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## LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AA | Area of Attainment |
| amsl | Above Mean Sea Level |
| ARARs | Applicable or Relevant and Appropriate Requirement |
| Army | U.S. Department of the Army |
| bgs | Below Ground Surface |
| CEA | Classification Exception Area |
| CERCLA | Comprehensive Environmental Response, Compensation and Liability Act of 1980 |
| CERCLIS | Comprehensive Environmental Response, Compensation and Liability Identification System |
| COC | Contaminant of Concern |
| COPC | Contaminant of Potential Concern |
| COPEC | Contaminant of Potential Ecological Concern |
| DGI | Data Gap Investigation |
| DNT | Dinitrotoluene |
| EEQ | Ecological Effects Quotient |
| ELCR | Excess Lifetime Cancer Risk |
| ERA | Ecological Risk Assessment |
| ER-L | Effects Range-Low |
| ESTCP | Environmental Security Technology Certification Program |
| FS | Feasibility Study |
| gpm | Gallons per Minute |
| HAL | Health Advisory Level |
| HHRA | Human Health Risk Assessment |
| HI | Hazard Index |
| HQ | Hazard Quotient |
| IC | Institutional Control |
| IGW | Impact to Groundwater Criteria |
| ISQG | Interim Sediment Quality Guidelines |
| IT | International Technology |
| LOC | Level of Concern |
| LUC | Land Use Controls |
| MCL | Maximum Contaminant Level |
| MCLG | Maximum Contaminant Level Goal |
| mg/kg | Milligrams per Kilogram |
| MMRP | Military Munitions Response Program |
| MNA | Monitored Natural Attenuation |
| NCP | National Oil and Hazardous Substances Pollution Contingency Plan |
| NJDEP | New Jersey Department of Environmental Protection |
| NJGWQC | New Jersey Groundwater Quality Criteria |
| NJGWQS | New Jersey Groundwater Quality Standards |
| NJMCL | New Jersey Maximum Contaminant Level |
| NJNRSRS | New Jersey Non-Residential Soil Remediation Standards |
| NJSWQC | New Jersey Surface Water Quality Criteria |
| NPL | National Priorities List |
| NRDCSCC | Non-Residential Direct Contact Soil Cleanup Criteria |
| O&M | Operations and Maintenance |
| PAERAB | Picatinny Arsenal Environmental Advisory Board |
| PAH | Polycyclic Aromatic Hydrocarbons |
| PCB | Polychlorinated Biphenyl |
| PP | Proposed Plan |
| PQL | Practical Quantitation Limit |
| RA | Response Action |
| RAO | Remedial Action Objective |
| RBC | Risk-Based Concentration |
| RD | Remedial Design |
| RDX | Cyclotrimethylenetrinitramine |
| RI | Remedial Investigation |
| ROD | Record of Decision |
| SARA | Superfund Amendments and Reauthorization Act of 1986 |

| | |
|---|---|
| SCL | Site Cleanup Level |
| SF | Square Feet |
| SQB | Sediment Quality Benchmark |
| SVOC | Semi-Volatile Organic Compound |
| TAL | Target Analyte List |
| TNT | Trinitrotoluene |
| TBC | To-Be-Considered |
| TPH | Total Petroleum Hydrocarbons |
| µg/L | Micrograms per Liter |
| USEPA | U.S. Environmental Protection Agency |
| UV | Ultra-Violet |
| UXO | Unexploded Ordnance |
| WRA | Well Restriction Area |
| WWI | World War I |
| WWII | World War II |
| ZVI | Zero Valent Iron |

## 1.0 PART 1 - DECLARATION

### 1.1 SITE NAME AND LOCATION

Picatinny Arsenal is formally designated as U.S. Department of the Army (Army), Installation Management Command, Northeast Region, Garrison Office. It is located in north central New Jersey in Morris County near the city of Dover. The facility was included on the National Priorities List (NPL) in March of 1990 and assigned a Comprehensive Environmental Response, Compensation, and Liability Identification System (CERCLIS) number of NJ3210020704.

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The Group 1 Sites (PICA 079) are located in Area I at Picatinny. Area I is located along the western banks of Picatinny Lake encompassing approximately four acres. Area I is comprised of four sites (see **Figure 1**); Site 93 is bounded to the southwest by Picatinny Lake and northeast from Site 93, along the Lake, is Site 40, Site 156 and Site 157. However, Site 157 is comprised of two different areas; a portion of the Site is located directly south of Site 40 and east of Site 93. This Record of Decision (ROD) addresses groundwater, soil, and surface water at the Group 1 Sites (PICA 079) at Picatinny Arsenal (Picatinny), located in Rockaway Township, Morris County, NJ (**Figure 1**).

### 1.2 STATEMENT OF BASIS AND PURPOSE

This ROD presents the Response Action (RA) selected for the Group 1 Sites (PICA 079). The RA has been selected in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, and to the greatest extent possible, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The information supporting the decisions on the selected RA is contained in the administrative record file for the Site. These decisions have been made by the Army and the U.S. Environmental Protection Agency (USEPA). Comments received from the New Jersey Department of Environmental Protection (NJDEP) were evaluated and considered in selecting the final response actions for both soil and groundwater. NJDEP concurs with the selected Response Action.

### 1.3 ASSESSMENT OF THE SITE

The Response Action selected in this ROD is necessary to protect public health and welfare and the environment from actual or threatened releases of hazardous substances in to the environment at the Group 1 Sites (PICA 079).

### 1.4 DESCRIPTION OF THE SELECTED RESPONSE ACTION

The Response Action for the Group 1 Sites (PICA 079), pursuant to this ROD, is part of a comprehensive environmental investigation and remediation process currently being performed at Picatinny. The remaining areas in Picatinny are being considered separately, and remedies for these areas are presented in separate documents.

Studies conducted at the Group 1 Sites (PICA 079), presented in **Table 1**, have shown various constituents present in soil and groundwater at concentrations above the levels of concern (LOCs). **Tables 2, 3** and **4** summarize the constituents that exceeded LOCs in surface soil, subsurface soil and groundwater samples collected at the Group 1 Sites.

The selected Response Action for explosives in soil at Group 1 Sites (PICA 079) consists of excavation and off-site disposal; the selected RA for arsenic and polycyclic aromatic hydrocarbons (PAHs) in soil at Group 1 Sites (PICA 079) consists of land use controls (LUCs); the selected RA for polychlorinated biphenyls (PCBs) in soil at Group 1 Sites (PICA 079) consists of LUCs; and the selected RA for groundwater at Group 1 Sites (PICA 079) includes the implementation of LUCs and monitored natural attenuation (MNA). Surface water/sediment monitoring will be conducted in conjunction with the groundwater monitoring program implemented as part of the selected groundwater RA. Surface water and sediment monitoring will be conducted to characterize impacts on Picatinny Lake as a result of existing groundwater contamination; both media will be monitored for contaminants of concern (COCs) identified within groundwater.

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The Selected Response Actions (referred to herein as the Selected Response Action) were chosen based on protection of human health and the environment. The Selected RA addresses the risk posed by soil and groundwater effectively and is the most implementable and cost-effective while satisfying the remaining selection criteria.

## 1.5 STATUTORY DETERMINATIONS

The Selected Response Action satisfies the chemical-specific cleanup levels and complies with action- and location-specific applicable or relevant and appropriate requirements (ARARs). Site Cleanup Levels (SCLs) were selected for soil in the Group 1 Sites (PICA 79) Feasibility Study (FS) based on the New Jersey soil cleanup criteria which were in effect at the time. Subsequently, NJDEP promulgated new soil cleanup standards on June 2, 2008; SCLs for soil at Group 1 Sites (PICA 79) have been updated to reflect the new standards. SCLs were selected for groundwater in the FS based on the lower of the following values: Federal Maximum Contaminant Levels (MCLs); New Jersey State MCLs (NJMCLs); New Jersey Groundwater Quality Standards (NJGWQS) or New Jersey Practical Quantitation Limits (PQLs) (whichever is lower); and, any non-zero Federal Maximum Contaminant Level Goal (MCLG).

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As concluded in the Risk Assessment (RA), none of the contaminants that exceeded LOCs at Group 1 Sites (PICA 079) meet the criteria of principal threat waste. The Selected RA was selected over response actions which included treatment after considering the balancing criteria such as, short term effectiveness, implementability, cost, and community acceptance.

Because the Selected Response Action will result in contaminants remaining on-site above levels that do not allow for unlimited use and unrestricted exposure, five-year reviews will be conducted in compliance with CERCLA and the NCP to ensure that the Selected RA is, and will be, protective of human health and the environment.

## 1.6 DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary (Part 2) of this ROD. Additional information can be found in the Administrative Record for this site.

| Criterion | Section | Page No. |
|---|---|---|
| Contaminants of concern and their respective concentrations | Tables 2, 3 and 4 | NA |
| Baseline risk represented by the contaminants of concern (COCs) | 2.8 | 2-5 |
| Cleanup levels established for COCs and the basis for these levels | Table 7<br>2.8.4 | 2-10 |
| How source materials constituting principal threats will be addressed | 2.13 | 2-25 |
| Current and reasonably anticipated future land use assumptions used in baseline risk assessment and ROD | 2.7 | 2-5 |
| Potential land and groundwater use available as a result of the Selected Response Action (RA) | 2.14.5 | 2-27 |
| Estimated capital, annual operation and maintenance (O&M) and total present worth costs, discount rate, and the number of years over which the RA cost estimates are projected | 2.14.4 | 2-26 and 2-27 |
| Key factors leading to selection of Selected RA | 2.14.1 | 2-25 |

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NA – Not Applicable

## 1.7 AUTHORIZING SIGNATURE

John P. Stack
Lieutenant Colonel, U.S. Army
Garrison Commander

Date

Walter E. Mugdan, Director
Emergency and Remedial Response Division
United States Environmental Protection Agency, Region 2

Date

## 2.0 PART 2: DECISION SUMMARY

### 2.1 SITE NAME, LOCATION, AND DESCRIPTION

This ROD describes the Selected Response Action at the Group 1 Sites (PICA 079) located at Picatinny Arsenal in Rockaway Township, Morris County, New Jersey. Picatinny is a NPL site and is registered under the CERCLIS number NJ3210020704. The Army is the lead agency for CERCLA actions at these sites, and USEPA Region 2 is the support agency with oversight responsibilities. In addition, plans and activities are also being coordinated with appropriate state agencies, including NJDEP.

Picatinny Arsenal is a 5,900-acre government-operated munitions research and development facility located in Morris County, New Jersey, approximately 40 miles west of New York City and four miles northeast of Dover, New Jersey. The Arsenal sits in the Highlands of the state of New Jersey (**Figure 1**).

The Group 1 Sites (PICA 079) are located in Area I in the central portion of Picatinny Arsenal, west of Picatinny Lake. Group 1 is approximately four acres in size and encompasses four sites (see **Figure 1**). Located to the east of the intersection of Fidlar Road and Crain Road, Site 93 includes Buildings 800 and 807. The southern area of Site 157 is located northeast of Site 93 and includes Buildings 823 and 824. The northern area of Site 157 is located east of Fidlar Road and includes Building 820. Located south of Site 157, with Picatinny Lake to the east, Site 156 includes Buildings 813, 816 and 816-B. Lastly, located to the south of Site 156, Site 40 includes Buildings 809 and 810.

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### 2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

#### 2.2.1 Picatinny Arsenal Background

Picatinny Arsenal was established in 1880 by the U.S. War Department as a storage and powder depot. Later it was expanded to assemble powder charges for cannons and to fill projectiles with maximite (a propellant). During World War I (WWI), Picatinny produced all sizes of projectiles. In the years following WWI, Picatinny Arsenal began projectile melt-loading operations and began to manufacture pyrotechnic signals and flares on a production basis. During World War II (WWII), Picatinny Arsenal produced artillery ammunition, bombs, high explosives, pyrotechnics, and other ordnance. After WWII, Picatinny Arsenal's primary role became the research and engineering of new ordnance. However, during the Korean and Vietnam conflicts, Picatinny resumed the production and development of explosives, ammunition, and mine systems.

In recent years, Picatinny Arsenal's mission has shifted to conducting and managing research development, life-cycle engineering, and support of other military weapons and weapon systems. The facility has responsibility for the research and development of armament items. The Base Realignment and Closure process in 2005 resulted in Picatinny being designated to remain open and to expand in mission.

#### 2.2.2 Group 1 Sites (PICA 079) Background

Site 40 consists of Buildings 809 and 810; Building 809 was originally constructed for use as a large-caliber projectile washout facility, and Building 810 was originally intended as an operating facility. Currently the Buildings are respectively used as an explosives wastewater treatment plant and a melt-pour research facility.

Site 93 used to consist of both Buildings 800 and 807; however, Building 800, first built as a loading facility for loading submissles into warheads, has since been demolished. For a short period of time, the Building served as an ammunition tear-down facility but was then utilized for routine and experimental stability testing of smokeless power and high explosives. The only building currently standing at Site 93 is Building 807. Building 807 was originally constructed as a receiving, cleaning and inspection facility, but is currently used for cold storage and for staging packing materials for Building 820 (Site 157). For a brief time during WWI, operations within the building focused on production and manufacturing.

Site 156 consists of Buildings 813, 816, and 816-B. Originally, Building 813 was constructed for use as a production facility for large-caliber projectiles. Currently this building is utilized as a remote automated control facility for Building 810 (Site 40). Building 816 was constructed as an assembly facility for primer, propellant, and cartridge cases. Six transformers located northwest of Building 816 have been removed after PCBs had been discovered in five of the six transformers.

Site 157 consists of Buildings 820, 823 and 824. Both Building 820 and Building 823 were constructed to be used as large-caliber projectile loading plants. Building 824 is ancillary to Building 823. In addition, Building 823 was used to treat operational wastewaters by utilizing a settling and filtering system. Wastewaters were discharged to collection boxes located northeast of the Building which discharged into Picatinny Lake. Building 820 has since been reactivated as an ammunition repack and surveillance facility.

The limits of Group 1 Sites (PICA 079) are presented in **Figure 1**.

Investigation results for Group 1 Sites (PICA 079) can be found in the Phase I Remedial Investigation (RI) (Dames and Moore, 1998). However, a list of previous environmental investigations conducted at Group 1 Sites (PICA 079) is presented below:

- Phase I RI conducted by Dames and Moore in 1994 (included in the 1998 RI Report);
- Additional field investigations, performed between December 1997 to January 1999 (results presented in the 2002 Phase II Group 1 RI);
- Phase II Ecological Risk Assessment (ERA), Remedial Investigation (RI)/FS conducted by International Technology Corporation (IT) in 2000;
- Phase II Group 1 RI conducted by IT and submitted as Final in 2002;
- Data Gap Investigation (DGI) conducted in 2002;
- Feasibility Study (FS) for Group 1 Sites conducted by Shaw Environmental (Shaw) in May 2005; and
- Environmental Security Technology Certification Program (ESTCP), an academic study conducted in 2007 to evaluate the use of in-situ bioremediation to treat energetic compounds in groundwater.

### 2.2.3 Enforcement Activities

No formal enforcement activities have occurred at the Group 1 Sites (PICA 079). Picatinny is working in cooperation with the USEPA and NJDEP to apply appropriate remedies that will preclude the necessity of formalized enforcement actions, such as Notices of Violation.

## 2.3 COMMUNITY PARTICIPATION

The Group 1 Sites have been the topic of presentations at the Picatinny Arsenal Environmental Restoration Advisory Board (PAERAB). PAERAB members have provided comments regarding the Selected Response Action for Group 1 Sites (PICA 079). A copy of the Proposed Plan (PP) (ARCADIS, 2009) was given to the PAERAB's co-chair and a copy was offered to all PAERAB members. A final version of the PP for Group 1 Sites was completed and released to the public on October 29, 2009 at the information repositories listed below:

Installation Restoration Program Office
Building 319
Picatinny Arsenal, New Jersey 07806

Rockaway Township Library
61 Mount Hope Road
Rockaway Township, New Jersey 07866

Morris County Library
30 East Hanover Avenue
Whippany, New Jersey 07981

Multiple newspaper notifications were made to inform the public of the start of the PP comment period, to solicit comments from the public and to announce the public meeting. The notification was run in the Star Ledger and in the Daily Record on October 16, 2009. Copies of the certificates of publication are provided in **Appendix A**. A public meeting was held on October 29, 2009 to inform the public about the Selected Response Action for Group 1 Sites (PICA 079) and to seek public comments. At this meeting, representatives from the U.S. Army, NJDEP, USEPA and the Army's contractor, ARCADIS U.S., Inc. (ARCADIS), were present to answer questions about the site and Response Actions under consideration. Following the public meeting, a public comment period was held from October 29, 2009 to November 28, 2009 during which comments from the public were received. Public comments and prepared responses are presented in Section 3.0 of this ROD.

## 2.4 SCOPE AND ROLE OF RESPONSE ACTION

This ROD addresses the selection of the Response Action for soil and groundwater at Group 1 Sites (PICA 079). The Selected Response Action will address the COCs, which were identified in soil and groundwater during previous investigations at the Group 1 Sites. The COCs are discussed in further detail in Section 2.8.4. The Response Action selected for Group 1 Sites (PICA 079) is designed to provide protection to human health and the environment.

The Group 1 Sites have been divided into four separate areas of remediation based on site- and media-specific COCs. Therefore, analytical evaluations were conducted for each of the following: explosives in soil, arsenic and PAHs in soil, PCBs in soil, and explosives in groundwater. Sediments located within Group 1 Sites will be evaluated as a part of Picatinny Lake (PICA 057) and addressed in a separate ROD. However, surface water and sediment monitoring will be conducted as part of the selected groundwater remedy to monitor impacts on Picatinny Lake as a result of existing groundwater contamination.

The RA selected for the remediation of explosives in soil at Group 1 Sites consists of excavation and off-site disposal. Between approximately 300 and 600 cubic yards of contaminated soil will be excavated.

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The RA selected for the remediation of arsenic, PAHs, and PCBs in soil at Group 1 Sites consists of the implementation of land use controls for each of the contaminated areas.

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The RA selected for explosives in groundwater at Group 1 Sites consists of the implementation of land use controls and monitored natural attenuation. Surface water and sediment at the Group 1 Sites will be monitored for groundwater COCs throughout the duration of the groundwater remedy.

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Land use controls (LUCs) for soil and groundwater will be implemented to control current and future activities at Group 1 Sites that could result in unacceptable risk to human health.

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The Selected Response Action also involves performing any site maintenance required to maintain the protectiveness of the Response Action. The LUCs and any maintenance that will be implemented by the Army will be detailed in the Remedial Design (RD). LUCs will be maintained until such time as contaminant levels are sufficiently reduced to allow unrestricted use.

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## 2.5 DOCUMENTATION OF SIGNIFICANT CHANGES FROM SELECTED RESPONSE ACTION FROM PROPOSED PLAN

The Proposed Plan presented the same Selected Response Action as this ROD. No significant changes have been made.

## 2.6 SITE CHARACTERISTICS

### 2.6.1 Physical Characteristics

Size, Topography, and Surface Water Hydrology

The Group 1 Sites (PICA 079) are located in Area I at Picatinny. Group 1 is approximately four acres in size and encompasses four sites (see **Figure 1**). Sites 40, 93 and a portion of Site 157 are located on an alluvial peninsula deposited into a proglacial lake in the basin of present-day Picatinny Lake. Site 156 and the remainder of Site 157 are located along the narrow shoreline to the northeast of the peninsula.

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**Deleted:** (20 acres with the inclusion of Picatinny Lake)

Group 1 Sites are bounded to the northwest by the steep ridges of Green Pond Mountain and to the southeast by the shoreline of Picatinny Lake. Within the area of Group 1 Sites there is very little topographic relief; however, Green Pond Mountain rises abruptly to the northwest to elevations of over 1,000 feet above mean sea level (amsl). The highest surface elevation within Group 1 Sites (PICA 079) occurs adjacent to the steep ridges of Green Pond Mountain along Fidlar Road at approximately 725 feet amsl. The ground surface slopes gently to the southeast with the lowest land elevations occurring on the shoreline of Picatinny Lake at approximately 710 feet amsl.

A site map showing existing site limits for Group 1 is provided as **Figure 1**.

Geology and Hydrogeology

In the main valley of the Arsenal, surface water flows overland into the valley floor from the ridges that bound the valley to the northwest and southeast. Surface water then drains along the axis of the valley, from the northeast to the southwest. Lake Denmark is located in the valley on the northeast side of the installation. Surface water discharges from Lake Denmark to Burnt Meadow Brook, which ultimately flows to Green Pond Brook. Green Pond Brook then flows to the southwest and discharges into Picatinny Lake.

Two distinct aquifers, the unconsolidated and bedrock, were characterized during the Phase II field investigations. The unconsolidated aquifer was encountered along the entire western shore of Picatinny Lake and in peninsulas, which extend into the lake (with the exception of Site 156) where competent bedrock was encountered at less than 10 feet below ground surface (bgs). This aquifer is thickest along the shores of the lake adjacent to the peninsula and pinches out where the bedrock is close to the ground surface. The total thickness of this aquifer on the delta is approximately 107 feet.

In general, groundwater flow in the water table aquifer is away from the ridge west of the site and towards Picatinny Lake (southeast). Analysis of the vertical gradients shows a slight downward vertical gradient.

Climate

Northern New Jersey has a continental temperate climate controlled by weather patterns from the continental interior. Prevailing winds blow from the northwest from October to April and from the southwest from May to September. The average monthly temperature ranges from a high of about 72°F in July to a low of about 27°F in January and February. The average date of the last freeze is May 2, and the first freeze is October 8. Average annual precipitation at the Boonton monitoring station located approximately 5 miles east of Picatinny is 48 inches and is evenly distributed throughout the year.

### 2.6.2 Summary and Findings of Site Investigations

**Table 1** summarizes environmental investigations and reporting that have been conducted at the Group 1 Sites (PICA 079). The extent of contamination in soil and groundwater is summarized below. In addition to the LOCs described below, all samples were compared to the Picatinny background thresholds (IT, 2002), when available.

Extent of Soil Contamination

Studies have shown various contaminants present in soil at the Group 1 Sites above LOCs. The LOCs for surface soil are based on the NJDEP Non-Residential Direct Contact Soil Cleanup Criteria (NRDCSCC). In cases where NJDEP Cleanup Criteria are not available, USEPA Region III Industrial ($1x10^{-6}$) RBCs were selected as LOCs. The LOCs selected for subsurface soil comparison were the lower of the NJDEP NRDCSCC or NJDEP Impact to Groundwater (IGW) Criteria (if the contaminant was observed in groundwater); in cases where no state standard exists, the USEPA Region III RBC was selected. Following the regulator's approval of the FS, the NJDEP replaced the NRDCSCC in June 2008 by promulgating the New Jersey Non-Residential Soil Remediation Standards (NJNRSRS). This ROD summarizes chemical data and remedial alternatives as presented in the FS, and therefore LOCs discussed in this document are based on the older NRDCSCC. However, as discussed and documented herein, Site Cleanup Levels (SCLs) will be based on the newer, promulgated, NRDCSRS.

Soil samples were collected at the Group 1 Sites (PICA 079) during the Phase II RI (1995-1996), the additional Phase II field investigations (1997-1999), a Data Gap Investigation (DGI) (2002-2003), a pilot study at Site 157 (2007-2008) and a pre-design sampling program at Site 40 (2007-2008). Soil samples collected from Group 1 were analyzed for PAHs, pesticides, PCBs, explosives, target analyte list (TAL) metals/inorganics, anions, total petroleum hydrocarbons (TPHs) and radiologicals.

Based on the analytical results, the surface soil COCs consist of semi-volatile organic compounds (SVOCs), PCBs, explosives and inorganics. The subsurface COCs consist of SVOCs, PCBs, explosives and inorganics. **Tables 2 and 3** summarize the constituents that exceeded LOCs in surface soil and subsurface soil samples collected from Group 1 Sites (PICA 079), respectively.

**Figures 2** through **8** show the extent of soil contamination at the Group 1 Sites by presenting the location and concentration of those samples that exceeded LOCs.

Extent of Groundwater Contamination

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Studies have shown various contaminants present in groundwater at the site above LOCs. The LOCs for groundwater are based on the lower of the Federal MCLs, the New Jersey State MCLs, the New Jersey Groundwater Quality Criteria or PQLs (whichever is higher) or any non-zero Federal MCLGs. In cases where none of the above were available, the lower of the following To-Be-Considered (TBC) criteria were selected as LOCs: Federal Drinking Water Standards and Health Advisory Levels (HALs) or USEPA Region III Tap Water RBCs. Following the regulator's approval of the FS, the NJDEP updated the New Jersey Groundwater Quality Criteria and PQLs in July 2008. LOCs discussed in this document are based on the older 1993 Quality Criteria and PQLs. However, there are no criteria specified for the COCs in groundwater at the Group 1 Sites; therefore, the SCLs for groundwater will not be affected by the 2008 changes and will still reflect the lower of the TBC values discussed above.

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Groundwater samples were collected at Group 1 Sites during the four rounds of monitoring well sampling, discrete interval sampling during deep monitoring well installation, HydroPunch® sampling, and piezometer sampling. In addition, three pre-design sampling events occurred in 2007 and 2008. Groundwater samples collected from Group 1 were analyzed for PAHs, explosives, TAL metals/inorganics, anions, TPHs, and radiologicals.

Based on the analytical results, the primary groundwater COCs consist of explosives. **Table 4** summarizes the constituents that exceeded LOCs in groundwater collected from Group 1 Sites (PICA 079).

**Figures 9** and **10** show plume maps of the TNT and RDX groundwater contamination.

## 2.7 CURRENT AND POTENTIAL FUTURE LAND USE

Current land use within the Group 1 Sites (PICA 079) is industrial. Specifically, Buildings 809 and 810 (Site 40) are being used for storing explosives-contaminated process water and as a melt and pour facility, respectively. Building 807 (Site 93) is being utilized for cold storage and to stage packing materials for Building 820 (Site 157). Although surveillance testing will be terminated at Site 93, Building 800, a hot gas decontamination facility will be installed. Building 813 (Site 156) is being utilized as a remote automated control facility for Building 810. Building 820 has currently been reactivated as an ammunition repack and surveillance facility. The future use of these sites at Picatinny is not expected to change from the current usage (military/industrial).

Relative to use of groundwater beneath the Group 1 Sites (PICA 079), the State of New Jersey has designated all groundwater within the state as a drinking water source. However, Picatinny has a centralized water distribution system, and it has no current or future plans for the use of Group 1 groundwater for any purpose. Moreover, the Group 1 Sites (PICA 079) are within a NJDEP-approved Classification Exception Area (CEA). As described in a letter dated July 29, 2002 to the NJDEP, the CEA was established for both the bedrock aquifer and the unconsolidated aquifer. Thus, the CEA addresses all aquifers and COCs for Group 1 (PICA 079) groundwater. Upon establishment of a CEA, NJDEP identifies the region within the CEA as a well restriction area (WRA). The WRA functions as an institutional control by which potable use restrictions can be effected. As long as the CEA is in place, NJDEP may prohibit the installation and pumping of wells within this area.

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## 2.8 SUMMARY OF SITE RISKS

As part of the RI/FS, a baseline risk assessment was conducted for the Group 1 Sites (PICA 079) to evaluate the potential risks to human health and the environment associated with exposure to site-related chemicals. As previously discussed, these sites are currently used for industrial purposes, and this use is not anticipated to change in the future.

Baseline risk assessments estimate the potential risks and hazards associated with exposure to chemicals at a site under current conditions—i.e., assuming no response action is taken for reasonably anticipated future uses. Unacceptable risks to human health and the environment, under the current and reasonably anticipated future use, were identified in soils and groundwater at the Group 1 Sites (PICA 079). The results of the human health risk assessment (HHRA) and ecological risk assessment are discussed below.

### 2.8.1 Human Health Risk Assessment

A human health risk assessment was conducted by IT Corporation, Inc. (IT) for the Group 1 Sites (PICA 079) as part of the Phase II RI (IT, 2002). The Phase II Sites went through an initial multi-phased risk assessment process that consisted of a three-step approach in order to streamline the risk assessment process. The first step of the process was the Screening-Level HHRA which implemented a generalized screening approach to identify sites with existing chemical concentrations exceeding their respective screening levels. Those sites retained during the Screening-Level HHRA moved on to the second step of the process and were evaluated during the default risk assessment. Any sites identified during the default risk assessment as being associated with unacceptable risks were then carried through to the third step of the risk assessment process, a site-specific multi-pathway risk assessment. Potential risks associated with exposure to chemicals in soil, groundwater, sediment, and surface water were quantified for current and future outdoor maintenance workers, current and future industrial/research workers, current and future industrial/research workers, current and future site workers, and future construction/excavation workers. On-site visitors were not evaluated as a receptor during the site-specific risk assessments because it was assumed their exposures would be lower than those of site workers who were being evaluated. However, a supplemental risk assessment (IT, 2001b) was later performed to address concerns related to an on-site youth visitor coming in direct contact with impacted surface water and sediment. In addition, a second supplemental risk assessment was conducted to evaluate risks associated with exposure to chemicals via ingestion of fish caught in water bodies near the Group 1 Sites. The results of the supplemental fish assessment are included as part of the Picatinny Lake (PICA 057) CERCLA Documents.

**Deleted:** Dames and Moore (1998)

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**Deleted:** Risks associated with exposure to sediment were included in the evaluation conducted during the HHRA in order to completely assess the risk to human health at the Group 1 Sites.

#### 2.8.1.1 Contaminants of Potential Concern

Contaminants of Potential Concern (COPCs) were identified by comparing the maximum detected concentration of an individual contaminant to its LOC value. For the purposes of the screening evaluation, soil and sediment concentrations were compared to the USEPA Region III RBCs for soil at industrial sites. Groundwater and surface water concentrations were compared to the USEPA Region III RBCs for tap water. Chemicals detected at concentrations greater than their respective screening levels were identified as COPCs and were further evaluated in the risk assessment.

The identification of COPCs is conservatively biased to ensure that the screening process retains all contaminants that might pose an unacceptable risk. However, the identification of a contaminant as a COPC does not indicate that an unacceptable risk actually exists, but only that further analysis is required. Whether or not the COPCs are addressed qualitatively or quantitatively in the risk assessment is dependent on the result of the comparison to background values and the availability of contaminant-specific toxicity information.

COPCs selected for surface soils at Group 1 Sites (PICA 079) included benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene, Aroclor 1260, 2,4-dinitrotoluene (DNT), cyclotrimethylenetrinitramine (RDX), 2,4,6-trinitrotoluene (TNT), arsenic, copper, lead and zinc.

COPCs selected for subsurface soils at Group 1 Sites (PICA 079) included benzo(a)pyrene, 2,4,6-TNT, arsenic and lead.

COPCs selected for sediment at Group 1 Sites (PICA 079) included acenaphthene, anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzofuran, bis(2-ethylhexyl)phthalate, fluoranthene, naphthalene, phenanthrene, pyrene, 4,4-DDD, endosulfan sulfate, RDX, 2,4,6-TNT, cadmium, copper, lead, mercury, silver and zinc.

COPCs selected for groundwater at Group 1 Sites (PICA 079) included methylene chloride, bis(2-ethylhexyl)phthalate, 1,3-dinitrobenzene, 2,6-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, amino DNT's, 2-nitrotoluene, RDX, 2,4,6-TNT, aluminum, arsenic, iron, lead, manganese, mercury, nickel, silver, vanadium and nitrite/nitrate.

COPCs selected for surface water at the Group 1 Sites included aluminum, cadmium, copper, cyanide, lead, nitroglycerin, RDX, 2,4,6-TNT and ammonia.

#### 2.8.1.2 Exposure Assessment

Exposure pathways were identified based on the site characterization information, the fate and transport properties of the COPCs, and likely points where human receptors may come in contact with affected media under current or potential future conditions at the site. An exposure pathway is defined by the following four elements:

1) a source and mechanism of contaminant release to the environment;
2) an environmental transport medium for the released contaminant;
3) a point of potential contact with the contaminated medium (the exposure point); and,
4) an exposure route at the exposure point.

Exposure can occur only when the potential exists for a receptor to contact released contaminants directly, or when there is a mechanism for released contaminants to be transported to a receptor. Without exposure there is no risk; therefore, the exposure assessment is a critical component of the risk assessment. Based on these criteria, the HHRA focused on several current and hypothetical future exposure scenarios.

Estimated risks and hazards were calculated for the following receptor populations for Group 1 Sites (PICA 079):

- Current exposed populations: outdoor maintenance workers; industrial/research workers; site workers; onsite youth visitors.
- Future exposed populations: outdoor maintenance workers; industrial/research workers; construction/excavation workers; onsite youth visitors.

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For purposes of the screening evaluation, soil and sediment concentrations were compared to USEPA Region 3 RBCs for soil at industrial sites, since the current and future site uses in the Group 1 Sites (PICA 079) are likely to be industrial, while groundwater and surface water concentrations of chemicals in surface water were compared to USEPA Region III RBCs for tap water or New Jersey Groundwater Quality Criteria (NJGWQC). Five chemicals had a maximum concentration that exceeded their respective screening levels based on drinking water exposure. However, surface water at Picatinny is not currently used as a drinking water supply and is not expected to be used for that purpose in the future. Therefore, these five constituents are not considered as a concern to human health. Furthermore, groundwater contact through any of these pathways is not expected to occur because of the facility-wide CEA and land use controls that will be implemented as a result of this ROD.

#### 2.8.1.3 Risk Characterization

Potential risks to human health are evaluated quantitatively by combining calculated exposure levels and toxicity data. A distinction is made between noncarcinogenic and carcinogenic endpoints, and two general criteria are used to describe risk: the hazard quotient (HQ) for noncarcinogenic effects and excess lifetime cancer risk (ELCR) for contaminants evaluated as human carcinogens. The HQs are summed to calculate the hazard index (HI). The regulatory benchmark for noncancer health effects is 1. An HI less than or equal to 1 indicates that health effects are not likely to be associated with adverse health effects; however, an HQ or HI that exceeds 1 does not imply that health effects will occur, but that health effects are possible. The NCP generally identifies cancer risks in the acceptable risk range of $1x10^{-4}$ to $1x10^{-6}$ as protective for site-related exposures for NPL sites. If the ELCR exceeds the $1x10^{-4}$ acceptable risk level, site-specific remedial goal options will be derived for the relevant contaminants and exposure scenarios.

Health effects were evaluated for current and future outdoor maintenance workers, current and future industrial/research workers, and future construction/excavation workers. The HI is the sum of all the HQs for all COPCs that affect the same target organ, or that act through the same mechanism of action within a medium, to which a given individual may reasonably be exposed. An HI of less than 1 indicates that toxic noncarcinogenic effects from all COPCs are unlikely. **Table 5** summarizes the results of the HHRA for Group 1 Sites (PICA 079).

Three supplemental assessments were performed to evaluate: potential risks to current and future youth visitors exposed to surface water and sediment (IT, 2001a), the Adult Lead Model (for Sites 40, 93, and 156), and risks associated with exposure to chemicals via ingestion of fish caught in water bodies near the Group 1 sites. The results of the supplemental current and future youth visitor assessment are included in the summary of the HHRA (**Table 5**). The results of the supplemental fish assessment are included as part of the Picatinny Lake (PICA 057) CERCLA Documents. The results of the Adult Lead Model are presented in **Table 6**.

Site 40

The cumulative cancer risks for the current and future outdoor maintenance worker, current industrial/research worker, and future construction/excavation worker are within USEPA acceptable risk range of $1x10^{-4}$ to $1x10^{-6}$. The cumulative cancer risk for the future industrial/research worker was $3x10^{-4}$, which is greater than the USEPA acceptable risk range. Exposure to RDX in soil accounts for a majority of the cancer risk; however, other risk-drivers include benzo(a)pyrene, Aroclor 1260, TNT, and arsenic. Exposures to TNT in groundwater results in a cancer risk of $4.6x10^{-5}$. The non-cancer HI for all receptors was greater than the target hazard of 1. Therefore, following USEPA (1989) guidance, the HI was segregated by target organ/effect. For the current and future outdoor maintenance worker, current and future industrial/research worker, and future construction/excavation worker, the HI for liver effects was greater than one. The HI for liver effects is driven by the presence of TNT in soil. In addition, ingestion of TNT in groundwater results in a HI for liver effects greater than 1 (HI = 6) for future industrial/research workers. The HIs for all other target organ/effects were less than or equal to one.

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In summary, the results of the risk assessment indicate that under the current conditions at Site 40, constituents in soil and groundwater pose an unacceptable risk to human health under the exposure scenarios evaluated in the HHRA.

Site 93

The cumulative cancer risks for all receptors are less than or within the USEPA acceptable risk range of $1x10^{-4}$ to $1x10^{-6}$. The non-cancer hazard associated with the exposure of current and future industrial/research workers to soil at Site 93 is equal to 1. The non-cancer hazard for a future construction/excavation worker was calculated to be greater than the hazard threshold of 1 (HI=6). Therefore, following USEPA (1989) guidance, the HI was segregated by target organ/effect. The HI for all target organ/effects for the future construction/excavation worker were less than or equal to one. The non-cancer hazard for an onsite youth visitor was calculated to be greater than the hazard threshold of 1 (HI=3). The onsite youth visitor HI is associated with sediment samples collected from two sumps, one of which has been removed and the other of which is located beneath a metal cover preventing contact to sediments; thus, the risk of actual exposure is less than that assumed for the HHRA.

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In summary, the results of the risk assessment indicate that under the current conditions at Site 93, constituents in soil do not pose an unacceptable risk to human health under the exposure scenarios evaluated in the HHRA.

Site 156

The cumulative cancer risk associated with the exposure of a current and future site worker exposure to soil at Site 156 was found to be $2x10^{-4}$, which is greater than the USEPA acceptable risk range of $1x10^{-4}$ to $1x10^{-6}$. The cumulative cancer risk for a future construction/excavation worker is $3x10^{-5}$, which is within the USEPA acceptable risk range of $1x10^{-4}$ to $1x10^{-6}$. The cancer risk at Site 156 is primarily associated with dermal absorption of arsenic found in soil. The non-cancer HI for a current and future site worker is equal to 1, indicating non-cancer effects are unlikely. The non-cancer HI for a future construction/excavation worker was calculated to be greater than the hazard threshold of 1 (HI = 5). Therefore, following USEPA (1989) guidance, the HI was segregated by target organ/effect. For the future construction/excavation worker, the HI for skin effects was greater than one (HI = 2) due to dermal absorption of arsenic in soil. The HIs for all other target organ/effects were less than or equal to one.

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As previously discussed, dermal absorption of arsenic in soil is the primary risk-driver for the unacceptable cancer risk for industrial/research workers and the non-cancer hazard for construction/excavation workers. However, recent USEPA (2002 and 2004) guidance indicates that the dermal pathway does not typically result in greater exposure to chemicals compared to direct ingestion of soil. In addition, the maximum concentration of arsenic (81 milligrams per kilogram [mg/kg] at I-156MW-1A) was used as the exposure point concentration to evaluate potential cancer risks and non-cancer hazards. The next highest arsenic concentration is 26.6 mg/kg (I-156-SS-001C), which is significantly less than the maximum concentration. Use of this concentration to estimate potential hazards to arsenic would result in a HI that is less than 1 and thus would be below the LOC. This indicates that an unacceptable concentration of arsenic is limited to the location of the maximum detection and thus it is likely that the risk and hazard associated with arsenic is overestimated. Consequently, arsenic was not selected as a COC.

In summary, the results of the risk assessment indicate that under the current conditions at Site 156, constituents in soil pose an unacceptable risk to human health under the exposure scenarios evaluated in the HHRA.

Site 157

The cumulative cancer risk for the current and future outdoor maintenance worker and future construction/excavation worker are within the USEPA acceptable risk range of $1x10^{-4}$ to $1x10^{-6}$. The cumulative cancer risk for a current and future industrial/research worker was found to be greater than the USEPA acceptable risk range ($2x10^{-4}$). Exposure to RDX in soil accounts for a majority of this cancer risk. Exposure to RDX in groundwater results in a cancer risk of $1.9x10^{-5}$. The non-cancer HI for current industrial/research workers (HI = 2) and future industrial/research workers (HI = 3) are greater than one. Therefore, following USEPA (1989) guidance, the HIs were segregated by target organ/effect. For both the current industrial/research worker and future industrial/research worker, the HIs for prostate effects (HI = 2 for both of these receptors) were greater than one. The HI for prostate effects is driven by the presence of RDX in soil, HIs for all other target organ/effects were less than or equal to one. In addition, the non-cancer HI for each of the remaining receptors was less than or equal to the target hazard threshold level of 1.

In summary, the results of the risk assessment indicate that under the current conditions at Site 157, constituents in soil pose an unacceptable risk to human health under the exposure scenarios evaluated in the HHRA.

### 2.8.2 Ecological Risk Assessment

A baseline ecological risk assessment was conducted at the Group 1 Sites as part of the Phase II RI (IT, 2000). The purpose of the baseline ERA was to evaluate the potential risk to aquatic, benthic, and terrestrial receptors associated with exposure to chemicals in environmental media under current conditions at each site. With the exception of Site 40 and Building 823 of Site 157, all of the Group 1 Sites were characterized as non-forested lands with little suitable habitat to attract wildlife in the sample areas. Thus, ecological assessments of these areas were not warranted and were eliminated from consideration in the Phase II ERA. However, surface water and sediment samples were collected from Site 156. Groundwater was not evaluated during the ERA and therefore is not discussed within this section.

The ERA used the white-footed mouse, the barred owl, and the American woodcock as the study species for which Ecological Effects Quotients (EEQs) were calculated. An EEQ greater than 1 indicated the potential for risk. Additional studies such as terrestrial earthworm bioassays, terrestrial plant community assessments, small mammal trappings, and small mammal community assessments were also performed as part of the ERA. The results of the ERA are presented below for soil, sediment and surface water. As stated above, groundwater was not evaluated during the Phase II baseline ERA.

#### 2.8.2.1 Summary of Findings for Soil and Terrestrial Food Chain Exposures

The results of the Phase II ERA indicate that surface soils at Sites 40 and 157 were toxic and likely to pose a risk to terrestrial plants and soil invertebrates. Results identified the following chemicals as soil risk drivers: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, Aroclor 1260, RDX, 2,4,6-TNT, and arsenic.

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Based on the results of the Phase II ERA, it was determined that surface soils at Sites 40 and 157 likely posed a risk to terrestrial plants and soil invertebrates. The FS identified ecological risk drivers and derived cleanup goals through a weight of evidence approach that considered both the calculated EEQs for the wildlife and plant species as well as the results of soil bioassays. Subsurface soils do not likely pose a risk to terrestrial plants and soil invertebrates.

#### 2.8.2.2 Summary of Findings for Surface Water and Sediment

Surface water and sediment within the Group 1 Sites (PICA 079) and Picatinny Lake were evaluated during the Phase II RI (IT, 2000). Several metals and one explosive exceeded respective LOCs in surface water at Group 1 Sites (PICA 079), including: aluminum, barium, boron, copper, cyanide, lead, manganese and nitroglycerin. Contaminants of potential ecological concern (COPEC's) within Picatinny Lake sediments, such as explosives, metals, PAHs, pesticides and VOCs had EEQs greater than one for benthic receptors. However, there were no unacceptable ecological risks identified during the RI for surface water.

Sediment bioassay tests indicated that sediment in Picatinny Lake was associated with toxic effects and significant biological toxicities, with the potential to adversely affect benthic receptors and semi-aquatic wildlife. Benthic community surveys conducted at Picatinny Lake indicated that the sediment is toxic to the benthic community. However, field observations indicate that toxicity may not be as great as that implied by the laboratory data. Benthic community surveys are generally given the most weight when comparing the results of multiple lines of evidence to determine whether significant risks exist, because they are a direct measure of effects on the assessment endpoint (i.e., the benthic invertebrate community). Based on the weight-of-evidence approach, ecological risks were identified in sediments. The benthic community surveys and the weight-of-evidence approach will be further discussed in the evaluation of Picatinny Lake (PICA 057). The ecological risks identified during these activities do not affect the selection of a Response Action for the Group 1 Sites, and therefore, will not be discussed for the remainder of this document.

### 2.8.3 Unexploded Ordnance

Unexploded ordnance (UXO) has not been, and is not anticipated to be, discovered at Group 1 Sites (PICA 079); however, Group 1 Sites are included within the 1926 explosion radius, which has been designated PICA 003-R-01. The need for any UXO assessment and/or clearance at the Group 1 Sites (PICA 079) would be evaluated under the Military Munitions Response Program (MMRP). Recent activities performed in support of the MMRP include the completion of a Historical Records Review and a Site Inspection. The Site Inspection concluded that PICA 003-R-01 would enter into the RI stage. Currently, consistent with Army and Picatinny regulations, UXO hazards are controlled by the Picatinny Safety Program. This program includes coordination with the Picatinny Safety Office, land-use restrictions, and UXO clearance procedures. These controls are in place to protect construction workers.

### 2.8.4 Contaminants of Concern and Site Cleanup Levels

COCs in soil and groundwater were identified in the *Final Group 1 Sites Feasibility Study* (Shaw, 2005). As part of the Group 1 Sites (PICA 079) FS, the contaminants detected in surface soil, subsurface soil, and groundwater were screened to identify COCs. COCs are defined as contaminants that:

1) Contribute to the majority of site-specific human health or ecological risk based on the HHRA or ERA; and,

2) Exceed the MCLs, MCLGs, NJGWQS, NJDEP NRDCSCC, or the NJSWQC, referred to as Non-Risk-Driver COCs.

Site cleanup levels were developed for contaminants identified in soil and groundwater at the Group 1 Sites (PICA 079) if the concentrations were a major contributor to human health risks or exceeded the SCLs. For soil COCs, NRDCSRS were used as the SCLs and for groundwater the NJGWQS were used. Surface water and sediment will be monitored for the duration of the groundwater response action. The final COCs, SCLs and respective concentrations for soil and groundwater are presented in **Table 7**.

Impacts were identified for surface soil and subsurface soil at Group 1 Sites (PICA 079) as presented on **Figure 11**. Group 1 groundwater impacts are shown on **Figures 9** and **10**. The estimated area and volume for each impacted area is presented in **Table 8**.

## 2.9 REMEDIAL ACTION OBJECTIVES

Remedial Action Objectives (RAOs) are based on human health and environmental factors, which are considered in the formulation and development of Response Actions. Such objectives are developed based on the criteria outlined in Section 300.430(e)(2) of the NCP and Section 121 of SARA.

The RAOs for the Group 1 Sites (PICA 079) have been developed in such a way that attainment of these goals will result in the continued protection of human health, ecological receptors and the environment. The RAOs are specific to the soil and groundwater contamination originating from Group 1 Sites (PICA 079). The RAOs are as follows:

- To prevent human exposure to contaminated groundwater that would cause unacceptable risk over the duration of the response action;
- To achieve the more stringent of the Federal MCLs or NJGWQS for the identified contaminants of concern in a reasonable timeframe, thereby restoring groundwater to its beneficial use as a drinking water source. For RDX and TNT, which have no established MCL or NJGWQS, the HAL will be used as the cleanup goal;
- To address soils with contaminants driving risk for the sites greater than $1x10^{-4}$ or HIs greater than 1; and
- To manage soils with calculated risk in the risk range of $1x10^{-4}$ to $1x10^{-6}$ following NCP guidance.

Areas of attainment (AAs) were developed during the Group 1 Sites (PICA 079) FS in order to define areas within the Group 1 Sites that the RAOs would be attained over. The AAs were based on the SCL exceedances. Dimensions of each AA have been calculated for planning and evaluation purposes. Descriptions for each of the AAs are provided in **Table 8**. The AAs for active RAs, meaning some form of treatment and/or removal is required, for surface and subsurface soils are shown in **Figure 11**.

## 2.10 DESCRIPTION OF RESPONSE ACTIONS

The Group 1 Sites (PICA 079) have undergone an RI/FS in accordance with the CERCLA process. The RI phase is the mechanism for collecting data to characterize the site and assess potential human health and ecological risk. The RI phase is followed by the FS phase, which involves the development, screening and detailed evaluation of response actions.

Technology types and process options appropriate for the COCs were identified and screened based on effectiveness, implementability and cost. The retained technologies and process options were developed into response actions. The RAs for explosives in soil at Group 1 Sites (PICA 079) are:

- Response Action S1-1: No Action;
- Response Action S1-2: Excavation and On-Site Treatment by Composting;
- Response Action S1-3: Excavation and On-Site Treatment by Slurry-Bioreactor;

- Response Action S1-4: Excavation and On-Site Treatment by Enhanced Bioremediation (Daramend®); and
- Response Action S1-5: Excavation and Off-Site Disposal.

The RAs for arsenic and PAHs in soil at Group 1 Sites (PICA 079) are:

- Response Action S2-1: No Action;
- Response Action S2-2: Implementation of ICs;
- Response Action S2-3: Installation of a Soil Cover and Revegetation;
- Response Action S2-4: Installation of an Asphalt Cover; and
- Response Action S2-5: Excavation and Off-Site Disposal.

The RAs for PCBs in soil at Group 1 Sites (PICA 079) are:

- Response Action S3-1: No Action;
- Response Action S3-2: Implementation of ICs; and
- Response Action S3-3: Excavation and Off-Site Disposal.

The RAs for groundwater at Group 1 Sites (PICA 079) are:

- Response Action GW-1: No Action;
- Response Action GW-2: Implementation of ICs and MNA;
- Response Action GW-3: Pump and Treat Using Carbon Treatment, Long-Term Groundwater Monitoring, and Implementation of ICs;
- Response Action GW-4: Pump and Treat Using Ultraviolet (UV)/Chemical Oxidation, Long-Term Groundwater Monitoring, and Implementation of ICs;
- Response Action GW-5: Pump and Treat Using Bioreactor Treatment, Long-Term Groundwater Monitoring, and Implementation of ICs;
- Response Action GW-6: Pneumatic Fracturing and Liquid Atomized Injection of Granular Zero Valent Iron (ZVI), Long-Term Groundwater Monitoring, and Implementation of ICs;
- Response Action GW-7: Nano-Scale ZVI Injection, Long-Term Groundwater Monitoring, and Implementation of ICs; and
- Response Action GW-8: Injection of Microbial Growth Substrate, Long-Term Groundwater Monitoring, and Implementation of ICs.

Response actions are described below.

### 2.10.1 Explosives in Soil

#### 2.10.1.1 Response Action S1-1: No Action

| | |
|---|---|
| Estimated Capital Cost: | *$0* |
| Estimated O&M Cost Over 30 Years: | *$0* |
| Estimated Present Worth Cost: | *$0* |

CERCLA and the NCP require that a No Action response action be evaluated at every site to establish a baseline for comparison of other response actions. Under this response action, no response action would take place.

#### 2.10.1.2 Response Action S1-2: Excavation and On-Site Treatment by Composting

| | |
|---|---|
| Estimated Capital Cost: | *$817,000* |
| Estimated O&M Cost Over 30 Years: | *$0* |
| Estimated Present Worth Cost: | *$817,000* |

Response Action S1-2 involves the excavation of approximately 300 to 600 cubic yards of explosives-contaminated soil and the confirmatory sampling of the limits of excavation. The excavation area for RA S1-2 is presented on **Figure 11**. The timeframe for the completion of site activities under RA S1-2 is approximately six months. Excavated media would be treated on-site through the process of windrow composting. Treated media would be returned to the soil excavation area and/or used on the base as nutrient-rich compost following confirmation that cleanup levels were achieved. One potential application of the treated compost would be use as vegetative topsoil for a remedial soil cover at other contaminated sites. The components incorporated into RA S1-2 are discussed in detail in the FS (Shaw, 2005). These components are: design and permitting, contractor and material procurement, mobilization and site preparation, UXO screening survey, excavation of contaminated soil with confirmatory sampling, windrow composting, backfill and restoration, site cleanup and demobilization, and implementation and maintenance of LUCs (discussed below).

Implementation and Maintenance of LUCs

Response Action S1-2 would be achieved in conjunction with the implementation and maintenance of LUCs, which are administrative and engineering measures put in place to maintain the current land use. The specific provisions and requirements of the LUCs necessary to ensure land use remains safe and appropriate for the level of protection afforded by the remedial action will be detailed as part of the remedial design. The Army is responsible for implementing, maintaining, reporting on and enforcing the LUCs. The LUCs will be maintained until the concentrations of hazardous substances in the soil are at such levels to allow for unrestricted land use.

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#### 2.10.1.3 Response Action S1-3: Excavation and On-Site Treatment by Slurry-Bioreactor

| | |
|---|---|
| Estimated Capital Cost: | *$735,000* |
| Estimated O&M Cost Over 30 Years: | *$0* |
| Estimated Present Worth Cost: | *$735,000* |

Response Action S1-3 involves similar activities as RA S1-2, except that excavated media would be treated via slurry-bioreactor. The excavated material would be prescreened to sort the material by size into treatable and untreatable fractions. Rocks would be power washed and returned to the excavation area, and the large grained fraction would be processed to remove all fine grained particles to which the contaminants predominantly adhere. Following confirmatory sampling, the large grained fraction would be returned to the excavation area or, if SCLs are not met, disposed off-site in a Subtitle D landfill (refer to RA S1-5). Final laboratory analysis will be performed on the treated slurry material for explosives, SVOCs, and metals, which could be returned to the soil excavation area when SCLs are achieved. The timeframe for the completion of site activities under RA S1-3 is approximately seven months.

Response Action S1-3 would be implemented in conjunction with the implementation and maintenance of LUCs. LUCs for RA S1-3 are identical to those detailed above for S1-2.

#### 2.10.1.4 Response Action S1-4: Excavation and On-Site Treatment by Enhanced Bioremediation (Daramend®)

| | |
|---|---|
| Estimated Capital Cost: | *$518,000* |
| Estimated O&M Cost Over 30 Years: | *$0* |
| Estimated Present Worth Cost: | *$518,000* |

Response Action S1-4 involves similar activities as RA S1-2, except that excavated media would be treated via Daramend® enhanced bioremediation using landfarming techniques. Amendments include ZVI and organic compounds, which would be evaluated during bench scale treatment/optimization studies. Due to the low soil bulking, treatment of the entire soil volume could be accomplished in a single batch within the available area on site. Vendor cost estimates are provided in Appendix G of the FS, which include a bench scale study, rental of tilling equipment, manufacture and delivery of amendments, and project support and oversight (Shaw, 2005). The treatment timeframe is estimated as five to seven weeks, but the overall timeframe for site activities is estimated at three months for RA S1-4.

Response Action S1-4 would be implemented in conjunction with the implementation and maintenance of LUCs. LUCs for RA S1-4 are identical to those detailed above for S1-2.

#### 2.10.1.5 Response Action S1-5: Excavation and Off-Site Disposal

Estimated Capital Cost: *$401,000*
Estimated O&M Cost Over 30 Years: *$0*
Estimated Present Worth Cost: *$401,000*

Response Action S1-5 involves similar activities as RA S1-2, except that excavated media would be transported off-site for disposal in a properly permitted landfill. Prior to commencing excavation activities, representative waste characterization samples would be collected and analyzed to ensure proper disposal of the excavated materials. Based on the results of previous sampling and analysis, it is assumed that the excavated soil would be disposed of as non-hazardous waste, but for cost estimating purposes, 10 percent of the material was conservatively assumed to require disposal as hazardous waste. The excavated areas would be backfilled with clean native soil. The estimated volumes of soil to be excavated, transported and disposed of is approximately 600 cubic yards. Excavated soil would be direct-loaded into end dump trucks for transport to the disposal facility. The estimated timeframe for the completion is approximately five weeks for RA S1-5, including mobilization, site preparation, excavation and site restoration.

Response Action S1-5 would be implemented in conjunction with the implementation and maintenance of LUCs. LUCs for RA S1-5 are identical to those detailed above for S1-2.

### 2.10.2 Arsenic and PAHs in Soil

#### 2.10.2.1 Response Action S2-1: No Action

Estimated Capital Cost: *$0*
Estimated O&M Cost Over 30 Years: *$0*
Estimated Present Worth Cost: *$0*

CERCLA and the NCP require that a No Action response action be evaluated at every site to establish a baseline for comparison of other response actions. Under this response action, no remedial action would take place. The evaluation of the No Action response action for arsenic and PAHs in soil is identical to that for explosives in soil.

#### 2.10.2.2 Response Action S2-2: Implementation of Land Use Controls

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Estimated Capital Cost: *$33,000*
Estimated O&M Cost Over 30 Years: *$109,000*
Estimated Present Worth Cost: *$141,000*

(Estimated present worth was calculated using a 7% discount rate.)

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Response Action S2-2 would be similar to the implementation of LUCs for S1-2, as detailed above, with the exception that RA S2-2 relies on the Group-wide application of LUCs to meet remedial goals for arsenic and PAHs in soil instead of remedial goals for explosives.

#### 2.10.2.3 Response Action S2-3: Installation of a Soil Cover and Revegetation

Estimated Capital Cost: *$187,000*
Estimated O&M Cost Over 30 Years: *$98,000*
Estimated Present Worth Cost: *$285,000*

(Estimated present worth was calculated using a 7% discount rate.)

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Response Action S2-3 involves containment of the contaminated soil using a vegetated soil cover. In addition, the property would be subject to LUCs (see RA S2-2) and access restrictions to prevent disturbances of the soil cover and exposure to the contaminated soil. The area to be contained by the soil cover is approximately 10,148 square feet (SF) (0.233 acres). The estimated timeframe for implementation of the vegetative cover, including site preparation and equipment mobilization is approximately four weeks. Once installed, the vegetative cover will require maintenance and inspections to ensure it is able to provide adequate protection to the materials contained within the cover. The maintenance activities are anticipated to go indefinitely; however, for cost estimating purposes, 30 years was used.

Response Action S2-3 would be implemented in conjunction with the implementation and maintenance of LUCs. LUCs for RA S2-3 are identical to those for S2-2.

#### 2.10.2.4 Response Action S2-4: Installation of an Asphalt Cover

Estimated Capital Cost: *$147,000*
Estimated O&M Cost Over 30 Years: *$98,800*
Estimated Present Worth Cost: *$246,000*

(Estimated present worth was calculated using a 7% discount rate.)

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Response Action S2-4 involves construction of an asphalt pavement cover for the containment of contaminated soil and to prevent erosion and direct contact with contaminants. The area to be contained by the asphalt pavement is approximately 10,148 SF (0.233 acres). The major components of RA S2-4 are largely similar to RA S2-3. The asphalt subgrade needs to be adequately prepared to ensure the best performance of the asphalt and long-term operations and maintenance (O&M) activities (also assumed for 30 years) would be required, which would include the submittal of a formal O&M report once every five years.

Response Action S2-4 would be implemented in conjunction with the implementation and maintenance of LUCs. LUCs for RA S2-4 are identical to those for S2-2.

#### 2.10.2.5 Response Action S2-5: Excavation and Off-site Disposal

Estimated Capital Cost: *$417,000*
Estimated O&M Cost Over 30 Years: *$0*
Estimated Present Worth Cost: *$417,000*

Response Action S2-5 involves similar activities as RA S1-5. The area of excavation for arsenic and PAH contamination is approximately 10,148 SF. The estimated volume of soil to be excavated is 790 cubic yards. Soil would be direct-loaded into end dump trucks for transportation to an approved disposal facility. Based on soil samples analyzed to date, the soil is assumed to be non-hazardous. The timeframe to implement this remedial action, including mobilization, site preparation and site restoration, is approximately five weeks.

Response Action S2-5 would be implemented in conjunction with the implementation and maintenance of LUCs. LUCs for RA S2-5 are identical to those for S2-2.

### 2.10.3 PCBs in Soil

#### 2.10.3.1 Response Action S3-1: No Action

Estimated Capital Cost: *$0*
Estimated O&M Cost Over 30 Years: *$0*
Estimated Present Worth Cost: *$0*

CERCLA and the NCP require that a No Action response action be evaluated at every site to establish a baseline for comparison of other response actions. Under this response action no remedial action would take place. The evaluation of the No Action response action for PCBs in soil is identical to that for explosives in soil.

#### 2.10.3.2 Response Action S3-2: Implementation of Land Use Controls

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Estimated Capital Cost: *$33,000*
Estimated O&M Cost Over 30 Years: *$109,000*
Estimated Present Worth Cost: *$141,000*

(Estimated present worth was calculated using a 7% discount rate.)

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Response Action S3-2 is identical to RA S1-2 with the exception that this RA relies on the Group-wide application of LUCs to meet remedial goals for PCBs in soil instead of remedial goals for explosives.

#### 2.10.3.3 Response Action S3-3: Excavation and Off-Site Disposal

Estimated Capital Cost: *$180,000*

Estimated O&M Cost Over 30 Years: *$0*
Estimated Present Worth Cost: *$180,000*

Response Action S3-3 involves similar activities as RA S1-5. The area of excavation for PCB contamination is approximately 990 SF. The estimated volume of PCB- contaminated soil to be excavated is 74 cubic yards. Soil would be direct-loaded into end dump trucks for transportation to an approved disposal facility. Based on soil samples analyzed to date, the soil is assumed to be non-hazardous. The timeframe to implement this remedial action, including mobilization, site preparation and site restoration, is approximately four weeks.

Response Action S3-3 would be implemented in conjunction with the implementation and maintenance of LUCs. LUCs for RA S3-3 are identical to those for S3-2.

### 2.10.4 Groundwater

#### 2.10.4.1 Response Action GW-1: No Action

Estimated Capital Cost: *$0*
Estimated O&M Cost Over 30 Years: *$0*
Estimated Present Worth Cost: *$0*

CERCLA and the NCP require that a No Action response action be evaluated at every site to establish a baseline for comparison of other response actions. Under this response action, no remedial action for groundwater would take place.

#### 2.10.4.2 Response Action GW-2: Implementation of Land Use Controls and Monitored Natural Attenuation

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Estimated Capital Cost: *$54,000*
Estimated O&M Cost Over 40 Years: *$436,800*
Estimated Present Worth Cost: *$520,000*

(Estimated present worth was calculated using a 7 percent discount rate.)

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Response Action GW-2 would involve continuous implementation of LUCs with particular restrictions on groundwater use and implementation of a groundwater monitoring program. Contaminant concentrations have been shown to be dissipating via natural attenuation processes and the plumes are stable. Since the submittal of the FS (Shaw, 2005), investigations have documented a decrease in both plume size and concentration, due to both degradation and migration.

Implementation of LUCs for GW-2 involves similar components as those specified for the soil RAs; however in addition to RA S1-2, the following components would be implemented as well.

Land Use Controls

The LUC objectives for Group 1 groundwater are to ensure no contact with groundwater occurs by industrial users that could result in unacceptable risk. Additionally, they control changes in groundwater use at the site. These LUC objectives will be met until such a time that contaminant levels are sufficiently reduced to allow for unrestricted use of groundwater. Currently Picatinny is under an installation-wide CEA. This CEA requires the NJDEP to restrict or require the restriction of potable groundwater uses within the CEA by implementing a WRA.

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Groundwater Monitoring

The primary objectives of the groundwater monitoring program under RA GW-2 are to: 1) monitor the continuing natural attenuation of contaminants in groundwater, and 2) to verify plume stability.

Recent data collected in 2007 and 2008 was used to refine the anticipated remedial timeframes for TNT and RDX concentrations to decrease below the SCLs. The analysis suggests a remedial duration for TNT at Site 40 of approximately 11 years and a remedial duration for RDX of approximately 9 years. Similar timeframes are calculated for the duration of MNA at Site 157, the timeframe is estimated to be 8 years for the MNA duration of TNT and 8 years for that of RDX at Site 157.

Anticipated remedy durations presented herein are calculated to the achievement of the HAL. However, MNA durations to achieve the NJDEP interim guidance standards were also calculated. The analysis suggests that the remedial timeframe for TNT will increase by two years to meet the NJDEP interim guidance standard. Similarly, the remedial timeframe for RDX at Sites 40 and 157 will increase by three and five years, respectively.

Implementation of the groundwater monitoring program under RA GW-2 would involve submittals of a remedial action work plan that would detail elements such as sampling locations, parameters, and frequency, as well as the exit strategy and the general evaluation criteria to evaluate the necessity of a contingency remedy. The reporting requirements would involve, at a minimum, submittal of the monitoring results and five-year review reports.

Surface Water/Sediment Monitoring

The objective of a monitoring program for surface water and sediment is to evaluate the potential for surface water and/or sediment impairment due to impacted groundwater discharging to Picatinny Lake. Therefore, surface water and sediment will be monitored for the COCs identified within Group 1 groundwater and screened against the NJSWQC for surface water and the lower of the following for sediment: ISQW, NYSDEC criteria, and SQB. In the absence of these values the ER-L or RBCs will be used to screen sediment results. Surface water/sediment monitoring will be conducted in conjunction with the groundwater monitoring program for the duration of the groundwater remedy.

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#### 2.10.4.3 Response Action GW-3: Pump and Treat Using Carbon Treatment, MNA, and Implementation of LUCs

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| Estimated Capital Cost: | *$1,050,000* |
| Estimated O&M Cost Over 15 Years: | *$1,450,000* |
| Estimated Present Worth Cost: | *$2,500,000* |

(Estimated present worth was calculated using a 7% discount rate.)

Response Action GW-3 would involve: 1) using pump and treat technology for the ex-situ treatment of the explosives compound plumes in the overburden aquifer at Sites 40 and 157; 2) long-term groundwater monitoring for all AAs; and 3) implementation of LUCs. Treated water from the pump and treat system would be discharged to Picatinny Lake. It is estimated that a total of five extraction wells would be required – three wells at Site 40 and two wells at Site 157.

Locations of the five proposed groundwater extraction wells have been chosen to target concentrations of RDX and TNT in groundwater with concentrations greater than 10 micrograms per liter (µg/L). The FS estimates that the pump and treat system would be operated for a period of approximately seven years at a total groundwater extraction rate of 50 gallons per minute (gpm). This would result in the extraction and treatment of over 180 million gallons of explosives contaminated groundwater over the duration of system operation. In this timeframe, the plume volume and aqueous explosive compound concentrations would be significantly reduced (within 10 µg/L) assuming no rebound effects.

An additional period of eight years is assumed to monitor the natural attenuation of the residual contaminants until concentrations are within SCLs. Results of continued groundwater sampling would be used to evaluate the effectiveness of MNA for the residual explosives concentrations. In addition to groundwater monitoring, surface water/sediment monitoring will be conducted for the duration of the groundwater remedy. Because of interconnectivity of groundwater and surface water and limited exceedances historically observed in surface water, surface water criteria are expected to be met quickly as a result of groundwater remedy implementation.

Implementation of LUCs for Response Action GW-3 requires similar components as those provided for RA GW-2. In addition, the surface water/sediment monitoring program for this RA would be identical to the program described in RA GW-2. The following sections provide additional details regarding the planning and implementation components of RA GW-3.

Site Preparations

In order to implement the pump and treat RA, modifications to the site would include installation of wells; temporary construction of a building to house the treatment system; and clearing, grubbing, and excavation of areas where wells, piping, and equipment would be constructed. Excavated material would be backfilled or reused on the base following appropriate sampling and analysis.

Installation of Pump and Treat System

Technical and construction oversight would be required prior to and during the installation of the pump and treat system. The following list describes the construction components of the pump and treat system. For cost estimating purposes, the specifications of these components are simplified.

- Construction of five groundwater extraction wells—three wells located at Site 40 and two wells located at Site 157.
- Construction of approximately 1,200 feet of piping and associated fittings and manifolds.
- Construction of an ex-situ treatment system consisting of liquid granular activated carbon filtration units to remove the explosive compounds from the extracted groundwater.
- Construction of treatment pads and buildings to house the ex-situ treatment system.
- Installation of five additional monitoring wells to monitor the performance of the pump and treat system.

Additional costs for the pump and treat system would include the performance of a pump test to determine the required extraction rates, radii of influence, and optimum operating conditions for the ex-situ treatment system. Also included in the cost of this RA are insurance, bonds and a contingency factor.

O&M of the Pump and Treat System

It is anticipated that the pump and treat system would require regular maintenance. The O&M activities would include periodic backflushing of the carbon units and spent carbon changeout, replacing filters, feeding of chemicals (including caustic), and maintaining pumps and instruments.

Groundwater Monitoring

Details of the long-term groundwater monitoring program are included in the FS (Shaw, 2005). The long-term monitoring would be designed to monitor the system performance and ensure that the plume characteristics are not changing, no new source areas are apparent, regulatory levels are being met, and the plume as a whole is acting as predicted. The analytical program for the long-term groundwater monitoring program would consist of all of the contaminants of concern, and any additional parameters, to ensure monitoring of the plume for regulatory compliance as well as changing geochemical and oxidation reduction states.

Additional parameters may be required for the treated water samples as specified in the National Pollutant Discharge Elimination System (NPDES) permit to determine compliance with the discharge criteria. It should be noted that while the duration of the groundwater monitoring program was estimated in the FS, there is uncertainty associated with this estimated duration. The actual monitoring duration will be determined by the ongoing sampling results and the review of these results by the Army and other stakeholders. Groundwater monitoring will cease in accordance with an exit strategy that will be presented in the Remedial Design for the site.

Reporting

One of the requirements of the NJDEP Technical Requirements for Site Remediation is the submittal of periodic reports of sampling and analytical results, as well as closeout reports and statistical demonstration of compliance with regulatory criteria.

#### 2.10.4.4 Response Action GW-4: Pump and Treat Using UV/Chemical Oxidation, MNA, and Implementation of LUCs

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| Estimated Capital Cost: | *$1,247,000* |
| Estimated O&M Cost Over 15 Years: | *$1,756,000* |
| Estimated Present Worth Cost: | *$3,004,000* |

(Estimated present worth was calculated using a 7% discount rate.)

Response Action GW-4 involves similar activities to RA GW-3, with the exception that the treatment technology for extracted groundwater would utilize UV and chemical oxidation in place of carbon adsorption. Extracted groundwater would flow through a UV/oxidation reactor capable of treating up to 100 gpm of contaminated water. Effective pretreatment for turbidity would be required as it would inhibit the transmission of UV light. Explosive contaminants would be destroyed by photolysis through exposure to UV light and direct oxidation through exposure to ozone and peroxide. An ozone destruction unit would be used to treat collected off gases from the reactor and downstream units where ozone gas may collect or escape. The primary benefit of oxidation over carbon filtration is the destruction of contaminants rather than the transfer of contaminants to an alternate media (carbon) that requires disposal; however, oxidation technologies typically involve increased capital and O&M costs.

Implementation of LUCs for Response Action GW-4 requires the same components as those provided for RA GW-2. Refer to the discussion of RA GW-2 for detailed descriptions of: LUCs, planning, and permitting; site preparations; installation of a pump and treat system; long-term groundwater and surface water/sediment monitoring; and reporting. Elements of the pump and treat installation would be the same as RA GW-3 except the carbon filtration units would be replaced with a 100 gpm UV/oxidation reactor, an ozone generator, and ozone and peroxide feeding equipment. The timeframe for contaminant concentrations to reach below SCLs is approximately 10 years.

O&M of the Pump and Treat System

It is anticipated that the pump and treat system would require regular maintenance. The O&M activities would include replacement of filters, feeding of chemicals (including caustic), and maintenance of pumps and instruments. An additional one-time repair cost is included in the estimate due to the complexity of these systems.

#### 2.10.4.5 Response Action GW-5: Pump and Treat Using Bioreactor Treatment, MNA, and Implementation of LUCs

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| Estimated Capital Cost: | *$1,203,000* |
| Estimated O&M Cost Over 15 Years: | *$1,358,000* |
| Estimated Present Worth Cost: | *$2,560,000* |

(Estimated present worth was calculated using a 7% discount rate.)

Response Action GW-5 involves similar activities to RA GW-3, with the exception that carbon filtration treatment would be replaced by microbial degradation in a bioreactor. Similar to RA GW-4, bioreactor treatment has the advantage of destroying the explosive compounds rather than concentrating contaminants in an alternate media for disposal.

Extracted groundwater would be pumped into the bioreactor, which would contain microorganisms capable of mineralizing RDX and TNT. Conditions including temperature, pH, and nutrient addition would be controlled within the bioreactor to maximize contaminant degradation. The type of bioreactor proposed in the FS is a fluidized bed reactor, which utilizes granular activated carbon. Temperature, pH, nutrients, residence times and other operating parameters would be determined during treatability studies conducted prior to implementation. The treatability studies would also determine the type of microorganisms that would be necessary to degrade the COCs. Liquid granular activated carbon treatment could be added as a polishing step.

Implementation of LUCs for Response Action GW-5 requires the same components as those provided for RA GW-2. Refer to the discussion of RA GW-2 for detailed descriptions of: LUCs, planning, and permitting; site preparations; installation of a pump and treat system; long-term groundwater and surface water/sediment monitoring; and reporting. Elements of the pump and treat installation would be the same as those for RA GW-3, except the carbon filtration units would be replaced with a fluidized bed reactor. The timeframe for contaminant concentrations to reach below SCLs is approximately 10 years.

O&M of the Pump and Treat System

It is anticipated that the pump and treat system would require regular maintenance. The O&M activities would include periodic cleaning of the bioreactors, replacing filters, feeding of chemicals (including caustic and nutrients), and maintenance of pumps and instruments.

#### 2.10.4.6 Response Action GW-6: Pneumatic Fracturing and Liquid Atomized Injection of ZVI, MNA, and Implementation of LUCs

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| Estimated Capital Cost: | *$1,580,000* |
| Estimated O&M Cost Over 10 Years: | *$614,000* |
| Estimated Present Worth Cost: | *$2,194,000* |

(Estimated present worth was calculated using a 7% discount rate.)

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Response Action GW-6 would involve: 1) implementation of pneumatic fracturing and liquid atomized injection of granular ZVI for the in-situ treatment of the explosives plumes; 2) long-term groundwater monitoring for all groundwater AAs; and 3) implementation of ICs.

Similar to the pump and treat Response Action, RA GW-6 would target concentrations of RDX and TNT with concentrations greater than 10 µg/L. Under RA GW-6, it is estimated that the concentrations of COCs in groundwater would be reduced rapidly within the target zone.

Permeable reactive barriers utilizing ZVI have been shown to be effective at reducing RDX and TNT concentrations in groundwater. However, permeable reactive barriers are typically constructed downgradient of the plume to prevent migration of COCs rather than to target source areas for remediation. Extensive remedial timeframes are required for permeable reactive barriers for which cost effectiveness decreases as the depth of application increases. The effectiveness of the pneumatic fracturing and liquid atomized injection application of ZVI is primarily dependent on the ability to uniformly distribute the ZVI over the treatment area.

MNA is expected to reduce residual COC concentrations (both inside and outside the target area) to below SCLs within a total of 10 years. Monitoring of groundwater, as well as surface water, would be performed quarterly for the first 5 years, and semi-annually for the subsequent 5 years. Therefore, RA GW-6 would require an estimated total remediation time of one year and a total of ten years of monitoring. If RA GW-6 is chosen, pilot tests will be necessary to validate the estimated timeframe.

ZVI would be injected in the form of iron slurry with a trade name of Ferox$^{sm}$. Ferox$^{sm}$ is a patented technology owned by ARS Technologies. ZVI particles would be delivered using a gas-based liquid atomized injection technology following the pneumatic fracturing of the aquifer matrix. The remediation system will consist of iron slurry, nitrogen gas, transfer pumps, and injection points.

The iron powder is suspended in the slurry consisting of water and nitrogen gas. Nitrogen gas is injected into the formation immediately prior to injecting the slurry to create a network of fractures by which the slurry can travel. The gas is injected at pressures that exceed the inherent pressures in the soil and rock and at a flow volume that exceeds the inherent permeability. This injection of gas results in a fracture network, expanding outward from the fracture well. The iron slurry can be injected into the aquifer through direct push technology or injection wells, and discreet intervals can be packered to create a more accurate distribution of the slurry.

Response Action GW-6 would involve the following activities to be conducted at Sites 40 and 157:

- Pneumatic fracturing of the aquifer matrix;
- Injection of approximately 100,000 pounds of ZVI into a total of 78 injection points; and
- Monitoring of groundwater and surface water quarterly for the first 5-years, and biannually for the remaining years until the tenth year.

Implementation of LUCs for Response Action GW-6 requires the same components as those provided for RA GW-2. Refer to the discussion in the RA GW-3 for detailed description of: LUCs, planning, and permitting; site preparations; long-term groundwater and surface water/sediment monitoring; and reporting.

#### 2.10.4.7 Response Action GW-7: Nano-Scale ZVI Injection, MNA, and Implementation of LUCs

Estimated Capital Cost: *$1,369,000*
Estimated O&M Cost Over 10 Years: *$614,000*
Estimated Present Worth Cost: *$1,983,000*

(Estimated present worth was calculated using a 7% discount rate.)

Response Action GW-7 would involve: 1) injection of nano-scale ZVI for the in-situ treatment of the explosives plumes; 2) long-term groundwater monitoring for all groundwater AAs; and, 3) implementation of ICs. Implementation of RA GW-7 will comply with chemical-, location-, and action-specific ARARs.

Response Action GW-7 involves similar activities to RA GW-6. Nano-scale particles have greater surface area per unit mass than conventional iron powder, effectively increasing the reactivity of the iron. Bimetallic nano-scale particles couple a noble metal catalyst such as palladium, with the reactant ZVI to further increase the reactivity. Costs of nano-scale ZVI and bimetallic nano-scale particles are significantly greater than granular ZVI (per unit mass); however, the application of nano-scale ZVI slurry eliminates the need for pneumatic fracturing and liquid atomized injection and the mass of material applied is smaller. The mobility of nano-scale particles allows ZVI to be injected under significantly reduced pressures than those required for pneumatic fracturing and liquid atomized injection or applied by gravity feed. This increased mobility provides a more uniform distribution during injection and also allows the ZVI particles to be dispersed with groundwater flow. Bench-scale and pilot-scale tests would be conducted prior to full scale application to verify that this technology can be successfully applied to RDX and TNT. Given the increased reactivity and mobility of the iron particles, rapid reduction of COC concentrations would be expected; however, effects on the reducing conditions of the aquifer would likely be more transient than pneumatic fracturing/liquid atomized injection of ZVI powder. As with RA GW-6, concentrations exceeding 10 µg/L would be targeted. If necessary, multiple injections would be performed to reduce concentrations to less than 10 µg/L. Monitored Natural Attenuation is expected to reduce residual COC concentrations (both inside and outside the target area) to below SCLs within a total of 10 years.

Implementation of LUCs for Response Action GW-7 requires the same components as those provided for RA GW-2. Refer to the discussion in the RA GW-3 for detailed description of: LUCs, planning, and permitting; site preparations; long-term groundwater and surface water/sediment monitoring; and reporting.

#### 2.10.4.8 Response Action GW-8: Enhanced Anaerobic Bioremediation by Injection of Microbial Growth Substrate (Hydrogen Release Compound [HRC®], Emulsified Oil Substrate [EOS®], Sodium Lactate), MNA, and Implementation of LUCs

Estimated Capital Cost: *$1,192,000*
Estimated O&M Cost Over 10 Years: *$614,000*
Estimated Present Worth Cost: *$1,806,000*

(Estimated present worth was calculated using a 7% discount rate.)

Response Action GW-8 would involve: 1) injection of a microbial growth substrate, 2) long-term groundwater monitoring for the groundwater AA; and 3) implementation of ICs. All remediation components of RA GW-8 are similar to RA GW-7, except that a microbial growth substrate (electron donor) would be injected to promote anaerobic microbial degradation of the explosive compounds. RA GW-8, as evaluated in the FS, would involve: 1) installation of 80 injection points (assuming an injection point spacing of 15 feet on center laterally and 30 feet on center in the assumed direction of groundwater flow); and 2) injection of an electron donor (i.e. sodium lactate, whey, molasses or similar substrate). Due to logistical constraints and the desire to prevent the possibility of discharging electron donors into Picatinny Lake, the installation of injection points and implementation of this RA is assumed to be an iterative process. The initial stage would consist of installing approximately six injection and eleven monitoring points, followed by a pilot test.

The electron donor mass requirement is based on the mass required to achieve a concentration of 500 mg/L of organic carbon within the targeted region. In the case of sodium lactate, an estimated 70,000

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pounds of sodium lactate would be required to reach this objective. On an equivalent basis, injection via wells with several linear traverses containing multiple injection wells oriented perpendicular to groundwater flow and spaced hydraulically downgradient based on groundwater flow direction will be installed to deliver electron donor to the groundwater. The RD will detail the final optimum injection network, arrived at through use of an area-specific groundwater flow and COC fate numerical model.

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An alternative technology for the application of the microbial growth substrate is to use recirculating wells to introduce and distribute the microbial growth substrate. These wells would be used to create horizontal groundwater flow between the wells, which, along with introducing and mixing the substrate, would provide hydraulic control of the site.

Implementation of LUCs for Response Action GW-8 requires the same components as those provided for RA GW-2. Refer to the discussion in the RA GW-3 for detailed description of: LUCs, planning, and permitting; site preparations; long-term groundwater and surface water/sediment monitoring; and reporting.

## 2.11 COMPARATIVE ANALYSIS OF RESPONSE ACTIONS

The advantages and disadvantages of each of the response actions were compared using the nine CERCLA evaluation criteria established by the USEPA in Section 300.430(e) of the NCP. The detailed comparative analysis of all the Response Actions is provided in the FS for Group 1 Sites (PICA 079) and modifications made to the FS are provided in the Pre-Design Technical Memorandum for Group 1 Sites (PICA 079) (ARCADIS, 2009); a summary of this comparison is provided in the following text.

### 2.11.1 Protection of Human Health and the Environment

Soil

*Explosives in Soil:* Response action S1-1 does not provide adequate protection of human health or the environment, but all other RAs provide adequate protection of human health and the environment.

*Arsenic and PAHs in Soil:* Response action S2-1 does not provide adequate protection of human health or the environment, but all other RAs provide adequate protection of human health. Ecological risks for these areas are considered minimal.

*PCBs in Soils:* Response Actions S3-2 and S3-3 provide adequate protection for human health, but RA S3-1 does not provide adequate protection for human health. Ecological risks are considered to be minimal.

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Groundwater

Response Action GW-1 provides no control of exposure to the contaminated media and no reduction in risk to human health or the environment. Response Actions GW-2 through GW-8 provide protection to human health and the environment because contaminant concentrations would be reduced to SCLs either through natural processes or treatment (GW-2 through GW-8).

### 2.11.2 Compliance with Applicable or Relevant and Appropriate Requirements

Soil

*Explosives in Soil:* Although NJDEP promulgated the NJNRSRS in June 2008, these standards did not include explosives such as TNT and RDX. Therefore ARARs do not exist for explosives in soil. However, all RAs, with the exception of S1-1, comply with the SCLs. SCLs are based on the chemical-specific TBC criteria, which include calculated site specific criteria provided by NJDEP. All RAs will comply with action- and location- specific ARARs.

*Arsenic and PAHs in Soil:* RAs S2-3, S2-4, and S2-5 will comply with chemical-specific ARARs. S2-2 will comply with chemical-specific ARARs by implementing ICs and ECs to control exposure to contaminants that may result in unacceptable risk to human health until such a time that unrestricted use and unlimited exposure may occur. RAs S2-2, S2-3, S2-4, and S2-5 will comply with action- and location-specific ARARs.

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*PCBs in Soils:* RA S3-3 will comply with chemical-specific ARARs through active removal. S3-2 will comply with chemical-specific ARARs by implementing ICs and ECs to control exposure to contaminants that may result in unacceptable risk to human health until such a time that unrestricted use and unlimited exposure may occur. RAs S3-2 and S3-3 will comply with action- and location-specific ARARs.

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Groundwater

Chemical-specific ARARs are unavailable for the groundwater COCs. Thus for the purpose of this discussion, attainment of the SCLs (based on TBCs values) identified in **Table 7** will be evaluated. Groundwater RAs GW-2 through GW-8 will comply with chemical-specific SCLs, and action- and location-specific ARARs.

### 2.11.3 Long-term Effectiveness and Permanence

Soil

*Explosives in Soil:* Response Actions S1-2, S1-3, S1-4 and S1-5 satisfy the long-term effectiveness and permanence criterion for the Sites. Response action S1-1 does not propose any action, and therefore, does not offer an effective response to address the explosives in soils that is protective of human health and the environment.

*Arsenic and PAHs in Soil:* Response Actions S2-2, S2-3, S2-4, and S2-5 all provide long-term effectiveness and permanence for the reduction of human health exposure to the Group 1 Sites. Response Action S2-1 does not propose any action, and therefore, does not offer an effective response to address the explosives in soils that is protective of human health and the environment.

*PCBs in Soils:* RAs S3-2 and S3-3 provide adequate long-term effectiveness and permanence for the protection of human health exposure to the Group 1 Sites. Response Action S3-1 does not propose any action, and therefore, does not offer an effective response to address the explosives in soils that is protective of human health and the environment.

Groundwater

Response Action GW-1 does not provide any controls for reduction of exposure or long-term management measures, which means there is no method to determine whether the magnitude of the residual risks decrease over time. RAs GW-2 through GW-8 all provide similar long-term effectiveness and permanence as these RAs all result in the reduction of contaminants to concentrations less than the SCLs.

### 2.11.4 Reduction in Toxicity, Mobility, or Volume through Treatment

Soil

*Explosives in Soil:* The S1-5 RA provides the greatest reduction of the toxicity, mobility, and volume of contaminants at the Sites due to their permanent removal from the Site to an off-site disposal facility. Response Action S1-3 provides reduction of toxicity, mobility, and volume through the slurry-bioreactor treatment method. The S1-4 RA provides reduction of toxicity and mobility through the on-site bioremediation treatment process. The S1-2 RA also reduces toxicity and mobility of the contaminants on-site. The 'No Action' RA (S1-1) does not provide reduction of toxicity, mobility, or volume of contaminants.

*Arsenic and PAHs in Soil:* Response Actions S2-1 and S2-2 do not employ any treatment that would reduce the toxicity, mobility, or volume of the contaminants on-site. Response Actions S2-3 and S2-4 reduce the mobility of the contaminants by eliminating wind dispersion and erosion of particulate matter, and inhibit the potential infiltration to groundwater. Response Action S2-5 reduces the mobility of the contaminated material on-site because the contaminated material would be removed; however, the S2-5 RA will transfer the toxicity and volume to an off-site location.

*PCBs in Soils:* Response Actions S3-1 and S3-2 do not reduce the toxicity, mobility, or volume of the contaminated material on-site. Response Action S3-3 removes the contaminated material from the Site, resulting in the reduction of toxicity, mobility, and volume of the contaminated material on-site; however, the toxicity and volume would be transferred to the off-site disposal facility.

Groundwater

Response Action GW-1 does not provide any active reduction of contaminant concentrations nor is there any methodology, such as monitoring, to identify any naturally occurring reductions in contaminant concentrations. Response Action GW-2 takes advantage of on-going, natural processes to reduce contaminant concentrations and includes monitoring to measure and evaluate the progress over time. The remaining RAs provide active reduction of contaminant concentrations to a point, then also implements MNA to achieve the SCLs, over various timeframes.

### 2.11.5 Short-term Effectiveness

Soil

*Explosives in Soil:* Implementation of RA S1-1 does not pose any additional risks to the community, the workers, or the environment since there are no activities associated with this RA. All other RAs for explosives in soil would result in significant material handling, some dust generation, and additional risk during the transportation of contaminated soil on public roadways (i.e., highway accidents), resulting in minimal short-term risks. These short-term risks, however, can be adequately managed through implementation of good construction practices, use of personal protective equipment, standard dust suppression techniques, and compliance with the Department of Transportation's state and local shipping requirements.

*Arsenic and PAHs in Soil:* Response Actions S2-1 and S2-2, do not pose any additional risks to the community, the workers, or the environment because no active remediation would be conducted under these RAs. There are additional risks resulting from the implementation of RAs S2-3, S2-4, and S2-5, albeit low, which are due to handling contaminated material and resulting dust generation. These short-term risks, however, can be managed through implementation of good construction practices, use of personal protective equipment, and standard dust suppression techniques.

*PCBs in Soils:* Response Actions S3-1 and S3-2 do not pose any additional risks to the community, the workers, or the environment because no active remediation would be conducted under these RAs. Response Action S3-3 would result in short-term site risks due to material handling and dust generation; however, these risks can be managed through implementation of good construction practices, use of personal protective equipment, and standard dust suppression techniques.

Groundwater

All RAs for groundwater are equally effective in the short-term due to LUCs already in place restricting the use of groundwater. RAs GW-3 through GW-8 have greater short-term risks associated with construction activities and implementation activities. RAs GW-3, GW-4 and GW-5 also have increased short-term risks due to potential exposures to impacted media. RAs GW-6, GW-7, and GW-8 have increased short-term risks due to potential exposure to injection chemicals (ZVI and sodium lactate).

### 2.11.6 Implementability

Soil

*Explosives in Soil:* All Response Actions identified for explosives in soil are readily implementable with the exception of RA S1-1 as it has no action to implement. The FS noted that RA S1-2 has additional concern associated with UXO screening, but the equipment and construction practices are readily available.

*Arsenic and PAHs in Soil:* All Response Actions identified for arsenic and PAHs in soil are readily implementable with the exception of RA S2-1 as it has no action to implement. Response Action S2-2 would be the most implementable, as it requires establishing institutional controls that are largely already in place as various installation-wide regulations and/or have been readily implemented at other CERCLA sites at Picatinny.

*PCBs in Soil:* All Response Actions identified for PCBs in soil are readily implementable with the exception of S3-1 as it has no action to implement. Response Action S3-2 would be the most implementable, as it requires establishing institutional controls that are largely already in place as various installation-wide regulations and/or have been readily implemented at other CERCLA sites at Picatinny.

Groundwater

Response Action GW-2 is readily implementable; however, approvals from other agencies would be difficult to obtain for RA GW-1 as it has no specific action to implement. RAs GW-3 through GW-8 would require significant site improvements including the installation of injection points, monitoring wells, and staging locations. Operational restrictions will limit site access both spatially and time-wise. In addition, GW-6 and GW-7 require permits.

#### 2.11.7 Cost

Present worth (with an estimated discount rate of 7%) for each response action is presented herein. With the exception of Response Actions S1-1, S2-1, S3-1 and GW-1, Response Actions S1-5, S2-2, S3-2 and GW-2 have the lowest cost for both the soil and groundwater Response Actions. A summary of these costs are provided in **Table 9.**

Soil

*Explosives in Soil:* Response Action S1-1 is the least costly ($0) as no action is proposed. The remaining RAs in order of least expensive to most expensive are as follows: S1-5 ($401,000), S1-4 ($518,000), S1-3 ($735,000), and S1-2 ($817,000).

*Arsenic and PAHs in Soil:* Response Action S2-1 is the least costly ($0) as no action is proposed. The remaining RAs in order of least expensive to most expensive are as follows: S2-2 ($141,000), S2-4 ($246,000), S2-3 ($285,000), and S2-5 ($417,000).

*PCBs in Soils:* Response Action S3-1 is the least costly ($0) as no action is proposed for addressing PCBs in soil. The remaining Response Actions in order of least expensive to most expensive are as follows: S3-2 ($141,000) and S3-3 ($180,000).

Groundwater

The estimated cost to implement Response Action GW-1 is the least costly ($0) as no action is proposed. The remaining RAs in order of least expensive to most expensive are as follows: GW-2 ($520,000), GW-8 ($1,930,000), GW-7 ($2,100,000); GW-6 ($2,310,000), GW-3 ($2,650,000), GW-5 ($2,710,000) and GW-4 ($3,150,000).

### 2.12 MODIFYING CRITERIA

#### 2.12.1 State/Support Agency Acceptance

This document was prepared in partnership with USEPA and NJDEP representatives. USEPA approval and NJDEP concurrence of the Selected Response Action is anticipated. The NJDEP has demonstrated that it concurs with the Selected Response Action through the approval of the final PP.

CERCLA section 121(e) contains a permit exemption for all CERCLA actions. Only substantive provisions of otherwise applicable state permits need to be complied with. The CERCLA process exempts all administrative actions associated with state permits. The NJDEP will be provided with the appropriate information for any action so that NJDEP may verify the compliance with those substantive provisions which are applicable here.

#### 2.12.2 Community Acceptance

Community acceptance is based on comments received during the public comment period on Group 1 Sites Proposed Plan and is addressed in the Responsiveness Summary (Section 3) of this ROD.

### 2.13 PRINCIPAL THREAT WASTE

The NCP establishes an expectation that USEPA will use treatment to address the principal threats posed by a site wherever practicable [NCP 300.430(a)(1)(iii)(A)]. Identifying principal threat wastes combines concepts of both hazard and risk. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. Conversely, non-principal threat wastes are those source materials that generally can be reliably contained and would present only a low risk in the event of exposure. In addition, principal threat wastes are identified based upon the results of the quantitative risk assessment, with those compounds that have a value of $1x10^{-3}$ or higher being considered as principal threat waste. As concluded in the Risk Assessment, none of the contaminants that exceeded LOCs in soil or groundwater at the Group 1 Sites (PICA 079) meet the criteria of principal threat waste. In addition, groundwater itself is not a principal threat because it is considered a non-source material.

## 2.14 SELECTED RESPONSE ACTION

This ROD represents the Selected Response Action for the Group 1 Sites (PICA 079) at Picatinny, Rockaway Township, Morris County, New Jersey, developed in accordance with CERCLA as amended and consistent with the NCP. Based on the results of the comparative analysis and comments received from the USEPA and NJDEP, the Selected Response Action includes the following:

- Explosives in Soil: Response Action S1-5 - Excavation and Off-Site Disposal;
- Arsenic and PAHs in Soil: Response Action S2-2 - Implementation and Maintenance of LUCs;
- PCBs in Soil: Response Action S3-2 - Implementation and Maintenance of LUCs; and,
- Groundwater: Response Action GW-2 - Implementation of LUCs and MNA.

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### 2.14.1 Summary of the Rationale for the Selected Response Action

The Selected Response Action achieves the RAOs, meets the threshold criteria, and provides the best balance of tradeoffs with respect to the balancing and modifying criteria. The Selected Response Action addresses the risk posed by soil and groundwater effectively, is the most implementable, and is cost effective.

A detailed description of the Selected Response Action is provided in Section 2.14.2.

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### 2.14.2 Detailed Description of Selected Response Action

The Selected Response Action for remediation of soils at Group 1 Sites (PICA 079) includes the excavation of approximately 300 to 600 cubic yards of explosives-contaminated soil, the implementation and maintenance of land use controls, and the implementation of monitored natural attenuation for groundwater. The area of excavation is depicted on **Figure 11** and the area of LUC applicability is presented on **Figure 12**. Excavated soil would be transported off-site for disposal. ICs would also be implemented because some arsenic, PAH, PCB and explosive contamination above residential standards would remain at the site.

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In order to implement the Selected Response Action, the following actions will be required:

- Preparation of the following documents:
  - Remedial Design and construction work plans
  - Remedial Action Report
- Construction surveys;
- Waste characterization;
- Erosion and sediment controls as needed;
- Clearing of vegetation, as needed;
- Soil excavation and disposal;
- Confirmatory sampling;
- Backfilling;
- Site restoration; and,
- Implementation of ICs.

Upon the completion of the Selected Response Action the cumulative cancer risk at each Group 1 Site will be within, or below, the generally acceptable risk range of $1x10^{-4}$ to $1x10^{-6}$.

### 2.14.3 Land Use Controls

LUCs will be required at the Group 1 Sites (PICA 079) due to the residual contamination exceeding residential standards that will remain on-site following implementation of the Selected RA. The Army is responsible for implementing, maintaining, reporting on and enforcing the LUCs. The area of LUC applicability for Group 1 Sites is depicted on **Figure 12**. A change in land use would include notifying the regulators.

An LUC Remedial Design will be prepared as the land use component of the Remedial Design and will include the LUCs that will be implemented at the Group 1 Sites. Within 90 days of ROD signature, the Army shall prepare and submit to EPA for review and approval a LUC remedial design that shall contain implementation and maintenance actions, including periodic inspections.

The LUC objectives for the Group 1 Sites are as follows:

- Maintain the CEA and prevent access of use of the groundwater until cleanup levels are met.
- Maintain the integrity of any current or future monitoring systems such as monitoring wells.
- Prohibit the development and use of property for residential housing, elementary and secondary schools, child care facilities and playgrounds.

These LUC objectives will be met until such time as contaminant levels are sufficiently reduced to allow for unrestricted use and unlimited exposure. Requirements of NJDEP Deed Restriction policies will be included in the LUC Remedial Design. Many of the exhibits required by these policies, such as site maps, engineering drawings, and location maps, are already incorporated into CERCLA documents (such as attached Figures 1 and 12 of this ROD) and will be included in the Remedial Design. It should be noted that in the event that Picatinny is closed and the land ownership transferred, the LUCs would need to be documented through an appropriate mechanism for privately owned property (i.e., deed notice). Although the Army may later transfer these procedural responsibilities to another party by contract, property transfer agreement, or through other means, the Army shall retain ultimate responsibility for remedy integrity. Upon implementation of the remedy, the following activities will be completed to fully implement LUCs:

- Install and maintain engineering controls (typically signs) per the LUC Remedial Design;
- Amend the Geographic Information System to document the area of applicability, engineering controls, and sign locations;
- Prepare an announcement for all Picatinny employees and residents informing them of the LUCs at the Group 1 Sites; and,
- Conduct annual inspections of the site and complete an Annual Certification of LUCs.

### 2.14.4 Summary of Estimated Response Action Costs

The costs associated with the excavation of explosive-contaminated soils at the Group 1 Sites and implementation of LUCs for additional soils and Group 1 groundwater are detailed in **Tables 10, 11** and **12**, respectively, and are summarized in the following list:

Capital Costs

| | |
|---|---|
| ▪ Explosives-Contaminated Soil Excavation | $ 400,254 |
| – Permit and Report Writing | $ 45,000 |
| – Characterization and Sampling and Analysis | $ 67,781 |
| – Site Preparation | $ 15,087 |
| – Excavation and Disposal of Contaminated Soil | $ 110,257 |
| – Site Restoration | $ 14,857 |
| – Mobilization and Demobilization | $ 14,272 |
| – Construction Oversight | $ 43,114 |
| – Travel and Per Diem | $ 37,680 |
| – Contingency of Scope (10%) | $ 34,805 |

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ICs will be maintained and 5-year reviews will be performed until the concentration of hazardous substances in soil and groundwater are at such levels to allow for unrestricted use and unlimited exposure.

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- Contingency of Bid (5%) $ 17,402

- Implementation of Institutional Controls $ 32,200
- Implementation of LUCs, Long-Term Groundwater Monitoring and Evaluation of Monitored Natural Attenuation $ 54,000
  - Institutional Controls/Planning $ 14,000
  - Permit and Report Writing $ 40,000

**Total Capital Costs** **$ 486,254**

O&M Costs (30 Years) for LUCs

- Annual Site Inspection $ 93,068
- 5-Year Reviews (5 total for 30 years) $ 32,368
- Maintenance of Engineering Controls $ 18,815

O&M Costs (30 Years) for Long-Term Monitoring

- Sampling and Reporting Costs (over 30 years) $ 316,844
- Well Construction, Abandonment, and Maintenance $ 76,958
- 5-Year Review $ 10,695

**Total Present Worth O&M Costs (7% Dis., 30 years)** **$ 548,747**

**TOTAL PRESENT WORTH** **$1,125,251**

The costing information in this section is based on the estimates created in support of the FS (Shaw, 2005).

### 2.14.5 Expected Outcomes of the Selected Response Action

It is anticipated that current land use will continue unchanged after implementation of the Selected Response Action. It is expected that enforcement of LUCs will ensure that risks to human and ecological receptors remain within acceptable levels. Risk levels due to exposure to soils at Site 40 will be acceptable following implementation of the Selected RA.

## 2.15 STATUTORY DETERMINATIONS

Under CERCLA § 121 and the NCP, the lead agency must select remedies that are protective of human health and the environment, and comply with ARARs (unless a statutory waiver is justified), are cost effective, and utilize permanent solutions and response action treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment and permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes as a principal element and are biased against off-site disposal of untreated wastes. The following sections discuss how the Selected Response Action meets these statutory requirements.

### 2.15.1 Protection of Human Health and the Environment

The Selected Response Action will protect human health and the environment by reducing existing on-site contamination and maintaining LUCs that limit exposure.

### 2.15.2 Compliance with Applicable or Relevant and Appropriate Requirements

Three types of ARARs, chemical-specific, location-specific, and action-specific, were considered as part of the FS and are summarized for the Selected Remedies in **Tables 13** through **16**. COCs were identified for soil and groundwater at Group 1 Sites (PICA 079). SCLs were selected for soil in the Group 1 Sites FS based on the New Jersey soil cleanup criteria which were in effect at the time. Following the regulator's approval of the FS, the NJDEP replaced the NRDCSCC in June 2008 by promulgating the New Jersey Non-Residential Soil Remediation Standards (NJNRSRS). SCLS for soil are based on the newer NJNRSRS. However, even with the promulgated standards, chemical-specific ARARs do not exist for explosives in soil or for groundwater COCs. Instead, the SCLs for explosives in soils and groundwater are both based on the chemical-specific TBC criteria, which include calculated site specific criteria

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provided by NJDEP. Therefore, chemical-specific ARARs do not exist for explosives in soil or in groundwater, but do exist for arsenic, PAHs, and PCBs in soil.

Compliance with the action- and location-specific ARARs is readily achievable with currently available technologies proposed for each response action.

### 2.15.3 Cost Effectiveness

In the lead agency's judgment, the Selected Response Action is cost-effective and represents a reasonable value in the money to be spent. In making this determination, the following definition was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness" (NCP §300.430(f)(1)(ii)(D)). This determination was accomplished by evaluating the "overall effectiveness" of those response actions that satisfied the threshold criteria (i.e., were both protective of human health and the environment and ARAR-compliant). Overall effectiveness was evaluated by assessing the five balancing criteria in combination (long-term effectiveness and permanence, reduction in toxicity, mobility and volume through treatment, short-term effectiveness, implementability, and costs). A comparison of the costs to the overall effectiveness was conducted to determine cost effectiveness. The relationship of the overall effectiveness of the Selected RA was determined to be proportional to its costs, and hence the Selected Response Action represents a reasonable value for the money to be spent.

The Army believes that the Selected Response Action is cost-effective and is protective of human health and the environment.

### 2.15.4 Utilization of Permanent Solutions and Response Action Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Possible

Active remediation is not required to achieve the RAOs developed for Group 1 Sites (PICA 079), although it is proposed to remove the risk of exposure to explosive-contaminated soils via excavation and off-site disposal. Consequently, the Selected Response Action employs permanent solutions to treat and reduce the total volume of contaminants present at the site. The Selected Response Action satisfies the criteria for long-term effectiveness by preventing unacceptable exposures to site soils and groundwater. The Selected Response Action reduces the toxicity, mobility and volume of contamination at the site; and, is minimally intrusive and will have reduced short-term risks by removing explosives-contaminated soils and reducing the exposure to impacted soil and Group 1 groundwater. Additionally, there are no significant implementability issues associated with the Selected Response Action as the remedial activities have become commonly applied construction practices.

### 2.15.5 Preference for Treatment as a Principal Element

The Selected RA does not address remediation at the Group 1 Sites (PICA 079) through the use of active treatment technologies. As concluded in the Risk Assessment, none of the contaminants that exceeded LOCs at Group 1 Sites (PICA 079) meet the criteria of principal threat waste. The Selected RA was chosen over response actions which included treatment after considering the balancing criteria such as, short term effectiveness, implementability, cost, and community acceptance.

### 2.15.6 Five-Year Review Requirements

Because this Response Action will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, statutory reviews will be conducted every five years after response action initiation. Five-year reviews will ensure that the Response Action is, or will be, protective of human health and the environment.

## 3.0 PART 3: RESPONSIVENESS SUMMARY

The final component of this ROD is the Responsiveness Summary. The purpose of the Responsiveness Summary is to provide a summary of the stakeholders' comments, concerns, and questions about the Selected Response Action for Group 1 Sites (PICA 079) and the Army's responses to these concerns.

The Group 1 Sites (PICA 079) have been the topic of presentations at the Picatinny Arsenal Environmental Restoration Advisory Board (PAERAB). PAERAB members have provided comments regarding the proposed Response Action. A copy of the PP was given to the PAERAB's co-chair and a copy was offered to all PAERAB members. A final PP for Group 1 Sites (PICA 079) was completed and released to the public on October 29, 2009 at the information repositories listed in Section 2.3.

Multiple newspaper notifications were made to inform the public of the start of the PP comment period, solicit comments from the public, and announce the public meeting. The notification was run in the Daily Record and in the Star Ledger on October 16, 2009. Copies of the certificates of publication are provided in **Appendix A**. A public meeting was held on October 29, 2009 to inform the public about the Selected Response Action for Group 1 Sites (PICA 079) and to seek public comments. At this meeting, representatives from the U.S. Army, NJDEP, USEPA, and the Army's contractor, ARCADIS U.S., Inc., were present to answer questions about the site and response actions under consideration. A public comment period was held from October 29, 2009 to November 28, 2009 during which comments from the public could be submitted.

In general, the community is accepting of the Selected Response Action and is in favor of removing contaminated soils and groundwater contamination from the site. All comments and concerns summarized below have been considered by the Army, USEPA, and NJDEP in selecting the final cleanup methods for Group 1 Sites (PICA 079) at Picatinny.

### 3.1 PUBLIC ISSUES AND LEAD AGENCY RESPONSES

As of the date of this ROD, the Army endorses the Selected Response Action for Group 1 Sites (PICA 079). The USEPA and the NJDEP support the Army's plan. Comments received during the Group 1 Sites (PICA 079) public comment period on the PP are summarized below. The comments are categorized by source.

#### 3.1.1 Summary of Written Comments Received During the Public Comment Period

No written comments were received during the public comment period.

#### 3.1.2 Summary of Comments Received During the Public Meeting on the Proposed Plan and Agency Responses

Six comments specific to the Selected Response Action were received during the public meeting held on October 29, 2009. Transcripts from the public meeting have been submitted into the Administrative Record (located at the information repositories listed in Section 3.2) for the site.

The comments received on the Selected Response Action are summarized as follows:

Comment 1: Ms. Virginia Michelin, a member of the PAERAB: Was the detection of TNT at 9.65 expected, after prior sampling had shown no detections? What about the detection limits?

Response: Mr. Llewellyn: It is typical to see some variance at lower level concentrations; in addition, the plume is migrating. The detection limits are lower than the standards.

Comment 2: Mr. Michael Glaab, a member of the PAERAB: I am very encouraged by the plans to conduct excavation at certain areas and by the decreasing concentrations of TNT and RDX, but concerned that the center of the plume seems to be moving toward Picatinny Lake.

Response: Mr. Llewellyn: The groundwater is shallow in this area with the Lake right next to the site. The combination of degradation and the flow hydraulics is causing the decreasing concentrations. In addition, the source is no longer present as explosive contaminated wastewater is no longer being discharged. The lake sediment has high levels of carbon which may be helping the degradation process, along with naturally occurring dilution and dispersion. Studies have found no impact to the fish in the Lake.

Mr. Gabel: There is a fish advisory, as there are for most New Jersey lakes, due to the presence of PCBs and mercury.

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Comment 3: Mr. Glaab: I am concerned about TNT and RDX going off-site.

Response: Mr. Gabel: Those compounds were not seen in the Lake surface water.

Comment 4: Mr. Glaab: Is it possible to construct a small barrier at the edge of the plume.

Response: Mr. Llewellyn: It would not be feasible at this site as the use of a bio-treatment process so close to the Lake would create reducing conditions and have a negative impact on the fish in the Lake.

Comment 5: Mr. Greg Zalaskus: The State is in general agreement with the recommended alternative and is comfortable that a 13-year monitored natural attenuation program is very reasonable and this is an ideal site for natural attenuation.

Response: Comment received and acknowledged..

Comment 6: Mr. John Malleck: The EPA generally does not endorse a final remedy until after the public comment period and the State's concurrence is received, but is also in general agreement with the proposed remedy.

Response: Comment received and acknowledged.

### 3.2 TECHNICAL AND LEGAL ISSUES

No technical or legal issues were raised on the Selected Response Action.

## 4.0 PART 4: REFERENCES


ARCADIS U.S., Inc. (ARCADIS), 2009. *Pre-Design Technical Memorandum, Group 1 Sites (PICA 079), Picatinny Arsenal, New Jersey*, Prepared for U.S. Army Environmental Center, Final, April.

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ICF Kaiser Engineers, Inc. (ICFKE). 1999. *Picatinny Arsenal Phase II Remedial Investigation Report, Round 1 (Draft Final)*, Prepared for U.S. Army Corps of Engineers – Baltimore District, Contract No. DACA-31-95-D-0083, April.

IT Corporation (IT). 2001a. *PTA Phase II Sites Remedial Investigation*, Prepared for U.S. Army Corps of Engineers – Baltimore District, Contract No. DACA-31-95-D-0083.

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IT, 2002. *Picatinny Arsenal Task Order 5, Phase II Group 1 Sites Remedial Investigation Report, Sites 40, 93, 156, & 157*, Prepared for U.S. Army Corps of Engineers – Baltimore District, Contract No. DACA-31-95-D-0083, Final, June.

Shaw Environmental, Inc. (Shaw). 2005. *Group 1 Sites Feasibility Study*, Picatinny, New Jersey, Prepared for Army Total Environmental Program Support, Deliver Order No. 0017, Final, May.


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