical contamination at the site is considered to be fully covered under the IRP. Due to the lack of any identifiable MEC hazard at the site, it is considered to be ineligible for inclusion in the MMRP.

Inactive Rocket Fuel Test Areas (RI Concept Plan Site 2, PICA-008) - The Inactive Motors/Rocket Fuel Test Areas are located within other than operational range area that was characterized as operational at the time of completion of the Phase 3 Inventory report. As such, the site was not previously evaluated for inclusion in the MMRP.

The site includes numerous rocket test areas that were leased to the Naval Air Rocket Test Station (NARTS) division of the Navy. The Navy entered into a sublease agreement with the Reaction Motors Division (RMD) of Thiokol Chemical Co. in 1947. RMD tested and evaluated rocket engines at the site, including the Regulus Class I, Sparrow III, and Bullpup rockets. Other components tested at the site ranged from gas generators for jet engines to power sources for guided missile systems. Other operations known to have occurred in these test areas include new and alternative rocket fuel development and engine redesign. Rocket test firings were horizontal, creating the potential dispersion of exhaust. Activities at this site discontinued in 1962. The majority of the buildings were demolished between 1968 and 1986 and those left remain inactive and unimproved (PTA.T017.0047C). According to an

interview conducted with Mr. Doug Schicho and Mr. Ted Gabel, the area is currently used by the Department of Homeland Security for training (PICA00225).

Chemicals and products used throughout the site were alcohol-, amine-, and petroleum-based propellants; liquid oxygen; ammonia; nitric acid; hydrogen peroxide; fluorine gas; nitric acid; hydrazine; unsymmetrical methylhydrazine; monomethylhydrazine; halogenated fluoride-based oxidizers; boranes and borols (alcohol-boron mixtures); inhibited white fuming nitric acid and inhibited red fuming nitric acid; sulfuric acid; antimony; aluminum perchlorate; ammonia perchlorate; JP-4 and JP-5; magnesium- and aluminum-coating slurries; nitrogen tetroxide; peroxides; and Otto fuel (propylene glycol dinitrate, di-n-butyl sebacate, and 2-nitrodiphenylamine) (PTA.T017.0047C). Testing of Jet Assisted Take Off (JATO) units, which sometimes resulted in explosions leaving solid propellant on the ground, was reported in this area (PTA.D&M.0004). JATO units are solid fuel rockets used to give heavy military transport airplanes an extra push for takeoff from short airfields. No specific details on locations or the time period of these tests were identified in any documents. Otto fuel, which is a gel used in torpedoes, was reported to have been tested near Building 3505. No documents were identified to indicate further details regarding these tests.

Numerous studies have been completed at the site and throughout this portion of the installation as part of the IRP. MEC investigations and geophysical surveys have been completed as part of these investigations. None of the records reviewed indicate that MEC or munitions debris were ever encountered at the site. Soils and groundwater at the site have been thoroughly characterized during numerous site investigations, and an FS has been completed at the site. Review of the FS and the 2006 IAP indicates that all media were addressed in the investigation (PICA00205). The 2006 IAP goes on to state that contaminated surface soils and sediment will be excavated and disposed. Groundwater contaminated with VOCs will be treated via injection of zero valent iron followed by monitored natural attenuation polishing. Following remediation, LUCs are expected to be emplaced to preclude residential land use. Given the lack of any evidence for the presence of

MEC or munitions debris and that the site has been thoroughly characterized and is being addressed under the IRP, this site is not considered to be eligible for inclusion in the MMRP.

## Map 4-15: Areas of Interest

## **5 CONCEPTUAL SITE MODEL**

The CSM was developed following guidance documents issued by the USEPA for hazardous waste sites and by the USACE for MEC sites. Guidance documents included the USEPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (EPA/540/G-89/004)* and the USACE's *CSM Guidance Development of Integrated Conceptual Site Models for Environmental Ordnance and Explosives (OE) Sites (Engineer Manual (EM) 1110-1-1200)*, which was final as of February 2003. The CSM uses preliminary findings presented in this HRR to describe the site and its environmental setting. The CSM presents information regarding: (1) MEC and/or MC known or suspected to be at the site; (2) current and future receptors based on reasonably anticipated or proposed land uses; and (3) complete, potentially complete, or incomplete exposure pathways between known or suspected MEC/MC and identified potential receptors.

PTA-wide CSM profiles are provided in Section 5.1, and site-specific CSM profiles are provided in Section 5.2 for each of the MMRP eligible ranges.

### **5.1 PTA-WIDE CSM PROFILES**

#### **5.1.1 MMRP Installation Profile**

##### *5.1.1.1 Utilities*

Groundwater is the potable water source for all portions of PTA. Water pumped from three on-site water supply wells is directed to a treatment plant owned by PTA and operated by US Filter, a civilian contractor. Water is then distributed to all locations at the arsenal. One exception is the 650 area, where one service well is used for minimal water supply requirements. Electric service is provided by Sussex Rural, who leases a building at the arsenal, and communications are provided by AT&T. Sanitary sewer lines at PTA are owned by the government and maintained by US Filter. Ultimately, wastewater generated at PTA is handled by the Rockaway Sewer Authority. New Jersey Natural Gas provides fuel for individual boilers located at each building (PICA00226).

#### *5.1.1.2 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 Mount Hope Entrance. Gates are continuously monitored by video surveillance and a contracted security force referred to as DoD Civilian Police or Department of the Army Police. Restricted access areas on the interior of the installation are also patrolled. These include the Former Projectile Range, the Inactive Munitions Waste Pit, and the Former Munitions & Propellant Test Area.

### **5.1.2 Physical Profile**

#### *5.1.2.1 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 [°F]) are recorded in July, and the lowest (27.4°F) 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 (PTA.D&M.0003; PTA.TO17.0048S).

#### *5.1.2.2 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 (PTA.D&M.0003).

#### *5.1.2.3 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 (OTHFW.0017).

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 (OTHFW.0017). 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 (PTA.D&M.0003; PTA.TO17.0048S).

The majority of the installation appears on the Dover USGS topographic quadrangle. Elevations on PTA range from 685 to 1,287 feet amsl along the ridgeline of Green Pond Mountain (OTHFW.0017). 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.

#### *5.1.2.4 Soil*

There are 26 soil types on the installation that are recognized by the U.S. Department of Agriculture and Soil Conservation Service (OTHFW.0017). Soils in the area are primarily coarse-textured sandy loams that are derived from bedrock, glacial till, and colluvium (OTHFW.0017).

The northwestern 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 (PTA.D&M.0003; PTA.TO17.0048S).

#### *5.1.2.5 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 (PTA.D&M.0003).

#### *5.1.2.6 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 (OTHFW.0017). 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 north of and adjacent to the installation known as Green Pond. On PTA, Green Pond Brook's width varies from 10 to 30 feet (three to nine meters), with a maximum depth of 5 feet (OTHFW.0017). 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 (PTA.D&M.0003; PTA.TO17.0048S). Ames Brook carries headwaters off of 250 acres of PTA and exits the installation along the eastern boundary (OTHFW.0017).

Lake Denmark and Picatinny Lake are man-made features that collectively comprise 360 acres of open water (OTHFW.0017). 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 7 feet; Picatinny Lake's maximum depth is approximately 20 feet (PTA.D&M.0003; PTA.TO17.0048S).

PTA contains 1,250 acres of mostly forested and scrub/shrub wetlands (OTHFW.0017). Red maple swamp forests, lakes and ponds, and their associated wetlands comprise 92% of all wetlands present on the installation (OTHFW.0017). 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 (OTHFW.0015). Hydric soils are found on 26% of PTA, mainly in the Picatinny Valley and scattered riparian areas throughout the installation (OTHFW.0017).

#### *5.1.2.7 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*) (OTHFW.0017).

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.

### **5.1.3 Land Use and Exposure Profile**

#### *5.1.3.1 Current Human Receptors*

PTA currently directly 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 (PICA00226). Based on land use and knowledge of site activities, which primarily include military R&D, residential housing and recreation, potential human receptors at the installation include PTA residents, residents off the installation, outdoor maintenance workers, security workers, construction workers, indoor workers, recreationists (e.g., fishermen, hunters, boaters, hikers, baseball players), and visitors (PTA.D&M.0044).

Groundwater is currently the source of potable water for PTA and communication may exist between groundwater and surface water (PICA00226). All of PTA's four production wells are within the 1926 Explosion Site area. Explosives were detected in one production well, which has been taken out of service, and have not been detected since then. Explosives have not been detected in the remaining wells used for potable water. The water is pumped through an air stripper to remove volatile chemicals (PTA.D&M.0044). The potable water supply is monitored by PTA semi-annually. Potable water users at PTA are potential receptors. The source of potable water off-PTA is not known; therefore, potentially complete pathways for groundwater cannot be discounted

#### *5.1.3.2 Future Human Receptors*

Future human receptors are likely to be the same as, or similar to, present receptors. There is no planned land use change for PTA, and the facility will remain under the control of arsenal officials for the foreseeable future. Under these conditions, human exposure to contaminated media would continue to be minimized by LUCs and ICs that are currently in place.

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 whether a MEC removal action is necessary on a case-by-case basis (PICA00213).

#### *5.1.3.3 Zoning/Land Use Restriction*

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.

#### 5.1.3.4 *Beneficial Resources*

PTA contains the largest tract of undeveloped, forested public land in the New Jersey Highlands Region (OTHFW.0017). The collective acreage of PTA's undeveloped lands that are contiguous with adjacent public lands and safety easements on adjacent private properties is 11,368 acres (OTHFW.0017). 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 (OTHFW.0017).

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 (OTHFW.0017).

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 (*Phasianus colchius*). Whitetail deer (*Odocoileus virginianus*), wild turkey (*Meleagris gallopavo*), and ruffed grouse (*Bonasa umbellus*) are a few of the game bird species 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 (OTHFW.0017). A few popular species fished for in the lakes and ponds are largemouth bass, yellow perch, and catfish. Waterfowl species hunted at PTA include wood duck (*Aix sponsa*), mallard (*Anus platyrhynchos*), and green winged teal (*Anas carolinensis*) (OTHFW.0017).

#### 5.1.3.5 Demographics

The arsenal 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 (PICA00226). The nearest towns are: Wharton (population: 6298), 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. The area immediately surrounding PTA is either undeveloped or sparsely developed residential property (PTA.D&M.0003; U.S. Census, 2000).

#### 5.1.4 Ecological Profile

The following information was adapted from the Integrated Natural Resources Management Plan for PTA (OTHFW.0017).

##### 5.1.4.1 Habitat Type

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 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 because they provide habitat for ephemeral aquatic and amphibian species.

#### 5.1.4.2 Ecological Receptors

Ecological receptors at PTA consist of flora and fauna on the installation, as well as the ecosystems of which they are a part. 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 species of birds.

Approximately 70% of PTA is forested, while 21% of PTA is considered wetland, with some of these areas overlapping. Providing habitat for urban wildlife, 19% of the land at PTA is improved or semi-improved. Urban wildlife are species adapted to human presence and include small mammals (e.g., gray squirrels [*Sciurus 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.

Federally listed, endangered Indiana bats were documented in 1993 and 1994 hibernating in abandoned mines within 2 miles (3,219 meters) of PTA. It is believed that the Indiana bat depends on PTA for summer habitat. Two federally listed threatened animals are known to occur at PTA. The bald eagle (*Haliaeetus leucocephalus*) is a transient species. The last documented sighting of a bog turtle (*Clemmys muhlenburgii*) 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 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.

**5.2 SITE-SPECIFIC CSM PROFILES**

The site-specific CSM profiles are provided in the following sections. Information is only provided in the site-specific CSM profiles in Section 5.2 if it differs from the installation-wide information. If no site-specific information was available, reference is provided to the appropriate installation-wide CSM profile in Section 5.1.

**5.2.1 1926 Explosion Site**

*5.2.1.1 MMRP Site Profile*

The site-specific site profile is presented in Table 5-1:

**Table 5-1: Site Profile – 1926 Explosion Site**

Information Needs	CSM Findings
Area and Layout	Approximately 1,552 acres Covers a large portion of the south-central portion of PTA
Structures	Hundreds of buildings are located within the site area. The site 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 include manufacturing, storage, testing, R&D, and administration

Information Needs	CSM Findings
	buildings, as well as military housing.
Utilities	Refer to Section 5.1.1.1.
Boundaries	N: Approximately 1,000 feet (305 meters) south of the northern end of Picatinny Lake S: 4 <sup>th</sup> Street E: PTA boundary W: Ridgeline of Green Pond Mountain
Security	Refer to Section 5.1.1.2. No site-specific security practices or controls are associated with the 1926 Explosion Site.

5.2.1.2 *Physical Profile*

The site-specific physical profile is presented in Table 5-2:

**Table 5-2: Physical Profile – 1926 Explosion Site**

Information Needs	CSM Findings
Topography	Refer to Section 5.1.2.3.
Soil	Clay silt loams, loam, silt, sand, clay, gravel, rock outcroppings, and glacial till (PTA.D&M.0001)
Hydrogeology	Refer to Section 5.1.2.5.
Hydrology	The explosion site includes most of Picatinny Lake, EOD Pond, North and South basins, and Fisher’s Pond, Bear Swamp Brook, and Green Pond Brook, as well as several small streams.
Vegetation	Refer to Section 5.1.2.7.

5.2.1.3 *Land Use and Exposure Profile*

The site-specific land use and exposure profile is presented in Table 5-3:

**Table 5-3: Land Use and Exposure Profile – 1926 Explosion Site**

Information Needs	CSM Findings
Current Land Use/Activities	Military housing Army buildings Parking lots Undeveloped property Recreational areas
Current Human Receptors	PTA personnel Contractors Visitors PTA residents
Potential Future Land Use	Same as current use
Potential Future Human Receptors	Same as current receptors
Beneficial Resources	Refer to Section 5.1.3.4.

*5.2.1.4 Ecological Profile*

The site-specific ecological profile is presented in Table 5-4.:

**Table 5-4: Ecological Profile – 1926 Explosion Site**

Information Needs	CSM Findings
Habitat Type	On undeveloped areas of site, there are patches of forest, wetlands, lakes, ponds, and streams used by ecological receptors, including threatened and endangered plants and animals and several invertebrate species.
Degree of Disturbance	While a large portion of the area is developed, there are some portions of the site where undisturbed habitat remains and disturbance is considered to be low.
Ecological Receptors	Refer to Section 5.1.4.2.

5.2.1.5 *Munitions/Release Profile*

**5.2.1.5.1 Munitions Types**

Table 5-5 presents a summary of MEC types that could be expected to exist within the 1926 Explosion Site based on the information collected for this HRR. 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 (PICA00096).

**Table 5-5: Summary of Potential MEC Types – 1926 Explosion Site**

Potential Munitions	Potential MEC
Mines Depth charges Fuzes Projectiles Explosives Small arms ammunition Propellants	Partially/fully functioned mines, depth charges, fuzes, projectiles, propellants, and explosives

**5.2.1.5.2 Maximum Probability 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 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.

**5.2.1.5.3 MEC Density**

The density of MEC is unknown since it was reported that PTA was cleaned up and rebuilt after the explosion. However, not all the MEC were removed; there have been numerous

MEC finds since 1926 (PTA.D&M.0003; PICA00096; PICA00208; PICA00209; PICA00213).

#### **5.2.1.5.4 Munitions Debris**

A visual survey was not conducted as part of the HRR; however, a historical report on the explosion indicates that shell fragments were found up to 1 mile (1,609 meters) away from the explosion center (PICA00096).

#### **5.2.1.5.5 Associated Munitions Constituents**

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 (PICA00096). (Refer to the appropriate Ordnance Technical Data Sheets in Appendix D.) As shown on Plate 1, metals were detected at concentrations greater than LOCs in soil, surface water, and sediment at several locations throughout the 1926 Explosion Site. Plate 3 indicates explosives were detected at concentrations greater than LOCs in soil, surface water, and sediment at several locations throughout the 1926 Explosion Site.

MC associated with projectiles includes perchlorate. As shown on Plate 2, perchlorate was detected in groundwater at concentrations greater than the LOC.

#### **5.2.1.5.6 Transport Mechanisms/Migration Routes**

The primary transport mechanisms identified for the 1926 Explosion Site 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. Future 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.

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

***Infiltration:*** Based on the soil types associated with the 1926 Explosion Site, 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 1926 Explosion Site.

#### 5.2.1.6 Pathway Analysis

##### 5.2.1.6.1 MEC

Based on the information that not all the MEC were removed and numerous MEC finds have been made since 1926, it appears that MEC associated with the explosion are still present at PTA (PTA.D&M.0003; PICA00096; PICA00208; PICA00209; PICA00213). The MEC Pathway Analysis, Figure 5-1, shows that several complete pathways exist for PTA personnel, PTA residents, and biota that may contact, via handling or treading underfoot, MEC in the surface soil or surficial sediments of the waterbodies within the 1926 Explosion Site. Complete exposure pathways exist for biota that may nest or burrow at the site and, in so doing, may come into contact with MEC. Potentially complete exposure pathways also exist for contractors who may need to access underground utilities in the subsurface soil. This includes intrusive work that would occur during construction activities. As stated in Section 5.1.3.2, clearance must be given by PTA's Safety Office prior to any subsurface activity. In addition, there are several sites within the 1926 Explosion Site for which access is restricted, including the Shell Burial Grounds.

##### 5.2.1.6.2 MC

As illustrated in the MC pathway analysis, Figure 5-2, soil and surface water/sediment impacted by MC are the primary source media for all human and ecological receptors. Complete exposure pathways exist for all receptors who are likely to contact soil or surface

water and sediment containing MC. PTA personnel and PTA residents may be exposed to surface soil during their normal activities. Potentially complete pathways exist for contractors who may contact surface, subsurface soil, and/or sediment when accessing underground utilities or conducting future development. Exposure routes include direct contact, ingestion, and inhalation of dust. Complete exposure pathways exist for biota that come into contact with surface soil through feeding/preening activities and with subsurface soil through burrowing activities.

PTA personnel and PTA residents who fish or go boating in any of the water bodies may be exposed to MC in surface water via dermal contact or to sediment via incidental ingestion and dermal contact. These are complete exposure pathways. While swimming is banned at PTA, it is possible that recreational users, primarily children or teenagers, might engage in swimming<sup>9</sup>. Therefore, ingestion of surface water is a potentially complete pathway for PTA residents. 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 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.

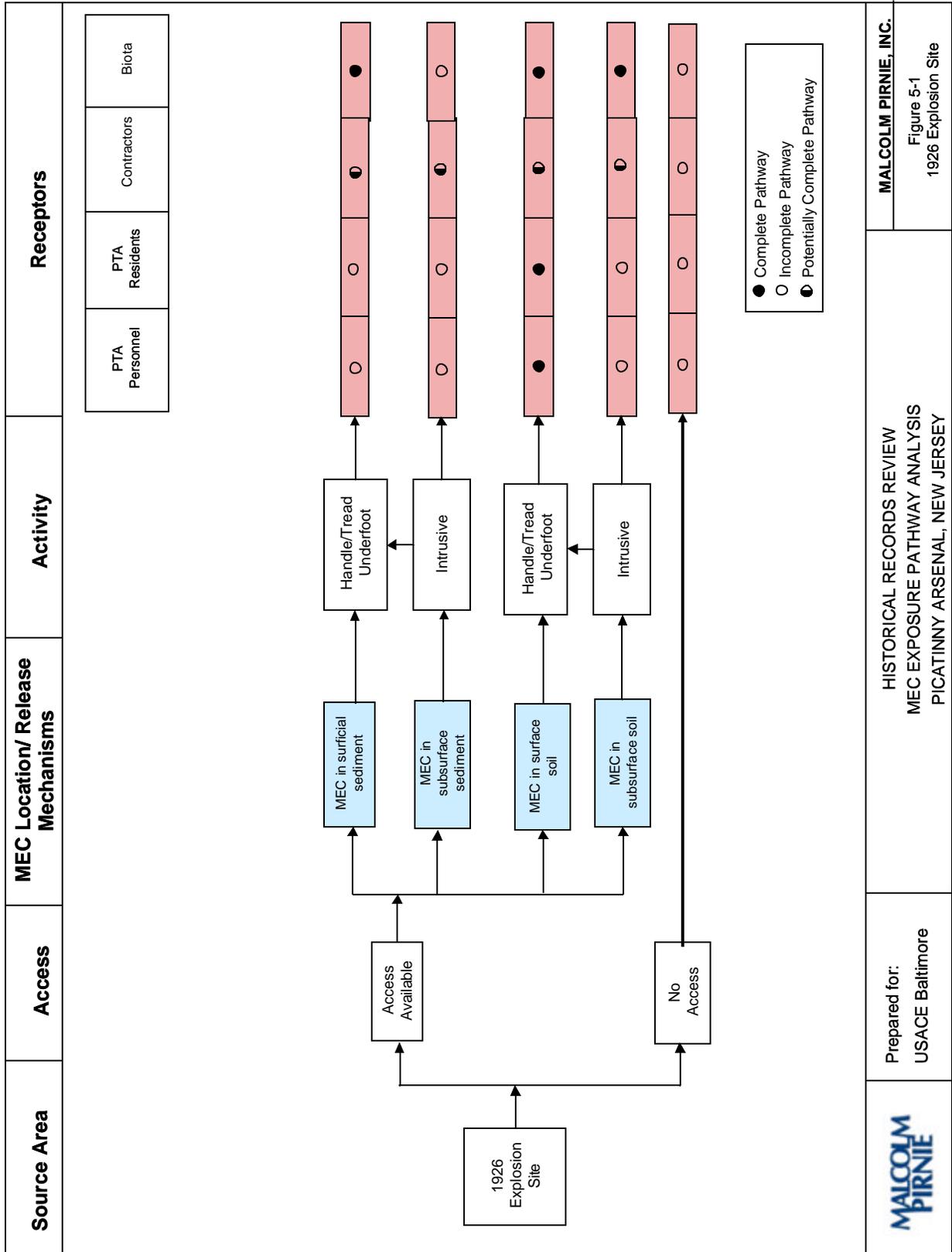
Potentially complete pathways through the food chain exist for assimilative/ bioaccumulative MC to both human and ecological receptors. PTA personnel and PTA residents may ingest MC that have bioaccumulated in game animals hunted in the undeveloped portions of the 1926 Explosion Site. As stated in Section 5.1.3, 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,

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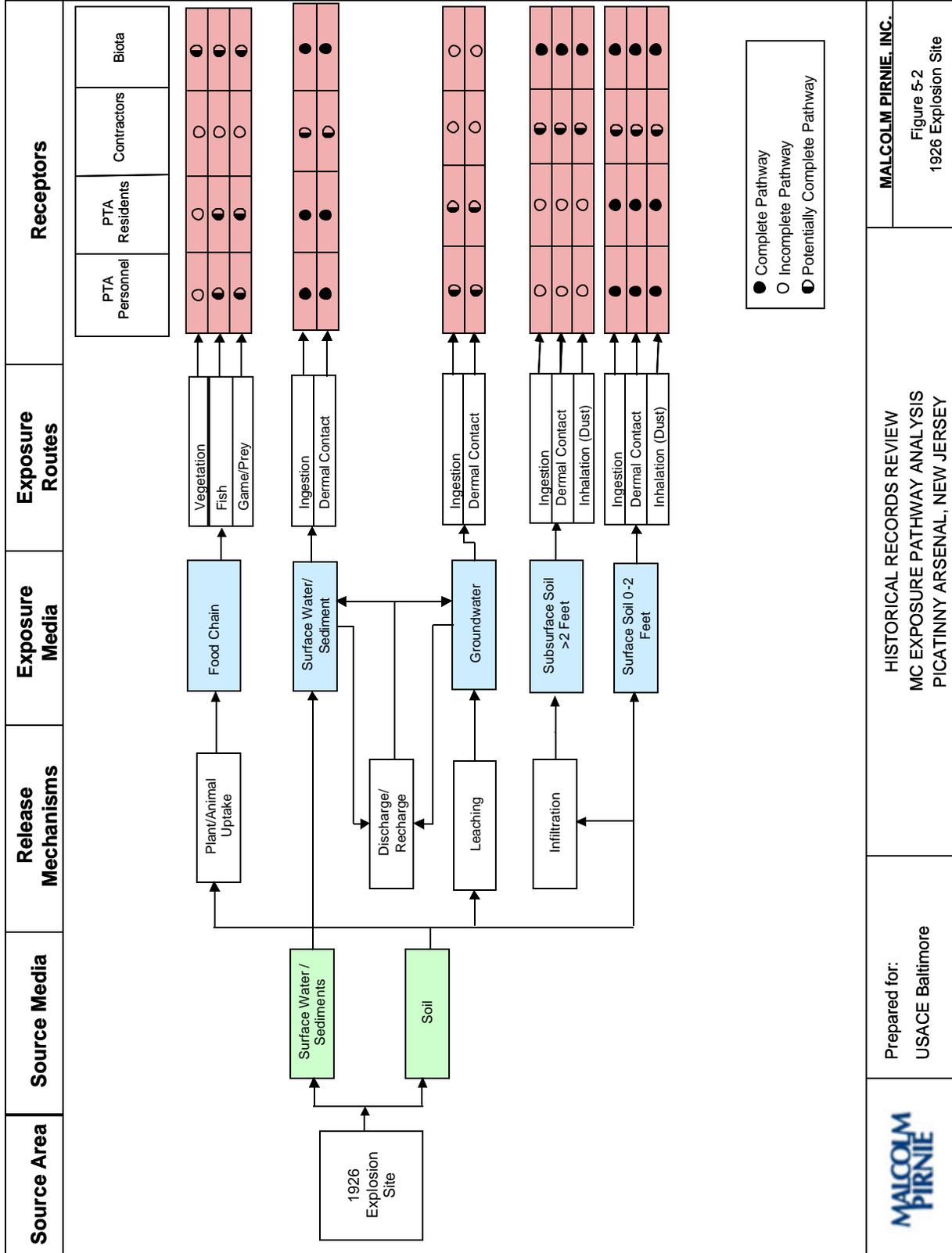
<sup>9</sup> It should be noted that PTA has established several institutional controls including swimming bans and fish advisories for several of their water bodies. This is discussed in more detail in Section 4.

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 5-1: MEC Pathway Analysis Figure – 1926 Explosion Site**



**Figure 5-2: MC Pathway Analysis Figure – 1926 Explosion Site**



**5.2.2 1926 Explosion Site – Off-Post**

*5.2.2.1 MMRP Site Profile*

Since the 1926 Explosion Site – Off-Post is located outside of the PTA boundary, some of the PTA-wide information provided in Section 5.1 is not applicable to this site. Additional information has been added to the 1926 Explosion Site – Off-Post CSM, where appropriate, to address these differences. The site-specific site profile is presented in Table 5-6:

**Table 5-6: Site Profile – 1926 Explosion Site – Off-Post**

Information Needs	CSM Findings
Area and Layout	Approximately 833 acres Located outside the eastern boundary of PTA (Map 5-2)
Structures	Residential housing Buildings associated with the operations at the Mt. Hope Quarry Driveways and parking lots
Utilities	Expected at the Mt. Hope Quarry, but locations are unknown
Boundaries	N: PTA boundary S: PTA boundary E: Approximately the middle of Hope Lake W: PTA boundary
Security	None Located outside of secured PTA boundary

*5.2.2.2 Physical Profile*

The site-specific physical profile is presented in Table 5-7:

**Table 5-7: Physical Profile – 1926 Explosion Site – Off-Post**

Information Needs	CSM Findings
Topography	Moderately steep terrain sloping east southeast toward Hope Lake and Mt Hope Pond Approximately 800 to 1,000 feet amsl
Soil	Rock outcrop and Rockaway sandy loam ( <a href="http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx">http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx</a> )
Hydrogeology	Refer to Section 5.1.2.5. Due to the proximity of the site to PTA, it is assumed that the hydrogeology description for PTA is applicable to the adjacent off-PTA area.
Hydrology	Mt. Hope Pond and portions of Hope Lake (Map 5-2)
Vegetation	Developed land Deciduous and mixed forests ( <a href="http://www.nj.gov/dep/gis/dep splash.htm#">http://www.nj.gov/dep/gis/dep splash.htm#</a> )

5.2.2.3 *Land Use and Exposure Profile*

The site-specific land use and exposure profile is presented in Table 5-8:

**Table 5-8: Land Use and Exposure Profile – 1926 Explosion Site – Off-Post**

Information Needs	CSM Findings
Current Land Use/Activities	Residential Mt. Hope Quarry operations
Current Human Receptors	Mt. Hope Quarry personnel Residents Visitors
Potential Future Land Use	Same as current use
Potential Future Human Receptors	Same as current receptors
Beneficial Resources	Refer to Section 5.1.3.4.

5.2.2.4 *Ecological Profile*

The site-specific ecological profile is presented in Table 5-9:

**Table 5-9: Ecological Profile – 1926 Explosion Site – Off-Post**

Information Needs	CSM Findings
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. ( <a href="http://www.nj.gov/dep/gis/depsplash.htm#">http://www.nj.gov/dep/gis/depsplash.htm#</a> )
Degree of Disturbance	High as the majority of the site is the Mt. Hope Quarry.
Ecological Receptors	Refer to Section 5.1.4.2.

5.2.2.5 *Munitions/Release Profile*

**5.2.2.5.1 Munitions Types**

Table 5-10 presents a summary of MEC types that could be expected to exist within the 1926 Explosion Site – Off-Post based on the information collected for this HRR. 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 (PICA00096).

**Table 5-10: Summary of Potential MEC Types – 1926 Explosion Site – Off-Post**

Potential Munitions	Potential MEC
Mines Depth charges Fuzes Projectiles Explosives Small arms ammunition Propellants	Partially/fully functioned mines, depth charges, fuzes, projectiles, small arms ammunition, and propellants Explosives

**5.2.2.5.2 Maximum Probability 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.

**5.2.2.5.3 MEC Density**

The density of MEC is unknown since it was reported that the area affected by the 1926 explosion was cleaned up after the explosion. However, since 2002, seven MEC finds have been documented at the Mt. Hope Quarry (PICA00096; PICA00090; PICA00175; PICA00212; PICA00224).

**5.2.2.5.4 Munitions Debris**

A visual survey was not conducted as part of the HRR; however, a historical report on the explosion indicates that shell fragments were found up to 1 mile (1,609 meters) away from the explosion center (PICA00096).

#### **5.2.2.5.5 Associated Munitions Constituents**

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 (PICA00096). (Refer to the appropriate Ordnance Technical Data Sheets in Appendix D). No known sampling events have occurred outside of PTA boundaries.

#### **5.2.2.5.6 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 (PICA00206).

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 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 beneath the surface of the soil 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.

#### 5.2.2.6 *Pathway Analysis*

##### **5.2.2.6.1 MEC**

Based on the information available that all the MEC was not removed and seven MEC finds have been documented at the Mt. Hope Quarry since 2002, it appears that MEC associated with the explosion are still present at this site (PICA00090; PICA00175; PICA00212; PICA00224). The MEC Pathway Analysis, Figure 5-3, shows complete exposure pathways exist for the Mt. Hope Quarry personnel who may contact MEC via handling/treading underfoot in both surface and subsurface soil. Exposure pathways for biota are complete for ecological receptors that may contact MEC in surface soil during normal feeding and nesting activities and in subsurface soil during burrowing. Complete exposure pathways also exist for aquatic and semi-aquatic ecological receptors that may contact MEC in the surficial sediments of Hope Lake or Mt. Hope Pond. Potentially complete exposure pathways exist for off-PTA residents that may contact MEC in surface soil or surficial sediment via handling or treading underfoot. In addition, potentially complete exposure pathways exist for contractors who may conduct intrusive work during future construction activities.

##### **5.2.2.6.2 MC**

As illustrated in the MC pathway analysis, Figure 5-4, soil and surface water/sediment impacted by MC are the primary source media for all human and ecological receptors and all pathways are potentially complete since no investigations for MC have been conducted in the 1926 Explosion Site Off-Post area. Potentially complete exposure pathways exist for all receptors who may contact soil or surface water and sediment containing MC. Mt. Hope Quarry personnel, off-PTA residents, and contractors may be exposed to surface soil during their normal activities. Mt. Hope Quarry personnel and contractors may also contact subsurface soil during quarrying and when accessing underground utilities or conducting

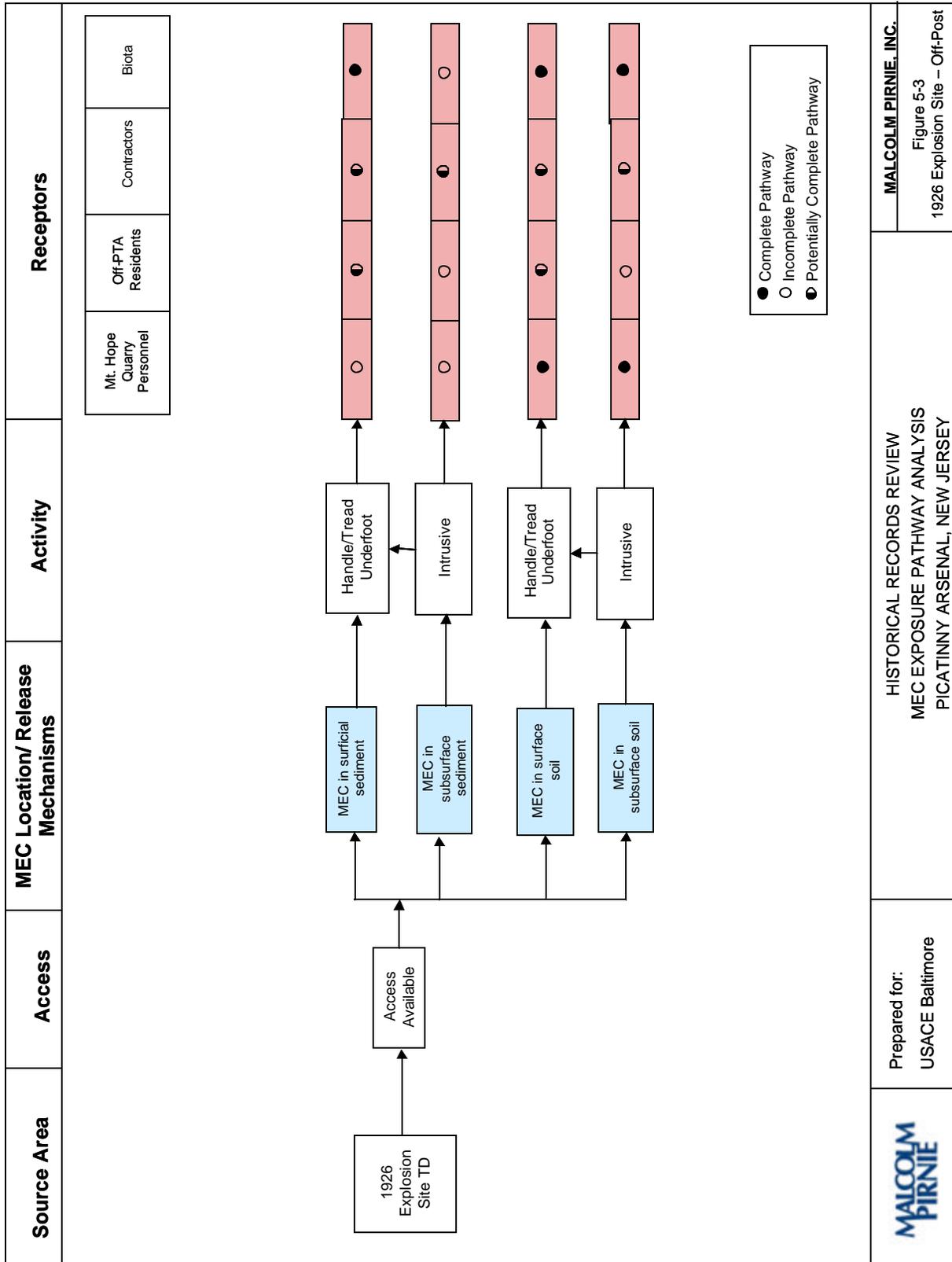
future development, respectively. Exposure routes include direct contact, ingestion, and inhalation of dust. Biota may also come into contact with surface soil through feeding/preening activities and with subsurface soil through burrowing activities.

Off-PTA residents who may fish or go boating in Hope Lake or Mt. Hope Pond may be exposed to surface water via dermal contact or to sediment via incidental ingestion and dermal contact. Ingestion of surface water is a potentially complete pathway for off-PTA residents since 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.

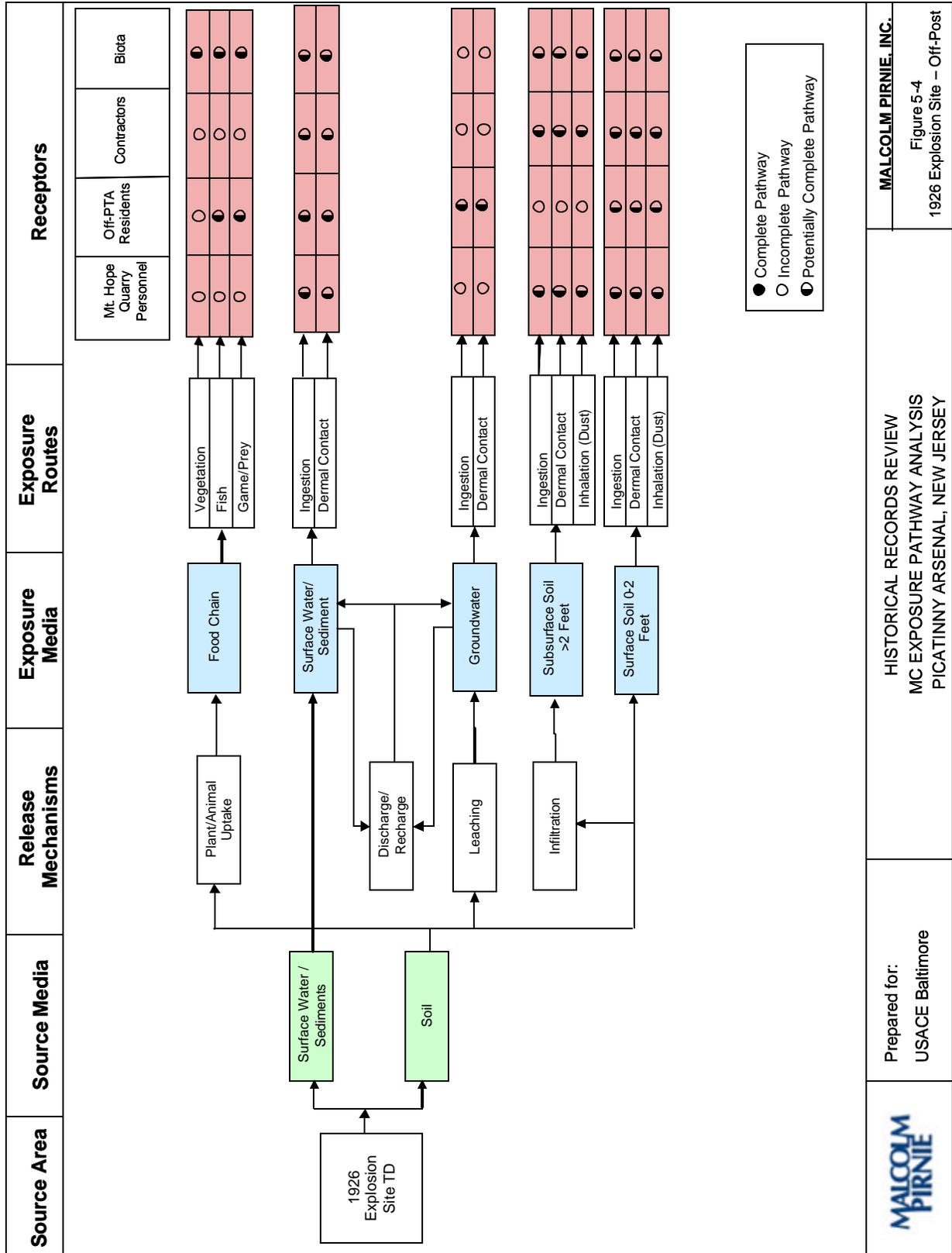
The source of potable water off-PTA is not known; therefore, potentially complete pathways for groundwater cannot be discounted.

Potentially complete pathways through the food chain exist for assimilative/ bioaccumulative MC to both human and ecological receptors. Off-PTA residents who engage in hunting or fishing in the area and consume their catch may ingest MC that have bioaccumulated in fish or game animals (i.e., waterfowl). 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 5-3: MEC Pathway Analysis Figure – 1926 Explosion Site – Off-Post**



**Figure 5-4: MC Pathway Analysis Figure – 1926 Explosion Site – Off-Post**



### 5.2.3 Dredge Pile and Former Sanitary Landfill

#### 5.2.3.1 MMRP Site Profile

The site-specific site profile is presented in Table 5-11:

**Table 5-11: Site Profile – Dredge Pile and Former Sanitary Landfill**

Information Needs	CSM Findings
Area and Layout	Dredge Pile is located entirely within the Former Sanitary Landfill. The site covers 13 acres (PTA.TO17.0113B). Located in southernmost part of PTA
Structures	No buildings or other structures are present on the site.
Utilities	Refer to Section 5.1.1.1.
Boundaries	N: Abandoned railroad line S: Spicer Avenue E: Spicer Avenue W: Abandoned railroad line
Security	Refer to Section 5.1.1.2. No site-specific security practices or controls are associated with the Dredge Pile or Former Sanitary Landfill.

#### 5.2.3.2 Physical Profile

The site-specific physical profile is presented in Table 5-12:

**Table 5-12: Physical Profile – Dredge Pile and Former Sanitary Landfill**

Information Needs	CSM Findings
Topography	Almost level to gently rolling Elevation ranges between 690 and 705 feet amsl
Geology	A geophysical survey conducted in 1986 identified bedrock at 375 to 450 above mean sea level.
Soil	A geophysical survey conducted in 1986 revealed that the Dredge Pile is an anomalous area. It is comprised of 15-20 feet of fill, over approximately 1.8 acres, from Green Pond Brook and Bear Swamp.  The soil in this area of PTA is fill overlying fluvial sand and gravel
Hydrogeology	Underlain by an upper water table and lower semi-confined aquifer Shallow groundwater flows to the west-northwest, presumably towards nearby Green Pond Brook.
Hydrology	No surface water bodies are present on the site. Surface water runoff on the site most likely infiltrates and flows west-northwest with shallow groundwater, towards Green Pond Brook.
Vegetation	Most of the site is covered by maintained grass. Surrounding area is predominantly deciduous forest.

5.2.3.3 *Land Use and Exposure Profile*

The site-specific land use and exposure profile is presented in Table 5-13:

**Table 5-13: Land Use and Exposure Profile - Dredge Pile and Former Sanitary Landfill**

Information Needs	CSM Findings
Current Land Use/Activities	Unutilized grassy area
Current Human Receptors	PTA personnel PTA residents Trespassers
Potential Future Land Use	LUC with restricted access A vegetative cover will be placed on ~ 1 acre

Information Needs	CSM Findings
Potential Future Human Receptors	PTA personnel PTA residents Trespassers Contractors (i.e., construction workers)
Beneficial Resources	Refer to Section 5.1.3.4. Lies within Green Pond Brook watershed

*5.2.3.4 Ecological Profile*

The site-specific ecological profile is presented in Table 5-14:

**Table 5-14: Ecological Profile – Dredge Pile and Former Sanitary Landfill**

Information Needs	CSM Findings
Habitat Type	Grass fields Mowed lawn Deciduous forest
Degree of Disturbance	Low
Ecological Receptors	Soil invertebrates Vegetation Small and large mammals Songbirds and raptors

*5.2.3.5 Munitions/Release Profile*

**5.2.3.5.1 Munitions Types**

Table 5-15 presents a summary of MEC types that are expected to exist within the Dredge Pile and Former Sanitary Landfill, based on the information collected for this HRR. The mechanism by which the MEC may have been released into the environment is also presented in this table.

**Table 5-15: Summary of Potential MEC Types – Dredge Pile and Former Sanitary Landfill**

Potential Munitions	Primary Mechanisms	Release	Potential MEC
Rifle grenades	Disposal		Malfunctioned rifle grenades
Large and small caliber ammunition	Disposal		Unfired small arms ammunition

**5.2.3.5.2 Maximum Probability Penetration Depth**

The penetration depth does not apply to this site due to the manner in which munitions were deposited. Since dredged sediments were placed to an estimated thickness of 15 to 20 feet on the Dredge Pile, MEC may be buried up to 20 feet in depth.

**5.2.3.5.3 MEC Density**

The density of MEC in the Dredge Pile or throughout the Former Sanitary Landfill is unknown. It is believed MEC may have been placed in the Dredge Pile incidentally, along with dredge spoils from Green Pond Brook. The landfill area was a disposal site for rubbish, industrial waste, sewage sludge, and MEC from the 1940s to the early 1970s (PTA.TO17.0113B). A geophysical survey conducted for the RI in 1998 revealed several ferrous anomalies throughout the landfill. Seven areas were excavated; however, no munitions were identified.

**5.2.3.5.4 Munitions Debris**

A visual survey was not conducted for the HRR. It is assumed that since the Dredge Pile and Former Sanitary Landfill are known depositories of MEC, munitions debris may also be present on site.

#### **5.2.3.5.5 Transport Mechanisms/Migration Routes**

The primary transport mechanisms identified for the Dredge Pile and Former Sanitary Landfill include:

**Soil Disturbance:** The current degree of disturbance is low and is expected to remain low since LUCs have been proposed as the remedy for soils at the site. Future soil disturbance, such as that caused by the implementation of an asphalt cap over the Former Sanitary Landfill, could uncover MEC that are buried beneath the surface soil.

**Erosion:** Erosion of soil may uncover MEC buried beneath the surface soil.

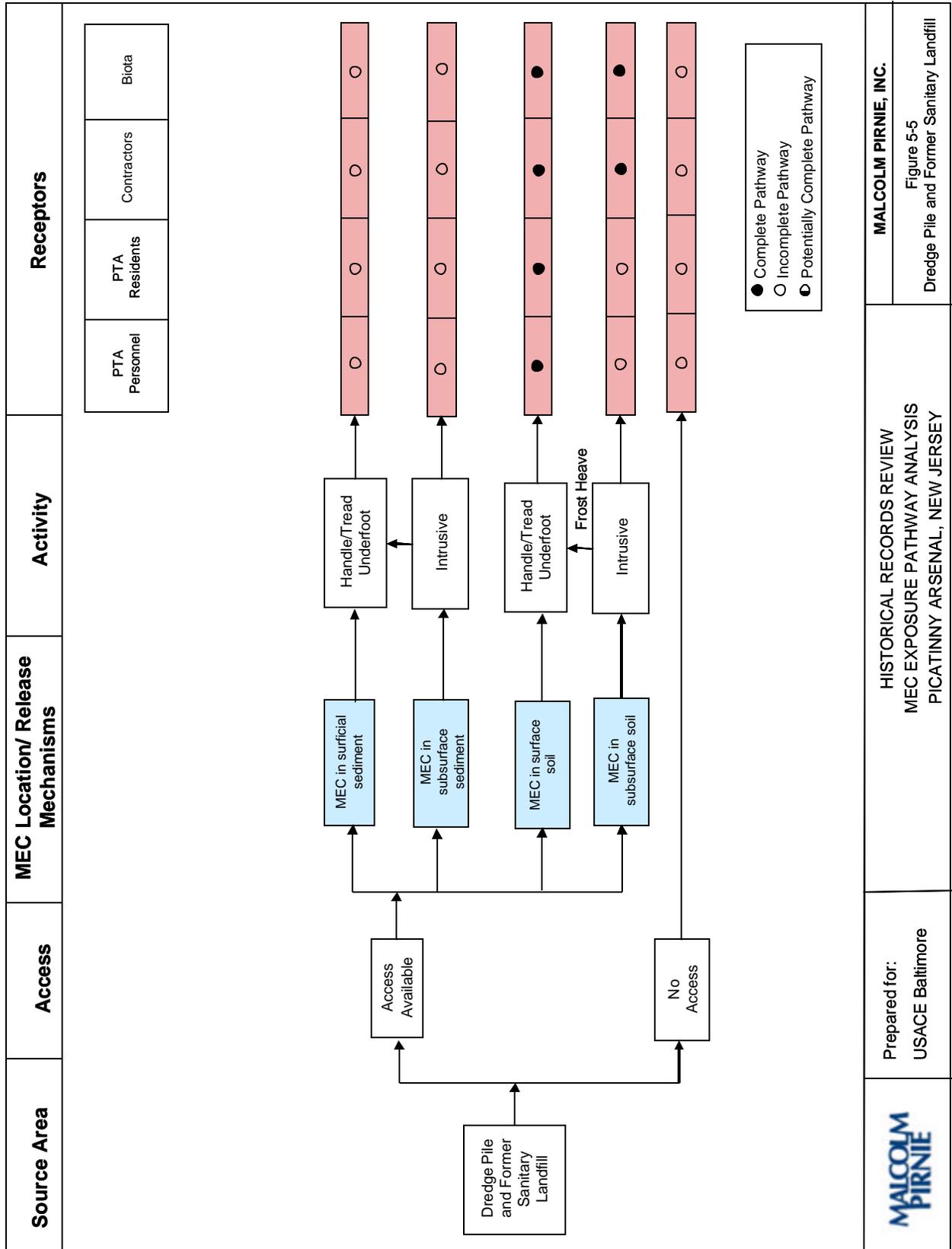
**Frost Heave:** Periodic, alternating freezing and thawing during the winter may cause MEC to rise beneath the surface of the soil to the soil surface.

#### *5.2.3.6 MEC Pathway Analysis*

These analyses assume that trespassers to the site are PTA personnel or PTA residents who access the site without permission.

The MEC Pathway Analysis, Figure 5-5 indicates that complete pathways exist for PTA personnel and PTA residents who have access to the site and may contact MEC in surface soil via handling or treading underfoot. There are complete pathways for contractors (i.e., construction workers) who may contact MEC in surface or subsurface soil while performing future redevelopment activities, such as the installation of the asphalt cap over the Former Sanitary Landfill. Complete pathways also exist for biota that may contact MEC in both surface soil and subsurface soil while feeding, nesting, or burrowing.

**Figure 5-5: MEC Pathway Analysis Figure – Dredge Pile and Former Sanitary Landfill**



## 5.2.4 Former DRMO Yard and Former Burning Ground

### 5.2.4.1 MMRP Site Profile

The site-specific site profile is presented in Table 5-16:

**Table 5-16: Site Profile – Former DRMO Yard and Former Burning Ground**

Information Needs	CSM Findings
Area and Layout	The Former DRMO Yard is located in Area G of PTA, adjacent to Green Pond Brook. The site is located along 11 <sup>th</sup> Avenue, south of the intersection of 6 <sup>th</sup> Street and Reilly Road (PTA.TO7.0055G). The site occupies approximately 9.5 acres.
Structures	Buildings 314 (DRMO office) and Buildings 314B, 314C, 314 D, and 314E (used for excess materials storage) Chain link fence surrounds the area
Utilities	Refer to Section 5.1.1.1.
Boundaries	N: Buildings outside of fenced area S: Poorly drained, marshy land E: Green Pond Brook and undeveloped, forested land W: Buildings outside of fenced area
Security	Refer to Section 5.1.1.2. Chain link fence and an entrance gate on East 6 <sup>th</sup> Street are also on this site.

5.2.4.2 *Physical Profile*

The site-specific physical profile is presented in Table 5-17:

**Table 5-17: Physical Profile - Former DRMO Yard and Former Burning Ground**

Information Needs	CSM Findings
Geology	<p>The bedrock formation underlying the site is Green Pond Conglomerate (RI Concept Plan).</p> <p>The unconsolidated soil that overlies units in this area consists of an unsorted and unstratified glacial lacustrine till, comprised mainly of boulders, cobbles, and pebbles with a fine silty, sand matrix (PTA.TO17.0055G). The thickness of the overburden in this vicinity is estimated at around 100 feet.</p> <p>Approximately 10 feet of fill material overlies medium to fine sand with clayey silt and gravel.</p> <p>On the eastern portion of the site (near Green Pond Brook), a 2-foot layer of peat underlies the fill material (PTA.TO17.0055G).</p>
Topography	<p>Northern portion of the site is relatively level, reworked floodplain surrounded by swampy areas with little topographic relief (PTA.TO17.0055G).</p>
Soil	<p>Most of the area is paved. Soils are classified as the Otisville Series (RI Concept Plan). Otisville soils are deep, gently sloping to steep, excessively drained soils formed in assorted gravelly and sandy outwash deposits that have a high proportion of granitic gneiss coarse fragments (RI Concept Plan).</p> <p>The site is underlain by 5 to 8 feet of fill material consisting of silt, sand, gravel, and boulders, with wood, cinder blocks and other miscellaneous debris.</p>
Hydrogeology	<p>Two glacial overburden aquifers, one unconfined and one semi-confined</p> <p>One bedrock aquifer</p>
Hydrology	<p>Surface water runoff on the northern portion of the site is minimal and tends to pool before infiltrating. Surface water runoff on the southern portion of the site, which is asphalt-paved, is significant. On the western side of the site, runoff is directed to a drainage ditch, northwest of Building 314, which empties into Green Pond Brook. Runoff on the eastern side of the site drains directly to Green Pond Brook (PTA.TO17.0055G).</p> <p>There is a depressional wetland / marshy area in the center of the site.</p>
Vegetation	<p>Unpaved portions of the site are covered with trees or grass.</p>

5.2.4.3 *Land Use and Exposure Profile*

The site-specific land use and exposure profile is presented in Table 5-18:

**Table 5-18: Land Use and Exposure Profile - Former DRMO Yard and Former Burning Ground**

Information Needs	CSM Findings
Current Land Use/Activities	The Former DRMO Yard was closed in the mid-1990's. The Former Burning Ground operated until the mid-1940's. Currently the site is inactive (PTA.TO17.0055G).
Current Human Receptors	PTA personnel Visitors Trespassers
Potential Future Land Use	A portion of the site will be capped. The remainder will remain paved. LUCs are expected to be in place.
Potential Future Human Receptors	PTA personnel Visitors Trespassers Contractors (i.e., construction workers)
Beneficial Resources	Refer to Section 5.1.3.4. Wetlands and forested areas adjacent to site Green Pond Brook, along the eastern boundary of the site

5.2.4.4 *Ecological Profile*

The site-specific ecological profile is presented in Table 5-19:

**Table 5-19: Ecological Profile - Former DRMO Yard and Former Burning Ground**

Information Needs	CSM Findings
Habitat Type	The site offers limited wildlife habitat, because the majority of the site is asphalt-paved and surrounded by a chain-link fence. However, there are some forested and grassy areas and a depressional wet area near the center of the site.
Degree of Disturbance	Currently, the degree of disturbance is low. However, a higher degree of disturbance is expected in the future due to planned construction activities. Subsequent to that, return to low.
Ecological Receptors	Refer to Section 5.1.4.2.

5.2.4.5 *Munitions/Release Profile*

**5.2.4.5.1 Munitions Types**

Table 5-20 presents a summary of the types of munitions that could be expected based on information collected during the HRR process. Also presented in this table are the mechanisms by which munitions would be expected to be released to the environment if present.

**Table 5-20: Summary of Potential Munitions Types – Former DRMO Yard and Former Burning Ground**

Potential Munitions	Primary Release Mechanisms
Any munitions or equipment that were used on or passed through PTA from approximately 1921 to the 1980s.	Discarded or malfunctioned munitions

#### **5.2.4.5.2 Maximum Probability Penetration Depth**

Munitions were not fired or tested in this area, so the standard penetration depth calculation is not applicable. Munitions can be expected to have penetrated only as far as they were buried (if they were buried).

#### **5.2.4.5.3 MEC Density**

The MEC density of the Former DRMO Yard and Former Burning Ground is unknown; however, it may be significant. This area was used for the storage of scrap material, used batteries, potential PCB-containing transformers, vehicles, motors, generators, and materials used in making explosives, pyrotechnics, and munitions. It is also believed that debris following the 1926 Explosion may have been used to fill the depression wetland near the center of the site.

#### **5.2.4.5.4 Munitions Debris**

Based on GIS photography, all discarded or malfunctioning materials stored on the site have been removed. However, there is the possibility of buried munitions.

#### **5.2.4.5.5 Transport Mechanisms/Migration Routes**

The primary transport mechanisms identified for MEC on the site include:

**Erosion:** Erosion on the undeveloped portions of the site may uncover MEC beneath the surface soil. The implementation of an asphalt cap over the Former Burning Ground and the majority of the Former DRMO Yard will eliminate erosion as a primary transport/migration route.

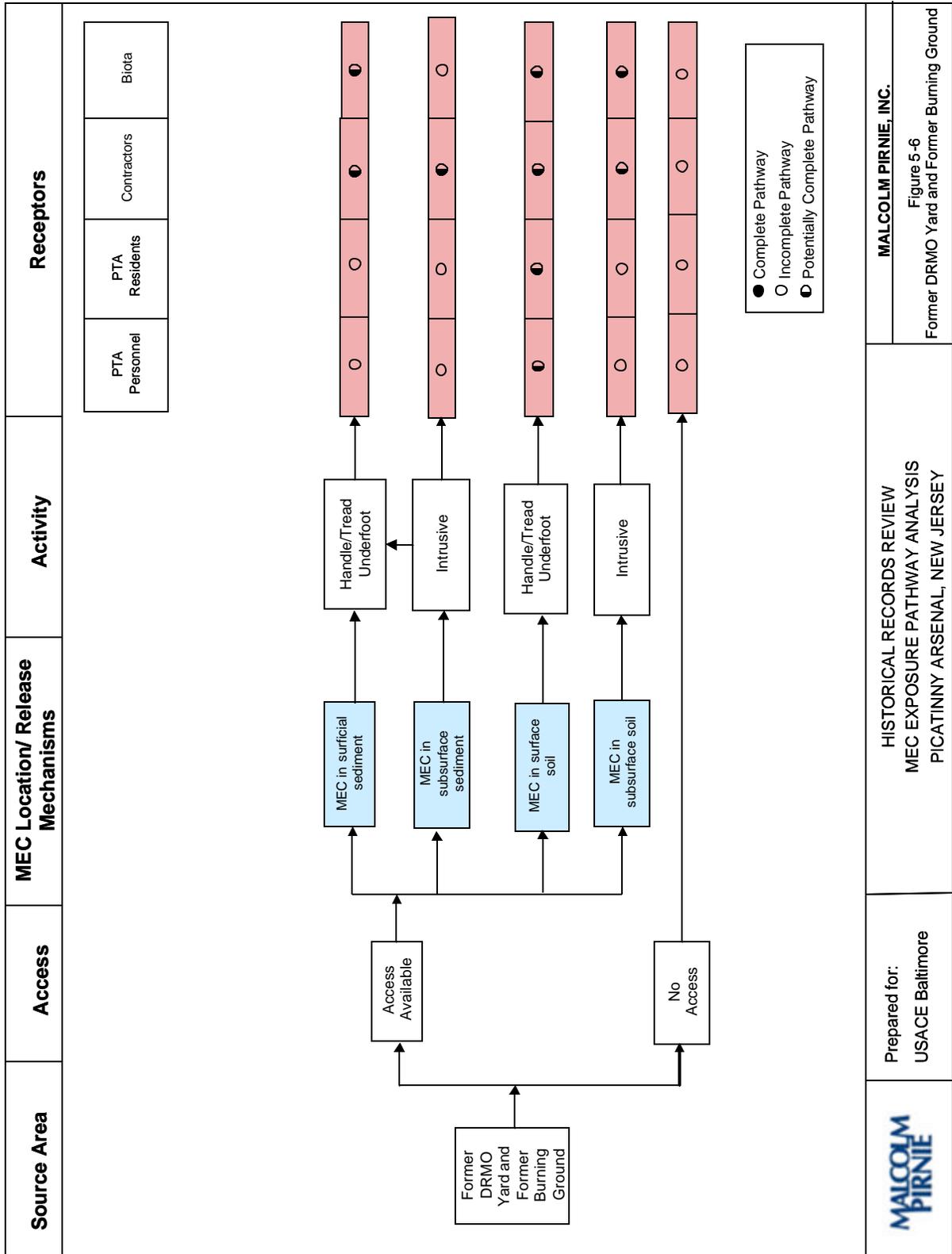
**Soil Disturbance:** Current land use is inactive; therefore, soil disturbance is not considered a primary transport/migration route. Future soil excavation and capping of the Former Burning Ground and the majority of the Former DRMO Yard would create surface and subsurface soil disturbance that may result in the transport or migration of MEC.

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

#### 5.2.4.6 *MEC Pathway Analysis*

The MEC Exposure Pathway Analysis is illustrated in Figure 5-6. There is the possibility of buried munitions on the site; however, MEC density is unknown. Therefore, potentially complete exposure pathways exist for identified receptors who have access to the site. Potentially complete exposure pathways are identified for PTA personnel, PTA residents, and contractors (i.e., construction workers) who may contact MEC in surface soil. A potentially complete exposure pathway exists for contractors who may contact MEC in surface and subsurface sediment and in subsurface soil as a result of intrusive work, such as excavation. In addition, potentially complete exposure pathways account for potential exposure of biota to MEC in surface soil and surface sediment and for potential exposure of burrowing wildlife to MEC in subsurface soil.

**Figure 5-6: MEC Pathway Analysis Figure – Former DRMO Yard and Former Burning Ground**



## 5.2.5 Former Munitions and Propellant Test Area

### 5.2.5.1 MMRP Site Profile

The site-specific site profile is presented in Table 5-21:

**Table 5-21: Site Profile – Former Munitions and Propellant Test Area**

Information Needs	CSM Findings
Area and Layout	Located in northwestern part of PTA Approximately 25 acres Contains two separate firing lines (500-meter and 900-yard) with one common firing area Overlaps a portion of the edge of the SDZ for the 20-mm cannon range at the Lake Denmark MRS.
Structures	Large berm Battleship gun turret (13.5 feet x 10 feet) Water tank cradles
Utilities	None
Boundaries	N: Undeveloped PTA property S: Undeveloped PTA property E: Copperas Ridge Road W: Green Pond Mountain
Security	Refer to Section 5.1.1.2. No site-specific security practices or controls are associated with the Former Munitions and Propellant Test Area, except that no personnel are allowed on site during testing operations at nearby ranges.

### 5.2.5.2 Physical Profile

The site-specific physical profile is presented in Table 5-22:

**Table 5-22: Physical Profile - Former Munitions and Propellant Test Area**

Information Needs	CSM Findings
Geology	Green Pond Conglomerate overlain by alluvial material Depth to bedrock encountered between 0 and 10 feet bgs within short horizontal distances (PTA.D&M.0004)
Topography	Rolling hills 1,000 to 1,100 feet amsl
Soil	Rockaway Rock Outcrop Association Fine-grained sand with silt and clay overlain by poorly sorted sand and gravel
Hydrogeology	Groundwater likely discharges to Green Brook Pond. Groundwater is currently the source of potable water for PTA (PICA00226).
Hydrology	The western portion of the area crosses Green Pond Brook. Wetlands associated with Green Pond Brook
Vegetation	Wetlands and deciduous forest

5.2.5.3 *Land Use and Exposure Profile*

The site-specific land use and exposure profile is presented in Table 5-23:

**Table 5-23: Land Use and Exposure Profile - Former Munitions and Propellant Test Area**

Information Needs	CSM Findings
Current Land Use/Activities	Buffer zone between firing ranges Unutilized/undeveloped
Current Human Receptors	PTA Personnel PTA Residents Trespassers
Potential Future Land Use	Same as current land use

Information Needs	CSM Findings
Potential Future Human Receptors	Same as current receptors
Beneficial Resources	Refer to Section 5.1.3.4. Wetlands and forested area adjacent to site

5.2.5.4 Ecological Profile

The site-specific ecological profile is presented in Table 5-24:

**Table 5-24: Ecological Profile - Former Munitions and Propellant Test Area**

Information Needs	CSM Findings
Habitat Type	Forested Wetlands
Degree of Disturbance	Low; located within area designated as other than operational range.
Ecological Receptors	The SLERA completed for the site indicates a potential risk to wildlife under significant exposures associated with several metals (antimony, cadmium, chromium, copper, lead, and zinc). However, due to the limited amount of contamination and the relatively low concentrations, additional ERA was not warranted (PTA.TO17.0100B).

5.2.5.5 Munitions/Release Profile

**5.2.5.5.1 Munitions Types**

Table 5-25 presents a summary of the types of munitions that could be expected based on information collected during the HRR process. Also presented in this table are the mechanisms by which munitions would be expected to be released to the environment if present.

**Table 5-25: Summary of Potential Munitions Types – Former Munitions and Propellant Test Area**

Potential Munitions	Primary Release Mechanisms
57-mm M18, 75-mm M20, 90-mm M67, 105-mm M27, and 106-mm M40 recoilless rifles	Munitions firing, Discarded or malfunctioned munitions

**5.2.5.5.2 Maximum Probability Penetration Depth**

Due to the reported use of the site (firing munitions into a slug butt), 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.

**5.2.5.5.3 MEC Density**

A visual survey of the site was not conducted; therefore, the MEC density is not known.

**5.2.5.5.4 Munitions Debris**

A visual survey was not conducted as part of the HRR; however, based on the activities that occurred at the former range, there is the potential for munitions debris items. Potential munitions debris associated with the Former Munitions and Propellants Test Area include 57-mm, 75-mm, 90-mm, 105-mm, and 106-mm recoilless rifle projectiles.

**5.2.5.5.5 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

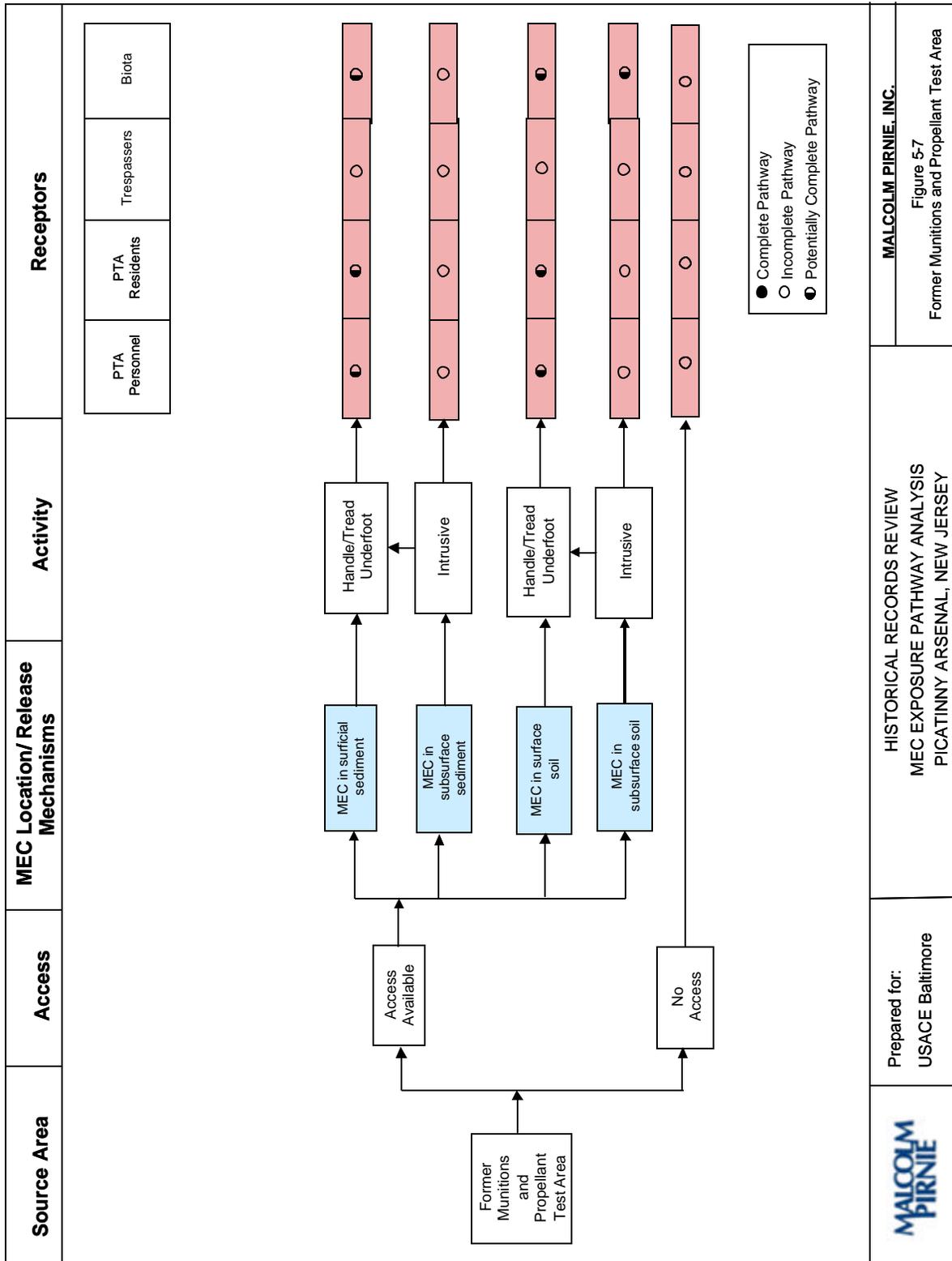
Test Area is within the buffer zone for operational ranges. Any future soil disturbance at the Former Munitions and Propellant Test Area would create surface and subsurface soil disturbances that could cause both the transport and migration of MEC.

***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.

#### *5.2.5.6 MEC Pathway Analysis*

As illustrated in Figure 5-7, potentially complete exposure pathways are identified for PTA personnel and PTA residents who may be exposed to MEC in surface soil and/or shallow sediment in Green Pond Brook. 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 potentially complete exposure pathway from MEC in subsurface soil to terrestrial wildlife that construct burrows.

**Figure 5-7: MEC Pathway Analysis Figure – Former Munitions and Propellant Test Area**



**5.2.6 Former Projectile Range**

*5.2.6.1 MMRP Site Profile*

The site-specific site profile is presented in Table 5-26:

**Table 5-26: Site Profile – Former Projectile Range**

Information Needs	CSM Findings
Area and Layout	Located near western border of PTA Less than 1 acre Rectangular area Contained one firing line and target butt Northwest of Picatinny Lake
Structures	None on site; near Building 620
Utilities	None
Boundaries	N: Undeveloped land S: Undeveloped land E: Undeveloped land, talus pile, Picatinny Peak W: Building 620
Security	Refer to Section 5.1.1.2. No site-specific security practices or controls are associated with the Former Projectile Range.

5.2.6.2 *Physical Profile*

The site-specific physical profile is presented in Table 5-27:

**Table 5-27: Physical Profile – Former Projectile Range**

Information Needs	CSM Findings
Geology	Unconsolidated glacial deposits of interbedded layers of sand, silt, and clay Deposits overlie Green Pond Conglomerate of Silurian age (PTA.D&M.0004).
Topography	Sloping towards Picatinny Lake Approximately 850 feet amsl
Soil	Reworked by urban activity Soil type indiscernible Well-drained
Hydrogeology	Refer to Section 5.1.2.5. Detailed information unknown; assumed that groundwater flows southeast to Picatinny Lake.
Hydrology	Located in watersheds of Picatinny Lake and Green Pond Brook Surface water flows southeast to Picatinny Lake.
Vegetation	Sparsely forested area Partially developed

5.2.6.3 *Land Use and Exposure Profile*

The site-specific land use and exposure profile is presented in Table 5-28:

**Table 5-28: Land Use and Exposure Profile – Former Projectile Range**

Information Needs	CSM Findings
Current Land Use/Activities	Former training area designated as other than operational range.
Current Human Receptors	PTA Personnel PTA Residents

Information Needs	CSM Findings
	Contractors Trespassers
Potential Future Land Use	Same as current land use
Potential Future Human Receptors	Same as current receptors
Beneficial Resources	Refer to Section 5.1.3.4. Forested area Picatinny Lake southeast of site

5.2.6.4 *Ecological Profile*

The site-specific ecological profile is presented in Table 5-29:

**Table 5-29: Ecological Profile – Former Projectile Range**

Information Needs	CSM Findings
Habitat Type	Forested area
Degree of Disturbance	Low
Ecological Receptors	Refer to Section 5.1.4.2.

5.2.6.5 *Munitions/Release Profile*

**5.2.6.5.1 Munitions Types**

Table 5-30 presents a summary of the types of munitions that could be expected based on information collected during the HRR process. Also presented in this table are the mechanisms by which munitions would be expected to be released to the environment if present.

**Table 5-30: Summary of Potential Munitions Types – Former Projectile Range**

Potential Munitions	Primary Release Mechanisms
20- to 40-mm inert projectile rounds Rockets (from static testing activities)	Munitions firing Discarded or malfunctioned munitions

**5.2.6.5.2 Maximum Probability Penetration Depth**

Due to the reported use of the site (firing munitions into a slug butt), 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.

**5.2.6.5.3 MEC Density**

A visual survey of the site was not conducted; therefore, the MEC density is not known. Projectiles were fired into a slug butt, and the sand and munitions casing were removed after every test. This leaves the possibility of MEC on the site unlikely unless the sand from the last use spread out before the munitions were removed.

**5.2.6.5.4 Munitions Debris**

A visual survey was not conducted as part of the HRR; however, based on the activities that occurred at the former range from 1943 to the 1960s, there is the potential for munitions debris items. Potential munitions debris associated with 20- to 40-mm practice projectiles and rockets include spent projectiles, fragments, and shell casings.

#### **5.2.6.5.5 Associated Munitions Constituents**

The primary MC associated with the Former Projectile Range are propellants. Chemicals typically associated with propellants include lead, copper, antimony, zinc, TNT and its derivatives, RDX, and HMX. MC associated with projectiles include perchlorate. Given the proximity to explosive storage areas, explosives might also be of concern at the site.

To date, no soil or groundwater samples have been collected; therefore, it is not known whether MC are present in environmental media at the Former Projectile Range.

#### **5.2.6.5.6 Transport Mechanisms/Migration Routes**

The primary transport mechanisms identified for the Former Projectile Range include:

***Soil Disturbance:*** Although not currently planned, future construction within the former range area would create surface and subsurface soil disturbances that could cause both the transport and migration of MEC or MC.

***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.

***Infiltration and Groundwater Discharge:*** There is potential for MC to migrate from one environmental medium to another through infiltration. MC may migrate with percolating precipitation from surface soil to shallow groundwater. MC may be discharged with shallow groundwater to the surface water of Picatinny Lake or Green Pond Brook, or it may percolate into the bedrock aquifer.

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

#### 5.2.6.6 *Pathway Analysis*

The analysis assumes that no hunting or fishing activities occur at the Former Projectile Range and that trespassers to the site consist primarily of PTA personnel and PTA residents who are not permitted on the property.

##### **5.2.6.6.1 MEC**

The MEC Exposure Pathway Analysis is illustrated in Figure 5-8. Although munitions debris at the Former Projectile Range was cleared after each test, it is possible that munitions may still be present in surface soil. Therefore, exposure pathways for receptors that have access to the site are potentially complete.

Potentially complete exposure pathways exist for PTA personnel, PTA residents, contractors, and biota that have contact with surface soil at the site. Exposure routes include handling or treading underfoot. In addition, potentially complete exposure pathways exist for contractors (via construction activities or other intrusive work) and burrowing wildlife that have contact with subsurface soil. Because there is no sediment at the Former Projectile Range, exposure pathways through sediment are shown as incomplete.

##### **5.2.6.6.2 MC**

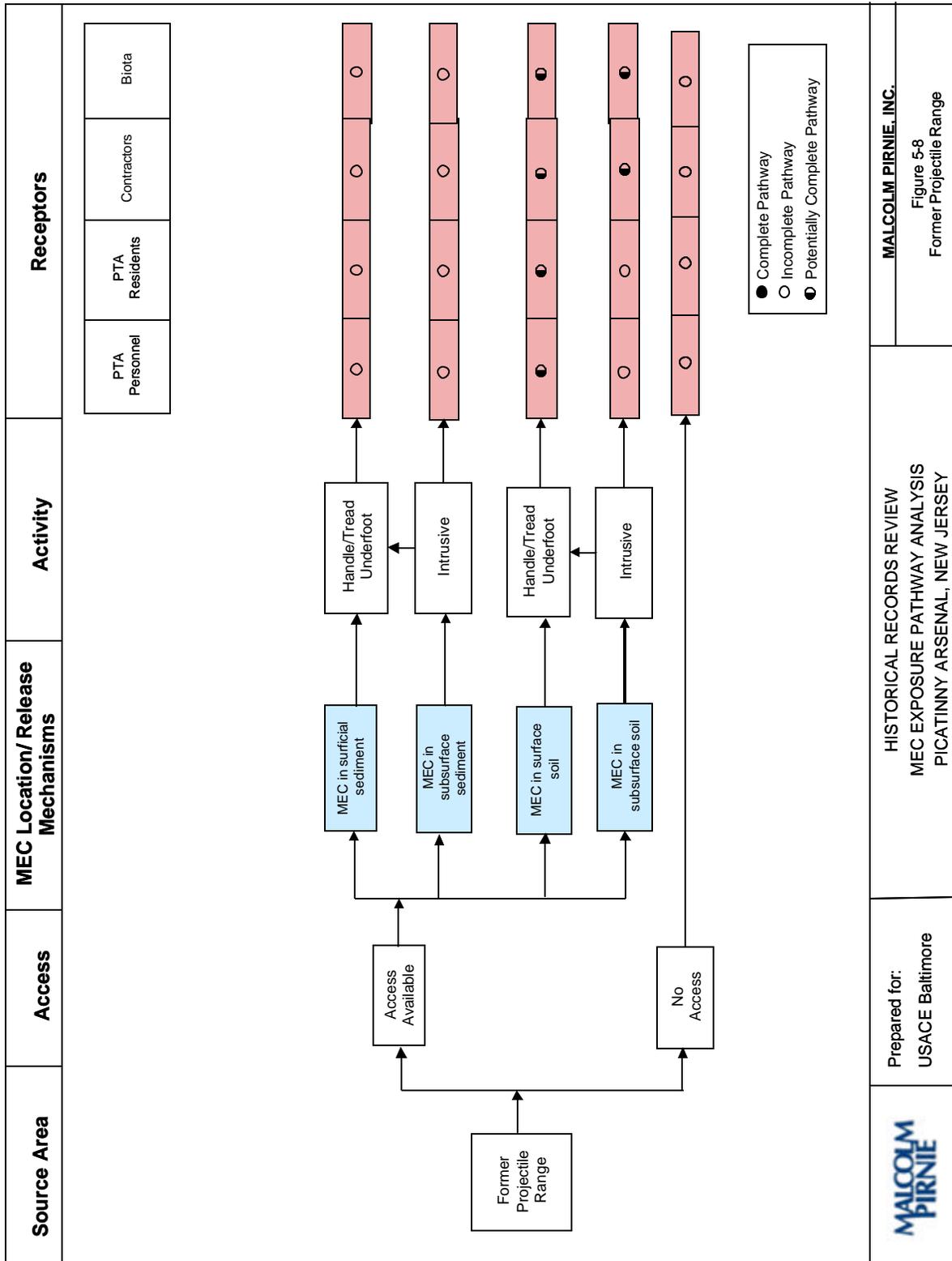
The MC Exposure Pathway Analysis is illustrated in Figure 5-9. Although no soil or groundwater sampling has been conducted at the Former Projectile Range, it is suspected that MC may be present due to the history of munitions testing activities. Soil is the primary source medium through which receptors may be exposed to MC.

Potentially complete exposure pathways exist for both human and ecological receptors that may have contact with MC in surface soil at the site. Exposure routes include incidental ingestion, dermal contact, and inhalation of dust. Exposure pathways to MC in subsurface soil are potentially complete for contractors who may engage in intrusive activities and for terrestrial wildlife (e.g., moles, shrews, voles, foxes, etc.) that construct burrows.

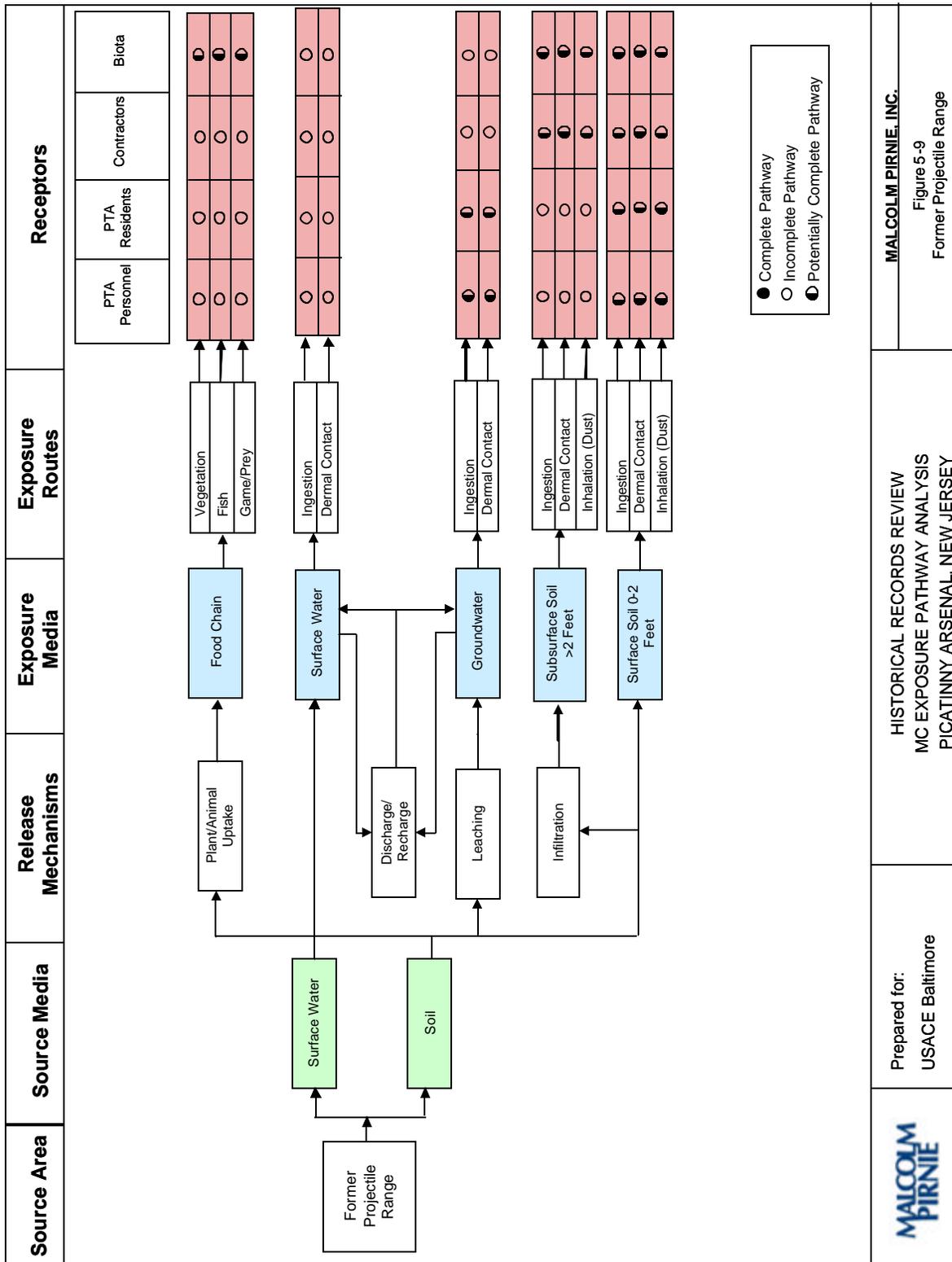
Shallow groundwater at the site is expected to discharge to Picatinny Lake. MC in shallow groundwater may also migrate to the bedrock aquifer. The nearest potable water production well is approximately 1 mile (1,609 meters) downgradient from the Former Projectile Range. Although the potable water supply 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 pathways through the food chain exist for assimilative/ bioaccumulative MC to ecological receptors. Terrestrial wildlife may ingest MC assimilated in vegetation and bioaccumulated in prey species. 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 5-8: MEC Pathway Analysis Figure – Former Projectile Range**



**Figure 5-9: MC Pathway Analysis Figure – Former Projectile Range**



**5.2.7 Green Pond Site**

*5.2.7.1 MMRP Site Profile*

The site-specific site profile is presented in Table 5-31:

**Table 5-31: Site Profile – Green Pond Site**

Information Needs	CSM Findings
Area and Layout	Located in a reach of Green Pond Brook adjacent to the Former DRMO Yard  Approximately 1.4 acres
Structures	No buildings or other structures present
Utilities	Refer to Section 5.1.1.1.
Boundaries	N: Former DRMO Yard boundary S: Former DRMO Yard boundary E: Just east of the top of the bank of Green Pond Brook W: Former DRMO Yard boundary
Security	Refer to Section 5.1.1.2. No site-specific security practices or controls are associated with the Green Pond Site.

*5.2.7.2 Physical Profile*

The site-specific physical profile is presented in Table 5-32:

**Table 5-32: Physical Profile - Green Pond Site**

Information Needs	CSM Findings
Geology	Refer to Section 5.1.2.2.
Topography	Generally flat west of Green Pond Brook and gentle slope east of Green Pond Brook.  Approximate elevation of 700 feet amsl
Soil	Refer to Section 5.1.2.4.

Information Needs	CSM Findings
Hydrogeology	<p>Refer to Section 5.1.2.5.</p> <p>Shallow groundwater likely discharges to Green Pond Brook</p> <p>Groundwater is currently the source of potable water for PTA (PICA00226). The nearest groundwater production wells are located approximately 1,250 feet (381 meters) west of the site.</p>
Hydrology	<p>Downstream of Picatinny Lake, generally a wide, straight channel with slow, warm water (PTA.T017.0075D)</p> <p>Bottom of fine sediment (PTA.T017.0075D)</p> <p>Lower reach of Green Pond Brook is considered a gaining stream (PTA.T017.0075D).</p> <p>Seasonal variations in flow due to fluctuations in precipitation (PTA.T017.0075D)</p> <p>Channelized portions are steep-banked (PTA.T017.0075D).</p>
Vegetation	<p>Steep banks lined with herbaceous and small woody plants</p> <p>Dense submerged aquatic vegetation beds in some reaches</p>

5.2.7.3 Land Use and Exposure Profile

The site-specific land use and exposure profile is presented in Table 5-33:

**Table 5-33: Land Use and Exposure Profile - Green Pond Site**

Information Needs	CSM Findings
Current Land Use/Activities	In portion of heavily utilized area of PTA
Current Human Receptors	<p>PTA personnel</p> <p>PTA residents</p> <p>Contractors</p>
Potential Future Land Use	<p>Same as current uses</p> <p>The 2005 ROD for Green Pond Brook indicates the remedy includes chemical and biological monitoring, as well as LUCs</p>

Information Needs	CSM Findings
	(PTA.TO17.0059C).
Potential Future Human Receptors	Same as current receptors
Beneficial Resources	Refer to Section 5.1.3.4.

5.2.7.4 *Ecological Profile*

The site-specific ecological profile is presented in Table 5-34:

**Table 5-34: Ecological Profile - Green Pond Site**

Information Needs	CSM Findings
Habitat Type	Aquatic warm water habitat with little shade; may have submerged aquatic vegetation beds Limited habitat on the steep-sloped banks
Degree of Disturbance	Currently, the degree of disturbance is low. However, a higher degree of disturbance may be expected in the future depending on the LUCs used at the site.
Ecological Receptors	Modified aquatic habitat due to channelization; species tolerant of warm slow water

5.2.7.5 *Munitions/Release Profile*

**5.2.7.5.1 Munitions Types**

Table 5-35 presents a summary of the types of munitions that could be expected based on information collected during the HRR process. Information on specific munitions used at the site was not available. However, the site may have been affected by the functions of the adjacent Former DRMO Yard and the Former Burning Ground. Also presented in this table are the mechanisms by which munitions would be expected to enter the environment if present.

**Table 5-35: Summary of Potential Munitions Types – Green Pond Site**

Potential Munitions	Primary Release Mechanisms
Any munitions or equipment that were used on or passed through PTA from approximately 1921 through the 1980s	Discarded or malfunctioned munitions

**5.2.7.5.2 Maximum Probability Penetration Depth**

There is no evidence to indicate that munitions were fired or tested in this area, so the standard penetration depth calculation is not applicable. Any MEC expected to be located at the site would be due to disposal/burial activities. MEC was found protruding from the banks of Green Pond Brook in the area adjacent to Building 314 (PICA00099). Based on this information, it is possible that munitions may be found from the ground surface to a depth just beneath the bottom of Green Pond Brook due to the channelization of the brook that has occurred over the years.

**5.2.7.5.3 MEC Density**

A visual survey to determine the density of MEC at the Green Pond Site has not been conducted as part of the HRR. The density of discarded or malfunctioned munitions is not known.

**5.2.7.5.4 Munitions Debris**

A visual survey has not been conducted as part of the HRR. However, since MEC items have been discovered at the site, it is possible that munitions debris is present.

**5.2.7.5.5 Transport Mechanisms/Migration Routes**

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

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

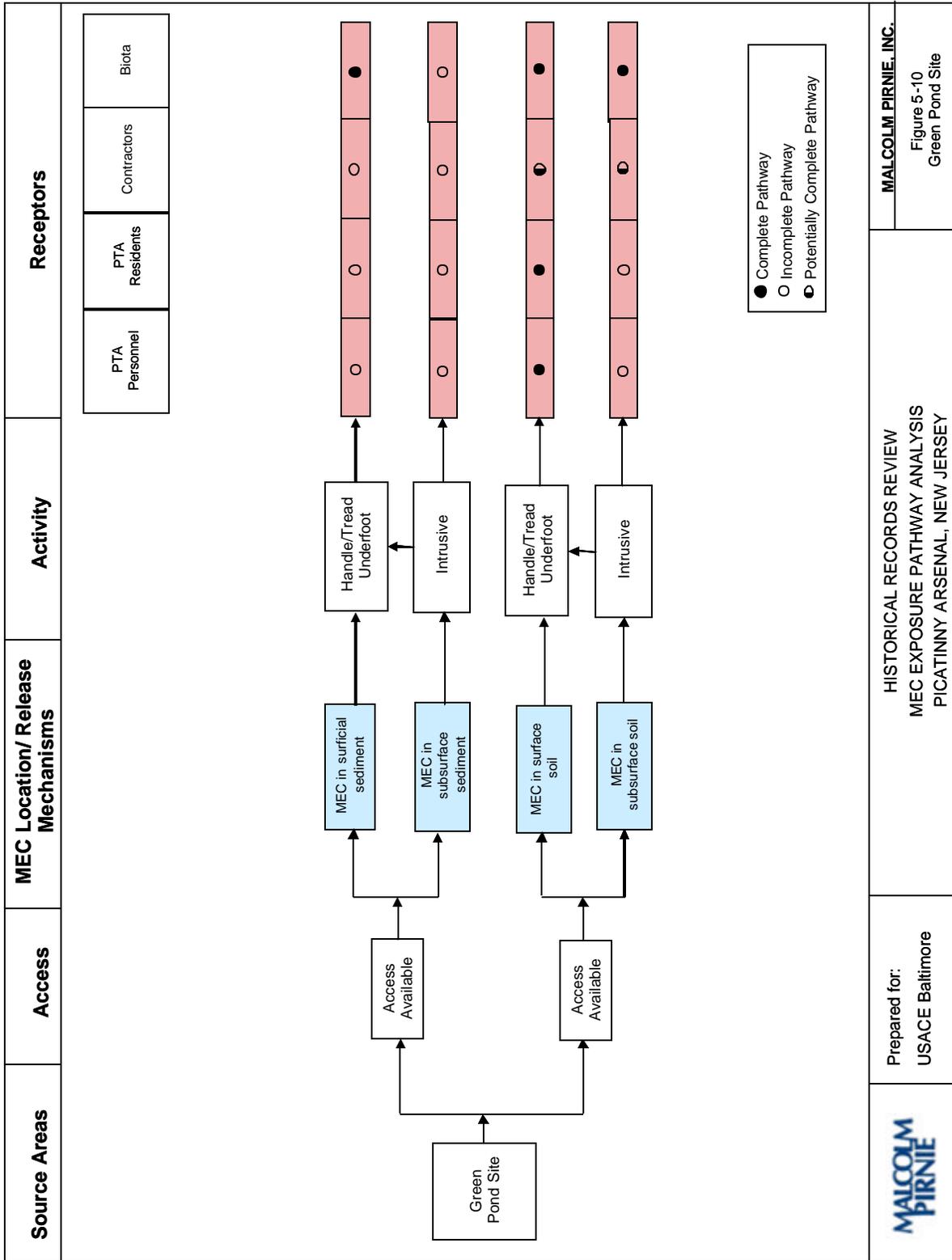
***Soil Disturbance:*** The current degree of disturbance is low and is expected to remain so due to the remedies proposed, including chemical and biological monitoring and LUCs. However, any future soil disturbance could uncover MEC that are in the surface or subsurface.

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

#### *5.2.7.6 MEC Pathway Analysis*

The MEC Exposure Pathway Analysis is illustrated in Figure 5-10. Since MEC has been found protruding from the bank at the Green Pond Site and more may be present at the site, complete exposure pathways exist for receptors that have access to the site. Specifically, complete pathways exist for PTA personnel, PTA residents, and biota that have contact with surface soil or surficial sediment (via handling or treading underfoot). Complete exposure pathways also exist for biota that have contact with subsurface soil while burrowing. In addition, potentially complete pathways exist for contractors that may have contact with subsurface soil or subsurface sediment during future construction or other intrusive work.

**Figure 5-10: MEC Pathway Analysis Figure – Green Pond Site**



**5.2.8 Inactive Munitions Waste Pit and Inactive Munitions Waste Pit – Off-Post**

Since open detonation occurred historically (before 1965), an area for SDZ that extends to 1,250 feet (381 meters) from the center of the site was added. A portion of the SDZ extends beyond PTA boundaries to the west. The CSM presented below applies to both the on- and off-PTA portions of this site. Some of the PTA-wide information provided in Section 5.1 is not applicable to the off-site portion of the site. Additional information has been added to the Inactive Munitions Waste Pit CSM, where appropriate, to address these differences.

*5.2.8.1 MMRP Site Profile*

The site-specific site profile is presented in Table 5-36:

**Table 5-36: Site Profile – Inactive Munitions Waste Pit**

Information Needs	CSM Findings
Area and Layout	<p>On Green Pond Mountain; approximately 700 feet (213 meters) east of the PTA boundary in the northwestern portion of PTA</p> <p>94 acres on-post and 7.5 acres off-post</p> <p>Oblong area with SDZ of 1,250-foot radius from center of the site</p> <p>Munitions testing until 1965; impact craters filled with gravel and sand fill material</p>
Structures	<p>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, several mounds of asphalt/concrete/brick debris (PICA00205)</p> <p>Historically, the control building (former Building 656), a guard shack, another elevated stand, two additional jet hulls, a steel test unit, and steel observation towers existed at the site (PICA00205).</p>
Utilities	Refer to Section 5.1.1.1.
Boundaries	<p>N: Berkshire Trail. SDZ extending to approximately 1,050 feet (320 meters) west of the PTA boundary.</p> <p>S: No distinct boundary; nearest site to the south is Site 13.</p> <p>E: No distinct boundary; nearest site to the east is Site 11.</p> <p>W: 20<sup>th</sup> Avenue</p>
Security	Refer to Section 5.1.1.2. No site-specific security practices or controls are associated with the Inactive Munitions Waste Pit.

5.2.8.2 *Physical Profile*

The site-specific physical profile is presented in Table 5-37:

**Table 5-37: Physical Profile – Inactive Munitions Waste Pit**

Information Needs	CSM Findings
Geology	<p>Lower to Middle Silurian Green Pond Conglomerate (a reddish-brown to olive-gray quartzitic conglomerate) has been encountered at shallow depths of 2 to 4 feet bgs (PTA.T017.0048V).</p> <p>The overlying unconsolidated unit consists of glacial till that varies in thickness from 0 to 3 feet (PTA.T017.0048V).</p>
Topography	<p>On-PTA portion: Relatively flat to sloping; 1,175 feet amsl (PTA.D&amp;M.0004)</p> <p>Off-PTA portion: Steep and mountainous terrain</p>
Soil	<p>Rockaway and Rock Outcrop associations, which are deep, well-to moderately well-drained, stony sandy loams (PTA.D&amp;M.0004)</p> <p>Slow permeability (PTA.D&amp;M.0004)</p>
Hydrogeology	<p>Depth to water table approximately 6.5 to 7 feet bgs</p> <p>Shallow groundwater flows to east (PTA.TO17.0048V)</p> <p>Bedrock groundwater flow complex depending on fractures (PTA.TO17.0048V)</p>
Hydrology	<p>None on the site</p> <p>Swampy area along southern boundary (PTA.D&amp;M0004)</p>
Vegetation	<p>Some bare ground associated with fill areas</p> <p>Deciduous forest surrounding the site</p>

5.2.8.3 *Land Use and Exposure Profile*

The site-specific land use and exposure profile is presented in Table 5-38:

**Table 5-38: Land Use and Exposure Profile – Inactive Munitions Waste Pit**

Information Needs	CSM Findings
Current Land Use/Activities	On-PTA portion: Operational military installation Off-PTA portion: Undeveloped
Current Human Receptors	PTA personnel Contractors Visitors PTA residents Off-PTA recreational users
Potential Future Land Use	On-PTA portion: Same as current land use Off-PTA portion: Likely to remain undeveloped due to steep slopes
Potential Future Human Receptors	On-PTA portion: Same as current human receptors Off-PTA portion: Likely to remain the same as current human receptors
Beneficial Resources	Refer to Section 5.1.3.4.

5.2.8.4 *Ecological Profile*

The site-specific ecological profile is presented in Table 5-39:

**Table 5-39: Ecological Profile – Inactive Munitions Waste Pit**

Information Needs	CSM Findings
Habitat Type	Forested area, including shrubby habitat, surrounding the site  Swampy area along southern boundary (PTA.D&M0004)  Off-PTA portion: Steep, mountainous terrain; possibly some forested areas
Degree of Disturbance	Low
Ecological Receptors	Refer to Section 5.1.4.2. The Phase III-1A Sites RI report suggests that, due to the wooded habitat surrounding the site, an ERA should be conducted at Area N (the general area of PTA in which the Inactive Munitions Waste Pit is located) (PTA.T017.0048V).

5.2.8.5 *Munitions/Release Profile*

**5.2.8.5.1 Munitions Types**

According to the 2006 IAP, “Historical practices consisted of testing munitions, and then filling the resulting crater with fill material, typically gravel and sand. Many ammunition fragments were projected out from the site and were never recovered” (PICA00205). Although it is known that munitions testing activities and, possibly, historical munitions disposal occurred at the Inactive Munitions Waste Pit, no information was available regarding specific munitions types or quantities (PICA00205; PTA.D&M.0004).

Table 5-40 presents a summary of the types of munitions that could be expected based on information collected during the HRR process. Also presented in this table are the mechanisms by which munitions would be expected to be released to the environment if present. This table is applicable to both on-PTA and off-PTA portions of the site.

**Table 5-40: Summary of Potential Munitions Types – Inactive Munitions Waste Pit**

Potential Munitions	Primary Release Mechanisms
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 (PTA.D&M.0004).

**5.2.8.5.2 Maximum Probability 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 on-PTA portion of the site, the maximum penetration depth can be estimated roughly at 4 feet (the maximum depth to bedrock) (PTA.T017.0048V). Assuming that the geology of the off-PTA 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-PTA portion as well.

**5.2.8.5.3 MEC Density**

A visual survey to determine the density of MEC at the Inactive Munitions Waste Pit (on- and off-PTA) has not been conducted as part of the HRR. There are no documented EOD records for either the on- or off-PTA portions of this site.

**5.2.8.5.4 Munitions Debris**

A visual survey was not conducted as part of the HRR; however, based on the activities that occurred at the Inactive Munitions Waste Pit, there is the potential for munitions debris items at both the on-PTA and off-PTA portions of the site. Because there is no information

available regarding the specific munitions used at the site, the specific types of munitions debris that may be present cannot be determined.

#### **5.2.8.5.5 Associated Munitions Constituents**

Because there is no information available regarding the specific munitions used at the site, MC that may be present cannot be determined. However, potential MC associated with many types of common munitions include lead, copper, antimony, zinc, steel, nitroglycerin, TNT and its derivatives, RDX, and HMX.

According to the 1989 SI report, four surface soil samples and two sediment samples were collected from the on-PTA portion of the site (PTA.D&M.0001). The sediment samples were collected from a swampy area located along the southern boundary of the site. All samples were analyzed for propellants, metals, and explosives. The surface soil data indicated the presence of explosives contamination (nitroglycerin, RDX, DNTs, and TNT) and metal contamination (copper and, possibly, lead and mercury) in both the metal cage and testing area at the site (PTA.D&M.0004). The sediment data suggested the presence of lead contamination and, possibly, cadmium and arsenic contamination (PTA.D&M.0004). As shown on Plates 1 and 3, no metals or explosives have been detected on the site since at least 1988.

In the early 1990s, a potable water well was installed adjacent to the site to serve the Advanced Warhead Development Facility, Building 660. Analysis of groundwater from this well indicated contamination with TCE and low levels of methyl tert-butyl ether, Freon, and toluene (PICA00205).

No information was available regarding soil, sediment, or groundwater sampling at the off-PTA portion of the Inactive Munitions Waste Pit.

#### **5.2.8.5.6 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. This is particularly true for the off-PTA portion of the site, which consists of steeply sloping terrain.

**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.

#### 5.2.8.6 Pathway Analysis

##### 5.2.8.6.1 MEC

The MEC Exposure Pathway Analysis is illustrated in Figure 5-11. Because munitions were used at the Inactive Munitions Waste Pit but no MEC have been found at the site to date, potentially complete exposure pathways are shown for receptors that have access to the site. Specifically, potentially complete pathways exist for PTA personnel, PTA residents, contractors, and biota that have contact with surface soil or surficial sediment of the swampy area (via handling or treading underfoot). In addition, potentially complete pathways exist for contractors (via construction activities and other intrusive work) and biota (via burrowing or feeding) that have contact with subsurface soil or deeper sediment.

Off-PTA recreational users are not shown as receptors in the MEC Exposure Pathway Analysis because their exposure to the off-PTA portion of the site would be extremely limited due to the steep and mountainous terrain.

#### **5.2.8.6.2 MC**

The MC Exposure Pathway Analysis is illustrated in Figure 5-12. Because several chemical parameters were detected in environmental media, complete exposure pathways exist for receptors with access to the site. Soil and sediments (in the swampy area) are the primary source media through which receptors may be exposed to MC.

Complete exposure pathways exist for PTA personnel and PTA residents that have contact with surface soil and sediment at the site. Exposure routes include ingestion and dermal contact and, for soil, inhalation of dust. Complete exposure pathways exist for biota that have contact with surface and subsurface soil and/or sediment while feeding, nesting, or burrowing. Potentially complete exposure pathways exist for contractors who may contact surface and subsurface soil and/or sediment while accessing underground utilities or conducting future development.

Potentially complete 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. The MC Exposure Pathway Analysis assumes that PTA personnel and PTA residents may be exposed to media impacted by MC through hunting activities. However, no information was available regarding hunting practices at the Inactive Munitions Waste Pit. 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.

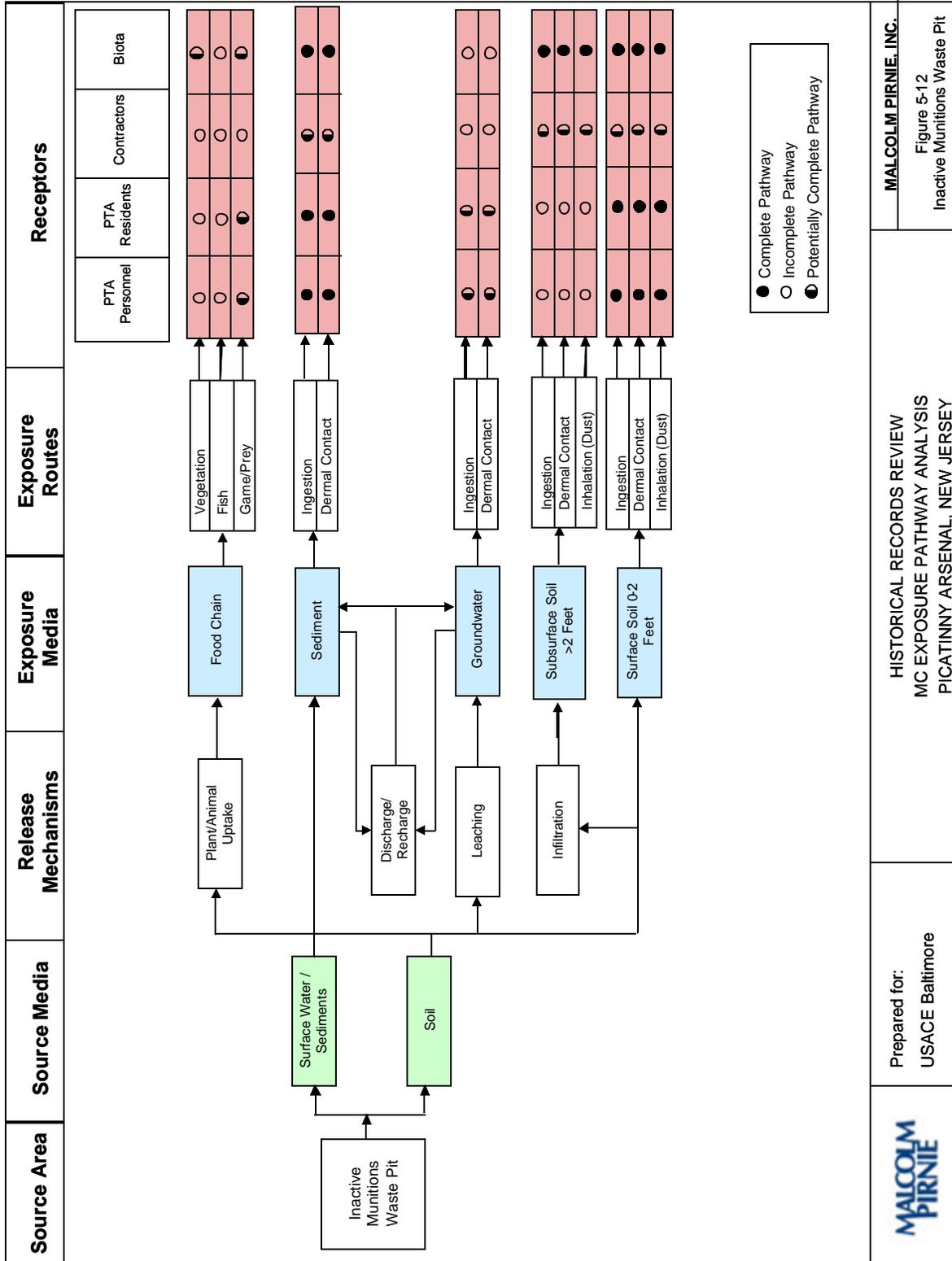
The nearest potable water production well is approximately 2 miles (3,219 meters) downgradient from the Inactive Munitions Waste Pit. Although the potable water supply is

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.

Off-PTA recreational users are not shown as receptors in the MC Exposure Pathway Analysis because their exposure to the off-PTA portion of the site would be extremely limited due to the steep and mountainous terrain.



**Figure 5-12: MC Pathway Analysis Figure – Inactive Munitions Waste Pit**



## 5.2.9 Lake Denmark and Lake Denmark Off-Post

This CSM presents information for the portion of the Lake Denmark site that is within PTA boundaries and for the contiguous area that is beyond PTA’s northeastern boundary, known as Lake Denmark – Off-Post.

### 5.2.9.1 MMRP Site Profile

The site-specific profile is presented in Table 5-41:

**Table 5-41: Site Profile - Lake Denmark**

Information Needs	CSM Findings
Area and Layout	<p>Located in the northeastern portion of the arsenal, near the PTA boundary</p> <p>Man-made Lake Denmark spans approximately 263 acres and has an average depth of 6.5 feet.</p> <p>Site encompasses 633 acres on-post and includes: southern open-water portion of Lake Denmark, undeveloped wetlands on northern end of lake, northern portion of Gravel Dam Cove, a softball field, an unnamed pond on the northwestern side of Lake Denmark, magazines along 25<sup>th</sup> and 12<sup>th</sup> Avenues, and forested land immediately surrounding the lake.</p> <p>Lake Denmark – Off-Post encompasses 96 acres and is located in the southeastern corner of the site and is occupied primarily by the RTI CERCLA site.</p> <p>Site boundaries are based on safety arcs for three former mortar ranges (with a main firing point on the dam at the southeastern end of the lake) and a former cannon range (located on the present-day softball fields).</p> <p>Gravel Dam Cove is a pond located at the southern end of Lake Denmark and is separated from the lake by an abandoned railroad track bed.</p>
Structures	<p>Explosives storage magazines in the 1200 series, along the western shoreline of Lake Denmark</p> <p>Three Public Service Electric and Gas (PSE&amp;G) utilities towers</p> <p>Buildings associated with the RTI site</p> <p>Lake Denmark Road bisects Lake Denmark – Off-Post from north to south.</p>
Utilities	<p>PSE&amp;G utilities right-of-way traverses Lake Denmark from west-northwest to east-southeast.</p> <p>Utilities information for Lake Denmark – Off-Post is unknown.</p>
Boundaries	<p>N: Scrub/shrub wetlands of Lake Denmark and Burnt Meadow Brook</p>

Information Needs	CSM Findings
	<p>S: Dam on southern end of Lake Denmark, 1200A and S-1200 Buildings, and southern half of Gravel Dam Cove</p> <p>E: Undeveloped, forested land</p> <p>W: Southern ridgeline of Copperas Mountain</p>
Security	Refer to Section 5.1.1.2. No site-specific security practices or controls are associated with Lake Denmark. Security for Lake Denmark – Off-Post is unknown.

5.2.9.2 *Physical Profile*

The site-specific physical profile is presented in Table 5-42:

**Table 5-42: Physical Profile - Lake Denmark**

Information Needs	CSM Findings
Geology	<p>Lake Denmark is predominantly underlain by Middle Proterozoic hornblende granite overlain by Pleistocene glacial sediments and post-glacial alluvium (PTA.TO17.0048W).</p> <p>Lake Denmark – Off-Post is characterized by Precambrian bedrock (granite gneiss).</p>
Topography	<p>Lake Denmark and associated scrub/shrub wetlands are situated at the base of the southern ridgeline of Copperas Mountain.</p> <p>Eastern slopes of Copperas Mountain are severe/steep.</p> <p>Lake Denmark and associated wetlands are at an elevation of approximately 850 feet amsl.</p> <p>Gradient of Lake Denmark – Off-Post slopes gently, westward toward Lake Denmark.</p>
Soil	<p>The thickness of surficial deposits on the western shore is expected to be less than 10 feet (PTA.TO17.0048W).</p> <p>Lake Denmark and scrub/shrub wetland sediment is post-glacial alluvium, which consists of silts and clay, muck, and peat (PTA.TO17.0048W).</p> <p>Lake Denmark – Off-Post soil is Byram Intrusive Suite, a medium to medium-coarse grained hornblende granite.</p>
Hydrogeology	Two separate aquifers are expected to be present: an unconfined glacial aquifer and a bedrock aquifer. Presumably, groundwater flow in the glacial aquifer surrounding Lake Denmark is towards the lake. Bedrock groundwater flow is complex due to the fractured nature of the rock

Information Needs	CSM Findings
	(PTA.TO17.0048W).
Hydrology	<p>Lake Denmark is fed by Burnt Meadow Brook from the north.</p> <p>Scrub/shrub wetlands are present on the northern end of the lake.</p> <p>Gravel Dam Cove is separated from Lake Denmark by an abandoned railroad bed.</p> <p>Unnamed pond is separated from Lake Denmark by 25<sup>th</sup> Avenue.</p> <p>The outfall from Lake Denmark flows southwest into Picatinny Lake.</p>
Vegetation	<p>Lake Denmark may contain submerged and floating aquatic vegetation.</p> <p>Gravel Dam Cove and unnamed pond may contain submerged and floating aquatic vegetation.</p> <p>Scrub/shrub wetlands are present on the northern end of the lake.</p> <p>Mostly undeveloped, forested areas surround the lake; dominant canopy species are of the red oak subgroup (e.g., red oak [<i>Quercus rubra</i>]), black oak [<i>Q. velutina</i>], and scarlet oak [<i>Q. coccinea</i>])</p>

5.2.9.3 Land Use and Exposure Profile

The site-specific land use and exposure profile is presented in Table 5-43:

**Table 5-43: Land Use and Exposure Profile - Lake Denmark**

Information Needs	CSM Findings
Current Land Use /Activities	<p>Boating and fishing are permitted in Lake Denmark.</p> <p>Advisories exist for fish consumption from Lake Denmark.</p> <p>No swimming or scuba diving is permitted in Lake Denmark due to the potential for UXO on the lake bottom.</p> <p>The former ranges at Lake Denmark and the surrounding upland forested areas are designated as other than operational range.</p> <p>Lake Denmark is completely surrounded by A/I range on all sides.</p> <p>The RTI site is located off-post and is a CERCLA site with ongoing groundwater investigations.</p>

Information Needs	CSM Findings
Current Human Receptors	PTA personnel Contractors PTA residents and their visitors Off-site residents Trespassers
Potential Future Land Use	On-PTA portion: Same as current land use Lake Denmark – Off-Post is zoned residential (R-5); potential future land use is unknown.
Potential Future Human Receptors	Same as current receptors
Beneficial Resources	Refer to Section 5.1.3.4. Scrub/shrub wetlands north of Lake Denmark –function in storm water retention and nutrient cycling; provide wildlife habitat Undeveloped, forested areas surrounding Lake Denmark and on Lake Denmark – Off-Post – increase surface water infiltration; provide terrestrial wildlife habitat Game species – fish and waterfowl Lake Denmark – functions in groundwater recharge, storm water retention, and nutrient cycling Gravel Dam Cove – unique pond habitat supports breeding population of rare damselfly, the New England bluet ( <i>Enallagma laterale</i> ) (OTHFW.0017)

5.2.9.4 Ecological Profile

The site-specific ecological profile is presented in Table 5-44 (OTHFW.0017):

**Table 5-44: Ecological Profile - Lake Denmark**

Information Needs	CSM Findings
Habitat Type	Open water/aquatic lake and two ponds Scrub/shrub wetlands dominated by smooth alder ( <i>Alnus serrulata</i> ) and swamp azalea ( <i>Rhododendron viscosum</i> ) Forested – upland; dominant canopy species are members of the red oak subgroup

Information Needs	CSM Findings
	Gravel Dam Cove and the eastern shoreline of Lake Denmark support a premier breeding habitat of rare damselfly, the New England bluet ( <i>Enallagma laterale</i> )
Degree of Disturbance	Low; recreational activities such as fishing and waterfowl hunting occur at Lake Denmark.  Moderate; the RTI site is currently a CERCLA site with ongoing groundwater investigations.
Ecological Receptors	Fish (e.g., largemouth bass, chain pickerel, northern pike, and yellow perch)  Birds (i.e., waterfowl, wading birds, piscivorous birds, songbirds, and raptors)  Reptiles and amphibians  Small and large mammals  Four state-listed endangered aquatic plant species occur in Lake Denmark: featherfoil ( <i>Hottonia inflata</i> ), Robbin's pondweed ( <i>Potamogeton robbinsii</i> ), small bur ( <i>Sparganium minimum</i> ), and lesser bladderwort ( <i>Utricularia minor</i> ).  Gravel Dam Cove – unique pond habitat supports breeding population of rare damselfly, the New England bluet.

5.2.9.5 *Munitions/Release Profile*

**5.2.9.5.1 Munitions Types**

Table 5-45 presents a summary of the types of munitions that could be expected based on information collected during the HRR process. Also presented in this table are the mechanisms by which munitions would be expected to be released to the environment if present.

**Table 5-45: Summary of Potential Munitions Types – Lake Denmark**

Potential Munitions	Primary Release Mechanisms
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

**5.2.9.5.2 Maximum Probability Penetration Depth**

According to the United States Army Corps of Engineers’ *Ordnance and Explosives Response Manual* (EM1110-1-4009), from June 2000, the maximum probable penetration depth for a 4.2” Mortar is 5.4 feet.

**5.2.9.5.3 MEC Density**

It is most likely that MEC are concentrated towards the southern end of Lake Denmark; the main firing point for the three former mortar ranges was the dam, and the firing point for the former cannon range was located on the current location of the softball field. A large number of anomalies were identified during a geophysical survey of the southern end of Lake Denmark (PTA.TO17.0048W).

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 in the lake is thought to have occurred from the western shoreline.

No site-specific investigations for the presence of MEC have occurred on Lake Denmark – Off-Post.

#### **5.2.9.5.4 Munitions Debris**

A visual survey was not conducted as part of the HRR; however, based on the activities that occurred at Lake Denmark from 1926 through the 1970s, 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.

#### **5.2.9.5.5 Associated Munitions Constituents**

Potential contaminants in Lake Denmark include propellants and metals. (Refer to the appropriate Ordnance Technical Data Sheets in Appendix D.) Potential MC associated with pyrotechnics include perchlorate. However, Plate 2 indicates that perchlorate has not been detected on the site.

Explosives and metals were analyzed in surface soil samples collected in 1996 from three areas: 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. No visual or chemical evidence of significant contamination was found in soil samples from the firing point or impact area (PTA.TO17.0014D).

Sediment and surface water samples were collected from 1998 to 1999 along the western shore of Lake Denmark, where munitions dumping may have occurred, and along the eastern shore near the RTI Site. Plate 1 indicates that metals (aluminum, cadmium, lead, and mercury) were detected above LOCs in one surface water sample. Cadmium, copper, lead, mercury, and nickel were detected above LOCs in several sediment samples collected from Lake Denmark. Plate 3 indicates explosives were not detected at concentrations greater than available LOCs in any surface water or sediment samples.

An RI/FS was conducted for the Radiation Technology, Inc. CERCLA Site from 1987 to 1990. Although groundwater remediation was recommended, remediation of surface water and sediment near the Superfund site was not warranted (PTA.TO17.0014D).

#### 5.2.9.5.6 Transport Mechanisms/Migration Routes

The primary transport mechanisms identified for Lake Denmark 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. Future re-development of Lake Denmark – Off-Post could uncover MEC or MC that are potentially in the surface or subsurface soil.

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

**Infiltration and Groundwater Discharge:** Most of the land immediately surrounding Lake Denmark is undeveloped and forested. Therefore, drainage to Lake Denmark is mainly a result of 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 water of Lake Denmark or it may percolate into the bedrock aquifer.

**Sedimentation:** MEC that historically may have been dumped into Lake Denmark 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.

#### 5.2.9.6 *Pathway Analysis*

The pathway analysis figures for the site are presented separately for the portion of the Lake Denmark site that is within PTA boundaries (Lake Denmark) and the portion of the site located beyond PTA's northeastern boundary (Lake Denmark – Off-Post). This is due to differences in land uses and characteristics of the two areas, which result in differences in potential receptors and exposure pathways for MEC and MC.

##### 5.2.9.6.1 MEC

MEC may be present within the safety fans of the three former mortar ranges. It is most likely that MEC are concentrated towards the southern end of Lake Denmark, nearest the main firing points for the three former mortar ranges and the former cannon range. A large number of anomalies were identified during a geophysical survey of the southern end of Lake Denmark (PTA.TO17.0048W).

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 in the lake is thought to have occurred from the western shoreline.

#### Lake Denmark

As illustrated in Figure 5-13, potentially complete exposure pathways are identified for PTA personnel and PTA residents who may be exposed to MEC in surface soil. Contractors who access the PSE&G utilities right-of-way may be exposed to MEC in surface soil and surface sediment. In the event of intrusive work on the site, contractors may be exposed to MEC in surface and subsurface soil or surface and subsurface sediment. While swimming is banned at PTA, it is possible that recreational users, primarily children or teenagers, might engage in swimming. Therefore, potentially complete pathways are also identified for PTA personnel, residents, and their visitors who may be exposed to MEC in surficial sediment. 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 potentially complete exposure pathway from MEC in subsurface soil to terrestrial wildlife that construct burrows.

*Lake Denmark - Off-Post*

The potential exposure pathways for MEC that may be present on Lake Denmark – Off-Post are presented in Figure 5-14. In the event of intrusive activities for future redevelopment of Lake Denmark – Off-Post, there is the potential for contractor (construction/utility worker) exposure to MEC in surface and subsurface soil. There is a potentially complete exposure pathway to MEC in surface soil for off-site residents and trespassers who may access the undeveloped, forested portions of Lake Denmark – Off-Post for hiking or hunting. Terrestrial vegetation and wildlife may be exposed to MEC in surface soil, and burrowing wildlife may be exposed to MEC in subsurface soil.

**5.2.9.6.2 MC**

*Lake Denmark – Off-Post*

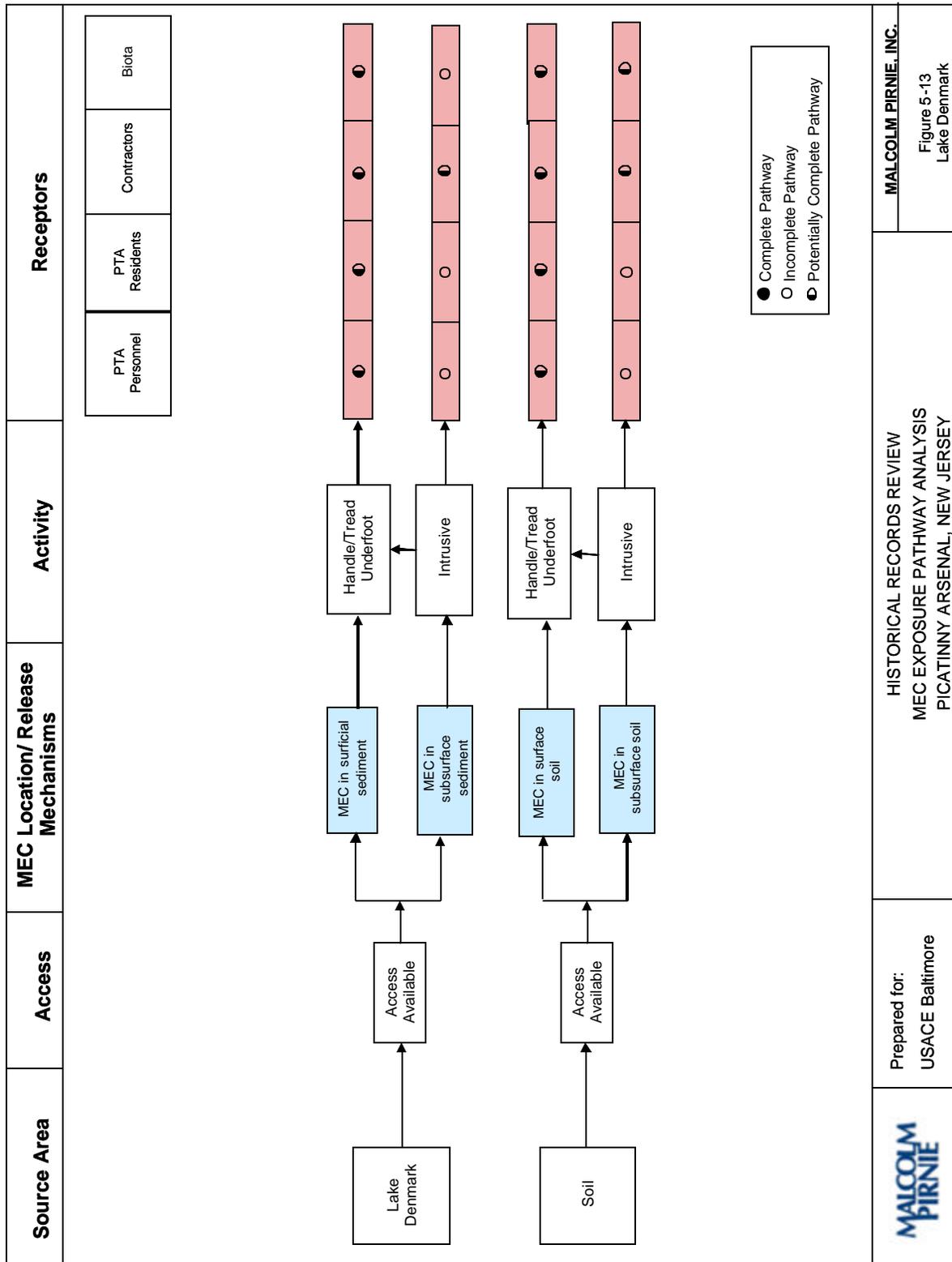
As illustrated in Figure 5-15, soil impacted by MC represents the primary source medium for the Lake Denmark – Off-Post site. Potentially complete exposure pathways exist for all receptors who may have contact with surface soil on the site. Off-site residents and trespassers (e.g., hunters or hikers) who may access the undeveloped portions of the site or the RTI CERCLA site may be exposed to MC in surface soil. In the event of intrusive activities for future redevelopment of the site, there is the potential for contractor (construction/utility worker) worker exposure to MC in surface and subsurface soil. Terrestrial wildlife may be exposed to MC in surface soil, and burrowing wildlife may be exposed to MC in subsurface soil.

Potentially complete exposure pathways are identified for construction/utility workers who may be exposed to MC in shallow groundwater that has pooled at the bottom of an excavation, in the event of intrusive activities for future redevelopment of the site. MC in shallow groundwater may migrate to the bedrock aquifer. However, as stated in Section

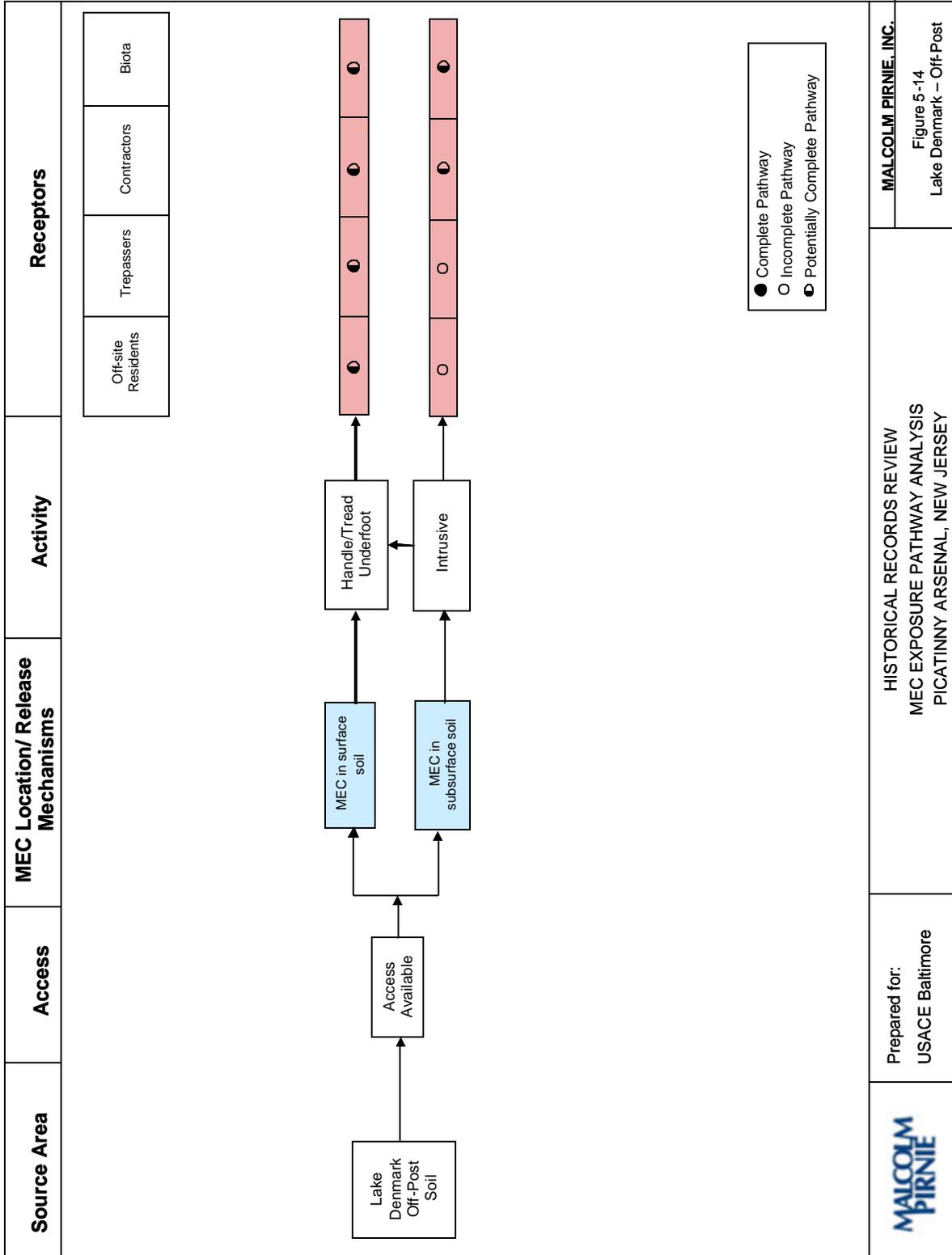
5.1.3.1, the exposure pathway from MC in potable groundwater to off-site residents is potentially complete.

Potentially complete exposure pathways through the food chain exist for assimilative/bioaccumulative MC to both human and ecological receptors. Off-site residents and trespassers, who may access the site for hunting, may be exposed to MC that have bioaccumulated in game. As stated in Section 5.2.1, while catch-and-release fishing may be practiced by most anglers at PTA, some may consume their catch. Therefore, human consumption of fish is a potentially complete exposure pathway. Terrestrial wildlife may ingest MC assimilated in vegetation and bioaccumulated in prey species.

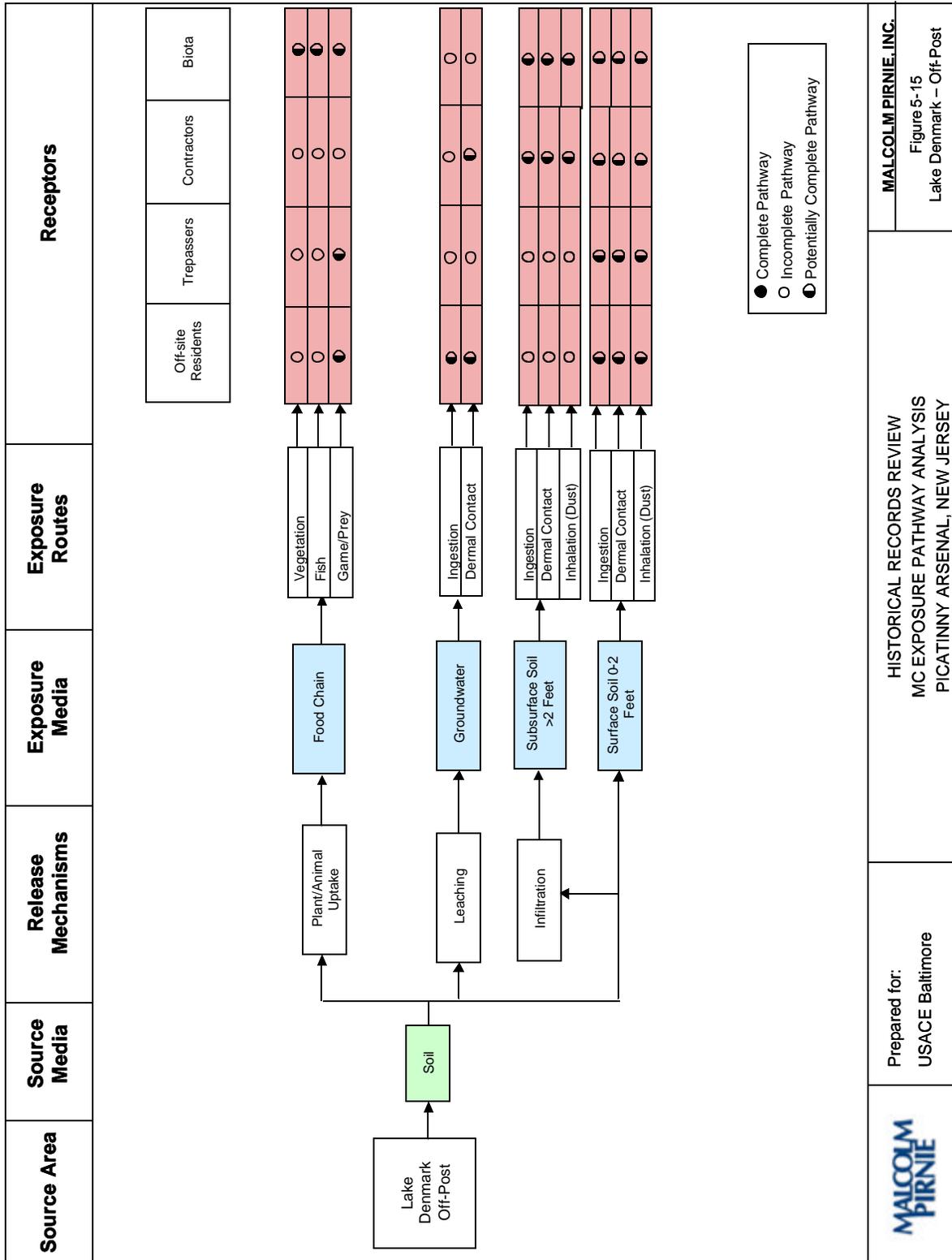
**Figure 5-13: MEC Pathway Analysis Figure – Lake Denmark**



**Figure 5-14: MEC Pathway Analysis Figure – Lake Denmark – Off-Post**



**Figure 5-15: MC Pathway Analysis Figure – Lake Denmark – Off-Post**



## 5.2.10 Picatinny Lake

### 5.2.10.1 MMRP Site Profile

The site-specific profile is presented in Table 5-46:

**Table 5-46: Site Profile - Picatinny Lake**

Information Needs	CSM Findings
Area and Layout	<p>Located in the geographical center of PTA</p> <p>Site encompasses 125 acres and includes: open water of Picatinny Lake, Flare Island (man-made peninsula), Picnic Island, 800 and 500 series buildings, and a 3-inch Barbette Gun range with a firing point on the southeast shore of the lake and an impact area in the location of Buildings 810 and 824.</p> <p>Open water of man-made Picatinny Lake spans approximately 108 acres and has a maximum depth of 20 feet (PICA00205).</p> <p>Picatinny Lake has a fairly flat, featureless bottom with more shallow depths at the northern end (PTA.TEPS.0008).</p> <p>A marine bathymetric survey conducted in 1995 revealed depths in the center of the lake range from 9 to 15 feet (PTA.TEPS.0008).</p> <p>Flare Island is a man-made peninsula constructed of coal slag and located at the southern end of the lake (PTA.TO17.0060M).</p>
Structures	<p>No structures exist in Picatinny Lake or on Flare Island. However, numerous munitions production, testing, and storage buildings surround the lake (PTA.D&amp;M.0004). Buildings of the 800 and 500 series are within the site boundaries.</p>
Utilities	<p>No known utilities exist in Picatinny Lake or on Flare Island. However, a magnetic survey conducted in 1995 revealed the presence of underwater linear features that may be pipelines (PTA.TEPS.0008). Utilities may exist for the 800 and 500 series buildings.</p>
Boundaries	<p>N: Scrub/shrub wetlands and Green Pond Brook</p> <p>S: Earthen dam with concrete spillway; numerous PTA munitions R&amp;D and production buildings; Building 506 (the steam and power generating plant for PTA)</p>

Information Needs	CSM Findings
	<p>E: PTA munitions R&amp;D, production, and storage buildings (500 and 900 series)</p> <p>W: PTA munitions R&amp;D and production buildings (700 to 900 series); steep slopes of Green Pond Mountain ridgeline</p>
Security	Refer to Section 5.1.1.2. Some parts of the lake are fenced, limiting access to the shoreline.

5.2.10.2 *Physical Profile*

The site-specific physical profile is presented in Table 5-47:

**Table 5-47: Physical Profile - Picatinny Lake**

Information Needs	CSM Findings
Geology	The majority of Picatinny Lake is underlain by Precambrian gneiss and Lower Cambrian Hardyston quartzite, overlain by Leithsville dolomite. The site is also underlain by Green Pond Conglomerate (PTA.D&M.0004).
Topography	<p>Picatinny Lake is situated at the base of the southeastern ridgeline of Green Pond Mountain.</p> <p>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 (PTA.TO17.0060M).</p> <p>Picatinny Lake is at an elevation of approximately 720 feet amsl.</p>
Soil	Very little soil on Flare Island, because it was constructed from coal slag (PTA.TO17.0060M)
Hydrogeology	Two separate aquifers are expected to be present: an unconfined glacial aquifer and a bedrock aquifer. Presumably, groundwater flow in the glacial aquifer is towards Picatinny Lake. Bedrock groundwater flow is complex due to the fractured nature of the rock (PTA.TO17.0048W).
Hydrology	<p>Picatinny Lake receives water from Lake Denmark and Green Pond, via Green Pond Brook.</p> <p>Picatinny Lake flows out over a spillway into Green Pond Brook.</p>

Information Needs	CSM Findings
Vegetation	<ul style="list-style-type: none"> <li>• Picatinny Lake contains submerged and floating aquatic vegetation (PTA.TEPS.0008).</li> <li>• Scrub/shrub wetlands are present on the northern end of the lake.</li> <li>• Tall trees are present on the lake's shoreline, especially in the southern part of the lake near the utility plant (PTA.TEPS.0008).</li> </ul>

5.2.10.3 Land Use and Exposure Profile

The site-specific land use and exposure profile is presented in Table 5-48:

**Table 5-48: Land Use and Exposure Profile - Picatinny Lake**

Information Needs	CSM Findings
Current Land Use/Activities	<p>Lake water is a non-potable source for process water and fire protection (PICA00205).</p> <p>Boating and fishing are permitted in Picatinny Lake. No wading, swimming, or scuba diving is permitted.</p> <p>Advisories exist for fish consumption from Picatinny Lake.</p> <p>Currently, many active, inactive, and demolished buildings surround the lake. Activities include propellant and munitions R&amp;D, production, and storage; steam and electric power generation; chemical laboratories; and a betatron and x-ray laboratory (PICA00205; PTA.TO17.0060M).</p>
Current Human Receptors	<p>PTA personnel</p> <p>PTA residents and their visitors</p> <p>Contractors</p> <p>Trespassers</p>
Potential Future Land Use	Same as current land use
Potential Future Human Receptors	Same as current receptors

Information Needs	CSM Findings
Beneficial Resources	<p>Picatinny Lake – functions in groundwater recharge, storm water retention, and nutrient cycling</p> <p>Picatinny Lake is classified “FW-2” for freshwater, non-trout surface water (PTA.TO17.0060M).</p> <p>Scrub/shrub wetlands directly north of Picatinny Lake – function in storm water retention and nutrient cycling; provide wildlife habitat</p> <p>Game species – fish and waterfowl</p>

5.2.10.4 Ecological Profile

The site-specific ecological profile is presented in Table 5-49 (OTHFW.0017):

**Table 5-49: Ecological Profile - Picatinny Lake**

Information Needs	CSM Findings
Habitat Type	<p>Open water/aquatic lake</p> <p>Scrub/shrub wetlands</p>
Degree of Disturbance	<p>Low; recreational activities such as fishing occur on Picatinny Lake.</p> <p>Moderate; current activities on land immediately surrounding Picatinny Lake may result in some soil disturbance.</p>
Ecological Receptors	<p>Fish (e.g., largemouth bass, chain pickerel, northern pike, and yellow perch)</p> <p>Birds (i.e., waterfowl, wading birds, piscivorous birds, songbirds, and raptors)</p> <p>Small mammals adapted to human populated areas</p>

5.2.10.5 *Munitions/Release Profile*

**5.2.10.5.1 Munitions Types**

Table 5-50 presents a summary of the types of munitions that could be expected based on information collected during the HRR process. Also presented in this table are the mechanisms by which munitions would be expected to be released to the environment if present.

**Table 5-50: Summary of Potential Munitions Types – Picatinny Lake**

Potential Munitions	Primary Release Mechanisms
Mortars 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 buildings surrounding the lake Permitted discharges of process wastewater Discharge of explosives-contaminated groundwater from Buildings 800 area

#### **5.2.10.5.2 Maximum Probability Penetration Depth**

Because no information was available regarding specific caliber of munitions utilized at Picatinny Lake, a maximum probability penetration depth at Picatinny Lake cannot be determined.

#### **5.2.10.5.3 MEC Density**

Based on previous land use activities, it is most likely that UXO and explosives are present in Picatinny Lake (PTA.TO17.0060M). The entirety of the lake may contain scattered UXO from the 1926 explosion of the Lake Denmark Powder Depot. It is likely that MEC have settled in lake sediment and are most concentrated near Flare Island, where pyrotechnics testing occurred, and nearest the areas where the following documented releases may have occurred:

- Smokeless powder was stored underwater in Picatinny Lake from 1910 to 1960.
- Crockets of lead azide and mercury fulminate were partially submerged in the lake (PTA.TO17.0060M).
- In 1965, cluster bombs exploded, and ordnance spread through the entire area, including the lake (PTA.TO17.0060M).

A marine magnetometer survey conducted in 1995 revealed metallic anomalies at numerous locations along the shoreline. The areas around Flare Island and Picnic Island, in the southern end of the lake, showed high concentrations of metallic anomalies that may be MEC.

#### **5.2.10.5.4 Munitions Debris**

A visual survey was not conducted as part of the HRR. However, based on previous land use activities, it is most likely that munitions debris items are present in Picatinny Lake (PTA.TO17.0060M). The 1926 explosion of the Lake Denmark Powder Depot deposited munitions debris in the lake. In 1965, munitions debris was projected into Picatinny Lake by

an explosion in Building 808. It is possible that munitions were dumped into Picatinny Lake (PICA00205).

A 1995 magnetic survey of the lake bottom revealed several small anomalies that are likely metallic debris but are not necessarily munitions related (PTA.TEPS.0008).

#### **5.2.10.5.5 Transport Mechanisms/Migration Routes**

The primary transport mechanisms identified for Picatinny Lake are:

***Erosion:*** Erosion may uncover MEC in soil near buildings immediately surrounding Picatinny Lake.

***Soil Disturbance:*** Current land use in areas immediately surrounding 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 beneath the surface of the soil to the soil surface.

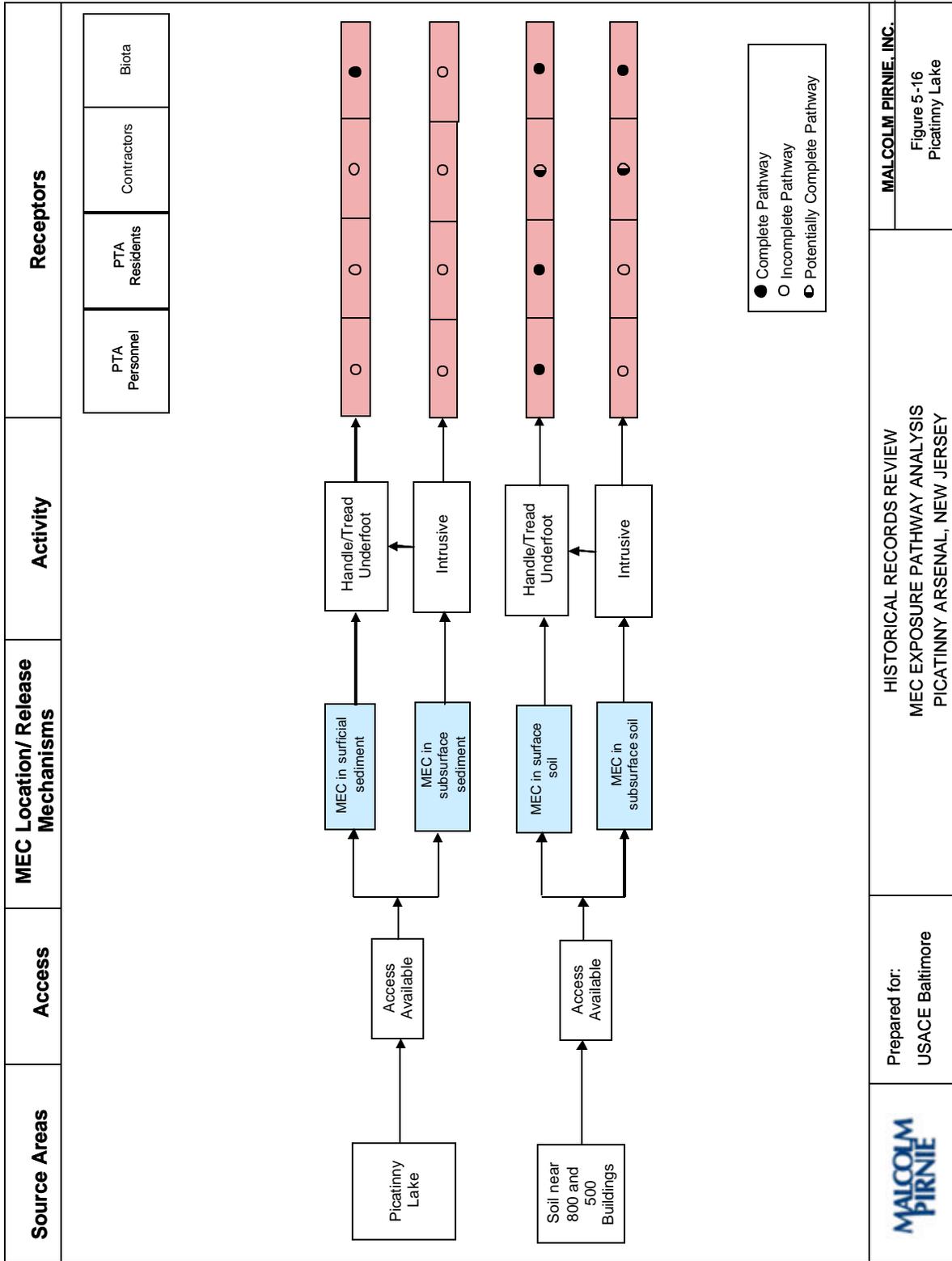
***Sedimentation:*** MEC that historically may have been stored or dumped in Picatinny Lake are unlikely to resurface. Mixing of surface water caused by wind and seasonal lake turnovers may re-suspend silt and sediment, which may in turn re-settle and bury MEC.

#### **5.2.10.5.6 MEC Pathway Analysis**

As illustrated in Figure 5-16, complete exposure pathways are identified for PTA personnel and PTA residents who may have contact with MEC in surface soil on the site. PTA personnel work in buildings of the 800 and 500 series, while PTA residents may access the shoreline of Picatinny Lake. Potentially complete exposure pathways are identified for contractors who may perform construction or maintenance work on the site and contact MEC

in surface soil and subsurface soil. Complete exposure pathways exist from MEC in surface soil and surface sediment to terrestrial wildlife. There is a complete exposure pathway from MEC in subsurface soil to burrowing wildlife.

**Figure 5-16: MEC Pathway Analysis Figure – Picatinny Lake**



**MALCOLM PIRNIE, INC.**  
 Figure 5-16  
 Picatinny Lake

HISTORICAL RECORDS REVIEW  
 MEC EXPOSURE PATHWAY ANALYSIS  
 PICATINNY ARSENAL, NEW JERSEY

Prepared for:  
 USACE Baltimore



**5.2.11 Shell Burial Ground Near Bldg. 3150**

*5.2.11.1 MMRP Site Profile*

The site-specific site profile is presented in Table 5-51:

**Table 5-51: Site Profile – Shell Burial Ground Near Bldg. 3150**

Information Needs	CSM Findings
Area and Layout	Approximately 1.5 acres Located on eastern portion of PTA on Gately Road near the gymnasium (Bldg. 3150)
Structures	None
Utilities	The RI report indicates that two water lines pass through the site. No other information regarding these lines is available (PTA.TO17.0048T). No information is available to identify whether any other utilities pass through the Shell Burial Ground Area Near Bldg. 3150.
Boundaries	The entire area is fenced. N: A fence S: Gately Road E: Gately Road W: Shrader Road
Security	Refer to Section 5.1.1.2. No site-specific security practices are associated with the Shell Burial Ground Near Bldg. 3150, but the site is fenced and posted with warning signs (PICA00214).

5.2.11.2 *Physical Profile*

The site-specific physical profile is presented in Table 5-52:

**Table 5-52: Physical Profile – Shell Burial Ground near Bldg. 3150**

Information Needs	CSM Findings
Geology	<p>Refer to Section 5.1.2.2.</p> <p>One well installed by Dames and Moore indicated the presence of bedrock (granitic gneiss) at 12 feet bgs that was overlain by till (gravel mixed with silt, clay, and sand) (PTA.D&amp;M.0001; PTA.D&amp;M.0004).</p>
Topography	<p>Relatively flat; gentle slope from east at approximately 980 feet amsl to west at approximately 970 feet amsl.</p>
Soil	<p>Refer to Section 5.1.2.4.</p> <p>Covered with approximately 20 feet of fill (PICA00204)</p> <p>Native soils are acidic, somewhat poorly drained, loamy upland soils (PTA.D&amp;M.0004).</p>
Hydrogeology	<p>Refer to Section 5.1.2.5.</p> <p>Groundwater measurements from monitoring wells associated with the site showed groundwater between 5 and 15.5 feet bgs (PTA.D&amp;M.0001; PTA.D&amp;M.0004).</p> <p>The water table occurs in the bedrock aquifer over most of the site and in discontinuous smaller areas in the unconsolidated aquifer (PTA.TO17.0018c).</p> <p>Groundwater is currently the source of potable water for PTA (PICA00226).</p> <p>Groundwater flow is northwest toward the EOD Pond (PTA.TO17.0018c).</p>
Hydrology	<p>No water bodies are on the site.</p> <p>Surface runoff is expected to flow west-northwest following topography.</p> <p>The EOD Pond is located approximately 500 feet (152 meters) northwest of the site.</p>
Vegetation	<p>Deciduous forest</p>

5.2.11.3 *Land Use and Exposure Profile*

The site-specific land use and exposure profile is presented in Table 5-53:

**Table 5-53: Land Use and Exposure Profile – Shell Burial Ground near Bldg. 3150**

Information Needs	CSM Findings
Current Land Use/Activities	None; the area is fenced and posted with warning signs and access is restricted by the Safety Office (PTA.TO17.0048t; PICA00214). The EOD Pond has boat landings (PTA.TO17.0018c) and fishing primarily for warm water species occurs in eight of the ponds at PTA (OTHFW.0017).
Current Human Receptors	PTA personnel PTA residents Visitors
Potential Future Land Use	Same as current land use
Potential Future Human Receptors	Same as current receptors
Beneficial Resources	Refer to Section 5.1.3.4.

5.2.11.4 *Ecological Profile*

The site-specific ecological profile is presented in Table 5-54:

**Table 5-54: Ecological Profile – Shell Burial Ground near Bldg. 3150**

Information Needs	CSM Findings
Habitat Type	Large forested area
Degree of Disturbance	Low
Ecological Receptors	Refer to Section 5.1.4.2.

5.2.11.5 *Munitions/Release Profile*

**5.2.11.5.1 Munitions Types**

Table 5-55 presents a summary of the types of munitions that could be expected based on information collected during the HRR process. The mechanism by which the MEC was released into the environment was disposal (PTA.TO17.0048S).

**Table 5-55: Summary of Potential Munitions Types –  
 Shell Burial Ground Near Bldg. 3150**

Potential Munitions	Potential MEC
Mines Depth charges Fuzes Projectiles Explosives Small arms ammunition Propellants	Partially/fully functioned and discarded mines, depth charges, fuzes, projectiles, small arms ammunition, and propellants  Explosives

**5.2.11.5.2 Maximum Probability 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 crater is reported to be between 25 to 35 feet deep (PICA00007).

### **5.2.11.5.3 MEC Density**

The MEC density of the Shell Burial Ground Near Bldg. 3150 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 (PTA.D&M.00004; PICA00096).

### **5.2.11.5.4 Munitions Debris**

A visual survey was not conducted as part of the HRR; however, since this area was used for the disposal of material from the 1926 explosion, it is likely that munitions debris items are present (PTA.D&M.00004; PICA00096).

### **5.2.11.5.5 Associated Munitions Constituents**

Potential MC associated with projectiles include lead, copper, antimony, zinc, steel, nitroglycerin, perchlorate, TNT and its derivatives, RDX, and HMX. (Refer to the appropriate Ordnance Technical Data Sheets in Appendix D.)

During the 1998-2000 RI for this site, one surface soil and three subsurface soil samples were collected and analyzed for VOCs, SVOCs, explosives, metals, and cyanide. No contaminants were found at levels that exceeded the LOCs. It should be noted that, due to safety restrictions, these samples were collected from areas surrounding the shell burial area and not the site itself (PTA.TO17.0048T).

During the 1989 SI and the 1998-2000 RI, groundwater was also sampled and analyzed for VOCs, SVOCs, explosives, metals, and cyanide. Five of the RI wells were screened in the bedrock aquifer, and five were screened in the unconsolidated overburden. During three rounds of sampling of these wells, only cyanide and a VOC (tetrachloroethylene) were detected at levels above the LOCs (PTA.TO17.0048T; PICA00205).

As shown on Plate 1, no metals have been detected on the site since at least 1988. Plate 2 indicates perchlorate has not been detected at this site. As shown on Plate 3, no explosives were detected on the site.

#### **5.2.11.5.6 Transport Mechanisms/Migration Routes**

The primary transport mechanisms identified for the Shell Burial Ground Near Bldg. 3150 include:

**Soil Disturbance:** Soil disturbance is not likely since PTA's Safety Office restricts access to this area (PICA00214).

**Frost Heave:** Frost heave is not likely to move MEC to the surface since any potential MEC are covered with approximately 20 feet of fill and are below the frost line.

**Infiltration:** The primary transport mechanism identified for the Shell Burial Ground Near Bldg. 3150 is infiltration. Based on the soil types associated with the site, and the fact that is not covered by an impermeable surface, the potential exists for MC to migrate from one environmental medium to another (surface to subsurface soil to groundwater) through infiltration of percolating precipitation. The water table may be at or above the disposed munitions most of the time as the water table is about 5 to 15 feet bgs.

#### *5.2.11.6 Pathway Analysis*

##### **5.2.11.6.1 MEC**

The information available indicates that MEC are still present within the Shell Burial Ground Near Bldg. 3150. However, no complete pathways for MEC were identified for either human or ecological receptors since the Shell Burial Ground 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 (PTA.TO17.0048T; PICA00214). 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.

#### 5.2.11.6.2 MC

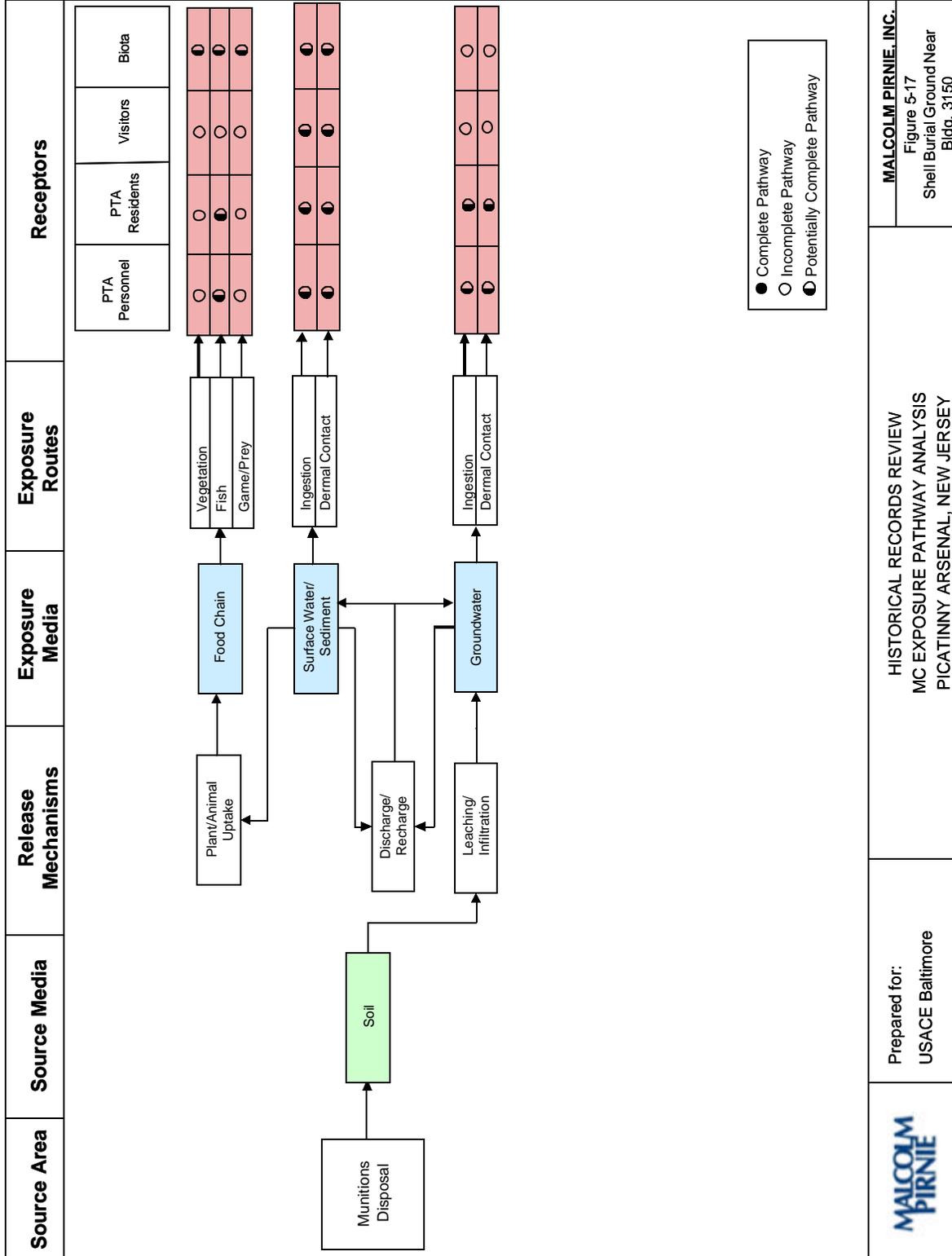
No complete soil pathways can be identified for either human or ecological receptors since the site (and any potential MC) is covered with 20 feet of fill, fenced and posted with warning signs, and the Safety Office does not allow any access to the site (PTA.TO17.0048T; PICA00214). Therefore, as illustrated in the MC Pathway Analysis, Figure 5-17, groundwater impacted through infiltration and potential discharge to the nearby EOD Pond represent the only potentially complete pathways for this site.

PTA personnel and PTA residents who may recreate at the EOD Pond may be exposed to surface water via dermal contact and to sediment via dermal contact and ingestion while boating or fishing. While swimming is banned at PTA, it is possible that recreational users, primarily children or teenagers, might engage in swimming. Therefore, ingestion of surface water is a potentially complete pathway for PTA personnel, residents, and their visitors.

As stated in Section 5.2.1, while catch-and-release fishing may be practiced by most anglers at PTA, some may consume their catch. Therefore, human consumption of fish is a potentially complete exposure pathway. A potentially complete exposure pathway exists for biota in the EOD Pond. It should be noted that explosives were not detected in any of the surface water or sediment samples collected from EOD Pond (PTA.TO17.0048U: PICA00205). Aluminum and zinc were detected in surface water at concentrations above the LOCs. Lead, copper, and zinc were detected in sediment. The source of the metals is unknown (PTA.T017.0048U).

As described in Section 5.1.3.1, exposure pathways for PTA personnel and PTA residents to MC in groundwater from potable water use are potentially complete. It should be noted that three rounds of groundwater sampling have been conducted in both the bedrock and overburden aquifers, and no explosives or metals were detected above the LOCs during any of the sampling events (PTA.TO17.0048T; PICA00205). Potable use of groundwater off PTA to the east is not likely, as the Mt. Hope Quarry is adjacent to the site on the east.

**Figure 5-17: MC Pathway Analysis Figure – Shell Burial Ground  
 Near Bldg. 3150**



**5.2.12 Shell Burial Ground Near Bldg. 3100**

*5.2.12.1 MMRP Site Profile*

The site-specific site profile is presented in Table 5-56:

**Table 5-56: Site Profile – Shell Burial Ground Near Bldg. 3100**

Information Needs	CSM Findings
Area and Layout	Approximately 4 acres Located in center of PTA, approximately 1,500 feet (457 meters) southeast of Picatinny Lake
Structures	None
Utilities	The RI report indicates that a sanitary sewer line cuts through the middle of the site. The installation date is unknown, although it is present on a 1969 map (PTA.TO17.0048T). No information is available to identify whether any other utilities pass through the Shell Burial Ground Near Bldg. 3100.
Boundaries	The entire area is fenced. N: Undeveloped land S: 99 <sup>th</sup> Road E: Building 3100 W: Belt Road and Main Road
Security	Refer to Section 5.1.1.2. No site-specific security practices are associated with the Shell Burial Ground Near Bldg. 3100, but the site is fenced and posted with warning signs (PICA00214).

5.2.12.2 *Physical Profile*

The site-specific physical profile is presented in Table 5-57:

**Table 5-57: Physical Profile – Shell Burial Ground Near Bldg. 3100**

Information Needs	CSM Findings
Geology	<p>Refer to Section 5.1.2.2.</p> <p>Wells installed by Dames and Moore indicate the presence of bedrock (granitic gneiss) overlain by till.</p>
Topography	<p>Moderately steep from the east at approximately 830 feet amsl toward the west- southwest to approximately 815 feet amsl.</p>
Soil	<p>Refer to Section 5.1.2.4.</p> <p>The shell burial area is covered with approximately 20 feet of fill (PICA00204).</p> <p>Deep, moderately permeable, well-drained soils and gravelly loam to gravelly sandy loam subsoils over a fragipan (PTA.D&amp;M.0004)</p>
Hydrogeology	<p>Refer to Section 5.1.2.5.</p> <p>Groundwater measurements from monitoring wells associated with the site showed groundwater between 10 and 60 feet bgs (PTA.D&amp;M.0001).</p> <p>Water table is in bedrock aquifer and locally in the unconsolidated aquifer.</p> <p>Water table groundwater flow is west towards Green Pond Brook (PTA.D&amp;M.0004, PTA.TO17.0018c).</p>
Hydrology	<p>No water bodies are on the site.</p> <p>Surface runoff is expected to the west, following the topography.</p> <p>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 of the site.</p>
Vegetation	<p>Deciduous forest</p>

5.2.12.3 *Land Use and Exposure Profile*

The site-specific land use and exposure profile is presented in Table 5-58:

**Table 5-58: Land Use and Exposure Profile – Shell Burial Ground Near Bldg. 3100**

Information Needs	CSM Findings
Current Land Use/Activities	None; the area is fenced and posted with warning signs and access is restricted by the Safety Office (PTA.TO17.0048t; PICA00214).
Current Human Receptors	PTA personnel PTA residents Visitors
Potential Future Land Use	Same as current land use
Potential Future Human Receptors	Same as current receptors
Beneficial Resources	Refer to Section 5.1.3.4.

5.2.12.4 *Ecological Profile*

The site-specific ecological profile is presented in Table 5-59:

**Table 5-59: Ecological Profile – Shell Burial Ground Near Bldg. 3100**

Information Needs	CSM Findings
Habitat Type	Large forested area
Degree of Disturbance	Low
Ecological Receptors	Refer to Section 5.1.4.2.

5.2.12.5 *Munitions/Release Profile*

**5.2.12.5.1 Munitions Types**

Table 5-60 presents a summary of the types of munitions that could be expected based on information collected during the HRR process. The mechanism by which the MEC were released into the environment was disposal (PTA.TO17.0048S).

**Table 5-60: Summary of Potential Munitions Types –  
 Shell Burial Ground Near Bldg. 3100**

Potential Munitions	Primary Release Mechanisms
Mines Depth charges Fuzes Projectiles Explosives Small arms ammunition Propellants	Partially/fully functioned and discarded mines, depth charges, fuzes, projectiles, small arms ammunition, and propellants  Explosives

**5.2.12.5.2 Maximum Probability 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 and 35 feet deep (PICA00007).

**5.2.12.5.3 MEC Density**

The MEC density of the Shell Burial Ground Near Bldg. 3100 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 (PTA.D&M.0004; PICA00096).

#### **5.2.12.5.4 Munitions Debris**

A visual survey was not conducted as part of the HRR; however, since this area was used for the disposal of material from the 1926 explosion and other material until 1945, it is likely that munitions debris items are present (PTA.D&M.0004; PICA00096).

#### **5.2.12.5.5 Associated Munitions Constituents**

Potential MC associated with the materials involved in the 1926 explosion include TNT, picric acid, and MC associated with Class “B” explosives, Explosive “D”, and smokeless powder. Potential MC associated with projectiles include lead, copper, antimony, zinc, steel, nitroglycerin, perchlorate, TNT and its derivatives, RDX, and HMX. (Refer to the appropriate Ordnance Technical Data Sheets in Appendix D.)

During the 2005 RI for this site, one surface soil sample and two subsurface soil samples were collected from areas adjacent to the site. Soil samples could not be collected from within the site boundaries since PTA’s Safety Office does not allow work to occur in this area. As shown on Plate 1, none of the soil samples collected in the vicinity of the site had metals concentrations greater than the LOCs (PTA.TO17.0048S; PTA.TO17.0048T). Plate 2 indicates perchlorate has not been detected at this site. Plate 3 indicates no explosives have been detected at concentrations greater than LOCs in soil samples from locations adjacent to the site.

Groundwater samples were collected during several sampling events. Between 1981 and 1984, one well was sampled several times for inorganics and purgeable organics. Lead was found at a level slightly above the current LOC. Explosives were analyzed for, but were not detected. During a 1988 sampling event, 2,4-DNT was found in one well at 0.3 µg/L, which is below the current LOC (PTA.D&M.0004). During the RI, six groundwater samples were collected; four samples were collected from wells screened in the overburden (between 12 and 35 feet bgs) and two samples were collected from wells screened in bedrock. Analysis of these samples indicates the presence of lead in one sample (collected from a bedrock well) at a concentration slightly above the LOC (PTA.TO17.0048T).

#### **5.2.12.5.6 Transport Mechanisms/Migration Routes**

The primary transport mechanisms identified for the Shell Burial Ground Near Bldg. 3100 include:

**Soil Disturbance:** Soil disturbance is not likely since PTA's Safety Office restricts access to this area (PICA00214).

**Frost Heave:** Frost heave is not likely to move MEC to the surface since any potential MEC are covered with approximately 20 feet of fill and are below the frost line.

**Infiltration:** The primary transport mechanism identified for the Shell Burial Ground Near Bldg. 3100 is infiltration. Based on the soil types associated with the site, and the fact that is not covered by an impermeable surface, the potential exists for MC to migrate from one environmental medium to another (surface to subsurface soil to groundwater) through infiltration of percolating precipitation. The water table may be at or above the disposed munitions during times of high water table.

#### *5.2.12.6 Pathway Analysis*

##### **5.2.12.6.1 MEC**

The information available indicates that MEC are still present within the Shell Burial Ground Near Bldg. 3100. However, no complete pathways for MEC were identified for either human or ecological receptors since the Shell Burial Ground 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 (PTA.TO17.0048T; PICA00214). 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.

#### 5.2.12.6.2 MC

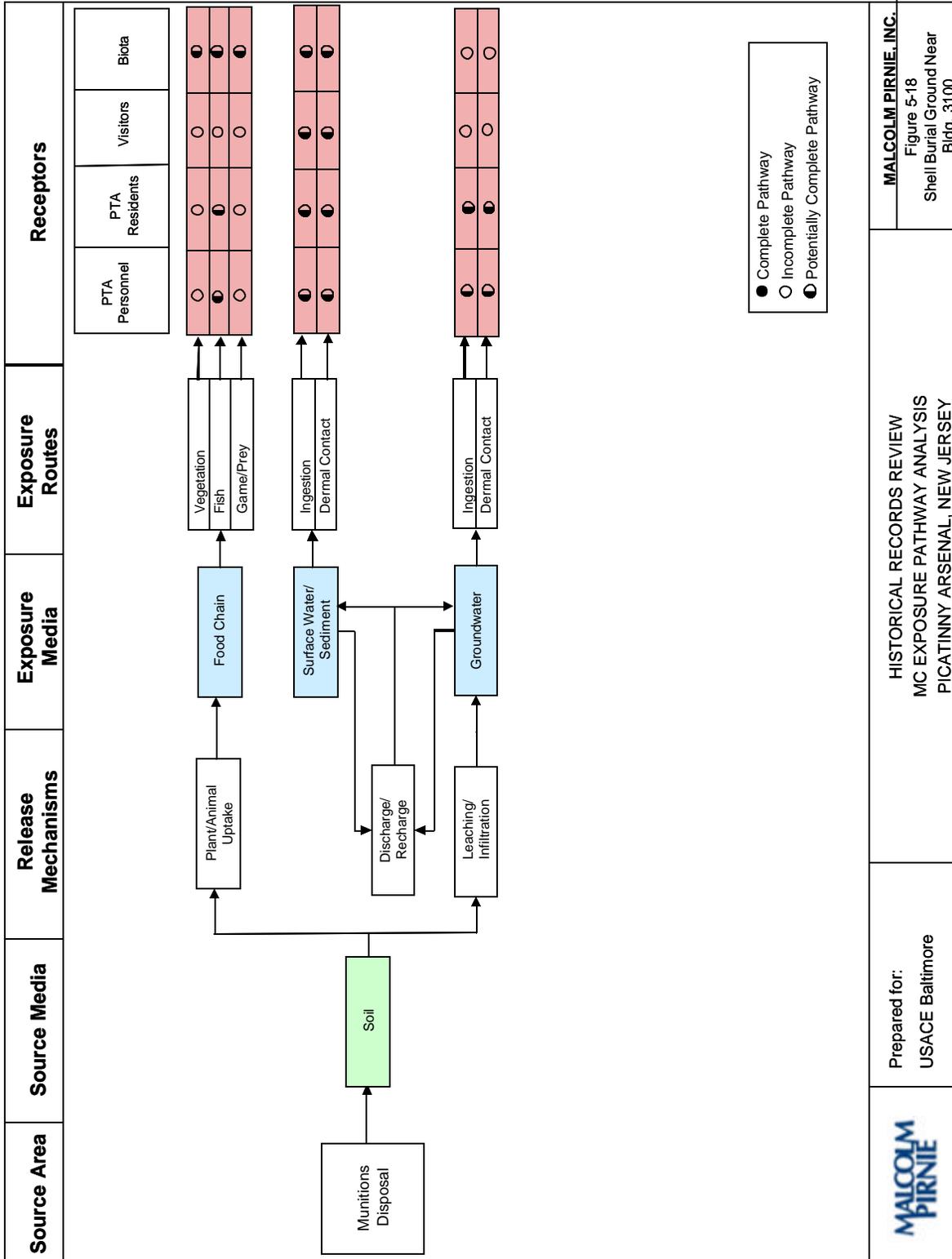
No complete soil pathways can be identified for either human or ecological receptors since the site (and any potential MC) is covered with 20 feet of fill, fenced and posted with warning signs, and the Safety Office does not allow any access to the site (PTA.TO17.0048T; PICA00214). Therefore, as illustrated in the MC Pathway Analysis, Figure 5-18, groundwater impacted through infiltration and groundwater discharge to Green Pond Brook represent the only potentially complete pathway for this site.

PTA personnel and PTA residents who may fish or otherwise recreate in Green Pond Brook may be exposed to surface water via dermal contact and to sediment via dermal contact and ingestion. While swimming is banned at PTA, it is possible that recreational users, primarily children or teenagers, might engage in swimming. Therefore, ingestion of surface water is a potentially complete pathway for PTA personnel, residents, and their visitors.

As stated in Section 5.2.1, while catch-and-release fishing may be practiced by most anglers at PTA, some may consume their catch. Therefore, human consumption of fish is a potentially complete exposure pathway. A potentially complete exposure pathway exists for biota in Green Pond Brook.

Although lead was the only MC detected in groundwater at a level above the LOC (PTA.TO17.0048T; PICA00205), as described in Section 5.1.3.1, exposure pathways for PTA personnel and PTA residents to MC in groundwater from potable water use are potentially complete.

**Figure 5-18: MC Pathway Analysis Figure – Shell Burial Ground Near Bldg. 3100**



**5.2.13 UXO Find Near Berkshire Trail**

*5.2.13.1 MMRP Site Profile*

The site-specific site profile is presented in Table 5-61:

**Table 5-61: Site Profile – UXO Find Near Berkshire Trail**

Information Needs	CSM Findings
Area and Layout	Approximately 500 m outside the Berkshire Hill Road gate and 50 m off the road in woods within the restricted easement area (between the installation fence and the actually property boundary). The site is less than 1 acre.
Structures	None.
Utilities	Refer to Section 5.1.1.1.
Boundaries	N/A
Security	Refer to Section 5.1.1.2. PTA police have increased security patrols in this area of the restricted easement due to vandalism.

*5.2.13.2 Physical Profile*

The site-specific physical profile is presented in Table 5-62:

**Table 5-62: Physical Profile – UXO Find Near Berkshire Trail**

Information Needs	CSM Findings
Geology	Refer to Section 5.1.2.2.
Topography	Refer to Section 5.1.2.3. The area where the mortar was found is rocky and sloped terrain. Steep slopes exist approximately 150 feet (46 meters) to the east/southeast.
Soil	Refer to Section 5.1.2.4.
Hydrogeology	Refer to Section 5.1.2.5. PTA potable water production wells are likely downgradient of the site, approximately 1 mile (1,609 meters) or more to the east/southeast of the site.

Hydrology	None on the site.
Vegetation	Refer to Section 5.1.2.7. Forested.

*5.2.13.3 Land Use and Exposure Profile*

The site-specific land use and exposure profile is presented in Table 5-63:

**Table 5-63: Land Use and Exposure Profile – UXO Find Near Berkshire Trail**

Information Needs	CSM Findings
Current Land Use/Activities	Restricted easement between PTA fence line and property boundary.
Current Human Receptors	PTA personnel Trespassers PTA residents (potable water)
Potential Future Land Use	Same as current land use, although future intrusive work cannot be discounted.
Potential Future Human Receptors	PTA personnel Trespassers PTA residents (potable water) Contractors
Beneficial Resources	Refer to Section 5.1.3.4.

*5.2.13.4 Ecological Profile*

The site-specific ecological profile is presented in Table 5-64:

**Table 5-64: Ecological Profile – UXO Find Near Berkshire Trail**

Information Needs	CSM Findings
Habitat Type	Forested area with steep, mountainous terrain in the vicinity.
Degree of Disturbance	Low
Ecological Receptors	Refer to Section 5.1.4.2.

*5.2.13.5 Munitions/Release Profile*

**5.2.13.5.1 Munitions Types**

**Table 5-65: Summary of Potential Munitions Types –  
 UXO Find Near Berkshire Trail**

Potential Munitions	Primary Release Mechanisms
<b>81-mm HE mortar</b>	UXO find; unknown origin; possible kick-out from open detonation.

**5.2.13.5.2 Maximum Probability Penetration Depth**

Because no information was available regarding specific munitions utilized in the area, a maximum probability penetration depth cannot be determined.

**5.2.13.5.3 MEC Density**

A visual survey was not conducted at the UXO Find Near Berkshire Trail. However, SFC Owens, EOD responder, reported no other MEC visible at the surface in the vicinity of the mortar.

#### **5.2.13.5.4 Munitions Debris**

A visual survey was not conducted at the UXO Find Near Berkshire Trail. However SFC Owens, EOD responder, reported no other MEC visible at the surface in the vicinity of the mortar. Because there is no information available regarding the history of the usage of the site, other specific types of munitions debris that may be present cannot be determined.

#### **5.2.13.5.6 Associated Munitions Constituents**

Potential MC associated with 81-mm HE mortars include lead, copper, antimony, zinc, steel, nitroglycerin, TNT and its derivatives, RDX, and HMX. (Refer to the appropriate Ordnance Technical Data Sheets in Appendix D.)

#### **5.2.13.5.7 Transport Mechanisms/Migration Routes**

The primary transport mechanisms identified for the UXO Find Near Berkshire Trail include:

***Erosion:*** Surface erosion at the site has the potential to transport soil impacted by MC. This is particularly true for steeply sloping terrain. Soil erosion also has the ability to uncover buried MEC.

***Soil Disturbance:*** Although not currently planned, future construction within the restricted easement area 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:*** MC have the potential to migrate from one environmental medium to another through infiltration. 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.

### 5.2.13.6 *Pathway Analysis*

#### 5.2.13.6.1 MEC

The MEC Exposure Pathway Analysis is illustrated in Figure 5-19. Since there is no information regarding munitions use in the area but the condition of the mortar found is consistent with kick out from detonation of munitions, it is possible that MEC are present in the area. However, SFC Owens, EOD responder indicated there were no other MEC visible at the surface in the vicinity of the mortar. While the mortar was found in the restricted easement area, which has signs warning trespassers, the PTA police have increased patrols in the area due to evidence of trespassing. Therefore, potentially complete pathways exist for trespassers, PTA personnel conducting patrols, and biota that have contact with surface soil and may contact MEC at the surface (via handling or treading underfoot). In addition, potentially complete pathways exist for contractors (via construction activities and other intrusive work) and biota (via burrowing or feeding) that have contact with subsurface soil.

#### 5.2.13.6.2 MC

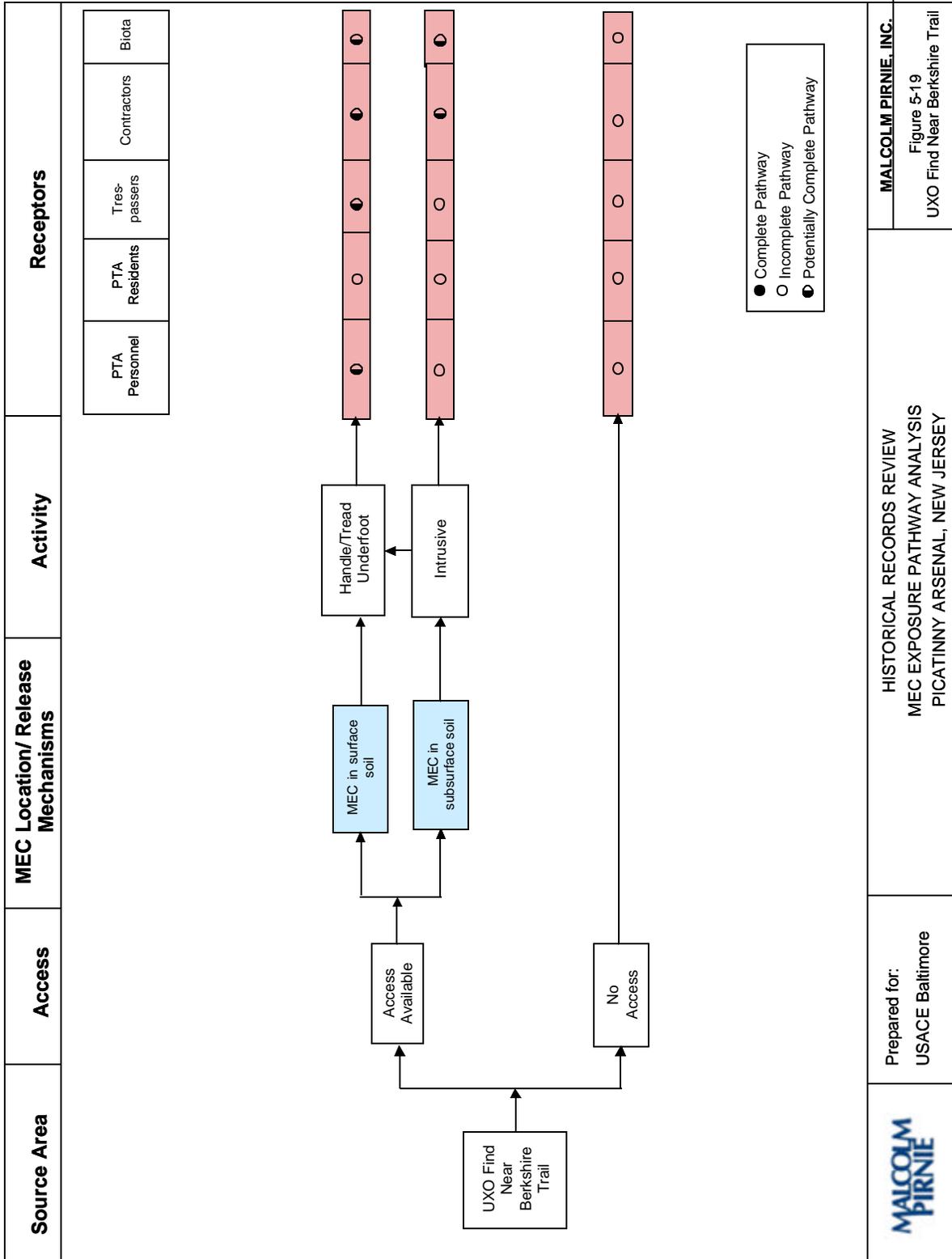
The MC Exposure Pathway Analysis is illustrated in Figure 5-20. Although only one mortar was found the potential for other MEC and MC cannot be discounted. If MC are present in soil or subsurface soil potentially complete exposure pathways exist for receptors with access to the site. Soil is the primary source medium through which receptors may be exposed to MC.

Complete exposure pathways exist for trespassers and PTA personnel conducting patrols that have contact with surface soil at the site. Exposure routes include ingestion of and dermal contact with soil and inhalation of dust. Complete exposure pathways exist for biota that have contact with surface and subsurface soil while feeding, nesting, or burrowing. Potentially complete exposure pathways exist for contractors who may contact surface and subsurface soil should any future intrusive activities be conducted (e.g., installation of a new fence).

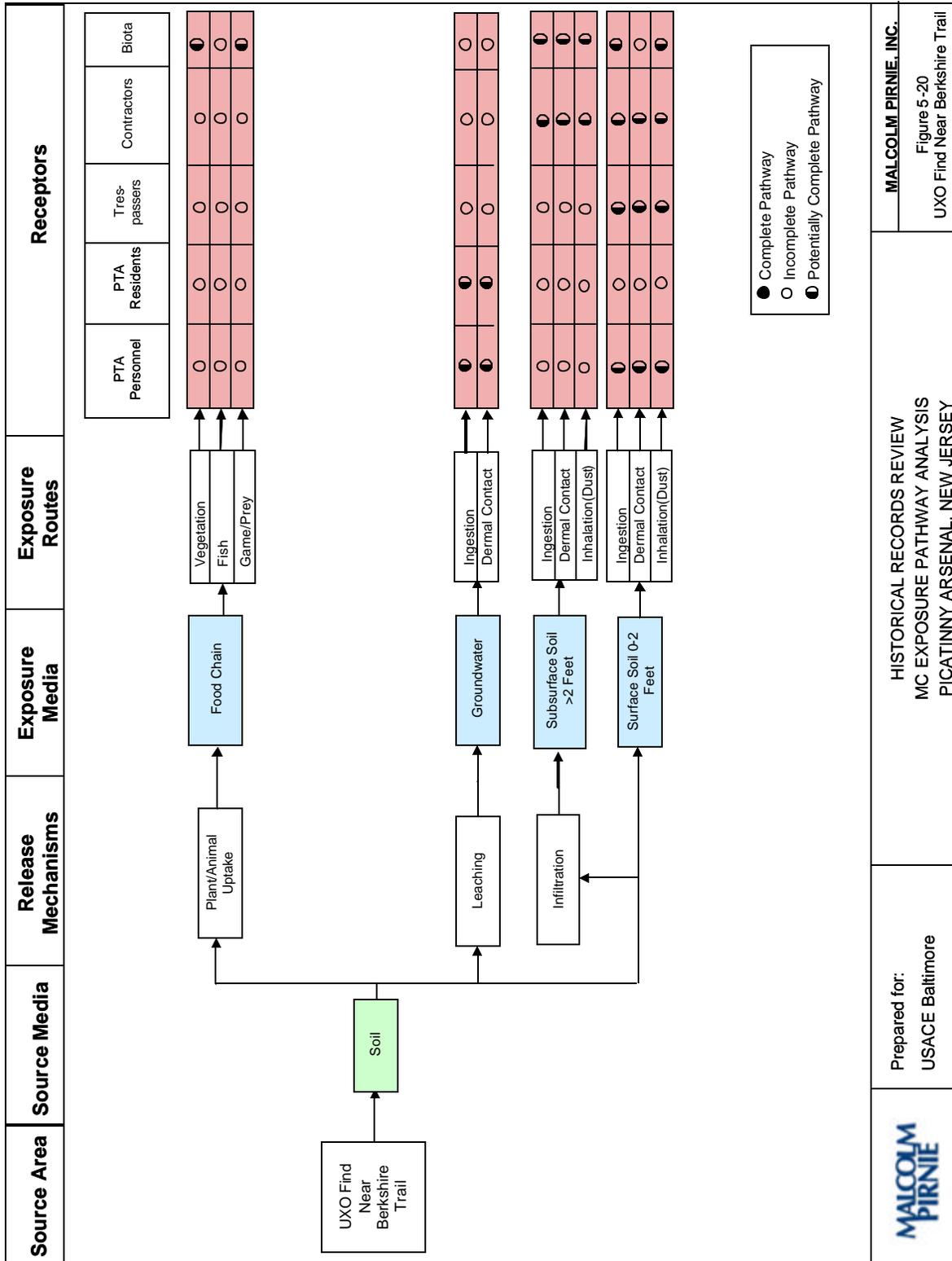
Potentially complete pathways through the food chain exist for assimilative/ bioaccumulative MC to ecological receptors. Terrestrial wildlife may ingest MC assimilated in vegetation and bioaccumulated in prey species. These pathways are potentially complete due to the nature and variability of the process 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.

The nearest potable water production well is approximately 1 mile (1,609 meters) downgradient from the UXO Find (Berkshire Trail). Although the potable water supply 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.

**Figure 5-19: MEC Pathway Analysis Figure – UXO Find Near Berkshire Trail**



**Figure 5-20: MC Pathway Analysis Figure – UXO Find Near Berkshire Trail**



**5.2.14 Waste Burial Area Near Sites 19 & 34**

*5.2.14.1 MMRP Site Profile*

The site-specific site profile is presented in Table 5-66:

**5-66: Site Profile – Waste Burial Area Near Sites 19 & 34**

Information Needs	CSM Findings
Area and Layout	<p>Located in the north-central portion of Area C (in the southwestern portion of PTA)</p> <p>Approximately 8.5 acres on the eastern side of Green Pond Brook</p> <p>Located in an isolated, sporadically used area of PTA</p> <p>Original site included several piles of debris containing railroad ties, concrete rubble, wood, scrap metal, and tires</p> <p>Site has been expanded to include additional waste piles in the vicinity of the original site.</p>
Structures	<p>Burial piles/landfill areas scattered throughout the site</p> <p>No buildings or other structures present</p>
Utilities	<p>Since there are no buildings or residences at the Waste Burial Area, no utilities are present.</p> <p>No potable water supply areas (PTA.T017.0098B)</p> <p>The nearest potable water source is Groundwater Operable Unit #4, located approximately 1/3-mile (531 meters) north of the site (PTA.T017.0018C).</p>
Boundaries	<p>N: Skeet Range</p> <p>S: Dense wooded area</p> <p>E: Dense wooded area</p> <p>W: Lower Burning Ground (Site 34)</p>
Security	<p>Refer to Section 5.1.1.2. No site-specific security practices or controls are associated with the Waste Burial Area.</p>

5.2.14.2 *Physical Profile*

The site-specific physical profile is presented in Table 5-67:

**Table 5-67: Physical Profile - Waste Burial Area Near Sites 19 & 34**

Information Needs	CSM Findings
Geology	Refer to Section 5.1.2.2.
Topography	<p>Generally flat and poorly drained, typical of the southern portion of PTA (PTA.T017.0098B)</p> <p>Approximate elevation of 690 feet amsl (PTA.D&amp;M.0037)</p> <p>Majority of topographic relief is formed by overgrown debris and waste piles.</p> <p>A man-made drainage ditch ends at a low-lying swampy or ponded area at the northeast end of the site (PTA.D&amp;M.0037).</p>
Soil	<p>Refer to Section 5.1.2.4.</p> <p>Fill material, up to 10 feet thick, underlies the majority of the site. Fill consists of fine to medium sand and gravel containing various types of debris (e.g., scrap metal, lumber). Fill appears to increase in thickness toward the northern end of the site.</p> <p>Dark gray organic-rich clay, considered the native soil, underlies the fill material in most areas of the site. Discontinuous lenses of black peat are present at the same depth as the clay (PTA.T019.0032B).</p> <p>Two sand units, a fine to medium sand overlying a coarse sand, form an unconfined aquifer that is approximately 20 feet thick (PTA.T017.0098B).</p>
Hydrogeology	<p>Refer to Section 5.1.2.5.</p> <p>Groundwater is currently the source of potable water for PTA (PICA00226). However, no groundwater production wells are located at the Waste Burial Area.</p> <p>The site is underlain by an unconfined sand aquifer (approximately 20 feet thick). Groundwater flow in this aquifer is southwest across the site toward Green Pond Brook.</p> <p>An upper semi-confined aquifer (approximately 50 feet thick) is located beneath the unconfined aquifer.</p>

Information Needs	CSM Findings
	A total of nine groundwater monitoring wells are located at the Waste Burial Area (PTA.T017.0098B).
Hydrology	<p>A surface water drainage ditch, formerly discharging to Green Pond Brook, currently ends at the northeast end of the site and forms a low-lying swampy or ponded area.</p> <p>Due to the lack of topographic relief, there is little surface water flow from the site (PTA.T019.0032B).</p> <p>Precipitation generally ponds in the lower areas of the site (between waste piles) and either infiltrates into the ground or evaporates (PTA.T017.0098B).</p> <p>Significant wetland areas are located within and immediately adjacent to the site.</p>
Vegetation	<p>Wetland plants, including mature trees, are located at the northern end of the site.</p> <p>Waste piles overgrown with weedy vegetation dominate the site.</p>

5.2.14.3 Land Use and Exposure Profile

The site-specific land use and exposure profile is presented in Table 5-68:

**Table 5-68: Land Use and Exposure Profile –  
 Waste Burial Area Near Sites 19 & 34**

Information Needs	CSM Findings
Current Land Use/Activities	<p>Isolated area, sporadically used</p> <p>Site is currently part of Hunting Area 18 and is used for small game (primarily pheasant) and deer hunting. Hunting on the site occurs only a few days per year. Hunting access is controlled by PTA personnel (PTA.T017.0098B).</p>
Current Human Receptors	<p>PTA personnel</p> <p>PTA residents</p>
Potential Future Land Use	<p>The only planned future change in land use is the construction of an asphalt cap over a portion of the site that is contiguous with the lower burning ground. The potential for future PTA use of the capped or uncapped areas is unknown. The use of</p>

Information Needs	CSM Findings
	the site as a hunting area is expected to continue in undeveloped areas of the site (PTA.T017.0098B).
Potential Future Human Receptors	PTA personnel PTA residents Contractors (e.g., construction workers)
Beneficial Resources	Refer to Section 5.1.3.4. Wetlands within and adjacent to the site Dense forested areas adjacent to the site Sensitive species, including the veery ( <i>Catharus fuscescens</i> ), barred owl ( <i>Strix varia</i> ), and American woodcock ( <i>Scolopax minor</i> ) (PTA.T017.0098B)

5.2.14.4 Ecological Profile

The site-specific ecological profile is presented in Table 5-69:

**Table 5-69: Ecological Profile - Waste Burial Area Near Sites 19 & 34**

Information Needs	CSM Findings
Habitat Type	Wetlands, including mature trees, within and adjacent to the site Dense forested areas adjacent to the site Limited open water habitats
Degree of Disturbance	Currently, the degree of disturbance is low. The site is located in an isolated, sporadically used area. However, a higher degree of disturbance is expected in the future due to construction activities. An asphalt cap planned for construction at Site 34 will extend into the southern portion of the Waste Burial Area (PTA.T017.0098B).
Ecological Receptors	Vegetation, such as deciduous trees, wetland plants, and terrestrial herbaceous plants Small mammals, birds, and soil invertebrates Sensitive species, including the veery ( <i>Catharus fuscescens</i> ), barred owl ( <i>Strix varia</i> ), and American woodcock ( <i>Scolopax minor</i> ) (PTA.T017.0098B)

5.2.14.5 *Munitions/Release Profile*

**5.2.14.5.1 Munitions Types**

Table 5-70 presents a summary of the types of munitions that could be expected based on information collected during the HRR process. Also presented in this table are the mechanisms by which munitions would be expected to enter the environment if present.

**Table 5-70: Summary of Potential Munitions Types –  
 Waste Burial Area Near Sites 19 & 34**

Potential Munitions	Primary Release Mechanisms
175-mm and 8-inch projectiles, ejection type (PTA.T019.0016C) 40-mm grenades (PTA.T019.0032B)	Disposal/burial

**5.2.14.5.2 Maximum Probability Penetration Depth**

Munitions were not fired or tested in this area, so the standard penetration depth calculation is not applicable. Any MEC expected to be located at the site are from disposal/burial activities. Large projectiles were observed on the ground surface during a site walk in 1998. Several grenades were discovered at a depth of less than 5 feet bgs during trenching activities conducted in 1998. Based on these data and the history of land use at the Waste Burial Area, it is possible that munitions may be found from the ground surface to a depth of approximately 10 feet (the approximate depth of fill and buried materials) at the site.

#### **5.2.14.5.3 MEC Density**

A visual survey has not been conducted as part of the HRR to determine the density of MEC at the Waste Burial Area. It is expected that MEC density is roughly homogenous throughout the landfilled areas of the site.

A geophysical survey was conducted in 1998 as part of the Phase I RI at the Waste Burial Area (PTA.D&M.0037). Results did not reveal any locations of buried metal or potential burial pits. Anomalies detected correlated to surface debris piles. During a site walk in January 1998, large projectiles were observed on the ground surface of the site (PTA.T019.0016C). Trenching activities in 1998 revealed several 40-mm grenades, all located within proximity of each other (PTA.T019.0032B).

#### **5.2.14.5.4 Munitions Debris**

A visual survey has not been conducted as part of the HRR. However, since the Waste Burial Area was used for the disposal of various materials, and UXO items have been discovered at the site, it is possible that munitions debris is present. Potential munitions debris items associated with large projectiles include base plates and fuzes/nose plugs; these items were not observed following the discovery of the projectiles in 1998.

#### **5.2.14.5.5 Transport Mechanisms/Migration Routes**

The primary transport mechanisms identified for the Waste Burial Area include:

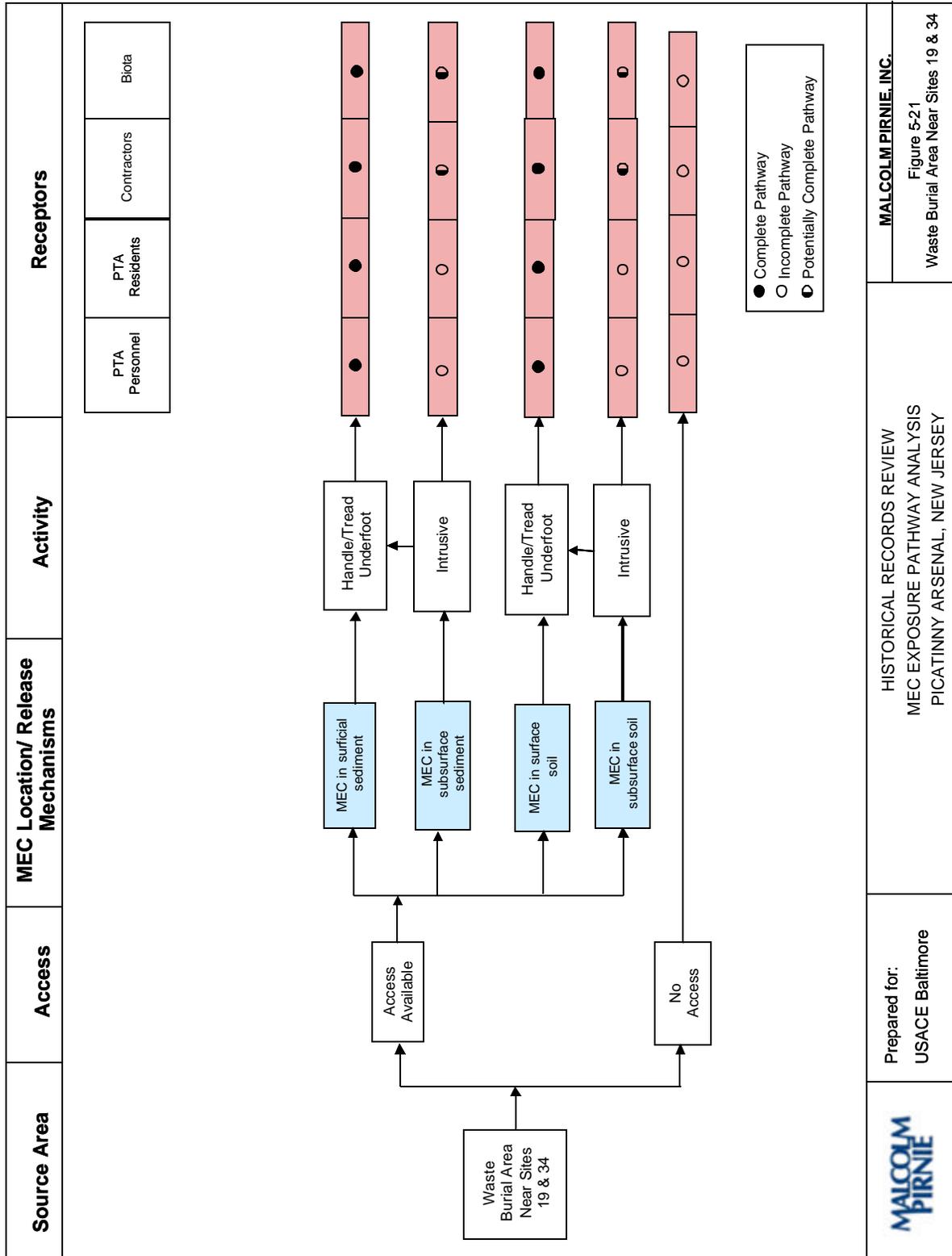
**Soil Disturbance:** Currently, there is little or no soil disturbance at the Waste Burial Area. However, future construction of the asphalt cap in the southern portion of the site would create surface and subsurface soil disturbances that may result in the transport and migration of MEC.

**Frost Heave:** Intermittent freezing and thawing of soil in the Waste Burial Area has the potential to move MEC from the subsurface to the surface, particularly during the spring. Frost heave is more likely to transport MEC to the surface in areas of shallow fill depths and/or in areas where MEC are buried close to the ground surface.

#### 5.2.14.6 MEC Pathway Analysis

The MEC Exposure Pathway Analysis is illustrated in Figure 5-21. Since MEC have been found at the Waste Burial Area and more may be present at the site, complete and potentially complete exposure pathways exist for receptors who have access to the site. Specifically, complete exposure pathways exist for PTA personnel, PTA residents, contractors, and biota that may have contact with surface soil or surficial sediment (via handling or treading underfoot) under current or future land use activities. Potentially complete pathways exist for contractors (via construction activities and other intrusive work) and biota (via burrowing or feeding) that may have contact with subsurface soil or subsurface sediment.

**Figure 5-21: MEC Pathway Analysis Figure – Waste Burial Area  
 Near Sites 19 & 34**



Prepared for:  
 USACE Baltimore

HISTORICAL RECORDS REVIEW  
 MEC EXPOSURE PATHWAY ANALYSIS  
 PICATINNY ARSENAL, NEW JERSEY

**MALCOLM PIRNIE, INC.**  
 Figure 5-21  
 Waste Burial Area Near Sites 19 & 34



## 6 CONCLUSIONS

### 6.1 MR SITES

The following summary and conclusions are provided as a result of the information reviewed for this HRR. The following 11 individual sites were initially identified during the Phase 3 CTT Range Inventory Report:

- 1000-Meter Impact Range
- 1000-Meter Range
- 1926 Explosion Site
- 1926 Explosion Site-Off-Post
- Bear Swamp/Green Pond Site
- Dredge Pile/Landfill
- DRMO Yard
- Lake Denmark
- Picatinny Lake Site
- Shell Burial Ground #1
- Shell Burial Ground #2

Due to a change in the operational range footprint, the 1000-meter range and 1000-meter impact range were combined and given a new name (Former Munitions and Propellant Test Area) for this HRR. Only one of the two AEDB-R numbers was retained for this range, PICA-001-R-01, and the other, PICA-002-R-01, is considered RC.

During research performed for this HRR, the following new sites were identified:

- Former Projectile Range
- Inactive Munitions Waste Pit
- UXO Find Near Berkshire Trail
- Waste Burial Area Near Sites 19 & 34

As a result of these changes, there are a total of 14 MRSs identified at PTA.

A synopsis of the HRR evaluation is included in Tables 6-1 and 6-2. Table 6-1 summarizes the historic uses of each site, whether MEC and MC contamination are known, and the final HRR acreage for each MRS. Also listed in the table are the original Phase 3 inventory acreages and the rationale for changing the size of the site. Map 6-1 depicts the boundaries of the 14 MRSs.

A comparison of the MRSs to the corresponding IRP site is provided in Table 6-2. The table summarizes the most recent phase completed at the site under the IRP as well as the portion and media at each site that is covered by each program.

## **6.2 MC EVALUATION**

As described in Sections 4 and 5, numerous MC samples (metals, explosives, and perchlorate in groundwater) have been collected from various media, including soil, surface water, sediment, and groundwater, for the majority of the MR sites. Due to the extensive MC sampling conducted as part of the IRP, and since MC for these sites are addressed under the IRP, MC is considered to be adequately characterized for these sites and MC for these sites is not included in the MMRP.

- Dredge Pile and Former Sanitary Landfill
- Former DRMO Yard and Former Burning Ground
- Former Munitions and Propellant Test Area
- Green Pond Site
- Lake Denmark
- Picatinny Lake Site
- Waste Burial Area Near Sites 19 & 34

There are also two MRSs, the Shell Burial Ground Near Bldg. 3150 and the Shell Burial Ground Near Bldg. 3100 that are collocated with IRP sites for which MC samples were collected adjacent to, but not from, the MRS. Samples cannot be collected from this site since an area clean of MEC cannot be found and since the site was covered with

approximately 20 feet of fill. MC is addressed for these sites in the IRP through LUCs and long-term monitoring.

In addition, there are several MRSs that are not collocated with an IRP site. These include the 1926 Explosion Site, the 1926 Explosion Site – Off-Post, the Former Projectile Range, the Inactive Munitions Waste Pit, the UXO Find Near Berkshire Trail, as well as any portion of an MRS that falls off-post. Although these sites are not collocated with an IRP site, some sample data may be available. A summary of the data associated with these sites is given below. Note that no analytical samples were found for any of the off-post portions of the MRSs.

- **1926 Explosion Site** – Although this is not an IRP site, there are many IRP sites located wholly or partially within the radius of this MRS. Therefore, numerous samples have been collected throughout the 1926 Explosion Site. MC is considered to be adequately characterized and addressed for all portions of the 1926 Explosion Site that are collocated with an IRP site. However, MC is not considered to be adequately characterized for portions of the MRS that are not collocated with an IRP site.
- **Former Projectile Range** – No associated samples
- **Inactive Munitions Waste Pit** – Four surface soil sample and two sediment samples have been collected from this site and analyzed for propellants, metals, and explosives. Since it was reported that elevated concentrations of metals and explosives were detected in the soil samples, additional MC characterization will be required in the MMRP.
- **UXO Find Near Berkshire Trail** – No associated samples

### 6.3 MEC EVALUATION

As described in Sections 4 and 5, numerous MEC finds have been made at PTA at the majority of the MR sites. Each site is listed below, along with associated MEC finds, if applicable.

- 1) 1926 Explosion Site - presence of MEC confirmed based on numerous finds across installation, including, but not limited to:
  - a) October 1967 – 180 rounds of 3, 4, and 5-inch Navy shells found up to four feet bgs during installation of parking lot for Bldg. 3002
  - b) 1995 – 14 inch AP projectile found during widening of parking lot between Bldgs. 3022 and 3028
  - c) 1998 – Numerous MEC items found while replacing floor in Bldg. 3150
- 2) 1926 Explosion Site – Off-Post - presence of MEC confirmed based on seven documented MEC finds over last four years
- 3) Dredge Pile and Former Sanitary Landfill - presence of MEC confirmed based on the following:
  - a) Several documents indicate that shells were reportedly disposed of in the landfill
  - b) Interviews with PTA personnel indicated the MEC were identified in trenches installed in the landfill for utility lines
  - c) Green Pond Brook was reportedly dredged due to the presence of shells
  - d) Nitrocellulose has been detected in soil and groundwater samples from this MR site
- 4) Former DRMO Yard and Former Burning Ground - presence of MEC confirmed since buried UXO were found during installation of a fence post
- 5) Former Munitions and Propellant Test Area - presence of MEC not confirmed
- 6) Former Projectile Range - presence of MEC not confirmed
- 7) Green Pond Brook - presence of MEC confirmed based on the following:
  - a) MEC has been observed protruding from the banks
  - b) This brook was dredged due to the presence of shells
- 8) Inactive Munitions Waste Pit - presence of MEC not confirmed; however, site covered with 12 feet of fill

- 9) Lake Denmark - presence of MEC suspected due to the presence of three anomalous readings found in the lake during a geophysical survey
- 10) Picatinny Lake Site – presence of MEC confirmed based on the following:
  - a) High concentrations of metallic anomalies, including around Flare Island, were found during a geophysical survey
  - b) MEC was found in several test pits installed adjacent to the site
- 11) Shell Burial Ground Near Bldg. 3150 – presence of MEC confirmed based on the following:
  - a) Documented disposal of tons of explosives from 1926 explosion
  - b) Documented use by Navy for explosives disposal until 1945
- 12) Shell Burial Ground Near Bldg. 3100 – presence of MEC confirmed based on the following:
  - a) Documented disposal of tons of explosives from 1926 explosion
  - b) Documented use by Navy for explosives disposal until 1945
- 13) UXO Find Near Berkshire Trail – presence of MEC confirmed
- 14) Waste Burial Area Near Sites 19 & 34 – presence of MEC confirmed since projectiles were visible at site during 1998 visual survey

Note that with the exception of the 1926 Explosion Site, MEC has not been documented at any off-post portions of an MR Site. This includes Lake Denmark and the Inactive Munitions Waste Pit.

**Table 6-1 Summary of HRR Acreage Changes and AEDB-R IDs\***

MRS Name	Phase 3 Inventory Acreage	HRR Acreage	MMRP AEDB-R ID	Munitions Use	Known MEC/MC	Rationale for Acreage Change
1926 Explosion Site	1,028	1552	PICA-003-R-01	Magazine and storage building explosion; mines, depth charges, fuzes, projectiles, explosives, small arms ammunition, and propellants	Known MEC/Suspect MC (metals, explosives and perchlorate)	1) Arc of influence around explosion center changed from ¾-mile to 1-mile (1,207 to 16,09 meters) radius based on historic reports 2) Operational range footprint of base changed between Phase 3 Inventory and HRR
1926 Explosion Site – Off-Post	472	833	PICA-004-R-01	Magazine and storage building explosion; mines, depth charges, fuzes, projectiles, explosives, small arms ammunition, and propellants	Known MEC/ Unknown MC	Arc of influence around explosion center changed from ¾-mile to 1-mile (1,207 to 1,609 meters) radius based on historic reports
Dredge Pile and Former Sanitary Landfill	9	13	PICA-006-R-01	Disposal site for munitions such as rifle grenades, and large and medium caliber ammunition, and for dredging materials containing small caliber ammunition	Known MEC/Known MC (explosives and metals)	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.
Former DRMO Yard and Former Burning Ground	2	9.5	PICA-007-R-01	Storage and disposal of munitions which include primary explosives,	Suspect MEC/Known MC (metals)	A former burning ground was discovered adjacent to the Former DRMO Yard. These

MRS Name	Phase 3 Inventory Acreage	HRR Acreage	MMRP AEDB-R ID	Munitions Use	Known MEC/MC	Rationale for Acreage Change
				secondary explosives, and pyrotechnics. The timeframe of use and the types of material burned in the Former Burning Ground are unknown.		two sites were combined for this HRR.
Former Munitions And Propellant Test Area	0.4	25	PICA-001-R-01	Range for recoilless rifles, such as the 57-mm M18, 75-mm M20, 90-mm M67, 105-mm M27, and the 106-mm M40.	Suspect MEC/All MC at levels below the LOCs	In the Phase 3 Inventory, the area between the firing point and impact area was deemed operational range, and therefore, was not MMRP-eligible. Due to the subsequent change to the installation's operational range footprint, this area is now designated other than operational range.
Former Projectile Range	NA	< 1	NA	Used as a projectile range for unknown munitions and also for testing smaller diameter projectiles, such as 20-mm, 37-mm, and 40-mm. May contain fuzes and spotting charges.	Suspect MEC/Unknown MC	This range was identified during the HRR.
Green Pond Site	8	1.4	PICA-005-R-01	Munitions types might include rifle grenades and large and medium caliber ammunition.	Known MEC/Known MC (metals)	Bear Swamp Brook is no longer part of this site since no documentation that MEC exists in the brook was discovered.

MRS Name	Phase 3 Inventory Acreage	HRR Acreage	MMRP AEDB-R ID	Munitions Use	Known MEC/MC	Rationale for Acreage Change
Inactive Munitions Waste Pit (includes an off-post portion)	NA	<b>On-Post</b> – 94	NA	Activities included the testing and storage of munitions and explosives.	<b>On-Post</b> - Suspect MEC/Known MC (metals and explosives). The explosives were not reported to be detected at elevated concentrations.	This site was identified during the HRR; it lies within a portion of the installation recently characterized as other than operational range area. A portion of this site falls outside the installation boundary.
		<b>Off-Post</b> – 7.5			<b>Off-Post</b> – Suspect MEC/Unknown MC	
Lake Denmark	327	<b>On-Post</b> – 633	PICA-008-R-01	Munition types include 60-mm, 81-mm, and 4.2-inch inert mortars, and 20-mm cannon mortars. Possibility of DMM in the lake.	<b>On-Post</b> - Known MEC/Known MC (metals)	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. It should also be noted that a portion of the SDZs associated with these ranges fall outside the installation boundary.
		<b>Off-Post</b> – 96			<b>Off-Post</b> – Suspect MEC/Unknown MC	
Picatiny Lake Site	108	125	PICA-009-R-01	Munition types include phosphorous grenades, experimental pyrotechnics, cluster bombs, and 3-inch projectiles. The lake was also used for storage of smokeless powder and	Known MEC/Known MC (explosives and metals)	1) A 3-inch projectile testing range was identified during research conducted for the HRR. 2) DMM was discovered in test pits installed near Bldgs. 565 and 823, which are adjacent to Picatiny Lake. These areas

MRS Name	Phase 3 Inventory Acreage	HRR Acreage	MMRP AEDB-R ID	Munitions Use	Known MEC/MC	Rationale for Acreage Change
				other explosives.		have been added to the site.
Shell Burial Ground Near Bldg. 3150	3	1.5	PICA-010-R-01	Ordnance includes mines, depth charges, fuzes, projectiles, explosives, small arms ammunition, propellants and possibly rocket fuels.	Known MEC/ Suspect MC	Based on a review of historic maps, the original CTT shape was found to be incorrect
Shell Burial Ground Near Bldg. 3100	4	4	PICA-011-R-01	Ordnance includes mines, depth charges, fuzes, projectiles, explosives, small arms ammunition, propellants and possibly rocket fuels	Known MEC/ Suspect MC	None
UXO Find Near Berkshire Trail	NA	< 1	NA	81-mm HE mortar find. Unknown origin, possible kick-out from open detonation	Known MEC/Unknown MC	This site was identified during the HRR.
Waste Burial Area Near Sites 19 & 34	NA	8.5	NA	Large projectiles including 175- mm or 8-inch projectiles, 40- mm grenades	Suspect MEC/Known MC (metals)	This range was identified during the HRR.

\* Sites that were not identified in the Phase 3 Inventory but were identified during research conducted for this HRR do not have an AEDBR ID.

**Table 6-2: Summary of MMRP and IRP Status at Overlapping Locations**

<i>MRS Name</i>	<i>MMRP AEDB-R ID</i>	<i>IRP Name</i>	<i>IRP AEDB-R ID</i>	<i>RI Concept Plan Site #</i>	<i>IRP Phase Completed</i>	<i>MEC Addressed in IRP</i>	<i>MC Addressed in IRP</i>	<i>MEC/MC Addressed in MMRP</i>
<i>1926 Explosion Site</i>	<i>PICA-003- R-01</i>	<i>Not an IRP Site</i>						<i>MEC for entire site (except excluded areas); MC for entire site except excluded areas and areas where MC is addressed for a collocated IRP site.</i>
<i>1926 Explosion Site – Off-Post</i>	<i>PICA-004- R-01</i>	<i>Not an IRP Site</i>						<i>MEC &amp; MC for entire site</i>
<i>Dredge Pile and Former Sanitary Landfill</i>	<i>PICA-006- R-01</i>	<i>Sanitary Landfill (Near Site 26)</i>	<i>PICA-067 &amp; PICA- 068</i>	<i>25 &amp; 26</i>	<i>Draft Final ROD submitted to agencies in July 2006.</i>	<i>No. However, a coincident vegetative cover for MC over a small portion of the site is proposed in the July 2006 Draft Final ROD</i>	<i>Yes. The Draft Final ROD proposes a vegetative cover on an approximately 1 acre portion of the landfill and LUCs for the entire site.</i>	<i>MEC for entire site</i>
<i>Former DRMO Yard and Former Burning Ground</i>	<i>PICA-007- R-01</i>	<i>Former Gas Station/DRM O</i>	<i>PICA-072</i>	<i>31</i>	<i>FS completed</i>	<i>No. However, coincidental capping over a portion of the site is proposed in the FS</i>	<i>Yes. Hot-spot excavation and capping proposed for a large portion of the site.</i>	<i>MEC for entire site</i>
<i>Former Munitions And</i>	<i>PICA-001- R-01</i>	<i>Munitions &amp; Proplts TST</i>	<i>PICA-053 PICA-056</i>	<i>7 10</i>	<i>FS being drafted</i>	<i>No</i>	<i>None detected above LOCs</i>	<i>MEC for entire site</i>

<i>MRS Name</i>	<i>MMRP AEDB-R ID</i>	<i>IRP Name</i>	<i>IRP AEDB-R ID</i>	<i>RI Concept Plan Site #</i>	<i>IRP Phase Completed</i>	<i>MEC Addressed in IRP</i>	<i>MC Addressed in IRP</i>	<i>MEC/MC Addressed in MMRP</i>
<i>Propellant Test Area</i>		<i>Area/Chem Burial</i>	<i>PICA-096</i>					
<i>Former Projectile Range</i>	<i>NA</i>	<i>Not an IRP Site</i>						<i>MEC &amp; MC for entire site</i>
<i>Green Pond Site</i>	<i>PICA-005-R-01</i>	<i>Former Gas Station/DRM O</i>	<i>PICA-072</i>	<i>31</i>	<i>ROD signed in 2005</i>	<i>No</i>	<i>Yes. Land use controls and long-term monitoring</i>	<i>MEC for entire site</i>
<i>Inactive Munitions Waste Pit</i>	<i>NA</i>	<i>Not an IRP Site</i>						<i>MEC &amp; MC for the entire site</i>
<i>Lake Denmark</i>	<i>PICA-008-R-01</i>	<i>Lake Denmark</i>	<i>PICA-015</i>	<i>54</i>	<i>FS will be completed</i>	<i>No</i>	<i>Yes. Land use controls</i>	<i>MEC for entire sit; MC for off-post portion</i>
<i>Picatinny Lake Site</i>	<i>PICA-009-R-01</i>	<i>Picatinny Lake/Propellant Plant (Bldg 561)</i>	<i>PICA-057 PICA-146</i>	<i>53 113</i>	<i>FS will be completed</i>	<i>No</i>	<i>Yes. Land use controls</i>	<i>MEC for entire site</i>
<i>Shell Burial Ground Near Bldg. 3150</i>	<i>PICA-010-R-01</i>	<i>Shell Burial Area Near Site 5</i>	<i>PICA-162</i>	<i>5</i>	<i>FS will be completed</i>	<i>No</i>	<i>Yes. Land Use Controls and Long-Term Monitoring</i>	<i>MEC for entire site</i>
<i>Shell Burial Ground Near Bldg. 3100)</i>	<i>PICA-011-R-01</i>	<i>Shell Burial Area Near B-3100</i>	<i>PICA-052</i>	<i>6</i>	<i>FS will be completed</i>	<i>No</i>	<i>Yes. Land Use Controls and Long-Term Monitoring</i>	<i>MEC for entire site</i>

<i>MRS Name</i>	<i>MMRP AEDB-R ID</i>	<i>IRP Name</i>	<i>IRP AEDB-R ID</i>	<i>RI Concept Plan Site #</i>	<i>IRP Phase Completed</i>	<i>MEC Addressed in IRP</i>	<i>MC Addressed in IRP</i>	<i>MEC/MC Addressed in MMRP</i>
<i>UXO Find Near Berkshire Trail</i>	<i>NA</i>	<i>Not an IRP Site</i>						<i>MEC &amp; MC for entire site</i>
<i>Waste Burial Area Near Sites 19 &amp; 34</i>	<i>NA</i>	<i>Waste Burial Area Near Sites 19 &amp; 34</i>	<i>PICA-093</i>	<i>180</i>	<i>FS completed</i>	<i>No. However, the proposed Lower Burning Ground cap covers a portion of the site.</i>	<i>Yes. Lower Burning Ground cap covers a portion of the site and land use controls for the entire site.</i>	<i>MEC for entire site</i>



## PLATES

## **Appendix A: Archives Searched/Data Sources**

The archival data reviewed for this HRR are presented by RG and source below. Items followed by an asterisk (\*) are items that provided useful information and were photocopied.

## National Archives

### Textual Records

#### **RG 18, Army Air Forces**

Entry 2, Air Adjutant General, Decimal File, 1944-46, [No Boxes]

Entry 2-C, Air Adjutant General, Decimal File, 1947, [No Boxes]

Entry 2-E, Air Adjutant General, Decimal File, 1948, [No Boxes]

Entry 46, Air Inspector, Decimal File, 1945, [No Boxes]

Entry 46, Air Inspector, Decimal File, 1946, [No Boxes]

Entry 46, Air Inspector, Decimal File, 1947, [No Boxes]

Entry 166, Central Decimal Files, 1917-38, [No Boxes]

Entry 169, Project Files—Camps, 1917-38, [No Boxes]

Entry 170, Project Files—Forts, 1917-38, [No Boxes]

Entry 176, Project Files—National Guard, [No Boxes]

Entry 292, Central Decimal Files, [No Boxes]

Entry 292 B, Central Decimal Files, 1942-44, [No Boxes]

Entry 294 A, Central Decimal Files, 1942-44: Bases and Fields, [No Boxes]

Entry 296, Project Files: Camps and Forts, 1939-1942, [No Boxes]

Entry 297, Correspondence re: Corps Areas, [No Boxes]

#### **RG 51, Bureau of Budget**

Entry 149-B, Inspection Reports, Box 118

#### **RG 69, Work Projects Administration**

Entry 628 (A1), WPA Construction Projects, 1935-39, Box 2\*

#### **RG 71, Bureau of Yards and Docks**

Naval Property Case Files, 1941-58, Lake Denmark, Boxes 795-798

**RG 77, Chief of Engineers**

Entry 104, Correspondence re: Military Affairs, 1918-23, Posts, Camps, Stations, [No Boxes]

Entry 106-B (UD), General Correspondence, 1918-45, Boxes 251-254, 311-318, 559, 708, 709, 710\*, 711, 712, 775-780, 803, 808, 823, 824

Entry 391, Construction Completion Reports, 1917-43, Boxes 246\*, 247\*, 248\*, 249\*, 250\*

Entry 391-B, Construction Completion Reports, Formerly Classified, Box 77\*

Entry 393, Historical Record of Buildings, Boxes 182-184

Entry 1011, Formerly Security Classified Subject Files, 1940-45, Boxes 651, 652, 710\*

**RG 92, Quartermaster General**

Entry 223, General Correspondence, 1920-23, [No Boxes]

Entry 1889, General Correspondence Subject File, 1922-35, Boxes 203-205, 221, 222, 705, 718

Entry 1890-A, General Correspondence, 1936-1945, Boxes 128, 168, 723, 724, 737

Entry 1890-B, General Correspondence, 1946-1948, Boxes 51-56, 71, 204, 273

Entry 1890-C, General Correspondence, 1949-1950, Boxes 29, 43, 137, 199, 200

Entry 1890-D, General Correspondence, 1951-1952, Boxes 51, 66, 119, 170

Entry 1890-E, General Correspondence, 1953-1954, Boxes 46-49, 67, 141, 206

Entry 1890-F, General Correspondence, 1955-1956, Boxes 127, 128, 189, 289, 476-479

Entry 1890-G, General Correspondence, 1957, Boxes 59, 60, 74-76, 190, 255-257

Entry 1890-H, General Correspondence, 1958-1959, Boxes 59, 78-80, 238, 357, 358, 360

Entry 1890-I, General Correspondence, 1960-1961, Boxes 73, 74, 80, 207, 303, 304

Entry 1892-A, General Correspondence, Geographic File, 1936-45, Box 470\*

Entry 1892-D, General Correspondence, Geographic File, 1951-52, Box 103

Entry 1892-E, General Correspondence, Geographic File, 1953-1954, Box 110

Entry 1892-F, Classified Geographic File, 1946-1952, Box 51

Entry 1930-A, Annual Historical Summaries, 1959-1962, [No Boxes]

Entry 1974-A, Completion Reports, 1917-1919, Boxes 219, 220\*

Entry 1975, Formerly Classified Construction Division Completion Reports, 1917-1938,  
Boxes 1, 3, 4, 6, 7

Entry 1976, Construction Division Plans & Photos, Boxes 1-3

Entry 1981, Construction Division, Miscellaneous Records, 1916-20, Boxes 1-3

Entry 1998, Real Estate Records, 1917-22, Boxes 152, 185, 250, 491, 504, 728

### **RG 111, Signal Corps**

Entry 50-A (NM-77), Personnel Division, ROTC General Correspondence, 1919-22, Boxes

Entry 1023-A, Unclassified Central Decimal File, 1941-57, Boxes 873-878

### **RG 120, American Expeditionary Forces**

Entry 14, Inspection Reports, 1919-20, [No Boxes]

### **RG 121, Public Buildings Service**

Entry 3, Office of Real Property, Disposal Case Files, [No Boxes]

Entry 4 (UD-WW), Office of Real Property Disposal Case Files, [No Boxes]

### **RG 127, Marine Corps**

Entry 18-B, General Correspondence, 1939-50, Box 225

### **RG 156, Chief of Ordnance**

Entry 463, Name and Subject Card Index, Picatinny, Boxes 24-26

Entry 493, Name and Subject Index to Entry 494, Box 53\*

Entry 494, Engineering Division, Trench Warfare Section, Decimal Correspondence, 1917-  
1919, Boxes 17, 19, 31, 37, 42-47, 85, 97-107, 108\*, 129, 131\*, 132

Entry 646, Histories of Ordnance Installations and Activities, 1940-45, Box A-654a

Entry 646-A, Military Historical Files, Boxes A-731, A-779

Entry 654-I (UD), Histories of Ordnance Field Installations and Activities, 1940-45, Boxes  
49\*, 50\*, 51\*, 52-59, 60\*, 61-67, 68\*, 69\*, 70\*, 71\*, 72\*, 73\*, 74\*, 75\*

Entry 685 (NM-26), Safety and Security Division, General Administrative Correspondence, 1940-50, Boxes F-20, F-75\*, F-78, F-91, F-94

**Entry 687, Disaster Files, Box F-120\***

Entry 775, Ordnance-owned/ Contract-operated Facilities, 1941-45, Boxes I-31, I-36

Entry 776, Government-owned and Operated Facilities, 1945-53, Boxes I-47\*, I-48

Entry 790, Specifications and Related Correspondence, 1921-53, Box I-135

Entry 793, Research and Dev. and Mobilization Planning Records, Boxes I-162, I-169, I-170, I-171\*, I-172

Entry 794, Records Related to Facilities Expansion, Boxes I-177, I-179, I-185, I-186, I-205, I-206, I-207

Entry 796, Records of Advisory Boards for Utilization of Surplus Industrial Facilities, Boxes I-214, I-215, I-216

**Entry 798-A, Studies re: Procurement, Box I-239\***

Entry 802, Records of Underwater Storage of Smokeless Powder and Explosion, Box I-283

Entry 817, Artillery Division, General Administrative Correspondence, Boxes I-381, I-386, I-388

Entry 829, Small Arms Division, Expansion, Box I-494

Entry 849, Inspection Branch, Boxes I-680, I-682, I-683

Entry 852, Demobilization, Boxes I-710 through I-712

Entry 903, Monthly Progress Reports of Arsenals, 1942-46, Boxes J737AK-J737AN

**RG 159, Office of Inspector General**

Entry 26D (NM-37), General Correspondence, 1939-47 (Unclassified), Boxes 407, 412, 424, 510

Entry 26E (NM-37), General Correspondence, 1939-47, (Formerly Classified), Boxes 145, 189, 326\*

**RG 160, Army Services Forces**

Entry 7, Second Service Command, 1942-46, Boxes 1-9, 10\*, 15, 32-37, 40, 41

Entry 153, Director of Military training, 1942-46, Boxes 169-179, 566, 567

Entry 155, Director of Military Training, History Records, 1942-46, Boxes 1-4

Entry 196A, General Records, 1941-45, Box 431

**RG 165, War Department General and Special Staffs**

Entry 310, Historical Files, 1900-41, Boxes 1, 55, 55-A, 414

**RG 168, National Guard Bureau**

Entry 1, History Files, Army National Guard, 1949-63, Box 5

Entry 2, History Files, Air National Guard, 1949-69, Box 6

Entry 3, Central Subject File, 1964-74, [No Boxes]

Entry 5, Formerly Security Classified Subject File, 1964-71, [No Boxes]

Entry 344B, State Decimal File, 1922-45, Box 497

Entry 344K, State Decimal File, 1953, [No Boxes]

Entry 348A, State Guard File, 1941-49, Box 137

**RG 175, Chemical Warfare Service**

Entry 1-A(UD), Chief Chemical Officer, Station and Miscellaneous Files, 1946-54, Boxes 287, 305, 306, 312, 313, 321, 327, 337, 351, 356, 359\*, 360-365, 369, 372-373, 384

Entry 1-B (UD), Chief Chemical Officer, Station and Miscellaneous Files, Boxes 336, 355, 358, 371, 455, 457, 458, 466

Entry 2(A-1), General Correspondence, Subject Series, 1955-60, Boxes 11, 12, 49, 88, 89, 115, 116, 183, 145-147

Entry 3 (A1), General Correspondence, Miscellaneous Series, 1955-59, [No Boxes]

**Entry 3 (PI8), Office of Chief, Special File, 1922-41, Box 3**

Entry 5 (A-1), General Correspondence, Station Series, 1955-59, Boxes 1-3, 12, 13, 18, 19, 35, 49, 50

**RG 177, Chief of Arms**

Entry 7, Subject Index to Series 8 and 9, Box 225

**RG 269, General Services Administration**

Entry 5, Administrator's General Subject File, 1949-68, [No Boxes]

Entry 69, Real Property Case Files, [No Boxes]

**RG 270, War Assets Administration**

Entry 9, Subject File, Central Office of Real Property, 1946-49, Boxes

**RG 291, Federal Property Resources Service**

Entry 1 (UD-WW), Real Property Disposal Case Files, 1963-67, Box 184\*

Entry 5 (A1), Real Property Disposal Case Files, 1949-62, [No Boxes]

Entry 6 (UD-WW), Real Property Disposal Program Files, 1970-71, [No Boxes]

Entry 7 (UD-WW), Real Property Disposal Case Files, 1971-72, [No Boxes]

**RG 319, Army Staff**

Entry 344-B, State Decimal File, 1922-45, Box 497

**RG 334, Interservice Agencies, Armed Forces Explosives Board**

Entry 15, Explosion Reports, 1939-48, Boxes 1, 8\*, 9\*, 13\*

**RG 337, Headquarters Army Ground Forces**

Entry 1, Inspection Reports, 1948-50, [No Boxes]

Entry 1, Inspection Reports, 1951, [No Boxes]

Entry 1, Inspection Reports, 1952, [No Boxes]

Entry 1, Inspection Reports, 1953, [No Boxes]

Entry 1, Inspection Reports, 1954, [No Boxes]

Entry 16, Administrative Division, Decimal Correspondence, 1941-52, Boxes 11, 12, 45, 46

Entry 27, Formerly Classified Decimal File, 1942-48, Box

Entry 27B, Program of Instructions, 1945-50, [No Boxes]

Entry 30, Inspection Reports, 1942-44, [No Boxes]

Entry 30A, Training Reports, 1943, [No Boxes]

Entry 31, Confidential and Secret Correspondence File, 1948-50, [No Boxes]

Entry 32A, Decimal File, 1946, [No Boxes]

Entry 32A, Decimal File, 1947, [No Boxes]

Entry 46, Coast Artillery Branch, Decimal Correspondence, 1942-45, [No Boxes]

**Entry 55, General Correspondence, 1942-48, Boxes 723, 724, 1098, 1121-1123**

Entry 55A, Project Decimal File, 1941-48, [No Boxes]

Entry 55F, Confidential and Secret Decimal Files, 1954, [No Boxes]

Entry 55I, Secret Decimal File, 1949-50, [No Boxes]

Entry 57, Decimal Correspondence, 1940-42, Boxes 49, 107

Entry 57A, Project File, 1940-42, [No Boxes]

Entry 57B, Ground AG Section, Project Decimal File, 1940-42, [No Boxes]

Entry 70, AGF Replacement Depot, [No Boxes]

**Entry 92B, Special Staff Ordnance Section Decimal File, 1944-47, Boxes 19, 20**

Entry 93A, Formerly Classified Decimal File, 1944-47, Boxes 1-6

Entry 96-C, Decimal File, 1948-50, Boxes 12, 13

Entry 102, Army Field Forces Headquarters Decimal File, 1946-48, Boxes 12, 23

**RG 338, US Army Commands**

Entry 21 (UD-UP)

Entry 37042, Unit Records

**RG 389, Provost Marshal General**

Entry 434, Administrative Division, Project Technical Services, 1941-45

**RG 391, U.S. Regular Army Mobile Units**

Entry 2118, Records of Field Artillery Regiments

Entry 2169, Records of US Guard Battalions

**RG 393, United States Army Continental Commands, 1821-1920**

Entry 387-10, General Orders, 1903-1919

Entry 387-13, Circulars and Memoranda, 1910-1916

Entry 387-25, Correspondence, 1906

Entry 387-27, Reports of Umpires for Tactical Exercises, 1906

Entry 424-10, General Correspondence, 1910-1919

**RG 394, United States Army Continental Commands, 1920-1942**

Entries by Corps Area

Entry 24, General Correspondence, 1920-35, Boxes 159-170, 314, 320

Entry 25, General Correspondence, 1920-42, Boxes 10, 12, 22

Entry 26, 2<sup>nd</sup> Corps Area, General Administrative File, 1924-40, Boxes 1-3

Entry 29, Annual Reports of CMTC, 1930-40, Box 7

Entry 40, 2<sup>nd</sup> Corps Area, Chemical Warfare Service, 1930-41, Boxes 1, 2

Entry 201, Adjutant General Administrative Files, 1920-41

Entry 567, General Correspondence

**RG 407, Adjutant General**

Entry 37-A, Project File, 1917-25, Box 1137\*

Entry 37-H, Project Files, 1926-1939, Boxes 2960, 2961\*

Entry 360-A, Formerly Classified Project Decimal Files, 1940-42, Box 1014

Entry 360-A, Formerly Classified Project Decimal Files, 1943-45, Box 3552

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#### **RG 30, Bureau of Public Roads**

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Fortifications Map File

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AMS Quads

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## **Appendix B: Bibliography (Relevant Historical Documents)**

**Note: All documents obtained during the HRR have been scanned and are included electronically on the accompanying CD**

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## **Appendix C: Interview Records**

## Interview Record

Project: Military Munitions Response Program - Site Inspection  
Site: Picatinny Arsenal, New Jersey  
Contract No.: W912DR-05-D-0004  
Delivery Order: 26  
Date: 25 April 2006  
Interview Conducted By: Al Larkins and Lisa Szegedi  
Person(s) Interviewed: William Aspinall, IV, Operations Manager and Joyce Watson,  
Public Relations Director, Tilcon, Mt. Hope Quarry

### General Information

Note that Peter Roland and Ed Pinson, PICA, and Nancy Flaherty, USACE were also present for this meeting.

- The quarry is approximately 700 feet (213 meters) from the fence line of PICA
- The entire Mt. Hope facility is approximately 600-700 acres in size. Part of this is used for the quarry. There are also several asphalt plants and a soil remediation plant at this facility.
- Currently, the quarry operations are moving closer to the installation boundary
- Approximately 80 people work at the quarry
- The quarry began operating in the early 1900's
- Tilcon has owned the quarry since April 2001. Prior to that it was called Mt. Hope Rock Products and was owned by Carl Lizza.

### Mt. Hope Quarry Operations and Site Tour

- During the site visit, the quarry's process for preparing the rock to be detonated, along with the process for crushing the rock, was viewed and includes the following:
  - The tree cover and all loose material are removed and bulldozed
  - To the extent possible, the soil layer is scraped from the rock and placed into wind rows (berms). The berms will ultimately get seeded and remain in place.
  - The soil layer on top of the rock is typically between a few inches to several feet deep. Since it is not possible to remove all of the overburden, a very thin

layer of soil, in addition to deeper pockets of soil, will remain after the top soil layer is scraped.

- The rock is then prepared to be removed by detonation. After detonation, large front end loaders load the rock into the back of dump trucks which take the rock over to the processing area.
  - In the processing area, the rocks go through the following. Note that this does not include the entire process. primary crusher – conveyor – screen – surge pile – conveyor belt and electro magnet – secondary crusher. The purpose of the electro magnet, which is located several inches above the conveyor belt, is to remove metal from the belt. This is typically when the ordnance is being found.
  - This second rock crusher has a screen that allows 6-8 inch size rocks through before being crushed. Rocks larger than 6- 8 inches bypass this rock crusher and are carried away to a different pile of rock, which is sent through the process again.
  - The surge pile could potentially contain material that has been placed there within the last few weeks; however, for the past two incidents Bill believes the material from the surge pile was recent.
- 
- During the site tour, Al Larkins asks Bill Aspinall if a magnet could be installed prior to the first rock crusher; however, Bill indicates that the rock is too large and the magnet would not be able to pull out the metal due to the magnet being too far away from the belt.
  - During the tour, Al Larkins found a 5 inch base plate (no explosives) that he gave to Ed Pinson.
  - Based on visual observation, Al Larkins indicates that the hill of the quarry would likely have caught much of the high velocity, low angle material from the 1926 explosion.

## Interview Record

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Project:	Military Munitions Response Program - Site Inspection
Site:	Picatinny Arsenal, New Jersey
Contract No.:	W912DR-05-D-0004
Delivery Order:	26
Date:	06 April 2006
Interview Conducted By:	Janis Karn and Larry Jordan
Person Interviewed:	John Bostonian, Range Control

### General Information

- Fragmentation Distance (SDZ) – 1 in a million chance a fragment will reach that distance
- Pyrotechnic Test Area – not operational in last 4 or 5 years but would like to use it again in the future. Flares at pyro test area will not throw fragments.
- 600 Area is off-limits.

### Information for MRSs Identified in Inventory Report

#### Lake Denmark

- Lake Denmark former firing point near the Dam may have fired only when lake was frozen in order to recover projectiles

#### Picatinny Lake

- WWII firing range near Battery 4 road near Bldg 3350. The Impact Area is near Site 36 across Picatinny Lake.

### Other MEC Areas Potentially on Base

- 900 yard range and 500 meter range closed in mid 1970s. Heavily wooded area now. Used to fire recoilless rifles into slug butts (probably inert items). The slugbutts are still in the woods. Both firing points fired into same slug butt.
- Rocket Test Stand near Bldg 3622
- Reaction motors site – Bldg. 3617
- Test flares suspended from towers and measure luminosity and burn time. Towers still exist, buildings 641F & 641A.
- Bldg. 617 firing point – Slug Butt may be 611C

### Additional Sources of Information

- Matt Whitehead - in charge of activities at the Burning Ground

## INTERVIEW RECORD

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Project: Military Munitions Response Program - Site  
Inspection  
Site: Picatinny Arsenal, New Jersey  
Contract No.: W912DR-05-D-004  
Delivery Order: 26  
Date: 04 April 2006  
Interview Conducted By: Lisa Szegedi and Larry Jordan  
Person Interviewed: Joseph Clark, Deputy Environmental Manager, Picatinny Arsenal

### **General Information**

- EODs main function at Picatinny is weapons exploitation
- Many UXO items have been found throughout the post
- DPW and Safety responsible for contracting for UXO sweeps during construction
- Ted Gabel is responsible for IRP related actions at Picatinny.
- Picatinny never did chemical warfare testing

### **Information for MRSs Identified in Inventory Report**

#### 1000 Meter Range-

- Safety explosion office (Ed Pinson) can give us the safety zone arcs for the 1000 m range
- The munitions used on the 1000 m range can be found by the historian (Dr. Owens)
- 1000 m range used for recoilless rifles

#### Bear Swamp/Green Pond-

- UXO presence – (hearsay) may be due to surface water runoff through area – May also be disposal from nearby area buildings
- Bear Swamp/Green Pond explosives may not have been dealt with under IRP. May have completed UXO surveys, but not removed items.

#### 1926 Explosion Site-

- At the gym, near the shell burial grounds, Picatinny redid the floor. When they did, they found munitions that are likely from the 1926 explosion under the floor.
- Numerous buildings have UXO underlying or around them

#### Dredge Pile/Landfill-

- Ted Gabel may have UXO records on that area
- Sampling for the IRP is ongoing at this site. As part of the IRP there may be a UXO survey.

Pistol Range-

- An FS may have been completed for this site
- No remediation has occurred there

Lake Denmark and Picatinny Lake-

- Picatinny Lake is completely enclosed by fencing and there is no access from off post. There are also signs indicating hazard areas.
- Lake Denmark is not enclosed by fencing and is accessible from off-site.
- Joe did not know where the impact areas for Picatinny Lake are
- Both lakes had targets that were fired at for target practice. It is possible that live rounds were used.

Shell Burial Areas-

- No UXO work has been completed for these sites since both shell burial areas are considered off-limits
- A few (possibly two) monitoring wells have been installed near the shell burial grounds

DRMO Yard-

- At one time UXO, including small 1" x 1" mines, have been found there

Other MEC Areas Potentially on Base

- Joe Clark found a suspected former range in area M, located between Stickle Road, Greenberg Road, and Bldg. 611B. Bear Swamp Brook flows through this area. The ground is littered with visible rounds and it appears that the area may have been used for projectiles and mines, as well as burning for disposal purposes. He believes this area may fall within the safety arc of an operational range. The area is currently forested.
- There is an open detonation area near building 1222
- The facility is in the process of doing a RCRA closure on the burning grounds, which are still operational. Picatinny has plans to install an incinerator and new burning ground in the 500 area.
- The bulk of the ranges are in the 600 area.
- There used to be a burning ground outside Bldg. 319, near the DRMO Yard. He doesn't know what was burned there, although it may be munitions. He knows it hasn't been used in at least 10 years.

**Additional Sources of Information**

- John Doll, Former Fire Chief, retired. He worked in all of the range areas. Joe does not have any contact information for him.

## INTERVIEW RECORD

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Project: Military Munitions Response Program - Site Inspection  
Site: Picatinny Arsenal, New Jersey  
Contract No.: W912DR-05-D-004  
Delivery Order: 26  
Date: 14 April 2006  
Interview Conducted By: Janis Karn and Lisa Szegedi  
Person Interviewed: Ted Gabel and Frank Misurelli

### General Information

- Background Study of Installation is in the Administrative Record
- ARARs for installation are NJ Groundwater Criteria, NJ Ecological Criteria and NJ Non-Residential Soil Standards. For parameters without NJDEP criteria, PICA has developed site-specific criteria. Ted will provide us the list.
- MC is covered under the IRP for all Sites, but not MEC.
- MC was addressed at Site 20/24, but not UXOs. If discrete cases of UXOs were found they were removed (i.e., if UXO was collocated with the chemical contamination, a UXO clearance was performed prior to removing the chemical contamination).
- The eastern property boundary is Rockaway Township and the western boundary is Berkshire Valley Road in Jefferson Township
- Property near the Route 15 entrance and baseball fields may be transferred and developed into a corporate research center. Archaeological grid sampling in the area is almost complete.

### Information for MRSs Identified in Inventory Report

#### 1926 Explosion Site-

- An 8-inch naval shell, circa 1926, was found on a conveyor belt at Tilcon the previous weekend. It is unknown if the shell was live. This is the 3<sup>rd</sup> or 4<sup>th</sup> time in recent years that ordnance has been found at Tilcon. Frank will make first contact with Tilcon to set up a meeting.

#### Lake Denmark and Picatinny Lake-

- Lake Denmark Report contains explosives data

#### DRMO Yard-

- Former DRMO Yard is an IRP site, so we need to check the most recent plan to see if MEC will be addressed.

#### Other MEC Areas Potentially on Base

- Site 180 near Lower Burning Grounds - might be ineligible under MMRP

Additional Sources of Information

- Clifford Day of U.S. Fish and Wildlife Service - Ted will provide contact information
- Kelly Nolte for archaeological reports
- Kevin Leondi and Dave Baneshetski of Enterprise Management
- Morris County's Sherriff's Office
- Rockaway Township Steve Robbison and Lou Coreal (they are on the RAB)  
Joy Pasquarelli of Shaw for explosives and other MCs from their database - Phases I,II,  
and III

## INTERVIEW RECORD

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Project:	Military Munitions Response Program - Site Inspection
Site:	Picatinny Arsenal, New Jersey
Contract No.:	W912DR-05-D-004
Delivery Order:	26
Date:	31 May 2006 and June 6, 2006
Interview Conducted By:	Scott Compston and Lisa Szegedi
Person Interviewed:	Ted Gabel, Army IMA-NERO Garrison, Picatinny Arsenal

### **General Information**

Ted Gabel, US Army IMA-NERO Garrison, Picatinny Arsenal was contacted for information regarding PICA utility providers, PICA security, and zoning on and around PICA. Mr. Gabel provided the following information:

### **Utilities**

- Water is provided to PICA by three wells (131, 302D, 410). A majority of the groundwater used is pumped from wells 131 and 302D.
- All water is pumped through the same treatment plant operated by US Filter prior to distribution across PICA.
- The AWDF area of PICA is supplied with water by its own service well. Water use in this area is minimal.
- Electricity is supplied to PICA by Sussex Rural by overhead lines owned by Sussex Rural.
- Sanitary sewer lines are owned by the US Government but are operated and maintained by US Filter, a private contractor. Sanitary sewer lines at PICA are connected to the Rockaway Sewer Authority sanitary sewer system.
- New Jersey Natural Gas provides fuel for boilers for each building or group of buildings at the arsenal.
- Communications service is provided by AT&T.

### **Security**

- Fencing is present around the entire perimeter of PICA with the exception of a portion of the 3500 area. Two gates are available for public entry, the main (front) gate and the Mount Hope gate.
- PICA security force includes both military and civilian personnel. Private contractors conduct security at both public entry gates. Military police are responsible for security within the arsenal.
- Restricted access areas on the interior of PICA are secured by military police.
- Video surveillance is conducted only at the two public entry gates.

**Zoning**

- Mr. Gable did not possess information regarding zoning on or around PICA.

**Personnel**

- There are 3,939 workers at PICA; this includes 73 military personnel, 2,950 DoD civilians, and 916 contractors
- There are 753 family members living on the installation; Note that this number includes the 73 military personnel who are working at the installation

## INTERVIEW RECORD

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Project: Military Munitions Response Program - Site Inspection  
Site: Picatinny Arsenal, New Jersey  
Contract No.: W912DR-05-D-004  
Delivery Order: 26  
Date: 04 April 2006 and August 2006  
Interview Conducted By: Janis Karn, Larry Jordan, and Lisa Szegedi  
Person Interviewed: Dr. Patrick Owens, Historian, Picatinny Arsenal

This interview record was modified based on information included in the HRR comments from Dr. Owens, as well as from several e-mails from Dr. Owens.

### General Information

- Picatinny was a powder depot until 1907
- There were a number of explosions but the biggest one was in 1926
- Research and development began at Picatinny in the 1920's; therefore, there was no test firing prior to that date.
- The current test ranges are primarily on the west side of the installation
- There was a major flood at Picatinny in 1936. This flood affected the Bear Swamp area.
- No chemical/poison gas/tear gas was ever used at Picatinny. Picatinny was not involved with chemical warfare – Edgewood in MD was responsible for that. Picatinny only made the shells to hold the chemical – they never had the chemical on site.
- The Village of Mt. Hope is located approximately 100 yards outside Picatinny's east gate
- The Navy owned a portion of property on PTA from the late 1800s to 1960. The following describes the use of the site during that time period:
  - 1890 -1945 - the site was used mainly as a storage depot
  - 1946 – 1960 – the Navy operated a Navy Air Rocket Test Station
  - 1960 – 1972 – the rocket test sites were still operating, but they were now under Army, not Navy control.
- Naval Hill was finally transferred back to the Army in 1960.
- Most of the work conducted at Picatinny during the 1960s was probably on a pilot line basis. The *Functions and Facilities of Picatinny Arsenal* from February 1956 lists an experimental high explosives area able to produce PBX, HMX, PETN, Teteryl, Comp B, and TNT. I believe these were still around well into the Vietnam Era. A facilities directory for the 1960s lists a DNT building and shows Picatinny was still making single base as well as double base propellants. It is likely they also conducted some work with C-4 since Ottoson invented it here.

## **Information for MRSs Identified in Inventory Report**

### Bear Swamp/Green Pond-

- Dr. Owens believes that the MEC in Bear Swamp/Green Pond may be associated with the old burning ground, especially since this area flooded during the big flood of 1936.

### 1926 Explosion Site-

- 12" – 16" navy rounds were involved in the 1926 explosion along with approximately 2.5 million lbs of TNT
- There have been finds associated with the 1926 explosion up to the 1960's. He will send us an article on the 1960 UXO find.
- During the 1926 explosion, the explosion could be felt as far away as Hibernia and Rockaway

### Picatunny Lake-

- During WWII Picatunny was scavaging the hill behind Picatunny Lake to salvage metal from rounds fired into the hill. The material was sent down chutes from the top of the hill to trucks at the bottom. He referenced a 1942 newspaper article of WWII salvage of old shells from mine shafts near Lake Picatunny.

### Lake Denmark-

- Lake Denmark and the area around the Lake was acquired by Picatunny around WWII

### Other MEC Areas Potentially on Base

- In 1951 there was an explosion inside a building. The explosion occurred when powder was being moved from one hopper to another.
- There was another burning ground prior to the current ones. The original burning ground was near the current DRMO Yard, by Bldgs. 314 and 316, behind Bldg. 151, the tennis courts and a swampy area. They burned material that is similar to what they burn on the current burning ground. It was probably moved to the current burning ground, located near the West Ridge Line, around WWII. DPW may be able to give MPI the dimensions of the former burning grounds.
- Naval Hill was a storage area until 1941 when it became a rocket test area.

### Additional Sources of Information

- DPW and Plant Engineering should have large maps of the installation. They are located in Bldg. 3002.
- Victor Lindner worked here for 60 years. Dr. Owens does not have his contact information; however, he believes the public affairs office may have it.

### Reports and Other Information Obtained

- The History of Picatunny Arsenal, March 1931
- Various historic newspaper articles (these were mailed to MPI after the interview)

- Various historic maps were reviewed; none appeared to contain information useful to the HRR
- Plant Design Report- study of building locations, test range locations, up until 1941

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**INTERVIEW RECORD**

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Project: Military Munitions Response Program - Site  
Inspection  
Site: Picatinny Arsenal, New Jersey  
Contract No.: W912DR-05-D-004  
Delivery Order: 26  
Date: 30 May 2006  
Interview Conducted By: Lisa Szegedi  
Person Interviewed: SSG Timothy Owens, EOD

I contacted SSG Owens to obtain some additional information regarding two EOD incidence reports (PICA00175) for the Tilcon Quarry. SSG Owens gave me the following additional information regarding these reports:

- 1) The shells that were found were naval shells
- 2) The shells were found on the magnet – they had not gone through the stone crusher
- 3) Both shells contained explosives

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## INTERVIEW RECORD

Project: Military Munitions Response Program - Site  
Inspection  
Site: Picatinny Arsenal, New Jersey  
Contract No.: W912DR-05-D-004  
Delivery Order: 26  
Date: 30 August 2006  
Interview Conducted By: Janis Karn and Hope Nemikas  
Person Interviewed: SSG Timothy Owens, EOD

SFC Owens was contacted to obtain additional information regarding the August 28, 2006 EOD incident report (PICA00229) of the 81-mm HE mortar found on Berkshire Trail. SFC Owens gave us the following additional information regarding the incident:

- 1) The item was found by the Picatinny Police during a routine patrol of the easement property between the fence line and the installation boundary.
- 2) The police escorted him to the location which was approximately 800 meters (0.5 miles) outside of the Berkshire Hill Road Gate.
- 3) The item was lying on the surface about 50 meters off the road.
- 4) The item was manufactured in 1975 and was missing the tail and fuze; the body contained explosives and was detonated in place.
- 5) In his opinion the item looked like "kick out" from detonation of the item.
- 6) The terrain in the general vicinity was rocky and steeply sloped; a cliff was only 150 feet (46 meters) away.
- 7) SFC Owens has been at Picatinny Arsenal for 1.5 years.

## **INTERVIEW RECORD**

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Project: Military Munitions Response Program - Site  
Inspection  
Site: Picatinny Arsenal, New Jersey  
Contract No.: W912DR-05-D-004  
Delivery Order: 26  
Date: 14 April 2006  
Interview Conducted By: Janis Karn  
Person Interviewed: Ed Pinson, Explosives Safety Specialist, Safety Office

### **General Information**

- Working at Picatinny for 6 years. Previously spent 21 years as an Army EOD specialist.
- DPW subcontracts all MEC removal actions at construction sites.
- EOD Incident Log Book may contain information older than 4 years
- Any water body is typical disposal site at installations in his experience

### **Information for MRSs Identified in Inventory Report**

#### **1926 Explosion Site-**

- Recommends changing radius of 1926 explosion to 1 mile (1,609 meters). As stated in the 1931 report, *History of Picatinny Arsenal*. Pages 72 through 74 of this report gives information on items stored at the time of the explosion.

#### **Pistol Range-**

- Probably only lead contamination

#### **DRMO Yard-**

- Deleted Uranium material found here.

### **Other MEC Areas Potentially on Base**

- Aquatic Center and New Housing Complex - UXO sweep only to 2 feet and anomalies detected but never investigated
- Rocket Test Area at end of "E" Area Road (near Bldgs. 3617 and others)
- Brass casings found in stream bed near or on Tilcon property. Ed was dispatched for investigation of incident.

### **Additional Sources of Information**

- DPW for Explosive Safety Submittals and UXO Clearance After Action Reports
- EOD for Incident Reports and/or Incident Log Book

## **INTERVIEW RECORD**

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Project: Military Munitions Response Program - Site  
Inspection  
Site: Picatinny Arsenal, New Jersey  
Contract No.: W912DR-05-D-004  
Delivery Order: 26  
Date: 05 April 2006  
Interview Conducted By: Janis Karn, Larry Jordan, and Lisa Szegedi  
Person Interviewed: Doug Schicho, Shaw Environmental and Paul Reibel,  
Environmental, Picatinny Arsenal

A windshield survey of portions of the installation was conducted by Doug Schicho and Paul Reibel. During the windshield survey, both people were also interviewed. Note that due to security reasons, photographs were not allowed during this survey.

### **General Information**

- Doug indicated that one of the GIS layers from mapping developed by Shaw shows the locations of UXO that were found during Shaw's investigations at the installation. The GIS layers were previously given to MPI.
- Post Farm Landfill is a fly ash landfill. It was reported that when Weston installed trenches in the landfill no MEC was found.
- The Navy formerly owned a portion of property at Picatinny Arsenal. This property, which is currently known as Navy Hill, was transferred to the Army in 1962.
- Picatinny was an active production facility through the Vietnam War. After the Vietnam War Picatinny switched to R&D only.
- Site 12 on the installation is currently inactive
- Site 20/24 is still an operational range
- Site 180 is an inactive area that borders the currently operational burning ground
- Burnt Meadow Brook flows from Lake Denmark to Green Pond Brook.
- The data contained in Shaw's Oracle database is not contained in ERIS. Chemical analytical data collected by Shaw prior to (and during) the Phase II Remedial Investigation was uploaded to IRDMIS.

### **Information for MRSs Identified in Inventory Report**

#### **Bear Swamp/Green Pond-**

- Shaw Environmental has conducted the following two interim remedial actions for Bear Swamp Brook:
  - A sediment basin rehabilitation, conducted near the indoor firing range. The sediment basins were built in the 1940's and are used to capture industrial sediments. Shaw dug out the sediments and rehabilitated the basins.
  - A PCB removal in between Bldgs. 60 and 64. This work was conducted in 1999 or 2000. During the PCB removal, Shaw dredged from 4 to 6 feet in the brook. They did not find any UXO, nor did they need UXO clearance from safety to conduct the work.

- Neither Doug nor Paul has any knowledge of Bear Swamp being dredged in conjunction with the Dredge Pile site.
- During the windshield survey Bear Swamp Brook and Bear Swamp were visited and the following observations were made:
  - There are numerous buildings, mostly in disrepair, around Bear Swamp. Doug reported that these buildings are former production facilities (including Bldgs. 205, 216, and 221) that were used for high explosives testing. Some of the buildings were also explosive loading areas (specifically Bldg. 64).
  - Doug reported that it is likely that explosive contaminated water from the production process were discharged into the swamp.
  - Shaw conducted a wetlands delineation of Bear Swamp in the area of Building 232 as part of the Mill Con project. During the delineation no evidence of dredging was found.
  - During MPI's observation of Bear Swamp it did not appear physically possible that the swamp has been dredged. This is based on the size of the trees, the characteristics of the other vegetation, and the general topography of the swamp.

#### Dredge Pile/Landfill-

- It is believed that this dredge pile was formed when Green Pond Brook was dredged in the early 1980's. The section of the brook that runs through the former DRMO Yard was dredged.
- The dredge pile is located in Site 25/26, near the baseball field.
- Currently, the dredge pile is wooded and overgrown.

#### Lake Denmark and Picatinny Lake-

- There was an explosion in the grenade loading area near Bldg 800 along the shore of Picatinny Lake. Shaw encountered UXO during test pitting beneath a parking lot in this area.
- Softball field on east side of Lake Denmark was a former firing point for 20-mm cannons. The impact area was located across the lake on top of the mountain in the 600 area.

#### Shell Burial Areas-

- The shell burial areas are located near the gymnasium (Bldg. 3150)
- The shell burial areas were filled in with the waste from the 1926 explosion. The Navy continued to use the shell burial areas for UXO disposal until around WWII.
- Currently, the shell burial areas are fenced in and posted with warning signs. They are heavily wooded but do not have a lot of under growth.
- Doug reported that Shaw has found UXO outside of the burial grounds. They also attempted to install a monitoring well in the burial grounds; however, they could not locate a UXO cleared area.

### DRMO Yard-

- The former DRMO Yard was toured during the windshield survey. This site is located behind Bldg. 319.
- There was a former burning ground near/adjacent to the DRMO Yard that appears on a historic map from the 1920's.
- In the 1990's, a sewer line through the former burning ground and DRMO Yard was replaced. During this work, charred material was found in the excavation.
- UXO has been found outside the DRMO Yard.

### Other MEC Areas Potentially on Base

- A pyro demo area (RI Site 19, Pyrotechnic Demonstration Area) is located just inside the operational range limits of the installation. This area is currently an open field located over an area of historic fill. The area was used for flares, which were shot off from an observation tower. It was reported that this site has not been used for several years; however, the date this area was taken out of service is unknown.
- Near the pyro demo area is a trap and skeet range. This area is also currently inactive and has not been used for several years. The date this area was taken out of service is unknown. The clay pigeons used at the skeet range were held together with coal tar so PAH's are associated with this site.
- There is a waste pile near the pyro demo area, near the current burning grounds fence. During test pit installation in the waste pile, Shaw found several live grenades in the trenches. EOD was called in and they detonated the grenades in place.
- The pyro demo area, trap and skeet range, and waste pile are all located near the current burning grounds, and are likely within the safety arc of the burning grounds.
- Near the shell burial areas is a pond referred to as the EOD pond. Doug indicated that this pond was not cleared after the 1926 explosion and it is possible that debris from the 1926 explosion was disposed in the pond.
- Doug reported that Shaw found UXO at the following 3 locations when installing test pits at the installation. Doug indicated that he did not believe any of the ordnance found was live.
  - Site 1 (G1 Area)
  - Bldg. 561
  - The parking lot behind Bldg. 823

## INTERVIEW RECORD

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Project: Military Munitions Response Program - Site  
Inspection  
Site: Picatinny Arsenal, New Jersey  
Contract No.: W912DR-05-D-004  
Delivery Order: 26  
Date: May 17, 2006  
Interview Conducted By: Janis Karn, Larry Jordan, and Lisa Szegedi  
Person Interviewed: Doug Schicho, Shaw Environmental and Ted Gabel,  
Environmental, Picatinny Arsenal

### General Information

- Ted would like one of the focuses of the HRR to be to rename the MRSs so that names are reflective of why they're MRSs and are not necessarily repeated with the IRP. All ranges should be labeled as former. The sites should also be identified by the RI Concept #.
- In the IRP many sites have been closed and folded into others for cleanup purposes.
- Shaw gave us all metals, explosives, volatiles, and perchlorate data.
- Boundaries for IRP sites are not the same as operational range boundaries. The IRP site boundaries were originally put forth in 88 or 89. The op areas were defined by AEC.

### General Questions

**Question 1)** The IAP references various parameter groups as being analyzed – what analytes are associated with each group? For example, does metals reference TAL metals, RCRA metals, or a different set of analytes?

**Answer 1)** All data groups reflect the analytes required at the time or run by the individual contractors. Prior to the Ph 1 SI (92 or 93) BNAs were run, after that SVOCs.

**Question 2)** In Shaw's data, is there any way to tell what PICA the data are associated with?

**Answer 2)** The data cannot be sorted in oracle but can be done in GIS. Shaw provided a list of RI Concept Plan Site#s and their associated PICA#s, so we can sort our database by PICA numbers.

The Oracle database we received as part of the Administrative Record, as provided by AEC, was updated in Fall '05. All data collected to that point is included. Joy Pasquarelli provided us a subset of the Oracle database two weeks ago which is more up to date. An additional upload will be completed in the next few weeks and Joy will e-mail us this data (collected first quarter 2006). When utilizing the Admin Record from AEC we should reference it as such.

## **Information for Identified and Potential MRSs**

### Former Munitions and Propellant Test Area near Bldg. 1242A (formerly known as the 1000-meter range and the 1000-meter impact range)-

- Range construction date - IAP indicates range was constructed in 1964 and CTT indicates range was constructed around WWII.
  - Discussion Points: What is the naming convention Ted would like to use? Site should be named: Former Munitions and Propellant Test Area (Near Building 1242a).
  - Site is not present on 51 aerials, is present on 74 aerials.
- Second impact area - IAP only references one impact area
  - Discussion Points: No one knows for sure if the second impact area was utilized but everyone assumes it was. Building 1240 was a safe house at firing point; it is still standing. Building 1242a was the slug butt. The second impact area could not be verified, there was no slug butt found within the second impact area.

### 1926 Explosion Site

- Area of Site – a) Currently, the site includes the explosion center and a  $\frac{3}{4}$  mile (1,207 meters) radius around it (excluding areas that fall within the operational range). According to interviews and a historic document regarding the explosion, it is likely that the radius needs to be expanded to 1 mile (1,609 meters); b) a portion of the site is under an EUL to a housing agent.

MP asked for an updated map (with higher quality data) with the EUL site. We will try to try and obtain this map from Parsons.

Green Pond Site/Bear Swamp –There is no evidence that the dredge pile contains material from Bear Swamp Brook; therefore it will not be included as a munitions response site. The name of the site will be changed to Green Pond site.

The ROD for this site was signed in FY '05

### Dredge Pile/Landfill

UXO may have been identified in the landfill area when excavating a utility line in the southwest corner of the landfill. The RI Concept plan indicates that MEC may have been disposed of in the landfill, but this has not been independently confirmed.

### Former DRMO Yard/Burning Ground

Shaw was asked why the IRP site boundary does not appear to include the burning ground. They indicated the IRP site border has been carried through from the RI Concept Plan. It appears these two sites are adjacent and do not overlap; however, they should be combined for the HRR. Shaw has collected samples from both areas and has submitted a draft proposed plan which involves capping the site. It is expected to be finalized within the calendar year. A ROD is probably a few years off.

In the IAP, no sampling of surface water/sediment is indicated for PICA-072. Shaw indicated that surface water/sediment samples were collected in conjunction with PICA-193.

Shaw indicated that a geophysical survey was never done at this site. The draft Proposed Plan was submitted to the Army in February 2006. Most of data included in FS was collected under the Green Pond site. A Weston Report may include explosives data.

#### Former Pistol Range

Shaw was asked if metals and explosives were analyzed for in the soil and groundwater at the site. They indicated that while their investigation focused on lead, explosives were analyzed for some soil and groundwater samples. None were detected above Levels of Concern.

#### Lake Denmark

Shaw indicated the acreage of the site in the MMRP (327 acres) comes from ARID and includes the lake and the range. The actual surface area of the lake is only 263 acres. The acreage of the site in the IRP (174 acres) comes from the RI Concept Plan. Shaw's IRP site actually covers 420 acres.

Shaw may have a historic map that shows the 20mm cannon firing point near the ball field located on the south side of Lake Denmark. The map number is Engineering DP-48922 dated March 1947. Shaw collected samples at the firing point. We can locate the FP by looking for those samples near the ball field. Report is the PA for non-evaluated Ph 3 RI Concept Plan sites. Draft Oct 1996.

#### Picatinny Lake Site

Shaw indicated that ferrous objects were identified in the lake during a geophysical survey – the report is by Blackhawk. Shaw encountered propellant in the lake while collecting samples. Shaw indicated that during flare testing on Flare Island, PICA personnel would fire from the island, straight into the air.

#### IRP – Inactive Rocket Fuel Test Area (Site 2)

Shaw was asked if any ferrous objects were found during the geophysical survey and if any potential UXO was found during the installation of test pits at this site. Shaw did not recall any. This area is currently used for training for the Homeland Security Agency. They are possibly using blanks. Contact Floyd Ribe or Jamie Ruffin for more information. Rockets were tested outdoors. Most of the buildings to the north were utilized as rocket stands with the exhaust pointed to the north. They fired west into undeveloped land. NARTS report details use of the site.

#### Former Motors/Rocket Fuel Test Area (3600) (Site 4)-

Shaw was asked if there are any site features present which are indicative of the former range activities (i.e. the rectangular pit, the trough, or materials associated with the firing point)? They indicated that the rocket test stand is still present and a circular depression still exists (was gunnite lined). A ballistic rail gun (BRG) is still being used in this area, although it is

scheduled to be moved to the hill shortly. Samples collected from this site were analyzed for a full suite of parameters plus perchlorate.

Former Reaction Motors/Rocket Fuel Test Area 1500

According to the IAP, the Eastern and Western Explosives Areas are currently used for storage, assembly, research, development, and testing of high explosives, propellants, and projectiles. MPI asked why this area is not included in the operational range footprint of PICA. MPI also asked if any operational ranges are associated with the SDZs shown for this area, and if so, do the SDZs relate to current activities. Shaw and Ted indicated that the former rocket test stands were converted to open detonation areas that are still in use. The area is still operational. Mission related detonations occur inside of bays which are closed on three sides (open to the south). There are no engineering controls in place to limit the dispersion of MEC.

Inactive Munitions Waste Pit (B-656) (Site 12)

The footprint for this site was originally provided in the RI Concept Plan; page 15-26 shows the layout. The site has been covered with rock from the excavation of a foundation for the Advanced Warhead Development Area. The site contains a gun turret that was not utilized for testing; it was a safe house. Building 656 was used as a guard house. The site was originally operational and so was not investigated any further. Shaw completed a records review before rock was placed. PICA-058 has groundwater work (TCE). Site may be buried up to 12 feet. It was removed from Shaw's scope by John Bostonian because he needed the site, but it has not been utilized in over 5 or 8 years. No PA or SI was completed for this site. At this site, Shaw has only tested for TCE in groundwater. UXO, explosives, and metals were listed as COCs because of historical testing activities - no soil sampling was done.

Munitions and Propellants Test Area (B-1222) (Site 8)

MPI asked what portion of this site is considered operational. MPI was informed that the entire site is considered operational; therefore, no IRP work has been completed. This is a RCRA site.

Munitions and Propellants Test Area (B670, B673, B674)

This entire site is operational.

Munitions Test Ranges (Bldgs. 647, 649, 650) Site 11

This site is still operational.

Munitions/Pyrotechnic Test Area (B640) (Site 13)

MPI asked why there is no safety arc associated with the operational range area. It was indicated that there should be one.

Baseball Fields (Site 163) and Little League Baseball Field (Site 176)

A geophysical survey has been conducted at the ballfields and anomalies were identified. Ted Gable indicated that a contractor either drilled or excavated at the anomalous locations to

look for UXO and none were encountered. Ted did indicate that Native American artifacts were found at the baseball fields.

Reservoir Near Bldg. 3159 Site 103

Sediment samples have been collected from throughout the pond, with the samples biased toward geophysical anomalies. The samples were collected with a hand auger and were analyzed for explosives, metals, VOCs, pesticides, and cyanide. Shaw completed the geophysical survey for the water portion of the pond using magnetometer. The report stated that ferrous anomalies may be UXO.

This reservoir was built in the 1950's when a berm was built around one side of the pond.

Ordnance/Explosive Bldgs. 800 Area and Ammunition Demo 1 Ordnance Facility (Bldgs. 800/807)

Shaw completed a test pit at site 93 and found fuzes.

Propellant Plant (Bldg. 561) Site 113

The recommended remediation for this site is likely to include LUC.

Metals are the main COCs associated with this site.

UXOs (fins) were identified in one of the excavations (test pit TP-5) next to Bldg 565. Test Pit Logs and Photos can be found in Phase II RI Report, Round 1, Volume I, Appendix F dated 1998. A geophysical survey indicated that there was an anomaly present. Excavation for site was conducted for RI Site 178. Existing engineering controls are the remediation approach for 178.

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## INTERVIEW RECORDS

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Project: Military Munitions Response Program - Site  
Inspection  
Site: Picatinny Arsenal, New Jersey  
Contract No.: W912DR-05-D-004  
Delivery Order: 26  
Date: 04 April 2006  
Interview Conducted By: Larry Jordan and Lisa Szegedi  
Person Interviewed: John VandeVenter, Natural Resources, Picatinny  
Arsenal

### Information for MRSs Identified in Inventory Report

Note that during this interview, Mr. VandeVenter referred to a 1994 Sportman Map, which should be available through Public Works and BIMS. He also supplied MPI with a copy of this map.

### Dredge Pile/Landfill-

- Mr. VandeVenter indicated that Green Pond, south of Picatinny Lake has been dredged. To his knowledge, Bear Swamp has never been dredged.

### Pistol Range-

- Mr. VandeVenter was shown the Inventory Report map and he confirmed the presence of the small pistol range. He did not have any additional information.

### Picatinny Lake-

- Impact area on Picatinny Lake is between building 806 and 816
- Firing point for Picatinny Lake was located SE of Belt Rd. near magazines (Bldgs. 3042, 3045, and 3046). Wooden posts forming an X mark the firing point.
  - Mr. VandeVenter was told this by Henry Van Dyke Jr., who is retired. However, his son, Henry Van Dyke III may still work at Picatinny.
- Firing point (Picatinny Lake) is near former Pistol Range
- Fish consumption advisories exist for Picatinny Lake. Boating in the lake is allowed; however, swimming in the lake is banned.

### Lake Denmark-

- The impact area for Lake Denmark was into the lake; however, sometimes material landed to the east of the lake. He reported that some rounds would have landed outside of the Picatinny Border
- While hiking out to the boardwalk leading through Denmark Swamp, Mr. VandeVenter observed signs indicating that UXO may exist near marsh at east end of Lake Denmark
- Fish consumption advisories exist for Lake Denmark. Boating in the lake is allowed; however, swimming in the lake is banned.

### Other MEC Areas Potentially on Base

- There is a Rocket Test Area below Lake Denmark, called the G2 area, which is identified in the 1989 Dames & Moore Report as Area 1. During a geophysical survey for construction (done in conjunction with the G2 gun project) potential UXO (grenades) was found and removed. This occurred sometime between 2002 and 2003. Dr. Ribey, Dept. of Homeland Defense Training Facility, should have a copy of the geophysical survey report. TetraTech wrote EA's for project.
- In spring 2005, runoff from the quarry adjacent to Picatinny (Tilcon Quarry), resulted in silting of one of the brooks/wetlands on post. During cleanup of this material, numerous empty casings were found at the NW corner of the foundation of Building 3213. This area is located down the road from Shell Burial Area #2.
- The dog pen (or dog pond, Mr. VandeVenter wasn't sure of the name) may have low level radiological waste. It may also have been used for aiming practice, not actual firing. Line of Site Road was used for the aiming.
- The Pyro Pond, located in the Pyrotechnic Area, within the operational range footprint of the installation, may contain MEC

### Additional Sources of Information

- AFSCME – American Federation of State, County, and Municipal Employees. They have a website ([www.afscme.org](http://www.afscme.org)) where MPI may be able to locate retired Picatinny personnel.
- NARFE - National Associated of Retired Federal Employees. They have a website ([www.narfe.org](http://www.narfe.org)) where MPI may be able to locate retired Picatinny personnel.
- The following personnel (includes retirees, personnel who no longer work at Picatinny, and current employees):
  - **John Milio**, John's former supervisor. He currently works for USFWS in Jacksonville, Florida. His contact information is 904-232-2580 ext. 112 / [John-Milio@FWS.gov](mailto:John-Milio@FWS.gov)
  - **Goldie** (Mr. VandeVenter only knows his nickname – he does not know his full name or any contact information). It is likely that John Milio will have Goldie's full name.
  - **Bob Pava** – retired from Roads and Grounds; no contact information available. Bradley Garie may know how to contact him.
  - **Pat Trainor** – retired from Safety; no contact information available. Michael Clure may know how to contact him.
  - **John Kirkpatrick** – retired from Safety; no contact information available. John Silecky or Michael Clure may know how to contact him.
  - **Michael Clure** – retired from Safety, currently works at Picatinny for a contractor (STG). He can be reached at Bldg. 151, phone 973-724-5910.
  - **Mark Eldridge** – former head of Environmental and Safety. He currently works on post for a contractor (Camber). He can be reached at Bldg. 171, phone 973-724-6095.
  - **Fred Haber** – retired from Environmental. He currently works on post for a contractor. He can be reached at Bldg. 1, phone 4-7414.

- **Ron Wally** – current employee – 973-724-3413, Bldg. 617. He is the head of test range operations.
- **Bradley Garie** – current employee – 973-724-3494
- **Dr. Ribey** – current employee

## **INTERVIEW RECORD**

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Project:	Military Munitions Response Program - Site Inspection
Site:	Picatinny Arsenal, New Jersey
Contract No.:	W912DR-05-D-004
Delivery Order:	26
Date:	04 April 2006
Interview Conducted By:	Janis Karn, Larry Jordan, and Lisa Szegedi
Person Interviewed:	Dr. Woo and Alan Richwald, EOD, Picatinny Arsenal

### **Information for MRSs Identified in Inventory Report**

#### **1926 Explosion Site**

- UXO has been found in an off-site quarry adjacent to Picatinny Arsenal. This material is likely from the 1926 explosion. It was indicated that this quarry is located approximately 1.5 miles (2,414 meters) from the installation.
- Picric acid was one of the main fillers in the naval shells from the 1926 explosion
- EOD believes the naval shells were 12 to 14 inches
- Other munitions stored in 1926 were depth charges and projectiles weighing up to 700 pounds

#### **Shell Burial Areas**

- Outside the installation's gymnasium, Mr. Richwald indicated that Picatinny may have buried munitions that were residuals from the 1926 explosion. Mr. Richwald indicated that this area is fenced in. (Note: Although Mr. Richwald did not know the name of this area, these are the Shell Burial Areas identified in the Inventory Report)

#### **Lake Picatinny**

- There is a direct fire berm area into the hill next to the lake
- Reference was made to Flare Island as a former test area
- Former production loading lines around lake may have a potential for UXOs

### **Other MEC Areas Potentially on Base**

- Mr. Richwald confirmed the location of rocket test area shown on the Dames & Moore 1989 Report (Site 1 in this report). Mr. Richwald was shown the map from this report for his confirmation. He also stated that this area was used for early rocket testing of polaris missiles.
- Reference to a ballfield that was built on an old landfill

### **Additional Sources of Information**

- Dr. Woo suggested that MPI ask Ted Gabel to send an email to managers at the installation asking if they have any information to contribute to the HRR. (Note: On 4/20/06 an email requesting this information was sent)
- Sgt. Soto has copies of the EOD incidence reports. The reports are kept for 3-4 years and then discarded.

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## INTERVIEW RECORD

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Project: Military Munitions Response Program - Site  
Inspection  
Site: Picatinny Arsenal, New Jersey  
Contract No.: W912DR-05-D-004  
Delivery Order: 26  
Date: 03 May 2006  
Interview Conducted By: Lisa Szegedi  
Person Interviewed: Bruce Zimmerman, Army Residential Communities  
Initiative

### **Background**

I contacted Mr. Zimmerman via telephone to discuss the following report that Ted Gable sent me:

- *Final Finding of Suitability to Transfer for the Army Residential Communities Initiative Properties at Picatinny Arsenal, New Jersey*, prepared for Commander, Picatinny Arsenal, New Jersey, by U.S. Army Corps of Engineers, Mobile District, with Technical Assistance from Tetra Tech, Inc., February 2005.
- The purpose of this report was to document the environmental suitability of transferring a portion of PICA consisting of installation housing.

### **Information obtained from Bruce Zimmerman**

- An Enhanced Use Lease (EUL) went through on 01 May 2006 for housing on Farley Avenue and Navy Hill.
- The lease, which is a 50-year lease, is with GMH Military Housing LLC, located in Philadelphia, PA.
- Under the EUL, GMH received 113 houses. It is anticipated that only 71 houses will be needed so GMH has plans to demolish some houses as well as replace some houses. This work is planned for sometime within the next five years.
- The contact for GMH is Neil Epstein, Community Manager. His number is 973-328-2992. We need to contact him if we need access to either of these properties for sampling. If we need to access these properties we should also let Bruce Zimmerman know.
- The map in the February 2005 report referenced above, which shows the footprint of the areas transferred, should be considered accurate.
- Currently, Mr. Zimmerman does not know of any other areas on the installation where an EUL is planned.

## **Appendix D: EOD Incident Reports**

## **Appendix E: Munitions Technical Data Sheets**