Department of the Army

Environmental Quality Technology Program

Addressing Defense Requirements with Tomorrow's Technology

Annual Report to Congress Fiscal Year 2002

Report To Congress For Fiscal Year 2002
Environmental Quality Technology Program

Foreword

On behalf of the Department of the Army, it is my pleasure to present the annual report on the progress and accomplishments of the Army's Environmental Quality Technology Program. In this report, we convey the most important environmental quality technology needs for the Army. We identify the Army process and technology solutions to meet these environmental requirements. Finally, we recommend a priority and funding structure within the Department of Defense budget formulation process to implement these solutions.

This program is a significant success and is an example of the kind of innovative thinking and creative management that will support the Army far into the 21st century. The process is structured to sustain the Army's science and engineering base for Environmental Quality Technology Research, Development, Test, & Evaluation. It is focused on a fixed amount of resources every year as it develops technologies to resolve the Army's emerging high-priority environmental requirements. This year's report emphasizes leadership through environmental stewardship, which includes removal technologies for lead-based paint contamination, signature modeling to discriminate unexploded ordnance, and emission control technology to support environmental compliance. These innovative technologies are targeted to reduce total ownership costs related to sustaining the environment and the Army mission.

The Environmental Quality Technology Program continues to address critical Army environmental needs now with tomorrow's technology. Thank you for this opportunity to present the Army's accomplishments for Fiscal Year 2002.

Thomas E. White
Secretary of the Army

April 2003

Executive Summary

This report provides the status of The Army's Environmental Quality Technology (EQT) Program and an overview of The Army's FY 2002 environmental quality research, development, test and evaluation (RDT&E) efforts through 30 September 2002. The Department of the Army has a legal obligation to comply with environmental regulations and Executive Orders to ensure that its industrial and operational activities meet national, regional, state, and local standards. Section 323 of the National Defense Authorization Act for Fiscal Year 2000, Public Law 106-65, amends Section 2706 of Chapter 160 of Title 10, United States Code, to establish the requirement for an annual report on the Department's EQT Program.

During Fiscal Year (FY) 2002, The Army continued its commitment as the Department of Defense (DoD) leader in caring for the installations, training lands, and weapon systems required to enable military readiness. The Army seeks to wisely invest and leverage available resources to support its responsibilities without compromising the primary warfighting mission and to enhance readiness, modernization, transformation of the force, and quality of life initiatives wherever possible. The Army's EQT Program executes environmental stewardship by providing investments in effective and efficient technological solutions to meet these challenges. Five major highlights are:

- Formulated twenty RDT&E programs for FY 2004-2009 Program Objective Memorandum including five fully funded programs.
- Finalized the EQT Management Plan and EQT-Operational Requirements Document for Unexploded Ordnance (UXO) Screening, Detection, and Discrimination.
- Finalized the EQT Management Plan for Hazard/Risk Assessment for Military Unique Compounds.
- Targeted $8.7M in FY 2002 for pollution prevention RDT&E.
- Produced and/or published over 80 products from appendix D.

The Army's EQT Program is based on a rigorous bottom-up identification and validation of user requirements through the Army Environmental Requirements and Technology Assessments (AERTA) process. Following the Army's planning, programming, budgeting, and execution cycle, this strenuous requirements-building process gives senior Army leadership the ability to set priorities for needs, focus resources, and ensure cost-efficient investments for technology transfer and fielding. The Army's FY 2002 EQT budget request was $30 million (M). Congress appropriated an additional $43M ($39M non-NDCEE and $4M NDCEE) for Congressional interest projects, which the Army leveraged to resolve high-priority environmental quality technology requirements. The Army's EQT Program provides a virtual toolbox of innovative technologies to resolve high-priority environmental quality technology requirements, while reducing total ownership costs, enhancing mission capabilities, and fulfilling the Army's environmental management and stewardship responsibilities.

Fiscal Year 2002 Army Environmental Quality Technology Programs									
Army EQT Programs		**Defense Planning Guidance**			**Leveraging Sources**				
	Pillar[1]	Army High Priority	Projected Payback	Cost Avoidance[2]	SERDP[3]	ESTCP[4]	NDCEE[5]	Navy/AF[6]	Federal Agency[7]
Unexploded Ordnance (UXO) Identification and Discrimination	RES	●	●	●	●	●		●	●
Hazard/Risk Assessment of Military Unique Compounds (MUC)	RES	●	●	●	●		●	●	●
Enhanced Alternative and In-Situ Treatment Technologies for Explosives, Organics and Solvents in Groundwater	RES	●	●	●	●	●			
Innovative and In-Situ Treatment Technologies for Soils Contaminated with Inorganics	RES	●	●	●		●			
Particulate Matter/Dust Control	COM	●	●	●					
Training and Testing Range Noise Control	COM	●	●	●		●			
Hazardous Air Pollutant (HAP) and Volatile Organic Compound Emission Control	COM	●	●	●		●	●		
Treatment Techniques for Wastewaters from Munitions Production	COM	●	●	●					
Sustainable Army Live-Fire Range Design and Maintenance	COM	●	●	●					
Removal, Treatment, and Disposal Technologies for Lead-Based Paint (LBP) Contamination	COM	●	●	●		●			
Sustainable Painting Operations for the Total Army (SPOTA)	P2	●	●	●			●		
Solid Waste Diversion	P2	●	●	●	●	●			
Develop a NESHAP Chemical Agent Resistant Coating (CARC) System	P2	●	●	●	●				
Ordnance Manufacture, Maintenance, Use, and Surveillance to Enable Sustainable Ranges	P2	●	●	●			●		
Reduce/Eliminate Pollution for Compliant Plating Processes	P2	●	●	●	●				
Reduce/Eliminate Pollution for Compliant Composite Manufacturing and Repair	P2	●	●	●			●		
Reducing Impacts of Threatened and Endangered Species (T&ES) on Military Readiness	CON	●	●	●					
Baseline Threatened and Endangered Species (T&ES) Surveys and Monitoring	CON	●	●	●					
Land Capability/Characterization	CON	●	●	●	●				
Land Rehabilitation	CON	●	●	●					
Non-Invasive Species Control for Army Installations and Operations	CON	●	●	●	●				
Electrokinetic Remediation of Contaminated Soils (U.S./German DEA Project)		●	●	●		●			

1. Army EQT Program Pillars: RES – Restoration; COM – Compliance; P2 – Pollution Prevention; CON – Conservation.
2. Payback within 3-5 years of demonstration and/or validation completion IAW DPG.
3. SERDP – Army managed Strategic Environmental Research and Development Program funding.
4. ESTCP – Army managed Environmental Security Technology Certification Program funding.
5. NDCEE – Army managed National Defense Center for Environmental Excellence funding.
6. Army programs that leverage other Department of Defense funding (Air Force or Navy).
7. Army programs that leverage funding from other Federal agencies.

Congressional Interest Project Index (Cross Ref. Appendix C, C-#)
C-2; Waste Minimization and Pollution Research (EM1)
C-3; Molecular and Computational Risk Assessment (EN8)
C-4; RangeSafe Technology Demonstration (Rangesafe) (F28)
C-5; Proton Exchange Membrane (PEM) Fuel Cells (EM3)
C-6; Plasma Energy Pyrolysis System (PEPS) (EN4)
C-7; Fort Ord Clean-Up Demonstration (EN2)
C-8; Vanadium Technology Program (EN7)Porta Bella Environmental Cleanup (EN5)
C-10; Transportable Detonation Chamber Validation (E12)
Commercialization of Technology to Lower Defense Costs InitiativeCasting Emission Reduction Program (CERP) (EN1)
C-13; Unexploded Ordnance in support of Military Readiness (EN6)
C-14; Managing Army Technologies for Environmental Enhancements (MANATEE)

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Army Environmental Quality Technology Program

1. Introduction

1.1 Background

In 2002, the Army published the third Environmental Quality Technology (EQT) Program Report to Congress constituting the Army's input to the U.S. Department of Defense (DoD) Report for Fiscal Year (FY) 2001 as required by Section 323 of the National Defense Authorization Act for FY 2000.

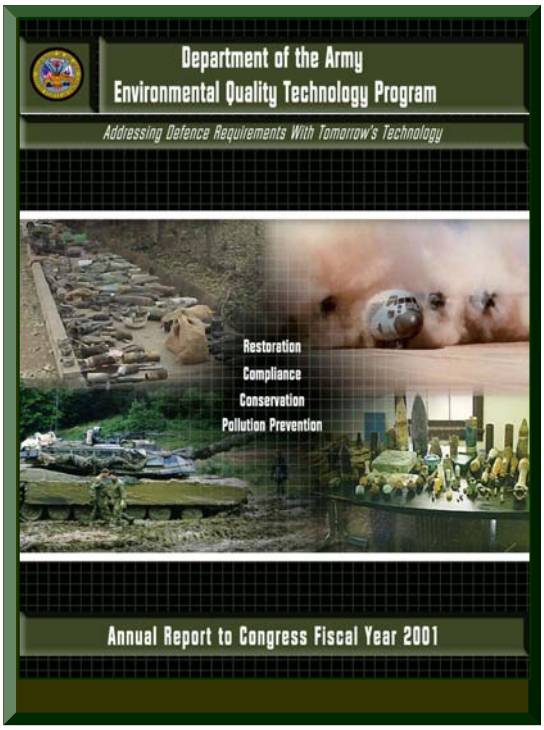


Figure 1-1. FY 01 Army EQT Annual Report

The technology planning process is part of an investment control process for the selection, prioritization, management, and evaluation of environmental quality technologies by the DoD, Military Services, and other Defense Agencies. The Army's EQT Program control processes are structured to adhere to this requirement with a management and oversight process responsive to the Defense Planning Guidance (DPG). The EQT Program addresses the Army's high-priority research, development, test, and evaluation (RDT&E) requirements by developing, exploiting, demonstrating, validating, and transferring the technologies for qualification and implementation.

Working within the six-year planning, programming, budgeting, and execution cycle, the EQT program process begins with a rigorous bottom-up identification and validation of Army Environmental Technology Requirements and Assessments (AERTA). This process continues with centralized top-down leadership oversight and culminates in demonstration/validation and efforts to transfer the technology to resolve these AERTA requirements.

The Army's FY 2002 budget request was $39 million (M). The FY 2002 Defense Appropriations Act reflected a $7M Congressional decrement from the FY 2002 budget request. However, Congress appropriated an additional $43M for Congressionally directed projects, which the Army exploited to the fullest extent possible to resolve its high-priority requirements.

The FY 2002 Army EQT Program continued to emphasize the importance of the AERTA process to systematically address EQT requirements and focus Army leadership on environmental quality priorities, preserve our natural resources, and be prepared for future wars and their aftermath. The Army calls for accountability in achieving performance-based results in the EQT Program by establishing a connection between program direction and achievement of performance-based results.

1.2 Army EQT Program Overview

To succeed in its commitment to mission readiness and environmental quality management and stewardship, the Army seeks to leverage resources wisely. The goal is to meet its responsibilities without compromising the Army's primary warfighting mission and to enhance readiness, modernization, transformation of the force, and quality of life initiatives wherever possible. This innovative approach to program development, management, and oversight supports the Army's commitment to environmental leadership and results in the transfer of technologies that reduce the Army's total ownership costs following qualification and implementation.

Figure 1-2. The Army's Environmental Leadership

The ability of the Army to fully achieve its environmental goals rests with the focused investment in and exploitation of technology. The Army's EQT Program is a systematic approach that begins with validating user requirements. Research, development, test, and evaluation (RDT&E) program development is driven by validated requirements. With the intent of reducing the Army's environmental impacts and future operating costs, the program executes environmental management and stewardship by supporting investments in effective and efficient technological solutions to challenges in restoration, compliance, conservation, and pollution prevention.

1.3 EQT Goals

The Army's overall goal in environmental quality technology is to enable mission readiness through the development, demonstration, and exploitation of technology that provides sustainable installations, training lands, and weapon systems. The objectives of the EQT Program are to:

- Focus efforts on high-priority user requirements;
- Implement technology development when technology is not commercially available;
- Provide an adequate science and engineering base for the future; and
- Integrate EQT efforts to support technology transfer.

Through the following actions, the EQT Program identifies and develops meaningful products:

- Identify and validate user requirements;
- Define and measure performance against program objectives;
- Produce quality results; and
- Service and support the users.

1.4 Army EQT High-priority RDT&E Programs

During 2001, the Army completed a thorough revision of the high-priority Army Environmental Requirements and Technology Assessments (AERTA) requirements to support program formulations for FY 2004 through FY 2009. This program formulation effort in FY 2002 resulted in adjustments where necessary in RDT&E programs under execution in FY 2002 and budgeted in future years. Twenty-one prioritized multi-year RDT&E EQT programs executed in FY 2002 focused program resources to resolve the highest priority environmental quality technology requirements as presented in AERTA. Five of the twenty-one Army EQT programs are fully funded. A description for each of these programs is provided in an appendix of this report. These summaries contain performance objectives, accomplishments, and dollars executed in FY 2002.

1.5 Congressional Interest Projects

Congressional interest projects typically address the application of technologies to resolve particular problems. FY 2002 Congressional interest projects totaled thirteen independent efforts, which Congress directed and funded the Army to address. Examples include technologies to decrease life-cycle costs for weapon systems from materiel corrosion, and develop guidance to assess health and environmental hazards from heavy metals used in weapon systems. A detailed description of each of these projects is found in an appendix of this report.

Fiscal Year 2002 Congressional Interest Projects
Waste Minimization and Pollution Research
Molecular and Computational Risk Assessment
Range Safety Technology Demonstration (Rangesafe)
Proton Exchange Membrane Fuel Cell Demo
Plasma Energy Pyrolysis System (PEPS)
Fort Ord Clean-Up Demonstration Project
Vanadium Technology Program
Porta Bella Environmental Cleanup
Transportable Detonation Chamber Validation
Commercialization of Technology to Lower Defense Costs
Casting Emission Reduction Program (CERP)
Unexploded Ordnance in Support of Military Readiness
Managing Army Technologies for Environmental Enhancements

1.6 National Defense Center for Environmental Excellence (NDCEE)

As the DoD Executive Agent for the National Defense Center for Environmental Excellence (NDCEE), the Army is committed to the success of the program to facilitate technology validation of innovative environmental quality technologies aimed at reducing total ownership costs in support of national defense. Established in 1991 by Congress, the NDCEE addresses DoD high-priority environmental technology requirements. Metrics applied to the NDCEE are based on the program validation of technology's usefulness to potential users. The FY 2002 NDCEE programs are described in the summaries contained in an appendix of this report.

2. Army EQT Program Accomplishments

2.1 Training and Testing Range Sustainment Technology Strategy

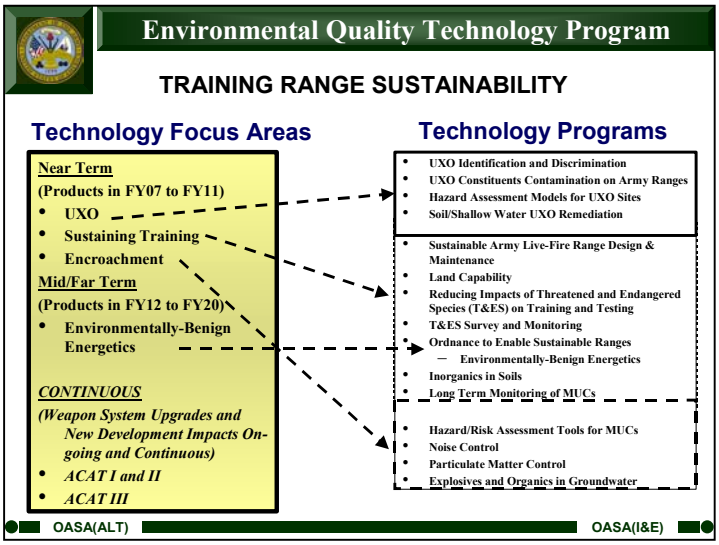


Figure 2-1. Training Range Sustainability.

In FY 2002, Army senior leadership endorsed a proposed strategy to focus the Army's EQT Program to address high-priority training range sustainment requirements. To preserve test and training range capabilities in the future and in doing so support the Army's mission, enhance readiness, modernization, and transformation of the force, specific focus areas were correlated with Army EQT projects that included added investment by the Army. The net result will provide the Army technology solutions to address the Army's high-priority RDT&E needs in the areas of Sustainable Army Live-Fire Range Design and Maintenance; Unexploded Ordnance Detection and Discrimination; Hazard/Risk Assessment for Military Unique Compounds; and others including ordnance improvements to enable sustainable ranges.

2.2 Sustainable Painting Operations

New air emission standards promulgated by the U.S. Environmental Protection Agency may cost the Army over $300 million between FY 2004 and FY 2009 with an additional cost of over $30 million each year thereafter. Thirty-two Army installations will be affected. During FY 2002, the Army formulated a new EQT program to enable Army installations to sustain painting operations by developing Clean Air Act compliant materials and processes through reformulation, substitution, validation, and qualification. Hazardous air pollutants from high performance coatings, munitions coatings, rubber-to-metal bonding materials, solvents, and depainting materials will be eliminated or reduced to meet new National Emissions Standards for Hazardous Air Pollutants (NESHAP) requirements. This approach minimizes detailed, expensive, manpower-intensive, record keeping associated with using emissions control technologies inherent in the compliance method currently in use for these hazardous air pollutants. This program has a high potential to benefit Defense-wide requirements by keeping painting operations uninterrupted.

2.3 Army Environmental Requirements and Technology Assessments (AERTA)

Documentation of the Army's environmental technology requirements is an iterative process. During FY 2002, the Army revalidated these "mission needs" and their respective performance

metrics. The AERTA process is, and will continue to be, the basis for formulating Army EQT RDT&E programs.

The Army's EQT process requires a rigorous validation and adjustments to the existing AERTA requirements every two years. Annually, the Army reviews these existing requirements and revalidates performance data. The Army's user community, as advocates for the AERTA requirements, identified needed adjustments to the existing requirements. The Army updated and compiled cost information for all requirements for consideration by Army leadership and integration into the program formulation process.

2.4 Program Measures of Performance

The Army's EQT Program management process evaluates the overall program effectiveness through a set of measurable goals and objectives, beginning with environmental quality technology requirements identification/ validation and ending with evaluation of transferred technologies to resolve the original user requirement.

All Army direct funded prioritized multi-year RDT&E programs met their performance objectives in FY 2002. The process achievements and completed technology products are further discussed within this report.

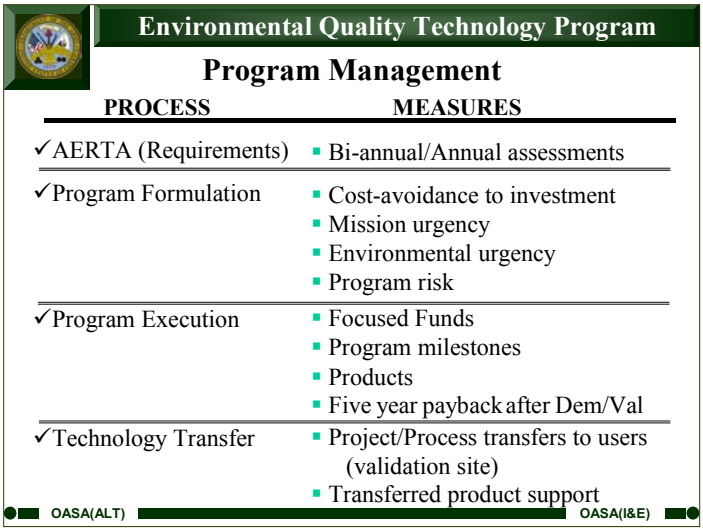


Figure 2-2. Program Management Measures of Performance.

2.5 Other FY 2002 Program Accomplishments

A number of fiscal and leadership decisions made in FY 2002 reflect the overall success and leadership confidence in the Army's EQT Program and its potential for significant impacts on reducing total ownership costs to the Army for environmental compliant weapon systems and industrial and installation operations.

Additional highlights of the FY 2002 EQT Program are:

- Formulated fifteen EQT programs for the FY 2004-2009 timeframe.
- Finalized two EQT Program Management Plans in Unexplored Ordnance (UXO) Identification and Discrimination and Hazard/Risk Assessment of Military Unique Compounds.
- Implemented first EQT Operational Requirements Document (EQT-ORD) for UXO Screening, Discrimination, and Identification.
- Targeted $8.7M in FY 2002 for pollution prevention RDT&E.

3. Program Investment

The Army's confidence in this program was reflected again with renewed commitment in FY 2002 for full support of EQT RDT&E programs. This is reflected by the Army's FY 2002 budget request for $39 million (M) to support the EQT Program. Although the FY 2002 Defense Appropriations Act reflected a $7M Congressional decrement from the FY 2002 budget request, Congress appropriated an additional $43M for thirteen Congressionally directed projects, which the Army exploited to the fullest extent possible to resolve its high-priority requirements.

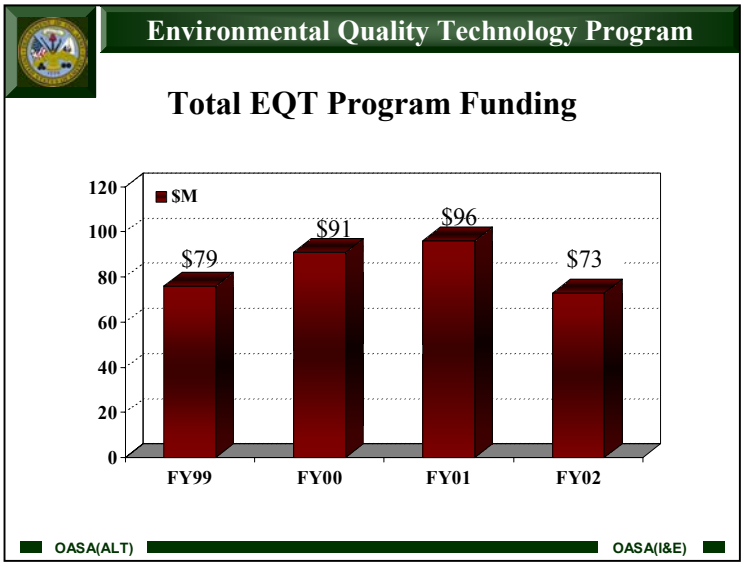


Figure 3-1. Army EQT Program Funding.

4. Army EQT Program Process

The Army's EQT Program formalized its operating processes. Endorsed by Army leadership, the EQT Operating Principles were developed during FY 2000 with implementation beginning in FY 2001. The Army's EQT Operating Principles define and document the Army's EQT operating and approval processes by Army leadership. These processes include EQT management, generation and validation of requirements, program formulation, program prioritization, and technology transfer.

4.1 EQT Management Oversight

The Army's EQT Program oversight structure focuses investments and provides visibility of the Army's RDT&E efforts for senior Army leadership and the Congress. The Environmental Technology Technical Council (ETTC) is a program management oversight council co-chaired by the Deputy Assistant Secretary of the Army for Environment, Safety, and Occupational Health, and the Director, Research and Laboratory Management. The Environmental Technology Integrated Process Team (ETIPT) integrates programs and addresses issues supporting the ETTC.

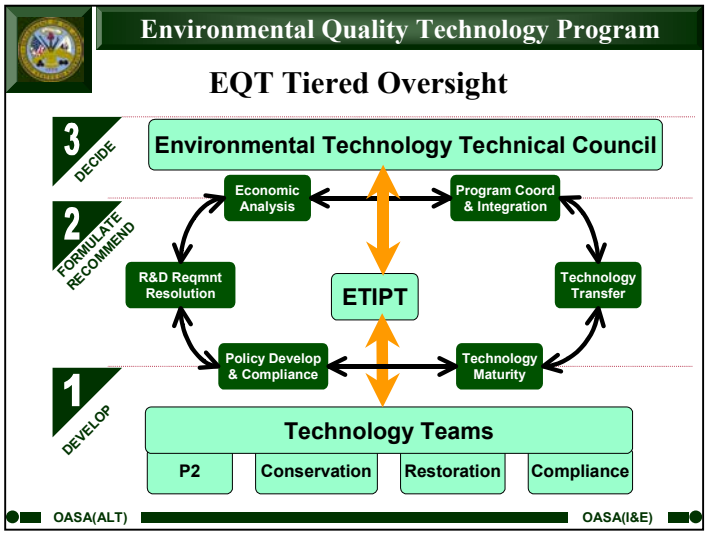


Figure 4-1. Army EQT Tiered Oversight.

Technology Teams are the foundation for the formulation and execution of the EQT Program. They are composed of members of the RDT&E community and potential users of the technology. Technology Teams identify, prioritize, and justify technological solutions, and formulate programs which address existing Army high-priority requirements in each of the four Army environmental quality pillars. Based on Department of the Army guidance, the ETTC members seek funding for programs through the Army planning, programming, budgeting, and execution system process. This helps ensure that Army high-priority user EQT requirements are identified from the bottom-up and programs are developed that meet the needs of the users.

4.2 Requirements Determination and Validation

Army Environmental Requirements and Technology Assessments (AERTA) are the basis for identifying the requirements for technology development in the EQT Program process. By design, the AERTA process is user-driven. The process begins with a definition phase of collection and identification of needs from the requiring community. The Assistant Chief of Staff for Installation Management completes the process by forwarding the final AERTA to the Assistant Secretary of the Army for Installations and Environment for insertion to the ETTC for oversight and execution of the Technology Development phase.

The Army's EQT requirements represent critical technology needs for accomplishing the Army's mission while minimizing impact on the environment. These requirements are Army-level requirements and include installation or weapon needs only when that need is critical to the execution of the Army's mission; thus, they are not installation or weapon specific. Review criteria for these EQT requirements include an evaluation of their impacts on readiness and quality of life, impact or threat to the environment, and timeliness needed for the Army to maintain compliance with environmental regulations.

Army Environmental Quality Technology Requirements

	Restoration
1	Unexploded Ordnance (UXO) Screening, Detection, and Discrimination [1.6.a]
2	Enhanced Alternative and In-situ Treatment Technologies for Explosives and Organics in Groundwater [1.2.a]
3	Develop Data and Model Integration Tool to Support Risk/Hazard Assessment, Fate/Effects, and Transport Predictability Models for Military Unique Compounds, Explosives and DU [1.5.g]
4	Innovative In-Situ and/or On-site Ex-Situ Treatment Technologies for Soils Contaminated with Inorganics [1.3.e]
5	Develop Long-Term Monitoring, Standard Analytical, and Groundwater Monitoring Techniques for Military Unique Compounds [1.1.i]
6	Soil/Sediment Unexploded Ordnance (UXO) (Neutralization/Removal/Remediation) [1.6.b]
7	Shallow Water Unexploded Ordnance (UXO) Recovery/Removal/Remediation [1.6.e]
8	Development of Optimization/Site Closure Tool for Groundwater Pump and Treat Systems [1.5.o]
9	Innovative Treatment Technologies for Depleted Uranium Soils [1.3.j]
10	Development of Hazard Assessment Models for Unexploded Ordnance (UXO) Sites [1.5.i]
11	Develop Data and Model Integration Tool to Support Risk/Hazard Assessment, Fate/Effects, and Transport Predictability Models for Non-Military Unique Compounds [1.5.b]

	Compliance
1	Particulate Matter/Dust Control and Measurement Tools for Maneuver Training, Smokes/ Obscurants Training, and Range and Road Maintenance [2.1.b]
2	Training and Testing Range Noise Control [2.4.f]
3	Sustainable Painting Operations for the Total Army [2.1.h/3.2.j]
4	Hazardous Air Pollutant (HAP) and Volatile Organic Compound (VOC) Emission Control from Non-Painting Sources [2.1.g]
5	Improved Treatment Technologies for Wastewaters from Munitions Production/Demilitarization [2.2.a]
6	Sustainable Army Live-Fire Range Design and Maintenance [2.5.e]
7	Improve Oil and Grease Removal/Treatment Technologies for Contaminated Wastewaters and Sludges/Soils [2.2.e]
8	Develop a Quick Analysis Test Kit for Military Unique Compound Detection [2.3.p]
9	Removal, Treatment and Disposal Technologies for Lead-Based Paint Contamination [2.3.k]
10	Develop New Technologies for Pretreatment, Treatment, Monitoring, and Quality Control/Quality Assurance of Army Wastewaters [2.2.f]

Army Environmental Quality Technology Requirements

	Pollution Prevention
1	Sustainable Painting Operations for the Total Army [3.2.j/2.1.h]
2	Solid Waste Diversion [3.5.c]
3	Develop a NESHAP-Compliant Chemical Agent Resistant Coating (CARC) System [3.2.a]
4	Alternatives to Ozone-Depleting Explosion Suppressants and Fire Fighting Agents [3.4.c]
5	Ordnance Manufacture, Maintenance, Use, and Surveillance to Enable Sustainable Ranges [3.3.c]
6	Reduce/Eliminate Pollution for Compliant Plating Processes [3.1.c]
7	Pollution Prevention in Facility Construction, Operation, Repair and Demolition [3.5.k]
8	Reduce/Eliminate Pollution from Military Unique Power Sources [3.9.d]
9	Alternatives to Open Burning/Open Detonation (OB/OD) of Stockpiled Munitions [3.3.a]
10	Improved Nuclear, Biological, and Chemical (NBC) Protection Techniques [3.6.j]
11	Reduce/Eliminate Pollution for Compliant Composite Manufacturing and Repair [3.10.f]
12	Reduce/Eliminate Pollution for Compliant Manufacturing, Testing, and Maintenance of Military Clothing and Textile Items [3.10.e]
13	Develop Environmentally-Compatible Lubricants and Fluids [3.7.l]
14	Alternatives to Ozone-Depleting Refrigerants for Military Unique Applications [3.4.b]

	Conservation
1	Reducing Impacts of Threatened and Endangered Species (T&ES) on Military Training, Testing, and Other Operations [4.6.a]
2	Baseline Threatened & Endangered Species (T&ES) Surveys and Monitoring [4.6.c]
3	Land Capacity and Characterization [4.2.a]
4	Land Rehabilitation [4.2.i]
5	Non-Native Invasive Species Control for Army Installations and Operations [4.3.e]

4.3 Program Development

After the AERTA requirements are sent to the ETTC, they are distributed to the Technology Teams for action. Within the Technology Teams, advocates from the RDT&E, technology transfer, and user communities are assigned to each requirement and they jointly develop a program plan to address the requirement. After the ETTC approves the program plans, the Technology Teams prepare and submit management plans for programs that are approved for funding to the ETIPT. The ETIPT reviews and approves these management plans. Each management plan outlines the tasks to be accomplished, offers a timetable for its completion, and details the resources required to develop the technology to resolve the user requirement. The RDT&E community and the user community endorse each management plan.

4.4 EQT Operational Requirements Document

An Environmental Quality Technology Operational Requirements Document (EQT-ORD) is prepared between the user, technology transfer, and RDT&E communities. The purpose of this plan is to coordinate, increase support, and validate the ability of a technological solution to resolve a user requirement. This plan is produced by the EQT Teams; the EQT-ORD is an integral part of the development of the individual Program Management Plans.

The initial EQT-ORD defines the technology capabilities needed to satisfy a user requirement in terms of minimum acceptable thresholds. When appropriate, longer-term objectives are established for each performance criterion and metric representing a measurable, beneficial increment in technology capability or environmental performance above the threshold level. However, longer-term objectives are generally not stated if they cannot be supported with operational rationale and are provided only when the Technology Team desires a relevant, operationally and environmentally significant capability above the threshold requirement. The EQT-ORD identifies essential performance parameters to appropriately focus the EQT Program and its decision making process throughout the validation effort. The Army's Materiel Acquisition Process establishes the need for a materiel acquisition program and how the Army will use the materiel and how the materiel solution must perform. As the acquisition process progresses, statements of required performance and design specifications mature.

4.5 Technology Transfer

Technology transfer and implementation of cost-effective methods and processes is the ultimate goal of the EQT Program. Technology transfer facilitates a technology's evolution from research, development, testing and evaluation to fielding with continuing technical assistance. Technology transfer supports the implementation of the decision-making process by providing accurate data and performance indicators. It facilitates communication among Army and other interested stakeholders. A technology transfer implementation plan is prepared as part of the program execution to balance the risks of cost, schedule and performance while effectively transferring technologies. To successfully conduct technology transfer, the user need and fielding objectives must be clearly established, and a description of how the technology will address the need must be illustrated. A technology transfer team is formed consisting of advocates from the RDT&E, technology transfer, and user communities. As data is developed, it is shared among all members of the technology transfer team and interested stakeholders. A final technology transfer report is produced and disseminated. Technology transfer can occur at any point in the EQT process.

Upon technology transfer, product responsibility transfers to Major Army Commands (MACOM) and installations for qualification, support, and maintenance for the life-cycle of the validated products. After the product has functioned for a sufficient time, the appropriate Technology Team will review and evaluate the technology to identify the need to update or modify it, to estimate a life-cycle cost, and to identify any "lessons learned" that can contribute to continual improvement of the process.

5. Army EQT Program Details

5.1 Army EQT Prioritized Programs

AERTA identified forty high-priority Army EQT requirements in FY 2002. The Army focused EQT Programs on the highest priority requirements and formulated fifteen RDT&E programs to address AERTA requirements in the FY 2004-2009.

FY 2004 - 2009 Army EQT Prioritized RDT&E Programs
Cost Effective Technologies to Remove, Characterize, and Dispose or Reuse Sources of Lead Paint
Hazardous Air Pollutant (HAP) Emission Control
Unexploded Ordnance (UXO) Detection and Identification
Hazard/Risk Assessment of Military Unique Compounds
Sustainable Army Live-Fire Range Design and Maintenance
Threatened and Endangered Species Surveys and Monitoring
Sustainable Painting Operations for the Total Army (SPOTA)
Particulate Matter/Dust Control
Land Capability and Characterization
Training and Test Range Noise Control
Solid Waste Diversion
Reducing Impacts of Threatened and Endangered Species on Military Training, Testing, and Other Operations
Characterization, Evaluation, and Remediation of Distributed Source Contamination (UXO-C) on Army Ranges
Reduce/Eliminate Pollution for Compliant Plating Processes
Long Term Monitoring for Military Unique Compounds
Ordnance Manufacture, Maintenance, Use, and Surveillance to Enable Sustainable Ranges
In-Situ Treatment Technologies for Inorganics Contaminated Soils
Enhanced and In-Situ Treatment Technologies for Explosives and Organics in Groundwater
Soil/Sediment and Shallow Water Unexploded Ordnance (UXO) Recovery/Removal/Remediation
Hazard Assessment Models for UXO Sites

The Army FY 2002 EQT Program priorities continue to illustrate a focused and momentum-building effort on high-priority EQT user requirements. All Army EQT programs are balanced against validated needs, available resources, and cost-effective investment needs.

Program priority is based on:

- High Army mission and environmental urgency;
- Maximizing potential cost-avoidance;
- Minimizing investment costs; and
- Minimizing program risk.

The Army goal is to invest today to reduce future environmental quality related costs.

6. Mutual Weapons Development Master Data Exchange Agreement (DEA) for Environmental Technology

The Army's EQT program is also involved internationally through the Mutual Weapons Development Master Data Exchange Agreement (DEA) between the governments of the United States and the Federal Republic of Germany. The DEA provides a framework for the sharing of information on environmental technologies that can enhance the environmental stewardship critical to the military missions of both the U.S. and Germany. The Deputy Assistant Secretary of the Army for Environment, Safety and Occupational Health is the DoD Executive Agent for the Environmental Technology Annexes to the agreement. This DEA encourages the involvement of private industry and academic institutions engaged in developing technologies that will resolve environmental challenges to the military.

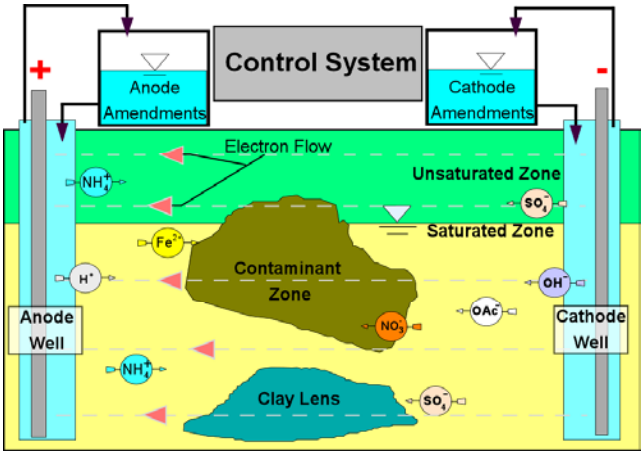


Figure 6-1. US/Germany Data Exchange Agreement Project: Electrokinetic Remediation of Soils.

As an example, heavy metal contamination is a concern at U.S. military training ranges as well as at German sites. Under the auspices of this DEA, U.S. Army expertise is being applied to the design and implementation of a pilot demonstration project to remediate cadmium and chromium-contaminated soil at a NATO training range in Bergen, Germany. This project, "Electrokinetic (EK) Remediation of Contaminated Soils," demonstrates the potential to remediate soils contaminated with heavy metals at both U.S. Army Europe and German sites.

This approach of combined demonstration and validation of cutting-edge technologies focuses diminishing resources on real-world problems, improves quality of life for our personnel, and reduces total ownership costs of environmental compliance. The appendix of this report contains a detailed description for this project. This Environmental Technology DEA continues to explore other opportunities that will take advantage of U.S. and German expertise to jointly develop and demonstrate high potential environmental quality technologies that respond to high-priority environmental technology requirements.

7. National Defense Center for Environmental Excellence (NDCEE)

In 1991, the U.S. Congress established the National Defense Center for Environmental Excellence (NDCEE) as the national resource for developing and disseminating advanced environmental technologies. The NDCEE mission includes transitioning materials and processes to DoD and industry, providing training, and performing RDT&E to accelerate the transition of new technology requirements for DoD.

Figure 7-1. National Defense Center for Environmental Excellence.

As the DoD Executive Agent for the NDCEE, the Army is committed to the success of the program to facilitate technology validation of innovative environmental quality, health, and occupational safety sustainability requirements aimed at reducing total ownership costs in support of national defense. The NDCEE targets innovative technologies with a focus on reducing total ownership costs related to sustaining the environment, DoD Transformation, and the DoD mission.

The NDCEE program identifies, validates, and promotes for implementation environmental quality technologies with high potential for effective validation and transfer. Under the Executive Agent's oversight, the Services identify individual high-priority requirements where cooperative efforts produce leveraged results. The NDCEE is effective in minimizing duplication of effort for environmental quality technologies throughout the DoD, and in doing so is positioned to support technology transfer from the development community to the user community. Congress has supported the NDCEE program with Congressional additions to the President's Budget Requests. The challenge to the Executive Agent is to leverage these requirements against the Services highest-priority technology needs.

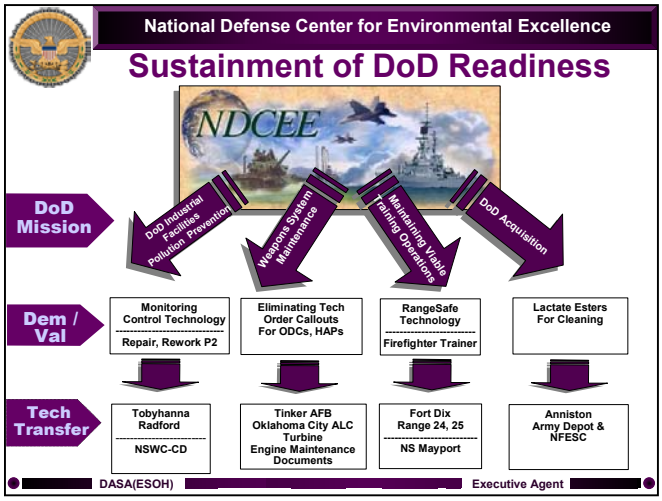


Figure 7-2. Sustainment Technologies for Defense-wide Application

FY 2002 NDCEE project highlights include evaluating technologies and tools for corrosion protection and avoidance, unexploded ordnance, environmental monitoring and control, surface finishing, firing range cleanup, bio-based products, solvent and hazardous air pollutant replacement, and heavy metals replacement.

Under the Sustainable Painting Operations for the Total Army (SPOTA) Program, the NDCEE is helping the Army take a pollution prevention approach to prepare for new National Emission Standards for Hazardous Air Pollutants (NESHAPs). These new regulations are designed to limit emissions of hazardous air pollutants and would impact military painting, de-painting, solvent usage, bonding, and munitions coating operations. Facilities may face fines and other penalties if they fail to comply with the new NESHAPs. As part of its regulatory and technical assistance, the NDCEE is identifying commercially available alternatives and assessing their projected environmental and cost benefits using the Environmental Cost Accounting Methodology (ECAM^{SM}). The NDCEE also performs gap assessments and provides recommendations that promote sustainability and compliance.

Figure 7-3. Assisting 15 Army facilities in complying with pending NESHAPs impacting surface coating operations.

The NDCEE is also supporting the Army to design a Vehicle Paint and Preparation Facility for the U.S Army Kwajalein Atoll/Reagan Test Site (USAKA/RTS). USAKA/RTS, located in the Republic of the Marshall Islands, is used for live missile testing and as a satellite launch site. The facility will feature new corrosion control equipment and concepts to reduce environmental pollutants and life-cycle costs associated with maintaining 850 vehicles and other large pieces of equipment. The NDCEE is also demonstrating and recommending corrosion control technologies for the USAKA/RTS marine center which maintains more than 20 large marine vessels.

Figure 7-4. USAKA/RTS Corrosion Control

Under the Managing Army Technologies for Environmental Enhancements (MANATEE) task, the NDCEE is helping the DoD to protect the New River watershed through environmental stewardship activities at Radford Army Ammunition Plant (RFAAP), Virginia. With NDCEE assistance, RFAAP is implementing and upgrading environmental monitoring and control technologies for its key air and water protection operations. This assistance is a continuation of work previously completed in which the NDCEE successfully developed and implemented an integrated environmental monitoring and control system. The web-based Environmental Information System (EIS) supports the activities of three independent yet integrated modules that connect 55 monitoring/control sites across the facility.

Unexploded Ordnance (UXO) potentially impacts millions of acres of DoD controlled lands. These UXO-containing properties have a significant impact on military readiness. The NDCEE is supporting the DoD's efforts in UXO neutralization and remediation technologies, development of a UXO recovery database, quality control procedures for UXO technology operators, land use controls as a UXO response, electronic fuze susceptibility to unintended detonation, and UXO subsurface migration.

Figure 7-5. Unexploded Ordnance in Support of Military Readiness

The tasks described above exemplify how the NDCEE is directly supporting DoD's environmental quality technology management efforts. To date, over 100 transitions and/or demonstrations of tangible technologies have been completed or are scheduled. These technologies include manufacturing materials and processes, environmental treatment and control devices, and site assessment and clean-up technologies. Complementing these technologies are the more than 80 technology product tools that have been developed and transitioned by the NDCEE. In addition to being environmentally preferred, many of these technologies and tools provide a return-on-investment through quantified cost avoidances and improved efficiency.

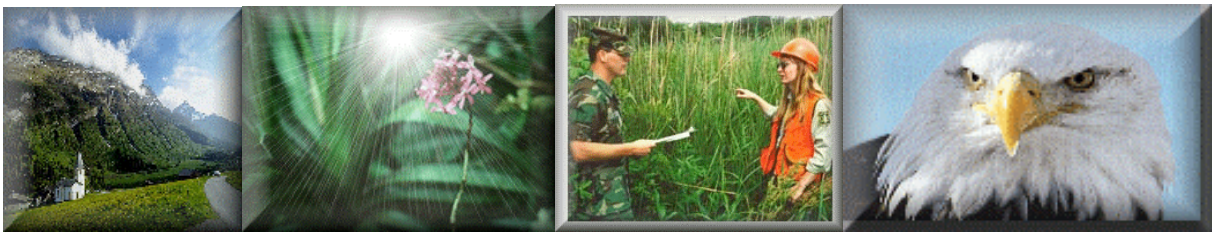
8. Summary

The Army's Environmental Quality Technology Program begins with a rigorous bottom-up identification and validation of the U.S. Army's environmental quality technology requirements. This strenuous requirements-building process provides senior Army leadership the baseline to set priorities for user needs, focus resources, and ensure cost-efficient investments for technology transfer and implementation in the field. The EQT Program focuses research, development, test, and evaluation and technology transfer efforts to enhance the U.S. Army's ability to conserve natural resources, reduce operating costs, and field weapon systems with minimal or no impact to the environment. The EQT Program's goal is to implement and transfer efficient, cost-effective methods and technologies to the field, to reduce or eliminate waste streams, and to provide a better quality of life for soldiers, their families, and the surrounding community.

As the DoD Executive Agent for the National Defense Center for Environmental Excellence and the Mutual Weapons Development Master Data Exchange Agreement for Environmental Technology between the governments of the United States and the Federal Republic of Germany, the Army leads DoD's efforts to address user communities' high-priority environmental quality technology requirements through transfer of innovative and validated technologies. The Army takes a similar systematic approach to its DoD Executive Agent responsibilities as it applies to its EQT Program. This approach includes validation of user requirements, formulation of RDT&E programs to resolve validated EQT requirements, and application of a program prioritization process that is based on projected cost-avoidance relative to investment, environmental and mission urgency of the requirement, and program development risk.

This program is an example of the kind of innovative approach and creative management that will support the Army far into the 21st century. It is responsive to the Defense Planning Guidance and focused on developing technologies to resolve the Army and Defense communities' emerging high-priority environmental quality requirements.

US Army Environmental Requirements and Technology Assessments (AERTA)



The Army's environmental quality technology requirements described and documented in this website represent the critical RDT&E needs for accomplishing the Army's mission with the least impact or threat to the environment. These requirements are Army-level requirements and include installation- or weapon-specific needs only when critical to the execution of the Army's mission. This website contains the Army's environmental quality technology requirements completed in July 2001 for the FY04-FY09 POM.

This effort is being developed as the Army Environmental Requirement Technology Assessments (AERTA) website on the Defense Environmental Network Information Xchange (DENIX) at:

http://www.denix.osd.mil/denix/DOD/Policy/Army/Aerta/tnstop.html

Army Environmental Quality Technology Requirements		
Pillar Priority	**Requirement Title and Identification Tag**	**Page No.**
1. Restoration		
1	Unexploded Ordnance (UXO) Screening, Detection, and Discrimination [1.6.a]	A-3
2	Enhanced Alternative and In-situ Treatment Technologies for Explosives and Organics in Groundwater [1.2.a]	A-4
3	Develop Data and Model Integration Tool to Support Risk/Hazard Assessment, Fate/Effects, and Transport Predictability Models for Military Unique Compounds, Explosives and DU [1.5.g]	A-5
4	Innovative In-Situ and/or On-site Ex-Situ Treatment Technologies for Soils Contaminated with Inorganics [1.3.e]	A-5
5	Develop Long-Term Monitoring, Standard Analytical, and Groundwater Monitoring Techniques for Military Unique Compounds [1.1.i]	A-6
6	Soil/Sediment Unexploded Ordnance (UXO) (Neutralization/Removal/Remediation) [1.6.b]	A-6
7	Shallow Water Unexploded Ordnance (UXO) Recovery/Removal/Remediation [1.6.e]	A-7
8	Development of Optimization/Site Closure Tool for Groundwater Pump and Treat Systems [1.5.o]	A-7
9	Innovative Treatment Technologies for Depleted Uranium Soils [1.3.j]	A-8
10	Development of Hazard Assessment Models for Unexploded Ordnance (UXO) Sites [1.5.i]	A-9
11	Develop Data and Model Integration Tool to Support Risk/Hazard Assessment, Fate/Effects, and Transport Predictability Models for Non-Military Unique Compounds [1.5.b]	A-9
Compliance		
1	Particulate Matter/Dust Control and Measurement Tools for Maneuver Training, Smokes/Obscurants Training, and Range and Road Maintenance [2.1.b]	A-10
2	Training and Testing Range Noise Control [2.4.f]	A-10
3	Sustainable Painting Operations for the Total Army [2.1.h/3.2.j]	A-11
4	Hazardous Air Pollutant (HAP) and Volatile Organic Compound (VOC) Emission Control from Non-Painting Sources [2.1.g]	A-11
5	Improved Treatment Technologies for Wastewaters from Munitions Production/Demilitarization [2.2.a]	A-12
6	Sustainable Army Live-Fire Range Design and Maintenance [2.5.e]	A-13
7	Improve Oil and Grease Removal/Treatment Technologies for Contaminated Wastewaters and Sludges/Soils [2.2.e]	A-14
8	Develop a Quick Analysis Test Kit for Military Unique Compound Detection [2.3.p]	A-14
9	Removal, Treatment and Disposal Technologies for Lead-Based Paint Contamination [2.3.k]	A-15
10	Develop New Technologies for Pretreatment, Treatment, Monitoring, and Quality Control/Quality Assurance of Army Wastewaters [2.2.f]	A-16
Pollution Prevention		
1	Sustainable Painting Operations for the Total Army [3.2.j/2.1.h]	A-16
2	Solid Waste Diversion [3.5.c]	A-17
3	Develop a NESHAP-Compliant Chemical Agent Resistant Coating (CARC) System [3.2.a]	A-17
4	Alternatives to Ozone-Depleting Explosion Suppressants and Fire Fighting Agents [3.4.c]	A-18
5	Ordnance Manufacture, Maintenance, Use, and Surveillance to Enable Sustainable Ranges [3.3.c]	A-18
6	Reduce/Eliminate Pollution for Compliant Plating Processes [3.1.c]	A-19
7	Pollution Prevention in Facility Construction, Operation, Repair and Demolition [3.5.k]	A-19
8	Reduce/Eliminate Pollution from Military Unique Power Sources [3.9.d]	A-20
9	Alternatives to Open Burning/Open Detonation (OB/OD) of Stockpiled Munitions [3.3.a]	A-20

A (1.6.a) Unexploded Ordnance (UXO) Screening, Detection and Discrimination

The Defense Site Environmental Restoration Tracking System (DSERTS) indicated in 1997 that 91 Army installations reported Unexploded Ordnance (UXO) contamination. There are also approximately 600 Formerly Used Defense Sites (FUDS) and 130 Base Realignment and Closure (BRAC) sites, covering millions of acres throughout the U.S., which may contain UXOs. As part of the DoD's UXO Environmental Remediation Mission, the Army has the responsibility to ensure that a significant number of these sites are fully characterized and remediated to a condition that is consistent with the intended future use. During the period FY2001-2007, under the Army Range and Training Land Program (RTLP), there is significant investments to improve its live training infrastructure. This includes eight Digital Multi-Purpose Range Complexes, construction of 37 Military Operations in Urban Terrain (MOUT) facilities, construction or upgrade of over 75 other ranges in all Army Major Commands (MACOMs), and expansion of National Training Center (NTC) land. Siting ranges over old ranges requires UXO detection and removal.

The effectiveness of UXO characterization and remediation efforts must meet ever increasing regulatory and stakeholder standards. In 1998, the Defense Science Board (DSB) Task Force report highlights the fact that current UXO characterization efforts lack adequate capability to discriminate buried UXO from non-hazardous materials (false alarms). The result is approximately 75 percent of the costs to remediate a UXO site are currently spent on excavating these false alarms. Research and development in three focus areas, (a) rapid wide-area screening/footprint reduction, (b) enhanced detection, and (c) discrimination, is urgently needed to address these focus areas.

Rapid wide area screening/footprint reduction is currently performed using survey and land management plans, aerial photography, and historical records to identify potential UXO sites. Improved airborne sensing, accurate positioning, and enhanced analysis technologies are required to rapidly screen large sites and to reliably identify UXO contaminated areas. In

addition to significantly reducing the acreage that would require more expensive ground surveys, these technologies will allow cost-effective characterization of areas that are currently inaccessible by vehicular and handheld systems.

Enhanced UXO detection technologies are required to meet regulator/stakeholder requirements for reliable UXO site characterization. Depending on intended future use, some sites require characterization to significant depths with near 100 percent detection confidence. Improvements in sensing (magnetometers, electromagnetic induction sensors, and ground penetrating radar) as well as analysis and systems integration are required to address this need. USACE-Huntsville reports indicate that the mean average survey and mapping cost to a depth of four feet is currently $5,433 per acre.

Recent technology demonstrations such as those at Jefferson Proving Ground Phase IV, indicate that emerging sensors have the potential to reliably discriminate UXO from clutter, and may eventually be capable of identifying the UXO type prior to excavation. The DSB report estimates that a 90 percent false alarm reduction from current levels is a realistic near term (five years) goal. Research, development, demonstration, and rapid transition of these emerging technologies are required to accomplish the Army's UXO Environmental Remediation mission in a timely and cost effective manner. Demonstrated UXO discrimination capability is critical to convince regulators and stakeholders that a site is clean of UXO without having to remove 100 percent of the detected buried anomalies.

The Army has leveraged and supports related efforts in the other UXO mission areas-Combat Countermine, Humanitarian Demining, Explosive Ordnance Disposal, and Active Range Clearance. Emphasis will be on ferrous and high metal content UXO, while relying on the other mission areas to address the low-metal/non-metallic UXO.

A (1.2.a) Enhanced Alternative and In-Situ Treatment Technologies for Explosives and Organics in Groundwater

The Army currently has explosives contaminated (RDX, TNT, HMX, TNB, 2,4-DNT, 2,6-DNT, 2NT, 3NT, 4NT, 1,3-DNB, Tetryl, and NB) groundwater, which is affecting both on- and off-post drinking water supplies. Over 16 sites have been confirmed as affecting drinking water quality. This drinking water quality is a concern at any installation that has historically performed open burning and open detonation (OB/OD) operations, load, assembly and pack, demilitarization, or PEP manufacturing. Nearly every Army installation mentioned in the their Installation Action Plan budgets the remediation of trichloroethylene, chloroform, 1,2-dichloroethane, methylene chloride, vinyl chloride, carbon dichloride, 1,1,2,2-tetrachloroethane, 1,1,1-trichloroethane, BTEX (benzene, toluene, ethyl benzene and xylene), acetone, 1,2-benzenedicarboxylic acid, bis (2-Ethylhexyl) ester, bis (2-Ethylhexyl) phthalate, naphthalene, and other organic compounds.

Although natural attenuation and in-situ treatment technologies have been implemented at select sites, many remedial actions undertaken in the past for solvent contaminated groundwater specified pump and treat operations in conjunction with other technologies. These other technologies may include filtration, liquid phase adsorption and biological destruction processes.

The traditional pump-and-treat operation is expensive, is not a destructive technology, may leave behind hazardous residuals (including contaminated carbon) requiring hazardous waste disposal, and in some applications cannot meet required discharge limits. Pump-and-treat operations may also be ineffective for very large contaminant plumes, slow recovering aquifers, deep aquifers, and fractured geology.

In 1999, approximately $1,135 million were requested by Army installations in Defense Site Environmental Restoration Tracking System (DSERTS) for remediation of explosives- and organics-contaminated groundwater. Currently available remediation technologies require enhancement, and improved alternative forms of groundwater remediation. New technologies should consider in-situ remediation. Intrinsic bioremediation, based on natural attenuation of organic contaminants in the groundwater, is an attractive alternative. However, information and data on in-situ remediation and the natural attenuation of organics in groundwater need to be developed and incorporated into remediation alternatives that are accepted by the environmental regulators. This would result in improved health and environmental risk prediction, contaminant plume control, prevention of further loss of aquifer resources, and increased cost savings.

A (1.5.g) Develop Data and Model Integration Tool to Support Risk/Hazard Assessment, Fate/Effects, and Transport Predictability Models for Military-Unique Compounds, Explosives, and Depleted Uranium

The Army is aware of 21 active and inactive military installations with 253 unique sites containing soil and groundwater contaminated with ordnance-related contaminants (e.g., explosives and military-unique compounds). These represent annual expenditures of $183 million for cleanup, as indicated in the 1999 DSERTS database. Risk assessment, fate and effects, and transport prediction models, utilized under the Risk Assessment Guidance for Superfund (RAGS) and other guidance, often use surrogate compound toxicological, physical, chemical, and biodegradability/plant uptake and assimilation data in conjunction with large safety factors. These often result in suspect levels of risk to human health and the environment and highly conservative risk determinations for affected sites. Additional toxicological data is needed, because the lack of sufficient scientific data to explain the interaction between ordnance-related compounds and the environment, it is likely that unnecessary time, money, and resources will be expended to evaluate and remedy perceived environmental threats in cases where contamination may be mitigated by natural processes. The development of such an integration tool could result in improved environmental risk prediction and significant cost savings to the Army.

A (1.3.e) Innovative In-Situ and/or On-site Ex-Situ Treatment Technologies for Soils Contaminated with Inorganics

Inorganic contaminants are introduced into soils from training activities (firing ranges and large caliber training and testing grounds), industrial operations, demilitarization activities and OB/OD activities. The Army cleanup program requires cost-effective technologies that target the following inorganic contaminants in order of priority based on prevalence at Army installations: lead, chromium, cadmium, copper, mercury, nickel, and cyanides. Currently available remedial technologies for soils contaminated with inorganics include: solidification/ stabilization, soil

flushing, vitrification, soil washing, chemical reduction/oxidation, and excavation for off-site treatment and/or disposal. Many of these technologies require excavation prior to treatment. Current approaches become increasingly more difficult and expensive to implement as disposal restrictions become stricter. Current off-site hazardous waste treatment and disposal costs are approximately $400 per ton and the distance to the nearest disposal facilities typically exceeds 600 miles each way. Groundwater may also incidentally become contaminated from the extraction of metals from soils (e.g., lead from firing ranges), and the removal of topsoil impacts the stability of training lands. Further, transporting hazardous wastes and residuals to off-site facilities for disposal and/or treatment is expensive and can create long-term liability for the Army.

A (1.1.i) Develop Long-Term Monitoring, Standard Analytical, and Groundwater Monitoring Techniques for Military-Unique Compounds

The Cost to Complete (CTC) database indicated in 1999 that 788 unique sites at 105 unique Army installations from ten MACOMs are currently conducting or intend to conduct long-term groundwater monitoring between FY1999 and FY2008 at an estimated cost of $482 million. Of the $482 million earmarked for long-term groundwater monitoring, approximately $12 million has been funded for FY1999 and $12.7 million is proposed for funding in FY2000. Additionally, the cost of collecting field samples and performing laboratory analysis to locate and characterize areas with subsurface explosives and military-unique compounds at Army industrial facilities exceeded $1 million in 1998. Explosives-contaminated areas at Army industrial facilities represent the significant portion of the contamination problems, followed to a lesser degree by chemical warfare materiel (CWM) contamination. The characterization, cleanup, and long-term groundwater monitoring of Army installations typically require extensive chemical analyses as required by federal, state, and local regulators. However, criteria for U.S. Environmental Protection Agency (USEPA) acceptance of methods developed for the analysis of military-unique compounds do not exist for some compounds (i.e., HMX, 1,3-DNB, NB, 3NT, and 4NT). Standardized analytical methods and techniques that are applicable to long-term groundwater monitoring and site characterization program can be readily accepted by regulators, be performed with greater efficiency and accuracy, prevent unnecessary laboratory analysis, reduce project costs, and expedite remediation at many Army sites.

A (1.6.b) Soil/Sediment Unexploded Ordnance (UXO) (Neutralization/Removal/ Remediation)

DSERTS database indicated in 1997 that 91 Army installations reported UXO contamination. In addition, there are also approximately 600 FUDS with UXOs. The Army is making significant investments, under the Army Range and Training Land Program (RTLP), during the period FY2001-2007 to improve its live training infrastructure, which includes eight Digital Multi-Purpose Range Complexes, construction of 37 MOUT facilities, construction or upgrade of over 75 other ranges in all MACOMs, and expansion of NTC land. Siting ranges over old ranges requires UXO removal. Existing UXO access and neutralization technologies are not adequate to accurately design removal actions. Therefore, conservative approaches must be utilized in removing/neutralizing UXO from the soil. Removal methods may involve hand digging. In

addition, after UXO removal, excavation of soil is often necessary to remove contaminants that may have leaked from ordnance and munitions.

Identification, excavation, removal, and disposal activities associated with UXOs and contaminated soils/sediments are very expensive, labor intensive, and dangerous. For example, after UXO removal, excavated soils (contaminated with explosives, organics, etc.) may cost approximately $220 to $1,100 per metric ton (all costs included) for off-site treatment/disposal. Disposal of soils contaminated with chemical material is even more costly as agent neutralization or removal is necessary prior to release for commercial treatment/disposal.

A (1.6.e) Shallow Water Unexploded Ordnance (UXO) Recovery/Removal/Remediation

There are approximately 600 FUDS, many of which may no longer be under military ownership. Some Army installations and FUDS have UXO contamination in shallow (<8 feet) and/or deep water (>8 feet depth). Existing UXO access and neutralization technologies are not adequate to accurately design removal actions. Therefore, conservative approaches must be utilized in removing/neutralizing submerged UXO and contaminated sediment. In addition, after UXO removal, excavation of sediment is often necessary to remove contaminants and chemical materiel, which may have leaked from submerged ordnances and munitions.

Removal and disposal activities associated with submerged UXOs and contaminated sediments are very expensive, labor intensive, and dangerous. It is estimated that removal costs for submerged UXO and contaminated sediment is comparable, if not even higher than for contaminated soil. For example, after UXO removal, excavated soils (contaminated with explosives, organics, etc.) may cost approximately $220 to $1,100 per metric ton (all costs included) for off-site treatment/disposal. Disposal of sediment contaminated with chemical materiel is even more costly as agent stabilization and/or removal, vessel support platforms, and volume reduction and transportation is necessary prior to release for commercial treatment/disposal. Many times, UXO contaminated sites may remain unremediated and result in water contamination from leaching and loss of use of the area.

A (1.5.o) Development of Optimization/Site Closure Tool for Groundwater Pump-and-Treat Systems

Currently, groundwater models exist for advection, mechanical and chemical dispersion, molecular diffusion, sorption, and natural bioremediation. However, these techniques are not adequate for site characterization, site remedial design, optimizing Operations and Maintenance (O&M), and prediction of site closure. Enhancements to current models and the development of new models are required to support site characterization, remedial alternative selection, design, remedial operations optimization and site closeout operations within the Army. Furthermore, current modeling techniques are very limited in their ability to evaluate Military-unique compounds, which severely limits the ability to establish appropriate remedial designs and target cleanup levels. The development and implementation of more effective groundwater models to predict contamination level, movement, and treatment effectiveness will aid demonstrating the viability of implementing new in-situ remedial technologies and optimizing existing systems for military unique compounds. This in turn will allow for reasonable and predictable treatment

design, operation and site closeout based on accurate site characterization resulting in decreased costs.

The development of adequate modeling techniques is required to predict the effectiveness of in-situ groundwater treatment and to select, design, and operate efficient treatment systems is essential to Army's environmental cleanup processes. Appropriate techniques will minimize or eliminate high-cost, low-efficiency systems, allow for phasing and operational adjustments for application of more efficient and cost effective remedies to closeout sites. It has been estimated that current construction costs for pump and treat systems at Army sites range from 1 to 10 million dollars for each operation plus indefinite long-term O&M. If appropriate and verifiable models were available for use to support decisions from implementing in-situ remediation technologies, the use of such technologies in lieu of pump and treat technology at applicable sites might be approved by regulators, which would significantly lower remediation costs. In addition, models could be used to optimize existing systems for site closeout.

A (1.3.j) Innovative Treatment Technologies for Depleted Uranium Soils

Army firing ranges upon which depleted uranium (DU) anti-tank rounds were fired have radioactive, hazardous, and UXO waste mixed together. The mixed waste requires multiple phased treatments/separations of the materials followed by burial of the waste materials at an approved disposal facility. The current cost for burial of the waste at an approved disposal facility is approximately $25 per cubic foot (disposal only). Ranges may contain millions of cubic feet of mixed waste material. Cleanup is driven by the Nuclear Regulatory Commission's decommissioning rules for radioactive materials with mandatory timeframes, and the EPA for the remediation and proper disposal of hazardous waste.

The migration potential for DU is from fugitive dust emissions (airborne migration) via undisturbed affected areas and remedial activities, and from transportation via surface waters. Currently available methods for the remediation of DU contaminated soils includes volume reduction, in-situ vitrification, polymer solidification and encapsulation, in-situ grout injection, electrokinetic soil processing, and excavation for off-site disposal. These technologies are very expensive and are becoming increasingly more difficult to implement as environmental regulations become more stringent. Transportation of wastes to off-site disposal facilities also increases the Army 's liability and increases project costs. Excavation and removal of soil affected by DU wastes negatively impacts the stability of training lands due to the destruction of vegetative cover and increased erosion. Due to the stringent regulatory requirements for the decommissioning and remediation of DU wastes, the Army currently does not have the option nor license to allow DU wastes to remain undisturbed on firing ranges. Treatment technologies are needed that can minimize the extent of excavation and the volume of material requiring off-site treatment and/or disposal. These technologies should be cost-effective, and, if practical, be incorporated into an overall plan that does not require extensive disturbance of land during remedial efforts and extensive restoration after remediation.

A (1.5.i) Development of Hazard Assessment Models for Unexploded Ordnance (UXO) Sites

According to the DSERTS database, 91 Army installations and active ranges reported Unexploded Ordnance (UXO) contamination in 1997. There are also approximately 600 FUDS with UXOs and related contamination. UXO remedial actions are extremely hazardous and pose significant health and safety concerns for removal crews and adverse impacts to the surrounding environment. No model is currently available to accurately assess hazards at UXO sites as a function of site characterization and remediation activities. A comprehensive model of the hazards associated with UXO during remediation, based on the site constraints and the remedial methods employed, will result in safer and more expedient remedial efforts. Model development should consider the type and number of UXOs present, the extent of UXO contamination if present, the characteristics of the site, the method(s) of remediation, migration potential, encounter dynamics, and the factors related to the attenuation of explosive energy through media. An accurate and verifiable hazard assessment model that considers these factors will identify the actual hazard associated with removal and will minimize perceived hazards and overly conservative removal actions.

A (1.5.b) Develop Data and Model Integration Tool to Support Risk/Hazard Assessment, Fate/Effects, and Transport Predictability Models for Non-Military-Unique Compounds

The Army is aware of many active and inactive military installations containing soil and groundwater contaminated with non-military-unique compounds (e.g., solvents). Risk assessment, fate and effects, and transport prediction models, utilized under the RAGS and other guidance, often use surrogate compound toxicological, physical, chemical, and biodegradability/plant uptake and assimilation data in conjunction with large safety factors. This often results in suspect levels of risk to human health and the environment and highly conservative risk determinations for affected sites. Due to the lack of sufficient scientific data, the results of the interaction between non-military-unique compounds and the environment is difficult to determine. It is likely that unnecessary time, money, and resources will be expended to evaluate and remedy the perceived environmental threat, which may be mitigated by natural processes.

Any data must be accompanied by, at a minimum, a description of the toxicological data sources, data collection and reporting methodology, analytical testing techniques, and the methods and practices employed in the validation of toxicological risk assessment data. The use of scientifically and regulatory acceptable toxicological data in risk assessment models will greatly assist in the development of accurate risk-based clean-up levels and sound remedial action decisions. These decisions will be based on risks to human health and the environment from the production, storage, transportation, use and disposal of non military-unique compounds and their breakdown products. To convince the EPA, state, and local environmental regulators that the use of the above-described toxicological data will result in improved risk determinations, the data screening procedures should include a thorough discussion of the criteria and rationale for using select toxicological data and realistic exposure scenarios in risk assessment models

A (2.1.b) Particulate Matter/Dust Control and Measurements for Maneuver Training, Smokes/Obscurants Training, and Range and Road Maintenance

Particulate matter (PM) is the pollutant *du jour* – multiple health studies have shown its links to increased human morbidity and mortality. As a result, many Military installations are increasingly subject to local regulations concerning PM issues. PM generated from Army non-facility sources is a significant source of air pollution and a military unique problem, particularly in arid regions of the South and West. Army non-facility sources include soil-based PM from training activities, prescribed burning, smoke and obscurant training, artillery practice, weapons impact testing, and open burning/open detonation. The majority of these sources are found on troop-based installations. PM emissions may create legal, regulatory, ecological and practical problems for the modern Army installation. For example, PM has the potential to limit or restrict time and frequency of training, to close ranges or completely shut down training exercises due to Clean Air Act regulations and necessary compliance with Title V permitting requirements. MACOMs primarily affected include FORSCOM, TRADOC, USARC, and NGB. These problems will worsen with mission realignments, new weapon systems, encroachment, and increasing urbanization. Thus, the impact of introducing new vehicle types (e.g., Interim Armored Vehicle) as part of the Objective Force transition will require careful study.

There are also major issues related to non-facility PM emissions that are not directly related to regulatory compliance. Excessive PM is a health hazard to troops and is an air quality hazard when it drifts into nearby housing and administrative areas or onto adjacent highways and streets. Excessive wear and tear on military vehicles and aircraft results from the intrusion of dust into engine and turbine compartments, air filtering systems, and other sensitive mechanical and electrical components. Continuous movement of training vehicles over training lands removes vegetation and reduces soil cohesion causing this soil to be much more susceptible to wind and water erosion. All these issues are a direct consequence of PM emissions and each can produce significant negative impacts on the Army's training mission.

A (2.4.f) Training and Testing Range Noise Control

The Army is losing training and testing capabilities because of noise. Noise concerns have caused installations to relocate training, restrict aircraft operations, limit firing frequency, limit time of day for training, and close ranges. MACOMs affected significantly by noise issues include AMC, NGB, USAR, TRADOC, and FORSCOM.

Loud training noise levels in the community result in complaints, damage claims and political and/or legal action. Damage claims (>$25K for each occurrence) amounted to over $60 million between 1990 and 1996, according to the Army Claims Service (ACS). The number of noise claims evaluated by ACS each year doubled during this period. If this trend continues, the number of complaints will triple by 2001 and quadruple by 2003. AEPI formal surveys of TRADOC and FORSCOM installation personnel revealed the perception that noise problems will worsen, especially with increasing urbanization. Many of the Army's active installations are experiencing regional growth rates at five to ten times the national average.

The lack of noise management technology greatly hinders execution of the Environmental Noise Management Plan (ENMP), and the Environmental Assessment (EA) and Environmental Impact Statement (EIS) processes. Army activities affected include large caliber (25 mm and greater) ranges, air to ground gunnery, demolition/disposal and small arms ranges, military training routes, helicopter ground maintenance and run-up pads, and armor training ranges.

The Army needs improved technology for affordable noise control. Research on development/ identification of cost-effective technologies to predict, assess, and control/mitigate noise impacts is required. Research results and available technologies need to be assembled into appropriate publications for installations.

A (2.1.h/3.2.j) Sustainable Painting Operations for the Total Army

Specific Hazardous Air Pollutants (HAP) sources are regulated by Title III of the Clean Air Act (CAA). The largest sources of Army HAP emissions are: (1) fuel transfer operations, (2) painting/coating and depainting operations, and (3) boilers and other combustion sources. This need description addresses painting/coating and depainting sources of Army HAPs. Eleven anticipated National Emission Standards for Hazardous Air Pollutants (NESHAPs) affecting Army painting, coating, and depainting activities will also have impacts on the major Army Volatile Organic Compounds (VOCs) producing activities. Expected NESHAP enforcement dates are in 2002 and compliance dates in 2005, and include processes such as vehicle surface coating, paint strippers, and metal and plastic part surface coating. These rulemaking activities will significantly affect the Army's ability to paint its equipment at both depots and troop installations. In addition, seven years after each NESHAP standard comes into effect, the USEPA will reassess each rule and determine whether stricter standards are needed based on risk assessments to surrounding communities. State regulatory agencies may also mandate more strict regulations or regulate sources not covered by the Federal NESHAPs. OSHA also regulates HAP concentrations in the workplace.

Processes, including painting, cleaning/degreasing, paint stripping, cleaning between coatings, adhesives, stenciling and marking, post painting clean-up such as window cleaning, paint gun cleaning, and paint booth cleaning, which are necessary to produce and maintain Army vehicles, armaments and equipment are targeted sources for regulation. In some instances, existing technology, equipment, or operational parameters are insufficient to meet these requirements. Primary Army contaminants of concern include toluene, methyl ethyl ketone, methyl isobutyl ketone, xylene, ethanol, and ethyl ether. Identification/evaluation of alternative paints, coatings, and paint stripping methods or technologies/ methods required to control, reduce, or recycle HAP emissions from Army sources is needed. These technologies/methods are required primarily by AMC, FORSCOM, TRADOC, and ARNG installations to control HAP emissions to maintain compliance with environmental laws at the federal, state, and local levels.

A (2.1.g) Hazardous Air Pollutants (HAP) and Volatile Organic Compounds (VOCs) Emissions from Non-Painting Sources

VOC sources are regulated by CAA Title I and specific HAP sources are regulated by CAA Title III. The largest sources of Army HAP emissions are (1) fuel transfer operations, (2) painting and

depainting operations, and (3) boilers and other combustion sources. This need description addresses fuel transfer and boiler/combustion sources of Army HAPs. Processes that are necessary to operate Army field boilers, vehicles, armaments and equipment are targeted sources for regulation. These processes include fuel storage and dispensing, electroplating, and combustion type sources such as boilers, hazardous waste combustors, and incineration. Even when equipped with the best current lead control devices, furnaces treating conventional munitions such as small rounds and explosives powder emit significant amounts of lead. Chemical furnace air exhaust systems have difficulty controlling mercury emissions during the demilitarization of mustard-containing ordnance. In these instances, existing technology, equipment, or operational parameters are insufficient to meet these requirements. Primary Army contaminants of concern include lead, mercury, and explosive byproducts.

Three anticipated NESHAPs affecting Army fuel and combustion activities will also have impacts on the major Army VOC producing activities. Expected enforcement dates are in 2000 and compliance dates in 2003, and include processes such as industrial boilers, hazardous waste combustors, and institutional/commercial boilers. Seven years after each NESHAP standard comes into effect, the USEPA will reassess each rule and determine whether stricter standards are needed based on risk assessments to surrounding communities. In addition, state regulatory agencies may mandate more strict regulations or regulate sources not covered by the Federal NESHAPs. Also, OSHA regulates HAPs concentration in the workplace and, as part of Executive Order 12856, the Army is required to reduce TRI chemical use by 50 percent by 1999. Many of the top TRI chemicals are also HAPs.

Identification/evaluation of technologies/methods is required to control, reduce, or recycle HAP emissions from Army sources. These technologies/methods are required primarily by AMC, FORSCOM, TRADOC, and ARNG installations to control HAP emissions to maintain compliance with environmental laws at the Federal, state, and local levels.

A (2.2.a) Improved Treatment Technologies for Wastewaters from Munitions Production/Demilitarization

Many of the Army's wastewater treatment plants are not capable of meeting new toxicity-based water quality standards and revised permit limits. Munitions production is threatened by increasingly stringent Federal and state environmental regulations. In addition, discharges from sanitary/industrial wastewater treatment facilities pose a significant threat to receiving waters based on projected future regulatory requirements.

Munitions wastewaters arise from two major, and significantly different, sources. The first source is the primary production of munitions, in which propellants, explosives, and pyrotechnics are produced at an industrial facility. Wastewaters from such facilities would be contaminated with the primary compound and its incomplete reaction products and/or purification by-products. The second source is the handling and disposal of munitions, where the products of primary production are packaged into munition shells and motor assemblies, or are removed from them for disposal. Examples of such sources include Load, Assembly, and Pack (LAP) processes and demilitarization operations such as melt/pour operations, melt out, steam-out and wash-out. Contaminants of concern include TNT (Pink Water), RDX, HMX, DNT,

TNB, tetryl, NC-Fines, ammonium perchlorate, and newer compounds such as CL-20, TNAZ, polynitrocubanes, and aqueous nitrates. TNT, RDX, and HMX are generated in the largest quantities. Ammonium perchlorate has also been identified as a significant wastewater treatment problem for AMCOM.

Contaminant concentrations vary from installation to installation. One AMC installation's wastewater treatment plant average monthly contaminant concentrations were 100 (parts per billion) ppb, with daily maximum concentrations of 500 ppb. Another AMC installation reported concentrations at less than 5 (parts per million) ppm total for all reportable contaminants.

To maintain mission readiness, the Army needs to identify, develop, and implement cost-effective water treatment or pre-treatment technology for propellants, explosives, and pyrotechnics (PEP) that ensures compliance with environmental laws for all facilities. As regulations become more restrictive, the research products must be ready to meet them immediately to avoid process shutdown.

A (2.5.e) Sustainable Army Live-Fire Range Design and Maintenance

Army live-fire ranges must be sustainable into the future. Range designs and maintenance procedures must integrate explosive safety, environmental compliance, and natural resources management with the objective of ensuring the operational capability of the live fire training environment. Munitions firing impacts, erosion control, scrap buildup, noise, particulate matter/dust, threatened and endangered species, and invasive species are significant issues for design and maintenance of training lands and firing ranges.

There are four areas, identified by the training support community, needed for sustainable Army ranges. First, a risk assessment model is needed to identify designs which pose significant environmental compliance risks (i.e., risk of compliance violations with the Clean Air Act, Clean Water Act, Resource Conservation and Recover Act, Safe Drinking Water Act, Comprehensive Environmental Response, Compensation, and Liability Act, and the Environmental Planning and Community Right-to-Know Act). Second, select range design specifications need to be modified to provide for sustaining the range's function, reducing maintenance and cleanup needs, and minimizing natural resource degradation problems and environmental compliance risk, while maintaining training condition requirements. Indirect-fire ranges typically involve open target or impact areas with no design features to facilitate maintenance, effective and low cost collection of range scrap, and clearance of UXO. Plans are needed for retrofit/upgrade packages for existing firing ranges, which will minimize or eliminate the environmental impacts from training. Standard range designs need to incorporate existing erosion control technologies for use on roads and trails on maneuver training areas, off-post/non-DOD training lands, collective live-fire ranges, and in drop/landing zones.

The third focus area requires an Army Training Testing Area Carrying Capacity (ATTACC)-like tool, based on Standards in Training Commission (STRAC), to monitor a range's munitions carrying capacity and to determine maintenance frequency. This tool will consider range condition requirements, air emissions, soil loading, munitions use monitoring requirements, environmental conditions, weather, quantity of weapons, etc. that indicate the cumulative

impacts of weapons use on training ranges. A fourth need is to evaluate off-the-shelf surveillance technologies to assist in controlling access to ranges and training areas and develop recommendations for their use. A search of the Army's 1999 Environmental Program Requirements (EPR) database revealed that $352,345,891 was requested for sustainable Army live-fire range design and maintenance.

A (2.2.e) Improve Oil and Grease Removal/Treatment Technologies for Contaminated Wastewaters and Sludges/Soils

Oil/water separators are used in vehicle washing processes, aircraft washing and firefighting training areas. A review of Pollution Prevention (P2) Plans indicate that most Army installations use armor piercing-incendiary (API) separators (on-ground or in-ground tanks with baffles) to separate oil and water by gravity segregation. Many of the existing oil/grease-water separator/treatment systems function inefficiently for their operating conditions and have not been adequately maintained.

In addition, silt generated during vehicle washing and the use of new cleaning solvents impair the separator capabilities. Consequently, oil, grease and contaminated solids are discharged to the wastewater treatment system or the environment, which may result in Notices of Violation (NOV), other enforcement actions, and their associated costs. A search of the Environmental Program Requirements (EPR) Database (1999) revealed that 209 projects were submitted concerning oil/water separators; with a total cost of $85,234,733 and total obligated cost of $17,620,541.

Improved oil and grease contaminated wastewater treatment/removal technologies are needed that require minimal maintenance and provide cost-effective treatment/disposal technologies for oil and grease contaminated sludges and soils. These technologies must consider different retention times and droplet sizes.

A (2.3.p) Develop a Quick Analysis Test Kit for Military-Unique Compound Detection

There is no current method to conduct rapid field analysis of military unique compounds during site assessments to support real estate transactions and disposal operations at Army installations. There are no technical tests being performed to determine the hazardous characteristics of range scrap. Failure to identify these may result in incorrectly handling "potentially hazardous waste" material. Range scrap is disposed of by TRADOC, FORSCOM, NGB, and USARC facilities. One problem in particular is the need for waste characterization of scrap materials such as expended cartridge cases, 120mm end caps, expended smoke pot canisters, expended smoke grenade canisters, expended pyrotechnic canisters and 120mm sabots returned from firing ranges to ammunition supply points (ASP).

Military personnel currently perform visual inspections of range scrap returned to the ASP. Current methods for other types of field testing are slow, costly and require samples to be sent to laboratories for analysis and quantitative results. The Army currently spends on an average $2,000 per sample on laboratory testing and quality control requiring up to two weeks for results. The inability to obtain a quick analysis may result in classifying non-hazardous materials as

hazardous waste, resulting in increased disposal costs. In addition, field analysis methods would reduce/avoid the need of laboratory operation and maintenance.

The ammunition inspectors at TRADOC and FORSCOM installations need a portable testing device to determine if these items exhibit any hazardous waste characteristics. The device should be capable of the Toxic Characteristic Leaching Procedure (TCLP) test and/or test to determine ignitability, corrosivity, reactivity, or toxicity. Research is needed to identify/develop a rapid, versatile, user-friendly method to determine the presence of Army typical contaminants from scrap.

A (2.3.k) Removal, Treatment, and Disposal Technologies for Lead-Based Paint (LBP) Contamination

Three important Federally-driven programs which are related to this requirement are: (1) Prevention of childhood lead poisoning; (2) Prevention of over-exposure of workers to lead; and (3) Characterization and proper disposal of lead-contaminated debris.

Routine maintenance, interim controls, or abatement of sources of LBP are inefficient and costly and can often result in exposure of children and workers to LBP as well as contamination of the environment through improper controls during abatement and disposal. The cost of managing or abating LBP sources is prohibitive, especially considering the large stock of older Army facilities, and often results in work not being affordable. For example, one of the commercial companies has applied lead-based paint encapsulants to reduce the lead hazards to occupants, at a cost $8-$9 per square foot, for a total cost of $8.7 M. Lead-contaminated paint, dust, and soil are common in and around Army residential properties, child support facilities, and wooden structures constructed prior to 1978. In addition, numerous steel structures such as towers, tanks, bridges, piers, locks, and dams were constructed using lead-based paint primers and lead-based paint coatings.

Surface area of steel structures at Army facilities is approximately 50 million square feet, with about 80 percent coated with red lead oxide primer. The Army also owns 800 million square feet of non-residential buildings with an estimated 1 billion square feet of wall surfaces that contain lead-based paint. In addition, the Army owns 95,400 family housing units in the United States and 26,200 in foreign countries. The average age of these facilities is 36 years, therefore 90,000 of these units, having a total area of about 1 billion square feet, predating 1978 and most likely containing some lead-based paint.

The removal of lead-based paint from steel structures and buildings is accomplished through a variety of methods. The two most common methods are chemical stripping and abrasive blasting. The waste generated from these operations is often hazardous due to the toxicity and leaching characteristics of lead. Currently used technologies result in emission of hazardous lead dust. Environmental contamination by fugitive dust emissions is regulated under the CAA and Clean Water Act (CWA) and their amendments while the Resource Conservation and Recovery Act (RCRA) addresses the proper disposal of lead-bearing wastes. In addition, chemical strippers also introduce chemicals such as trichloroethylene, phenol, xylene, methylene chloride, and methyl ethyl ketone, which are considered hazardous wastes under RCRA.

A (2.2.f) Develop New Technologies for Treatment, Monitoring, and Quality Control/Quality Assurance of Army Wastewaters

Many of the Army's wastewater and drinking water treatment and distribution systems are not capable of meeting new toxicity-based water quality standards, revised permit limits, and Solid Waste Disposal Act (SWDA) requirements. All AMC facilities in the Army industrial base are affected by these requirements. The Army's FY1999 EPR showed that approximately $38 million were obligated for water quality management. The Army needs to identify, develop and implement cost-effective water treatment or pre-treatment technology that ensures compliance with environmental laws and regulations (CWA and SWDA) for all facilities. Technology research must consider regional and influent specific conditions.

In addition, the development of monitoring and process evaluation technologies are required to control treatment processes and provide real-time continuous monitoring of industrial process waste streams entering domestic or industrial wastewater treatment plants. Monitoring techniques/ technology must provide method detection limits and practical quantification limits for Army unique compounds (e.g., pyrotechnics, explosives, and propellants).

A (3.2.j/2.1.h) Sustainable Painting Operations for the Total Army

Specific Hazardous Air Pollutants (HAP) sources are regulated by Title III of the Clean Air Act (CAA). The largest sources of Army HAP emissions are: (1) fuel transfer operations, (2) painting/coating and depainting operations, and (3) boilers and other combustion sources. This need description addresses painting/coating and depainting sources of Army HAPs. Eleven anticipated National Emission Standards for Hazardous Air Pollutants (NESHAPs) affecting Army painting, coating, and depainting activities will also have impacts on the major Army VOC producing activities. Expected NESHAP enforcement dates are in 2002 and compliance dates in 2005, and include processes such as vehicle surface coating, paint strippers, and metal and plastic part surface coating. These rulemaking activities will significantly affect the Army's ability to paint its equipment at both depots and troop installations. In addition, seven years after each NESHAP standard comes into effect, the USEPA will reassess each rule and determine whether stricter standards are needed based on risk assessments to surrounding communities. State regulatory agencies may also mandate more strict regulations or regulate sources not covered by the Federal NESHAPs. OSHA also regulates HAP concentrations in the workplace.

Processes, including painting, cleaning/degreasing, paint stripping, cleaning between coatings, adhesives, stenciling and marking, post painting clean-up (e.g., window cleaning, paint gun cleaning, and paint booth cleaning), which are necessary to produce and maintain Army vehicles, armaments and equipment, are targeted sources for regulation. In some instances, existing technology, equipment, or operational parameters are insufficient to meet these requirements. Primary Army contaminants of concern include toluene, methyl ethyl ketone, methyl isobutyl ketone, xylene, ethanol, and ethyl ether. Identification/evaluation of alternative paints, coatings, and paint stripping methods or technologies/ methods required to control, reduce, or recycle HAP emissions from Army sources is needed. These technologies/methods are required

primarily by AMC, FORSCOM, TRADOC, and ARNG installations to control HAP emissions to maintain compliance with environmental laws at the Federal, state, and local levels.

A (3.5.c) Solid Waste Diversion

Construction/demolition (C/D) debris is an Army unique solid waste stream due to the quantity and types of buildings aggressively being demolished in order to modernize Army installations. For example, World War II temporary wood buildings are only found on DoD installations as well as hammerhead barracks which are like mortar facilities. Due to aggressive take down and replacement programs, the costs associated with the disposal of C/D debris on Army installations are escalating at an alarming rate. Enormous quantities of natural resources are being permanently disposed of versus being reused or recycled.

If the trend to landfill C/D debris continues, the potential for compliance issues to surface escalates each year. In practice, there are currently few restrictions on landfilling or using demolition debris contaminated with lead-based paint. The USEPA has issued a proposed rule that adds clarity and some restrictions (Federal Register, 18 December 1998, page 70189). The potential for future liability is high if the landfill begins to leak over time. These issues may also complicate the transition of BRAC installations to the host community.

Approximately 15,000 buildings residing on Army Materiel Command production facilities are contaminated with energetic materials and will have to be decontaminated before demolition or salvage. The current method of disposal is to burn the buildings, which creates a hazardous waste stream. The ability to dispose of the buildings without burning may result in a special, possibly non-hazardous, versus a hazardous waste stream. Current decontamination and disposal costs are estimated to be $250K per building.

Under the Facilities Reduction Program (FRP), the Army is scheduled to remove 6.7 million ft^2 of WWII wood structures annually through 2003. This figure only addresses the "temporary" structures from the massive WWII-era build up. The Army has several other future construction/demolition initiatives that will multiply the waste stream by several times well beyond 2003.

A (3.2.a) Develop a NESHAP-Compliant Chemical Agent Resistant Coating (CARC) System

The CARC system, comprised of cleaning, pretreatment, priming and topcoating steps, includes materials and coatings that contain toxic and hazardous materials and/or are high in volatile organic compounds (VOCs). The proper application of the CARC system causes problems in complying with the Clean Air Act and exposes workers to dangerous chemicals (e.g., the present VOC content of 3.5 lbs/gal for the exterior topcoats already exceeds levels allowed in the South Coast Air Quality Management District in California). As more stringent air regulations are implemented in other areas of the country and internationally, the Army will be forced to purchase and install expensive pollution abatement equipment in order to continue using these CARC. Due to the hazardous material content in pretreatment chemicals, CARC removal prior to repainting and certain maintenance activities also generate hazardous wastes requiring costly

disposal. The Army needs to develop a zero/low-VOC chemical agent resistant coating system that meets or exceeds performance and operational requirements. In addition, the development of this new CARC system should minimize sustainment costs in the areas of application equipment investment/maintenance and in non-destructive inspection.

A (3.4.c) Alternatives to Explosion Suppressants and Ozone-Depleting Firefighting Agents

The Clean Air Act Amendments of 1990 mandated the domestic phaseout of Halon production by 1 Jan 94. This phaseout was essential for protection of the stratospheric ozone layer but it has had serious consequences for Army readiness. Eleven major air and ground weapon systems rely on Halon 1301 in fire suppression and/or explosion suppression applications. These systems include the M1 Abrams Tank, the M2/M3 Bradley Fighting Vehicle, the AH-64 Apache, the MLRS and others. Additionally, Halon 1301 is used extensively in fixed fire protection systems in Army facilities. The Army has found technologies and solutions for all Halon 1301 requirements in the engine compartments of ground combat vehicles. These technologies satisfy performance and safety requirements and can be applied by retrofit of existing systems. Although the retrofits have not all been accomplished, the technologies exist to do so. The Army has also identified suitable alternatives for the Halon 1301 used in facility applications. Most Halon 1301 systems are being replaced with water while others may be replaced with FM-200 or Inergen. Facility conversions are being managed by the MACOMs.

The Army has not yet identified a suitable Halon 1301 replacement for the explosion suppression systems in crew compartments of ground combat vehicles. Existing fire suppressants fail to satisfy the exacting performance requirements and/or the toxicity requirements necessary for crew safety and health. Until all Halon 1301 requirements in weapon systems are eliminated, the Army is temporarily sustaining weapons systems from a strategic reserve of Halon 1301 managed by DLA. The reserve depends on Halon 1301 removed from facilities for sustainment of stockage levels. The reserve is only a temporary source for Halon 1301, which makes it imperative that a suitable alternative be developed for the crew compartments of ground combat vehicles. It is also imperative that retrofits for Halon 1301 in ground combat vehicle engine compartments and other applications are accomplished as soon as possible and that Halon 1301 systems in facilities be replaced quickly.

A (3.3.c) Ordnance Manufacture, Maintenance, Use and Surveillance to Enable Sustainable Ranges

Ordnance and ordnance component (bullets, propellants, explosives and pyrotechnics) manufacture commonly involves use of hazardous materials. These materials are used not only in the energetic materials themselves, but also in the sealants, adhesives, liners, insulation, packaging, etc., which become an integral part of various ordnance systems. As a result, hazardous materials are used and emissions and waste are generated not only from ordnance manufacture, but also in the use, maintenance and demilitarization of the systems. Based on the Environmental, Safety and Health (ESH) impacts of these materials, EPA and DoD regulations and presidential executive orders have mandated reduction or elimination of such materials. Costs to handle and dispose of hazardous wastes are also a prime consideration as these costs can contribute significantly to the overall environmental life cycle cost of a weapon system. Lastly,

readiness is partially dependent on the availability of materials. Obsolescence, due to manufacturers ceasing production of hazardous materials, can compromise readiness if suitable substitutes are not available for manufacturing and testing of ordnance systems. Alternative materials and/or processes are needed that should minimize or eliminate ESH impacts and decrease affiliated life cycle costs and risks to readiness. Methods for the demilitarization of weapon systems utilizing alternative materials and processes must also be addressed.

In addition, the Army packages and transports many of its ordnance supplies using preservative treated pallets, preservative treated wooden boxes and containers, and asphalt impregnated fiber containers. These packaging materials require disposal as regulated wastes. The Army needs to develop and implement non-hazardous packaging materials or develop materials capable of being reused or recycled in order to reduce costs and environmental impacts. Existing treated wood may be disposed through a composting process at a lower cost than hazardous waste disposal.

A (3.1.c) Reduce/Eliminate Pollution for Compliant Plating Processes

Alternative coatings and more efficient processes need to be identified or developed to replace currently used processes for exterior coatings. Exterior coatings may include plated surfaces such as chromium, cadmium, zinc and copper that overlay zinc phosphate and chromium conversion coated surfaces, and may also be "topped" with sealers containing chromium. Cleaning and preparation of metals prior to coating involve use of hazardous solvents and treatments resulting in the generation of additional wastes. Also, chromic acid baths are frequently used for plating operations. This need focuses on the exterior coatings that are exposed to environmental conditions and mechanical wear. These coatings are used on virtually every equipment commodity including aircraft, wheeled and tracked vehicles, missiles, ordnance, and communications-electronics. New coatings and processes need to be identified that can meet current performance requirements but eliminate the use of toxic and regulated materials and thereby reduce generation of hazardous wastes. In addition, current non-destructive inspection techniques require coatings removal, which creates hazardous wastes. There is a need for methods to perform non-destructive inspection (NDI) without removing coatings.

A (3.5.k) Pollution Prevention in Facility Construction, Operation, Repair and Demolition

Operation, repair, maintenance, and demolition of Army facilities cost $4.5 billion in FY1997. These expenditures are about 6% of the total Army budget. They represent only about 30 percent of the actual requirements; two-thirds of the requirements are backlogged. Implementation of sustainable design concepts would enable the Army to decrease these costs throughout the facility management life-cycle and meet a higher percentage of actual requirements. The purpose of this research would be to examine facility life-cycle sustainable design principles, similar to current research and development on incorporation of pollution prevention throughout the weapons systems life-cycle, and incorporate them into appropriate guidance documentation. Army construction is governed by the Corps of Engineers (COE) Guide Specifications. The Green Building Criteria Update Program (GBCUP) has been responsible for incorporating environmentally-friendly materials, equipment, and/or procedures into Corps guidance documents. The COE guide specifications need to be examined to determine which sustainable

design concepts should be implemented, promoted further, and incorporated into more comprehensive guidance to address broader life-cycle issues. The Army also needs to develop methods to estimate the facility life-cycle pollution prevention and cost impacts of relevant sustainable design technologies.

A (3.9.d) Reduce/Eliminate Pollution from Military-Unique Power Sources

The Army purchases, uses, stores and disposes of large quantities of non-rechargeable primary and rechargeable batteries. These batteries are used by soldiers in such equipment as manpack radios, night vision equipment, thermal weapon sights and sensors. The batteries, because of their chemistries and constituents, are hazardous and have to be managed in accordance with RCRA. Disposal of these batteries is estimated to cost $3M per year. The Army needs to initiate a comprehensive program to minimize the environmental, health and safety costs for batteries. To this end, the Army must develop and implement safe, cost-effective, improved non-rechargeable primary and rechargeable batteries, develop technologies that make it easier for soldiers to recharge and use rechargeable batteries, and explore the potential use of fuel cells and other alternatives as rechargeable power sources. Thermal batteries and other unique power sources are used in weapon systems such as missiles and smart munitions. Thermal batteries contain heavy metals such as chromium and barium and must be disposed as hazardous waste. Current missile demil operations require disposal of approximately 16,000 batteries per year. Smart Munitions batteries are destroyed during the explosion, scattering the hazardous materials in the test site and combat area exposing the environment and the soldier to hazardous chemicals. Reducing the environmental requirements associated with field battery use has great potential to lessen the battery-related operating and support costs and the administrative burden encountered by tactical organizations.

A (3.3.a) Alternatives to Open Burning/Open Detonation (OB/OD) of Stockpiled Munitions

Historically, OB/OD had proven to be a safe and cost-effective method for munitions demilitarization. This is no longer the case as safety and health hazards are a major concern and the environmental impacts are unacceptable due to the resulting air, soil and water pollution. Although efforts are being made to recycle and reuse munitions, there are components for which this will never be possible. New demilitarization technologies are not yet in place that can handle the stockpiled quantities that are at or very near the end of their life cycle and must be disposed in the near future. A strategy needs to be developed for demilitarization of the stockpiled munitions that will minimize/ eliminate environmental contamination and decrease safety and health hazards with their affiliated costs.

A (3.6.j) Improved Nuclear, Biological and Chemical (NBC) Protection Techniques

Existing procedures for the decontamination of chemical protective masks, protective clothing, sensitive equipment, and other items of equipment are inefficient and fail to remove all traces of deadly chemical agents. These agents permeate the materials they contact and, unless completely removed, continue to off-gas into the environment even after decontamination. In addition, the Army uses wet chemistry (bubbler) technologies at its facilities to detect and monitor the presence of chemical agents. These technologies result in costly processing and disposal of the

chemical components. Annual costs for handling, processing and disposal of the wet chemistries are estimated at $2M. Further, the Army uses many carbon filtration systems in its chemical storage activities. Like the wet chemistries discussed earlier, the decontamination process for spent carbon is highly regulated and requires incineration and land disposal at considerable cost. The Army needs to implement new, more efficient and environmentally-safer procedures and methods for chemical agent decontamination. Research is needed to evaluate and respond to the permeation characteristics and off-gassing of agents. The Army also needs new, environmentally-friendly technologies for chemical monitoring to eliminate the need for disposal of wet chemistry components.

Equipment designed to detect, monitor, and alarm for the presence of chemical and biological agents must be tested as part of the acquisition process. The use of live chemical or biological agents is forbidden outside of the laboratory environment. The systems, however, are designed for the tactical environment and must be tested on actual test ranges. Chemical agent simulants are used in lieu of live chemical agents. These chemical simulants are themselves toxic, and as such, cannot be dispersed into the environment. Local and state governments have only allowed the use of a few non-pathogenic biological simulants, which are not practical or adequate as these strains do not mimic all of the properties of the target microorganisms. Alternative simulants are required in order to adequately test the detector, monitor, and alarm systems.

In addition, the resurgence of naturally occurring microorganisms that were once thought to have been eradicated, such as foot and mouth disease, pose a new threat to operational forces as they are required to be deployed to affected areas. The decontamination of equipment and materiel exposed to these microorganisms must be accomplished using the same decontamination solutions that are used for chemical and biological warfare agents. Decontamination must be completed prior to redeployment.

A (3.10.f) Reduce/Eliminate Pollution for Compliant Composite Manufacturing and Repair

The manufacture and repair of composites and ceramics involves use of hazardous sealing, bonding and adhesive materials. These materials pose health risks to workers and generate hazardous waste streams requiring management in compliance with RCRA. At present, the most predominant technology for composites involves thermal curing of thermoset resins. These resins have limited shelf-lives. At the expiration of their shelf-lives, the uncured or partially cured materials must be disposed of as hazardous waste. Additional uncured or partially cured quantities of these materials enter waste streams during manufacture and repair. VOCs and hazardous air pollutants are also released as the resins are applied. The Army needs to develop and implement new processes, materials, and/or technologies to eliminate the environmental impacts currently associated with composite manufacture and repair.

A (3.10.e) Reduce/Eliminate Pollution for Compliant Manufacture, Testing, and Maintenance of Military Clothing and Textile Items

The manufacture and fabrication of individual soldier items of clothing and textile products, chemical protective clothing and equipment involves use of heavy metals and solvents, which generate costly waste streams and air emissions. The use of these hazardous and toxic materials

exposes workers to health and safety risks and unnecessarily increases procurement costs for these items. Additionally, military-unique textile products such as utility uniforms, chemical protective ensembles, parachutes, tentage require testing and sampling to ensure that production lots demonstrate all required performance characteristics such as chemical agent protection, camouflage, water resistance, mildew resistance. The analysis of these textiles involves use of the hazardous materials and solvents. In the case of sensitive textile items, such as parachutes, hazardous materials are used in maintenance and cleaning processes since they leave no residue and do not adversely affect the composition or condition of the fabric. These hazardous materials and solvents cause waste streams that must be managed, controlled, and disposed of in accordance with RCRA. The Army needs to eliminate the use of hazardous and toxic chemicals in the manufacture, testing, and maintenance of military-unique clothing and textile items.

A (3.7.l) Develop Environmentally-Compatible Lubricants and Fluids

Many types of petroleum, oils, and lubricants (POLs) contain components that are considered toxic or hazardous. Problems have been identified from oil/water separators contaminated with lubricants and fluids in addition to oils. Some synthetic lubricants have been shown to cause the inversion of the oil layer, dysfunction of oil/water separator, and, in some instances, release of the lubricants, fluids and oil to soil and groundwater. Cleanup from release events from lubricants and fluids are costly to the Army. Lubricants and fluids in oil/water separators are a problem at many Army installations, including AMC/TACOM, FORSCOM, TRADOC, NGB, and USARC installations

A (3.4.b) Alternatives to Ozone-Depleting Refrigerants for Military-Unique Applications

The Clean Air Act Amendments of 1990 mandated the domestic phase-out of all CFC production by 1 Jan 94. This phase-out was essential for protection of the stratospheric ozone layer, but it has had impacts on Army refrigeration and air conditioning systems. Army-unique refrigeration and air conditioning systems will cease to function once stockpiles of current refrigerants are depleted. Existing systems cannot operate with available replacement refrigerants. This could be a major problem in the next six months because DoD policy states that no Class II ODCs will be used in foreign countries. The Army needs replacement refrigerants.

These replacements must satisfy Army performance and safety requirements and the procedures for retrofit of existing refrigeration systems must be developed. Facility conversions are being managed now by the MACOMs.

Until all Refrigerant R-22 and other ozone-depleting refrigerant replacements are identified/developed, the Army is temporarily supporting replenishment from a strategic reserve managed by DLA. The reserve is only a temporary source for these refrigerants, which makes it necessary that a suitable alternative be developed. It is also necessary that retrofits for various refrigeration applications be accomplished as soon as possible, and that Refrigerant R-22 systems in facilities be replaced quickly. Research should focus on replacing Class II ODCs.

A (4.6.a) Reducing Impacts of Threatened and Endangered Species (T&ES) on Military Training, Testing, and Other Operations

There is an urgent requirement to meet training standards while still protecting threatened and endangered species (T&ES). The Endangered Species Act (ESA) has adversely affected military training exercises due to the growing impacts of Army activities on T&ES located on CONUS Army installations. Impacts on threatened and endangered species can include, but are not limited to, elevated noise levels and air, water, and soil contamination from training with obscurants, riot control agents, and explosive impact demolition materials.

The Army must continually seek new ways to improve the availability of land for training without impacting T&ES. One objective is to reduce restrictions on training and existing land uses while still addressing T&ES habitat requirements. To accomplish this objective, new methods and technologies are needed that address impacts from T&ES habitats on maneuver training, smoke and obscurants, and noise from vehicle and blast. The loss of T&ES is most often due to loss or disturbance of habitat. Thresholds for Army-unique activities, such as maneuver training, blasting, and use of smoke and obscurants, need to be researched and established for categories of T&ES and resource areas. Transition plans are also needed to correlate species-specific thresholds to other resource areas and installations. Without these methods, technologies, thresholds, and transition plans, the U.S. Fish & Wildlife Service (USFWS) is forced to hold the Army to the most stringent standards to protect T&ES on Army lands.

In addition, habitat fragmentation is recognized to be the single greatest threat to biodiversity globally. Fragmentation includes both loss of habitat and isolation of increasingly smaller parcels of essential habitats. Maneuver training needs to avoid fragmentation effects on T&ES habitats. Research is needed on additional methods to mitigate fragmentation and to counteract any further loss of habitat on military lands critical to T&ES. Training corridors are currently being used to avoid the identified T&ES, but this affects training effectiveness. There is a need to find the balance between training corridor buffers that promote T&ES population growth while maximizing land acreage available for mission activities.

A (4.6.c) Baseline Threatened and Endangered Species (T&ES) Surveys and Monitoring

In compliance with the Endangered Species Act (ESA), the Army has identified 153 species that appear on the Federal list of T&ES on, or adjacent to, its installations. T&ES compliance decisions are made in consultation with the USFWS and are based largely on estimated population viability, potential occurrence of an impact/activity within the habitat, and recovery requirements. As a result, Army Regulation (AR) 200-3 requires each Army installation to establish individual T&ES population goals and habitat requirements. To implement this directive, further research is required to more efficiently identify T&ES populations and to understand T&ES habitats and population distribution.

The Army currently spends $5,128,000 annually conducting T&ES baseline surveys (FY99 Environmental Program Requirements EPR data), a 250 percent increase over the $2,000,000 in FY97. The Army needs a consistent and replicable set of protocols to more efficiently survey and

monitor T&ES with guidelines that enable categories of species, such as, birds, bats, insects, and mussels, protocols to be adapted to installation-specific conditions and species. Since new methods may not apply to all listed species, a "one method per category" approach is required. Collectively, the protocols need to reduce survey and monitoring costs Army-wide; and provide the best scientific and commercial data available to confirm species occurrence, distribution, relative abundance, biology and ecology of the species, and the potential impacts from training activities.

The data elements listed above, collected in a consistent and replicable manner, are also needed to generate a larger database for greater validity and credibility than small, independent surveys. This information will need to be integrated with landscape/ecosystem models developed for overall ecosystem management and modeling in order to examine long-term viable population trends, causes of changes, and effectiveness of recovery plans for enhancement of the species at the installation level.

In addition, a limitation to T&ES surveying and monitoring tasks is the risk to human health and safety from possible detonation of UXO during surveys conducted on military ranges. Applicable remote sensing options need to be identified to safely complete these inventorying tasks.

A (4.2.a) Land Capacity and Characterization

The Assistant Chief of Staff for Installation Management has Staff responsibility for sustaining renewable natural resources for Army missions. Soil is a renewable natural resource. The new Sikes Act Amendments of 1997 require that each installation having significant natural resources prepare and implement an Integrated Natural Resources Management Plan (INRMP). The Army has determined that 179 installations require an INRMP. This plan provides for the conservation and rehabilitation of natural resources and can cause no net loss to the mission. In addition, Army regulation 200-3 (section 2-15) requires that "Installation sources of dust, runoff, silt and erosion debris will be controlled to prevent damage to the land, water resources, equipment, and facilities, including property. An Erosion and Sediment Control Plan must be implemented where appropriate." Soil erosion is a serious issue on Army lands. Accordingly, Army needs to develop a "Soil Erosion and Sediment Control" component to the INRMP. This requirement was endorsed by the MACOMs at the 2000 Conservation Program Management Review.

The template for this plan might include a technical frame-work for step-down soil resource-use planning. A step-down approach includes a focus on issues and opportunities at various management levels -- region/watershed, installation/sub-watershed, training area/ecological response unit, and site-specific plans/projects. The plan component could integrate soils-related projects/funding from the conservation program, compliance program, ITAM program, and operations & maintenance account. The planning cycle could include developing goals, describing the capability/status of soil resources, assigning resource-use objectives, identifying and prioritizing management problems and needed actions, providing site-specific prescriptions for management, scheduling activities, and monitoring accomplishments. Plans must be revised every five years. The revised plan could document if the objectives of the previous plan were

met or not, if the soils are being sustained or not; and identify any amendments to the revised plan that are necessary to achieve sustainment of the soil resource.

The Army's mission requires the use of maneuver and testing land to maintain readiness through realistic optimal training opportunities. Loss of vegetation, soil destabilization, erosion, and invasion of non-native species impact the sustainability of those lands to meet Army mission requirements. Extensive resources, $12.2M of a total requirement of $182M in the FY1999 EPR database, are being invested to address these problems at over 120 Army installations worldwide. Land management practices and approaches that work well on one installation may not work on others. In order to sustain Army mission activities and training standards, land use planning needs to compliment local ecosystem management approaches by integrating maneuver and testing activities within a standard structure.

The ATTACC methodology applies a training load (based on past, scheduled, and predicted training) to the existing land condition (i.e., erosion status) to predict a future land condition. The final component of the ATTACC methodology applies the effects of land management practices to move the land to a desired condition. It also estimates the cost of these land management practices. ATTACC cost factors are calculated from the cost and effectiveness of these land maintenance practices. The ATTACC methodology is designed to provide scientifically-based information to the land managers to support sound decision-making. However, the current version of ATTACC is limited in its ability to provide the most accurate information for decision making. This limitation is due to the accuracy of input data and a simplistic characterization of the three components of the model. To improve the ATTACC methodology, research and development is needed to develop ATTACC protocols that increase the accuracy of the data inputted into the model; and further test, validate, and upgrade the three components of the methodology.

A (4.2.i) Land Rehabilitation

Force training is more efficient and effective if Army lands provide an environment that is realistic and simulates the battlefield environment or theatre of operations. Heavier and faster tactical vehicles, longer firing and engagement distances, increased mechanization, and task force and combined arms tactics combine to increase the requirements for land and the stress on these lands. This situation conflicts with efforts to concentrate training and testing activities on smaller land areas due to natural and cultural resource restrictions, and Base Realignment and Closure (BRAC) actions. The combined result of these actions is damaged land resources that no longer provide the necessary realistic environment for effective training.

The Sikes Act has provisions for no net loss of training land. To achieve no net loss requires an understanding of the interactions of land use that can damage or alter resources and the most appropriate land rehabilitation actions that can be used to maintain these resources. The Army Training and Testing Area Carrying Capacity (ATTACC) program provides one example of how this knowledge can be applied. The ATTACC concept of defining military use through maneuver impact miles (MIMs) and its relationship to land condition, through soil loss and land rehabilitation and maintenance requirements, illustrates the commitment to maintaining land resources.

Currently, the Army has employed many Federal and private sector technologies for land rehabilitation. However, experience has shown that simple application of techniques designed for other purposes (e.g., agricultural use), is not necessarily the most cost effective or efficient means to provide land rehabilitation. Nor are these techniques often appropriate for application on lands that are required for continued use to support a training or testing mission. The Army spends varying resources for land rehabilitation to support various objectives. In FY1997, approximately $9.5M was spent of the total $94.6M needed to restore ecosystem damage and approximately 50 percent of the ITAM budget, or $19M, was spent on land rehabilitation and maintenance.

The Army needs the capability to more effectively rehabilitate and configure Army training and testing lands as required to support the Army mission. Effectiveness needs to be measured in terms of cost per application, rehabilitation of training acreage related to erosion effects, ecological health, and increased training availability and opportunities (MIM's capacity).

A (4.3.e) Non-Native Invasive Species Control on Army Installations & Operations

Presidential Executive Order (EO) 13112, signed Feb 3, 1999, requires each Federal agency to "prevent the introduction of invasive species" and "detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner." It also requires agencies to "conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species and to not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species." Force training and other aspects of the operations of the U.S. Army and the management of Army mission lands create unique challenges to fully complying with the intent of this EO.

Army lands are subject to disturbances unique on Federal lands, including repeated high intensity fires on ranges and repeated soil disturbance in maneuver boxes. The nature of such disturbances requires the Army to explore methods beyond existing commercial off-the-shelf (COTS) technology to detect, control, eradicate, and monitor invasive species populations on mission lands. Likewise, certain types of Army training activities place soldiers at risk to adverse interactions with certain invasive species, such as non-native fire ants, beyond the risk realized by other users of federal lands. The greater risk precipitates a need for research beyond off-the-shelf technology to determine affective management protocols to prevent these species from adversely impacting soldier readiness.

Legend for reading the Army Environmental Quality Technology (EQT) FY2002 Program one pagers.

Program Title:
EQT Program Title

Unexploded Ordnance (UXO) Identification and Discrimination

A●R-1

Requirement Number:
EQT Management Number derived from Technology Team Priority and the AERTA Process

Potential Cost Avoidance of $1.1B w/an Investment of $31M*

* See Page B-

Potential Cost Avoidance:
A computed difference in current operations and operations based on employing the environmental technology program submitted

Geonics EM-63 with GPS positioning, Fort Ord, CA, 2002

Photograph:
Graphical depiction of the program

Description:
Verbal definition of Program objective, approach and the program's expected response to environmental need.

Description

Objective

To develop inclusive and can accurately identify UXO from scrap and shrapnel, and that

(GPR) and Chemical signatures of UXOs in representative environmental / geophysical conditions.

- Develop sensor fusion algorithms for discrimination of UXO.
- Develop advanced multi-sensor technologies for false alarm reduction.
- Validate technologies at standard UXO test sites.

How this project responds to need:
Multi-sensor approach addresses UXO discrimination focus on AERTA requirement 1.6.a. Decreased false alarm rate reduces number of items to be excavated, thereby reducing removal costs and safety risks.

FY02 Performance Objectives:

- Fundamental studies of sensor performance for discrimination of UXO.
- New algorithms for data acquisition and geophysical inversion.
- reduced false alarms
- processing algorithms.

Performance Objectives:
Performance Objectives for FY02

FY02 Performance Review:

- ce with UXO Screening,
- mental Quality
- T-ORD.

Annual Performance Review:
Assessment of FY02 performance against stated objectives

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Site Characterization and Screening Approaches	207	550				
			100			
			220	80		
UXO/Sensor Modeling, Analysis and Process	197	180	180			
	1,133	1,200				
	45	573	400			
Sensor Des Enhanceme						
UXO Multi-Sensor Systems Design		204				
	331	400	200			
	774	2,479	1,570	2,009		
Total $(K):	15,924	21,927	18,037	8,444		

RDT&E BA1 (0601102A T25) RDT&E BA2 (0602720A T25)
RDT&E BA3 (0603728A 03E) RDT&E BA4 (0603779A 04E)

Program Schedule:
Graphically depicts program schedule by FY, task and type of money

Milestones/Accomplishments:

- In FY02, developed final program for UXO Advanced development and technology demonstration in accordance with the UXO and Discrimination EQT Operational Requirements Document (EQT-ORD)
- In FY02, developed validated UXO signature Models of emerging sensors to support multi-sensor systems development and improved analysis techniques.

Milestones/Accomplishments:
Defines Program Milestones and Accomplishments by Fiscal Year

Unexploded Ordnance (UXO) Identification and Discrimination

A•R-1

Potential Cost Avoidance of $1.1B w/an Investment of $31M*

* See Page B-1

Geonics EM-63 with GPS positioning, Fort Ord, CA, 2002

Description:

Objective:

To develop technologies that are non-intrusive and can accurately identify UXO from scrap and shrapnel, and that identify the configuration and type of ordnance.

Approach:

- Develop models of electromagnetic, magnetic, Ground Penetrating Radar (GPR) and chemical signatures of UXOs in representative environmental / geophysical conditions.
- Develop and evaluate enhanced sensors for buried UXO detection / discrimination.
- Develop advanced multi-sensor technologies for false alarm reduction.
- Validate technologies at standard UXO test sites.

How this project responds to need:

Multi-sensor approach addresses UXO discrimination focus on AERTA requirement 1.6.a. Decreased false alarm rate reduces number of items to be excavated, thereby reducing removal costs and safety risks.

FY02 Performance Objectives:

- Fundamental studies of sensor performance for detection and discrimination of UXO.
- New algorithms for data acquisition and processing using physics-based modeling and formal geophysical inversion.
- Improved probability of detection and reduced false alarms through new sensor technologies and processing algorithms.

FY02 Performance Review:

Revised program schedule, in accordance with UXO Screening, Detection, and Discrimination Environmental Quality Technology Management Plan and EQT-ORD.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Site Characterization and Screening Approaches	207	550	100			
			220	80		
UXO/Sensor Modeling, Analysis and Processing	197	180	180			
	1,133	1,200				
	45	573	400			
	180	345	580	250		
Sensor Design and Enhancement	356					
	624	1,156	200			
	1,584	950	3,087	1,005		
UXO Multi-Sensor Systems Design		294				
	331	400	200			
	774	1,979	1,570	2,009		
Total $(K):	5,431	7,627	6,537	3,344		

RDT&E BA1 (0601102 BT25) RDT&E BA2 (0602720 AF25)
RDT&E BA3 (0603728 D03E) RDT&E BA4 (0603779 DO4E)

The Army EQT Program and DoD SERDP/ESTCP programs coordinate efforts to enhance the UXO focus area in addressing AERTA requirement 1.6.a. This coordinated effort results in the Army being able to leverage substantial SERDP/ESTCP funding.

Milestones/Accomplishments:

- In FY02, revised final program in accordance with the UXO Screening, Detection, and Discrimination Environmental Quality Technology Management Plan and the UXO Screening, Detection, and Discrimination EQT Operational Requirements Document (EQT-ORD).
- In FY02, developed validated UXO signature models of emerging sensors to support multi-sensor systems development and improved analysis techniques.
- By FY03, provide technical and performance specifications for an optimized UXO detection/discrimination system.
- By FY04, transition handheld sensor technologies and advanced discrimination algorithms to users.
- By FY05, demonstrate a 90%-95% probable UXO detection/discrimination system to reduce false alarm rates by 90% (10 false alarm rate decrease from current capabilities) at or above currently achievable Pd (90%-95%).

Hazard/Risk Assessment of Military Unique Compounds (MUC)

Potential Cost Avoidance of $1.5B w/an Investment of $27M*

* See Page B-1

Description:

Objective:

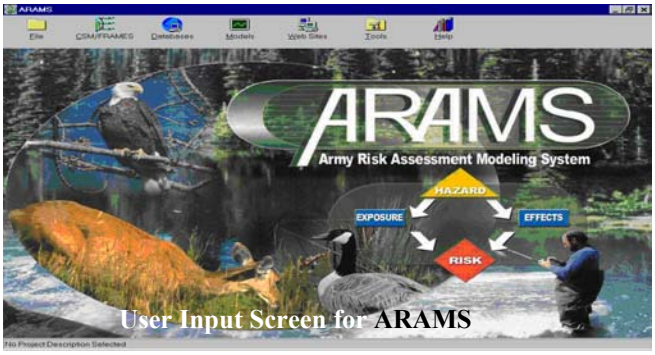
To develop an Army Risk Assessment Modeling System (ARAMS) to provide consistent and verifiable procedures to assess human and ecological health risks of Military Unique Compounds (MUC) at Army environmental restoration sites.

Approach:

- Develop screening-level models and spatially-explicit, comprehensive models of contaminant fate and transport.
- Conduct multi-media exposure pathway assessment with uptake and transfer to environmental endpoints.
- Link effects databases and options for higher-order effects models.
- Quantify probabilistic risk of MUC to ecological and human health with uncertainty.
- Integrate modeling platform reducing time/cost to conduct risk assessments at Army sites.

How this project responds to need:

Development of ARAMS (a knowledge model integration tool) is necessary to provide consistent use of the existing 200 plus risk assessment models described in AERTA requirement 1.1.a and 1.5.g.



User Input Screen for ARAMS

FY02 Performance Objectives:

- Release version 1.0 of Army Risk Assessment Management System (ARAMS).
- Develop for integration with ARAMS version 1.1:
  - Trophic Trace Beta Version, estimates transfer of contaminants to ecological and human receptors
  - Terrestrial Toxicity Database & Predictive Food Chain Models
  - Interactive information systems evaluate risk & toxicity mixture
  - Spatial heterogeneous landscapes exposure evaluation methods

FY02 Performance Review:

Revised program and schedule are in accordance with Environmental Quality Technology Management Plan.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Exposure Assessment	619	1,074	729	728		
	695	997	78			
	462	748	1,109	652		
Effects Assessment	210	288	248	250		
	904	1,564	213			
	216	441	1,135	281		
Risk Characterization	300	200				
	1,059	1,134				
	236	2,972	2,866	2,275		
Total $(K):	4,701	9,418	6,378	4,186		

RDT&E BA1 (0601102A H68/S04/T25) DT&RE BA2 (0602720A F25/835)

RDT&E BA3 (0603728A 03E)

The Army EQT Program and DoD SERDP/ESTCP programs coordinate efforts to enhance the Haz/Risk focus area in addressing AERTA requirement 1.1.a and 1.5.g. This coordinated effort results in the Army being able to leverage substantial SERDP/ESTCP funding.

Milestones/Accomplishments:

- In FY02, developed final program for Hazard/Risk advanced development and technology demonstration in accordance with the Environmental Quality Technology Management Plan for Hazard/Risk.
- In FY02, released version 1.0 of the ARAMS with process descriptors for explosives fate and transport, aquatic explosives uptake, and *in vitro* bioavailability data for humans.
- By FY03, release version 1.1 of the ARAMS with process descriptors for range compounds (propellants, smokes, illuminants) fate and transport, terrestrial explosives uptake, and expand fate/transport and toxicology databases.
- By FY04, complete ARAMS 2.0 with higher order assessment methods, i.e., Geographic Information System based spatially explicit wildlife exposure model and contaminant fate and transport models.
- By FY05, complete ARAMS 2.1 with tutorials and case studies of cost effectiveness for enhanced tech transfer.

Enhanced Alternatives and In Situ Treatment Technologies for Explosives, Organics and Solvents in Groundwater

A●R-3

Potential Cost Avoidance of $394M w/an Investment of $17M*

* See Page B-1

Description:

Objective:

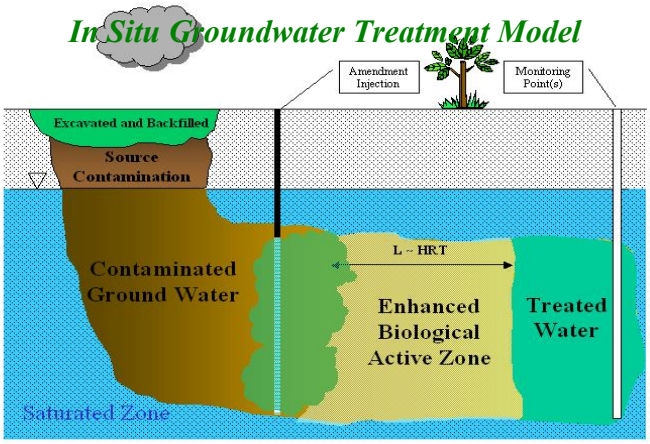
Demonstrate improved, cost effective, alternative forms of groundwater remediation for explosives and other organics contaminants.

Approach:

- Develop technologies and engineering approaches to enhance biological degradation of contaminants in groundwater.
- Develop new in situ chemical treatment technologies to focus on metal enhanced reactive transformation for explosives.
- Combine chemical/biological techniques to accelerate and improve treatment effectiveness for explosives and other organics in groundwater.

How this project responds to need:

In situ biotreatment approach degrades explosives and organics without the need for pump-and-treat systems currently used for groundwater treatment, as identified in AERTA requirement 1.2.a. Pump-and-treat systems are often expensive, only marginally effective, and require operations and maintenance for 15-20 years.



FY02 Performance Objectives:

Restructure program, including program schedule, to accommodate reprioritization of user requirements and initiate execution of new program.

FY02 Performance Review:

Met FY02 objective based on reprioritization of user requirements and continued basic research.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Biodegradation Mechanisms	648	508	230			
Zero-Valent Iron Passive Wall Technology	69	400	250			
Alkaline Passive Wall Technology			200	350	290	
In situ Bio – Electron Donors / Acceptors	229	450	350	100		
In situ Chemical Oxidation		300	350	200		
Electrical Treatment / Base Hydrolysis Remediation		350	350	300		
Total $(K):	946	2,008	1,730	950	290	

RDT&E BA1 (0601102A H68/S04/T25) RDT&E BA2 (0602720A F25)

The Army EQT Program and DoD SERDP/ESTCP programs coordinate efforts to enhance the Explosives, Organics, and Solvents focus area in addressing AERTA requirement 1.2.a. This coordinated effort results in the Army being able to leverage substantial SERDP/ESTCP funding.

Milestones/Accomplishments:

- In FY02, program restructured based on user-community reprioritization of user requirements.
- In FY02, isolated and characterized common acetogens capable of RDX degradation.
- In FY02, assessed the competitive effects of electron acceptors on the degradation of RDX.
- By FY03, optimize in situ bioremediation scheme for explosives and organics in groundwater.
- By FY04, develop zero-valent iron wall treatment technology for explosives in groundwater.
- By FY05, develop in situ chemical oxidation treatment technology for explosives and organics in groundwater.
- By FY05, protocol for utilizing direct current electrical power for the in situ production of hydroxide for treatment of explosives in groundwater.
- By FY06, develop method for delivery of nutrients into adverse geologic formations.

Innovative and In Situ Treatment Technologies for Soils Contaminated with Inorganics

A•R-4

Potential Cost Avoidance of $367M w/an Investment of $11M*

* See Page B-1

Description:

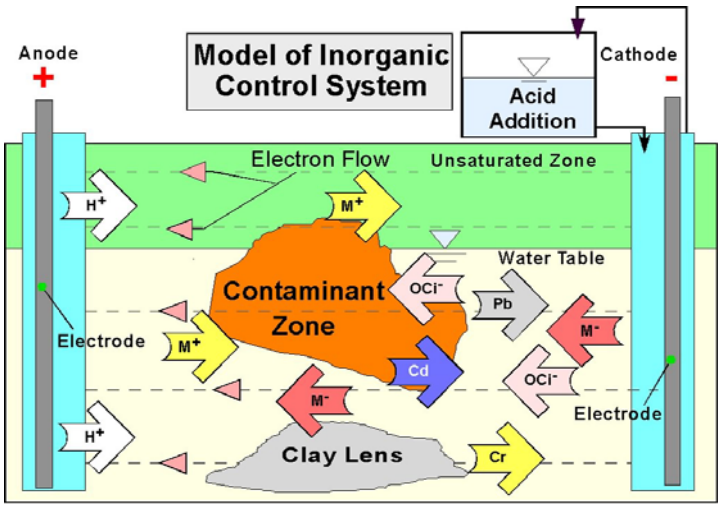
Objective:

- Inorganic contamination is a significant problem.
- Small Arms Training Ranges (SATR) are affected by lead contamination.
- Cost effective remediation technology must be developed and validated.
- Phytoremediation and contaminant separation techniques are required.

Approach:

- Phytostabilization / Phytoextraction technologies for small arms firing ranges and metal contaminated soil.
- Active and passive chemical treatment method for small arms ranges.
- On-line monitoring of physical separation processes will be demonstrated.

How this project responds to need:
AERTA requirement 1.3.e, treatment technologies for inorganic contaminants in soil and sediment.



FY02 Performance Objectives:

Restructure program, including program schedule, to accommodate reprioritization of user requirements and initiate execution of new program.

FY02 Performance Review:

Met FY02 objective based on reprioritization of user requirements and continued basic research.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Biostabilization	222	241	233			
		526	695	575	300	100
Electrokinetic's: Lab Scale to Evaluation	74	275	595	500	250	150
Chemical Immobilization	193	695	740	570	200	
Total $(K):	489	1,737	2,263	1,645	750	250
RDT&E BA1 (0601102A T25)			RDT&E BA2 (0602720A F25)			

The Army EQT Program and DoD SERDP/ESTCP programs coordinate efforts to enhance the Inorganics Contaminated Soils focus area in addressing AERTA requirement 1.3.e. This coordinated effort results in the Army being able to leverage substantial SERDP/ESTCP funding.

Milestones/Accomplishments:

- In FY02, restructured program based on user-community reprioritization of user requirements.
- In FY02, identified basic research activities with potential techniques for placing sorptive iron and manganese oxide barriers in the subsurface for interception of heavy metals in groundwater.
- By FY03, develop cost/benefit evaluation manuals for lead stabilization/extraction technologies for small arms ranges.
- By FY04, develop screening/selection manuals for biostabilization technologies.
- By FY05, determine engineering parameters for field scale demonstration of chemical immobilization.
- By FY06, determine engineering parameters for field scale demonstration of electrokinetics for in situ metals extraction.
- By FY07, determination of engineering parameters for field scale demonstration of biostabilization for in situ metals stabilization.

Particulate Matter (PM)/Dust Control

A•CM-1

Potential Cost Avoidance of $516M w/an Investment of $8.8M*

* See Page B-1

Description:

Objective:

Army training activities produce Particulate Matter (PM) that may exceed air quality standards resulting in fines and the reduction/shutdown of military training missions. Since emission characteristics and atmospheric behavior of PM emissions from non-facility sources are not well understood, the Army is at a disadvantage when negotiating with regulators. Standard PM control technologies are ineffective and costly. Measurement technologies are too expensive and not appropriate for training mission. Fugitive dust from military maneuvers, tactical vehicle emissions, prescribed burning and obscurant training is impacted.

Approach:

- Source characterization and modeling.
- PM mitigation technologies.
- PM measurement technologies.
- Receptor modeling of Army PM sources.

How this project responds to need:

Particulate matter models and measurement technologies meet the primary focus areas of AERTA requirement 2.1.b, with secondary emphasis on dust control technologies.

Sources of PM/dust contamination from Army Operations

FY02 Performance Objective:

Determine short-term performance of innovative chemical dust palliatives applied to unpaved roads.

FY02 Performance Review:

Met performance objective for FY02.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Tactical Vehicle Engine Emission Model for PM	147	95				
Chemical/Physical PM Mitigation Technologies	182	188				
PM Measurement Technologies for Opacity	152	145	145			
Receptor Modeling Method for Army Unique PM Source	119	120	170			
Biological PM Mitigation Technologies			171	322		
Technology for Field Measurement of PM Concentrations		105	220	215		
Total $(K):	600	653	706	537		

RDT&E BA2 (0602720A 896)

Milestones/Accomplishments:

- In FY02, completed draft technology verification reports detailing the short-term performance of palliatives applied to unsurfaced roads at Fort Leonard Wood to ascertain potential environmental effects from palliative application.
- By FY03, develop source characterization technologies and chemical/physical PM mitigation technologies.
- By FY04, develop opacity monitoring technology and receptor modeling methods.
- By FY05, develop biological PM mitigation technologies and PM concentration measurement technologies.
- By FY06, complete regional scale atmospheric models.

Training and Testing Range Noise Control

A•CM-2

Potential Cost Avoidance of $939M w/an Investment of $37M*

* See Page B-1

Description:

Objective:

Provide technology to comply with all noise laws and regulations at the federal, state, local and Army levels in order to maintain sustainable training/testing facilities and capabilities. This capability will help avoid loss of the use of training/testing ranges, which have a prohibitively high replacement cost.

Approach:

Develop technology and tools that, along with effective community engagement, provide the means to reduce costs and manage military noise impacts on mission capability.

How this project responds to need:

Provides methodology, knowledge and tools to:

- Forecast and assess noise impacts via noise software models.
- Plan/schedule training/testing operations for minimum noise impacts.
- Design training and testing facilities to minimize noise impact.
- Implement effective noise management programs at installations.
- Addresses AERTA requirement 2.4.f.

FY02 Performance Objectives:

Provide basic research results on the feasibility of blast noise absorbers.

FY02 Performance Review:

- Met performance objective for FY02.
- In a collaborative program with the Conservation Threatened & Endangered Species program, completed assessment of training noise impacts on Red-cockaded woodpecker (RCW) using noise dose-response information that justifies reduced training restrictions on several DoD training areas in the Southeast Region.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Noise Source/Response Characterization	290	200	309	536	250	
Develop Noise Model	210	200	720	597		
Development Noise Mitigation Techniques	200					
	125	275	430	530	300	
Noise Mitigation Demonstration	125					
Total $(K):	950	675	1,459	1,627	550	

RDT&E BA1 (0601102A T25) RDT&E BA2 (0602720A 896/048)

RDT&E BA4 (0603815D ESTCP)

Milestones/Accomplishments:

- In FY02, completed field experiments with encouraging preliminary results on the feasibility of using blast noise absorbers for large weapon firing positions for which standard noise attenuation techniques are not feasible. Final data analysis and conclusions will be completed in FY03.
- In FY02, obtained complete year data sets of field noise data from Small Arms Training Ranges (SATR) at several locations -- data will be used to improve noise modeling and mitigation.
- By FY03, investigate noise mitigation and modeling techniques for new weapons.
- By FY04, investigate utility of forests for blast noise mitigation.
- By FY05, develop real time single event blast prediction.
- By FY06, investigate human response to infrequent noise events.

Hazardous Air Pollutant (HAP) and Volatile Organic Compound Emission Control

A•CM-3

Potential Cost Avoidance of $202M w/an Investment of $6M*

* See Page B-1

Description:

Objective:

Develop and demonstrate cost effective Hazardous Air Pollutants (HAPs) and Volatile Organic Compound (VOC) emission control technologies that impact Army activities and operations regulated by the National Emissions Standards for Hazardous Air Pollutants (NESHAP), Occupational Safety & Health Administration (OSHA) and States.

Approach:

Develop and demonstrate technologies for controlling and/or recycling:

- Hazardous organic solvent emissions.
- Inorganic HAPs from surface treating.
- Toxic combustion sources.
- Chlorinated solvents.

How this project responds to need:

Addresses control of HAP emissions regulated under NESHAP prior to deadlines identified in AERTA requirement 2.1.g.

Mobile Zone Spray Booth

XCEM

FY02 Performance Objectives:

Develop new technologies for controlling and/or recycling inorganic HAP emissions.

FY02 Performance Review:

Met performance objective for FY02.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Combustion Source HAP Development	423	222	228			
Hazardous Organic HAP Technology Demonstrations	855	320				
Combustion Source HAP Demonstration	354	710	1,480	680		
Inorganic HAP Technology Demonstration	530	191				
Chlorinated Solvents Technology Demonstration Development	12					
Total $(K):	2,174	1,443	1,708	680		
RDT&E BA2 (0602720A 896)		RDT&E BA3 (0603728A 002)				

Milestones/Accomplishments:

- In FY02, completed developmental testing of Zero Emission Cr Electroplating System at Anniston Army Depot.
- In FY02, completed demo of continuous emission monitor (XCEM) at Tooele Army Depot, meeting EPA Performance Specification for five metals.
- In FY02, improved Mobile Zone Spray Booth Recirculation exceeding the 81% VOC removal efficiency requirement for control devices.
- By FY03, demonstrate hazardous organic solvent emissions technologies to remove 95% of HAPs and 20% cost reduction (baseline -10,000 cfm unit at $65/cfm).
- By FY05, demonstrate combustion source HAP control from hazardous waste incinerators (chemical and conventional demilitarization) and non-natural gas boilers to meet NESHAP requirements.

Treatment Techniques for Wastewaters from Munitions Production

A•CM-5

Potential Cost Avoidance of $394M w/an Investment of $20M*

* See Page B-1

Description:

Objective:

Munitions production is threatened by increasingly stringent environmental regulations. The Army does not have cost effective advanced treatment technologies required to maintain mission readiness for munitions production. Investigation will focus on:

- Energetic compound biological treatment under anaerobic conditions.
- Sonolytic/photolytic destruction of ordnance compounds.
- Reductive electrochemical treatment.

Approach:

Conduct applied research using synthetic wastes that simulate actual wastes. These studies evaluate a process as it treats a mixture of compounds that comprise the major components of the waste, and include field demonstrations. These are typically small-scale and can be conducted in a laboratory environment or at a field location. These advanced treatment processes must address widely varying contaminant concentrations that are typical of Army industrial facilities, and have the goal of reducing or limiting by product hazardous waste such as spent granular activated carbon.

Wastewater Treatment Plant, Picatinny Arsenal, NJ

FY02 Performance Objectives:

Verify anaerobic biodegradation of explosives.

FY02 Performance Review:

Met performance objective for FY02.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Develop Flow-Through Electrochemical Reactor	1	30				
Develop Sonolytic and Catalytic Photolysis	43	75				
Protocol for Energetic Compound Biological Treatment	73	125				
Develop Physiochemical Treatment Protocols	1	325	300			
Total $(K):	118	555	300			

RDT&E BA2 (0602720A 048)

How this project responds to need:

Electrochemical reduction, photolysis, biological and fluidized bed processes address several munitions production lines and the subsequent load, assemble and pack lines as indicated in AERTA requirement 2.2.a.

Milestones/Accomplishments:

- In FY02, verified the anaerobic biodegradation of explosives in reactors by replacing the activated carbon with sand.
- By FY03, complete protocol for energetic compound biological treatment under anaerobic conditions and transfer results to field.
- By FY04, identify new destructive techniques to cost-effectively mineralize hazardous wastes that impacting munitions production.

Sustainable Army Live-Fire Range Design and Maintenance

A•CM-6

Potential Cost Avoidance of $1.7B w/an Investment of $12M*

* See Page B-1

Description:

Objective:

Provide range risk assessment and management techniques integrating explosive safety, environmental compliance, and natural resources management with the objective of ensuring operational capability of the live-fire training environment. Technologies will target range planning, design and maintenance activities.

Approach:

- Identify environmental compliance risk to ranges and develop a functional planning and management protocol for assessment of risk.
- Review doctrinal range designs, military construction, and Objective Force (OF) requirements to evaluate and develop range design components that can be implemented to address environmental requirements.
- Develop long-term planning, construction, carrying capacity and operational protocols that will reduce environmental constraints, compliance and maintenance requirements.

FY02 Performance Objectives:

Identify range load and condition durability factors associated with range environmental compliance.

FY02 Performance Review:

Met performance objective for FY02 with bench prototype risk assessment matrix.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Range Risk Assessment Model	240	511	554	412		
Range Design Specifications		1150	1398	820		
Munitions Capacity Model		417	604	560		
Range Surveillance Tools		159	159			
Demonstration/Validation		211	1,312	1,367	186	
Technology Transfer		150	189	373	509	174
Total $(K):	240	2,598	4,216	3,532	695	174
RDT&E BA2 (0602720A 896)		RDT&E BA4 (0603779A 04E)				
RDT&E BA6 (0605857A M06E)						

How this project responds to need:

Army live-fire ranges must be sustainable into the future. Virtual and constructive training tools can support training but live-fire training events, facilities, and venues will not be eliminated. Work addresses AERTA requirement 2.5.e and will support sustainment of live training capabilities and facilities in the future and for the OF. Initial efforts in this program provide the foundation for the full program beginning in FY03 with transfer by FY07.

Milestones/Accomplishments:

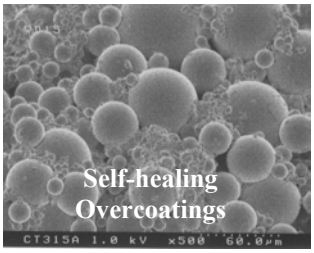
- In FY02, developed range risk and design assessment methodology.
- By FY04, complete development of a range design risk assessment model.
- By FY05, identify range design specification requirements and best management practices, incorporating environmental compliance.
- By FY05, complete development of a munitions carrying capacity model for range sustainment.
- By FY06, complete demonstration/validation of range design and retrofit packages.
- By FY07, technology transfer of risk, design, and capacity packages into standard range program.

Removal, Treatment and Disposal Technologies for Lead-Based Paint (LBP) Contamination

A•CM-9

Potential Cost Avoidance of $417M w/an Investment of $3.4M*

* See Page B-1



U.S. ARMY LEAD AND

ASBESTOS PROGRAM

Description:

Objective:

Demonstrate innovative technologies to provide Army installations environmentally safe and cost effective removal of lead-based paint hazards. Conduct demonstrations of mature technology to assist Army installations in becoming environmentally compliant in a cost-effective manner and without compromising mission readiness.

Approach:

Improve environmental compliance through:

- Thermal spray vitrification.
- Microwave assisted removal.
- Self-healing overcoatings.
- Lead-based paint hazard management system.
- Electrokinetic extraction for soils.

FY02 Performance Objectives:

Demonstrate lead-based paint hazard control technologies for steel structures and soil.

FY02 Performance Review:

Met performance objective for FY02.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Demonstrate Lead Abatement Technologies for Steel Structures	282					
Demonstrate Lead Abatement Technologies for Non-Residential Buildings	350	465				
Demonstrate Lead Abatement Technologies for Family Housing & Child Occupied Facilities	200	200				
Develop and Demonstrate Treatments for Lead in Soil	136					
Total $(K):	968	665				

RDT&E BA3 (0603728A 002)

How this project responds to need:

Overcoatings and encapsulants reduce the lead dust and health risk. Thermal spray removal and microwave-assisted removal render the waste non-hazardous and reduce the lead dust during lead hazard abatement and disposal in AERTA requirement 2.3.k.

Milestones/Accomplishments:

- In FY02, demonstrated feasibility of removing lead originating from lead-based paint from soil using electromigration to reduce lead level below EPA's level of concern of 400 ppm.
- In FY02, demonstrated environmentally acceptable chemical strippers and thermal spray for removal of LBP and decision tree for optimal selection of technologies for control and abatement of LBP hazards on steel structures.
- By FY03, demonstrate lead hazard removal technologies for buildings that result in non-hazardous waste that leaches less than 5 ppm lead and produces no hazardous pollutants. Develop a decision tree based on field demonstrations for optimum selection of cost effective technologies.

Sustainable Painting Operations for the Total Army (SPOTA)

A•P2-1

Potential Cost Avoidance of $610M w/an Investment of $46M*

* See Page B-1

Examples of materiel whose coatings will be regulated by NESHAPs

Description:

Objective:

Implement reformulated paints, sealants, adhesives, etc. that comply with forthcoming Clean Air Act (CAA) regulations, including the NESHAP surface coatings, thus allowing the Army's coating operations at affected installations to continue. Minimize the extensive record keeping required to comply with all of these new CAA and NESHAP regulations.

Approach:

- Develop a baseline for current coatings, adhesives, rubber-to-metal bonding materials, solvents, cleaners, and de-painters.
- Perform a gap analysis to determine which materials need reformulation and which have commercial-off-the-shelf (COTS) alternatives.
- Qualify and implement COTS.
- Reformulate, evaluate, qualify, and implement other materials.
- Perform commodity management - purge system of non-compliant materials; ensure that non-compliant materials do not enter the system in the future.

How this project responds to need:

This program addresses AERTA requirement 3.2.j/2.1.h if fully funded.

FY02 Performance Objectives:

- Begin baseline assessment of procedures, documentation, and validation of coatings, solvents, cleaners, and de-painters.
- Begin gap analysis for Hazardous Air Pollutant (HAP)-free rubber to metal bonding materials.
- Begin qualification and validation of rubber-to-metal bonding.

FY02 Performance Review:

Met all performance objectives for FY02.

Program Schedule:

Milestone / Product	FY02	FY03	FY04	FY05	FY06	FY07
Develop baseline for current materials and processes. Develop and staff test protocols for technology development, qualification, validation, and approval.	1,386*	815*				
Perform gap analysis, technology demonstration, and evaluation of HAP-free Solvent/Thinners/Cleaners		334	503	514		
Perform gap analysis, technology demonstration, and evaluation of MMPP-compliant non-CARC		315	642			
Perform gap analysis, technology demonstration, and evaluation of Materials and Processes			803	820	837	
Perform gap analysis, technology demonstration, and evaluation of HAP-free Rubber to Metal Bonding .	232*					
Qualify, validate and approve all Coatings, Solvents, Cleaners, and De-Painters	133*	1,165*				
Total $(K)	1,751	2,629	1,948	1,334	837	
RDT&E BA3 (0603728A 025)						
RDT&E BA4 (0603779A 035)						

* Portions of BA4 are FY00/01 funding committed in FY02 and FY02 funding committed in FY02/03.

Milestones/Accomplishments:

- By FY03, finalize a baseline of materials and processes that will be affected by NESHAPs.
- By FY03, develop and staff test protocols to begin technology development, qualification, validation and approval for all materials.
- By FY05, qualification and evaluation of alternatives for rubber-to-metal bonding.
- By FY06, technology demonstration, qualification and evaluation of alternatives for de-painting.
- By FY05, technology demonstrations for alternatives for CARC/and non-CARC solvents/thinners/cleaners and coatings.
- By FY06, qualify and validate alternatives for CARC/and non-CARC solvents/thinners/cleaners and non-CARC coatings, HAP-Free de-painting, and rubber-to-metal bonding.

Solid Waste Diversion

A•P2-2
A•P2-7

Potential Cost Avoidance of 495M w/an Investment of 44M*

* See Page B-1

Description:

Objective:

Identify, demonstrate, and develop technologies to provide Army installations environmentally safe and cost effective technologies and/or processes to achieve maximum recycle, reuse, volume reduction of the Army's solid waste (SW) stream to include: construction and deconstruction (C/D) debris, deployed base camp waste, field rations (Meals Ready to Eat (MRE) & polytrays), concertina wire, and scrap track.

Approach:

- Deconstruction/conversion technologies demonstration.
- Develop/demonstrate technologies to reduce/reuse C/D debris.
- Develop methods to reduce/eliminate deployed base camp waste.
- MRE shelf life extension/package re-engineering.
- Develop concertina wire reuse/recycle technologies.
- Develop technology to separate steel & rubber from scrap track.

How this project responds to need:

Shredding, deconstruction, conversion technologies, and MRE repackaging, reduce the volume of SW. Develop technologies to recycle/reuse concertina wire, separate steel and rubber. These meet the primary focus areas of AERTA requirements 3.5.c/3.5.k.

Military Unique Construction-Demolition Debris

FY02 Performance Objectives:

- Develop a decision tree for determining recyclability/ reusability of contaminated structures slated for demolition to achieve maximum benefit-economic, waste reduction, compliance with RCRA.
- Develop and implement guidance to deconstruct WWII buildings to maximize recycle/reuse potential. Include performance metrics to forecast recyclable materials and resources.
- Test and evaluate cellulose pulp from Ft. Campbell SW grinding project.

FY02 Performance Review:

Met all performance objectives for FY02.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Zero Footprint	470	575	255	125	200	
			127	169	379	262
	336	126	282	126	1,395	1,554
Construction/ Demolition	289	250	395	425	400	200
		199	327	227	380	895
					2,792	2,616
Total $(K):	1,095	1,150	1,386	1,072	5,546	5,527
RDT&E BA2 (0602720A 896/048)			RDT&E BA3 (0603728A 025)			
RDT&E BA3 (0603716D SERDP)			RDT&E BA4 (0603779A 035)			

Milestones/Accomplishments:

- In FY02, evaluated and validated SW conversion technology.
- In FY02, tested and evaluated SW conversion technology by-products: cellulose pulp/extruded plastic
- By FY03, investigate implications of lead coated components on masonry structures in reuse/recycle technologies; investigate lamination and coextrusion techniques for nanocomposite materials.
- By FY04, develop guidance document to deconstruct masonry structures to maximize recycle/reuse technologies.
- By FY04, demonstrate construction/demolition waste reuse/recycle technologies.
- By FY08, demonstrate other high value waste streams (MREs, scrap track, communication wire, concertina wire, & tires) technologies.

Develop a NESHAP-Compliant Chemical Agent Resistant Coating (CARC) System

A●P2-3

Potential Cost Avoidance of $98M w/an Investment of $6M*

* See Page B-1

Description:

Objective:

- Develop, prove and implement an improved CARC system containing no HAPs, nor requiring hazardous pretreatment systems, nor requires HAP-containing de-painting chemicals.
- Lower weapon systems life-cycle costs and improve readiness through improved coating performance and reduction of HAP compliance requirements (reporting and waste generation).

Approach:

- Develop HAP-free/non-hazardous coatings technologies with CARC characteristics.
- Evaluate products and pretreatments as part of a total CARC system.
- Research novel HAP-free de-painting methods.
- Transition coatings technologies to user community.

How this project responds to need:
Reduction or elimination of HAP in CARC systems allows depots and operating installations to maintain compliance with the Clean Air Act (Miscellaneous Metal Parts and Products NESHAP) while meeting operational levels as identified under AERTA requirement 3.2.a.

Weapons Systems Coated with CARC

FY02 Performance Objectives:

Validate water-dispersible CARC.

FY02 Performance Review:

- Met performance objective for FY02.
- Transitioned research on novel de-painting and NESHAP products to Sustainable Painting Operations for the Total Army.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Validation of Water-Dispersible CARC	1,250					
Total $(K):	1,250					

RDT&E BA3 (0603716D SERDP)

Milestones/Accomplishments:

In FY02, SERDP sponsored validation of water-dispersible CARC in final year of this program.

Ordnance Manufacture, Maintenance, Use, and Surveillance to Enable Sustainable Ranges

A●P2-5

Potential Cost Avoidance of $513M w/an Investment of $187M*

* See Page B-1

Description:

Objective:

To reduce hazardous components in the formulation and manufacture of propellants, explosives and pyrotechnics (PEP), including smokes and obscurants.

- Eliminate heavy metals.
- Eliminate VOCs.
- Eliminate toxic materials.
- Eliminate HAZMAT solvents.

Approach:

Identify materials, and develop, demonstrate and implement alternatives for:

- Munitions, ammo and missiles.
- Explosives and components at all maintenance locations.

How this project responds to need:

Elimination of heavy metals, VOCs, toxic materials and hazardous solvents encompasses both the manufacturing and use impacts of ordnance described in AERTA requirement 3.3.c.

The Army Requires Improved Ordnance and Related Weapons Systems to Sustain the Use of its Ranges

FY02 Performance Objectives:

Potential alternative materials and technologies will be developed for current methods.

FY02 Performance Review:

- Met performance objective for FY02.
- Identified new environmentally benign propellant and explosive ingredients based on nanomaterials.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Novel Initiatives to Eliminate Toxics: Case less Ammunition, Green Synthesis, and Laser Ignition	595		535	547		
Modeling, Design, and Experimentation of New Environmentally Benign Energetics				1,210	3,704	6,474
Technology Demonstration of Non-Energetic Ordnance Components						1,120
Technology Demonstration of New Propellant Technologies				1,155	1,786	1,266
Total $(K):	595		535	2,912	5,490	8,860
RDT&E BA1 (0601102A H67)	RDT&E BA2 (0602720A 895)					
RDT&E BA3 (0603728A 025)						

Milestones/Accomplishments:

- In FY02, demonstrated performance of laser ignited medium ammunition (30 mm) as part of a basic research effort that will eliminate lead/toxic components for M230 automatic cannon and ammunition.
- In FY02, researched and identified new explosive and propellant formulations based on ammonium nitrate, which are environmentally degradable into benign decomposition products.
- By FY03, demonstrate technology to replace BaNO3 and DPA (toxic propellant ingredients) with non-toxic nano-structured additives to formulations.
- By FY04, transition basic technology novel environmental alternatives to applied research.
- By FY05, begin design of non-toxic deterrents, stabilizers, and energetics pre-impregnated with microbes for neutralization of low order detonations.
- By FY07, begin technology demonstration of non-energetic ordnance components.
- By FY07, conduct technology demonstration of alternatives to hydrazine fuels.

Reduce/Eliminate Pollution for Compliant Plating Processes

A●P2-6

Potential Cost Avoidance of $91M w/an Investment of $22M*

* See Page B-1

Description:

Objective:

To identify alternative means to meet performance requirements to eliminate cadmium (Cd) plating and chromium (Cr) electroplating that:

- Decrease or eliminate hazardous waste generation.
- Reduce life-cycle costs of the part or component.
- Maintain or reduce current health and safety risk to production line workers and maintainers.

Approach:

Performance requirements will be defined, and the alternative processes and materials will be validated against these requirements:

- Develop performance requirements to replace Cd and Cr. Evaluate new coatings and materials targeted specifically to address these requirements.
- Demonstrate erosion resistant gun tube without using electroplated Cr.

How this project responds to need:

Reduction of Cd and chrome plating while maintaining corrosion and performance requirements reduces environmental impacts in both manufacturing and disposal of plated items as identified in AERTA requirement 3.1.c.

Non-Aqueous Metal Plating Process

FY02 Performance Objectives:

- Fire one tantalum coated 45mm gun barrel.
- Demonstrate deposition technologies.

FY02 Performance Review:

- Met all performance objectives for FY02.
- Satisfied nine of the original ten deposition performance program metrics for the material tantalum.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
New Initiatives to Replace Heavy Metals in Surface Protection	767	1,190	325	311		
Demo Electrospark Deposition	200					
Tri-service Green Gun Barrel	200					
Total $(K):	**1,167**	**1,190**	**325**	**311**		
RDT&E BA1 (0601102A H67)	RDT&E BA3 (0603716D SERDP)					

Milestones/Accomplishments:

- In FY02, began initial depositions on large caliber samples.
- By FY03, begin conducting vented combustor tests to expose lab samples to the firing environment to solve final adhesion challenges.
- By FY03, demonstrate electroplated chrome alternative for medium caliber gun barrels through test firings.
- By FY03, model the cylindrical magnetron sputtering system and increase fundamental understanding for target development for larger gun barrel applications.
- By FY03 transition results of biomimetic process of ceramics to Army Lightweight Soldier/Ballistic Protection Science and Technology Objective (STO).
- By FY04, deposit tantalum onto full-length large caliber guns.
- By FY04, identify novel laboratory-scale materials and processes for Cd and Cr elimination.
- By FY05, test fire tantalum coated large caliber gun barrels.
- By FY05, transition sputtered tantalum process to large caliber production facility at Watervliet Arsenal.
- By FY05, demonstrate Cd and Cr elimination through alloy and design changes.
- By FY06, demonstrate Diamond Like Coatings (DLC) as a hard chromium replacement.

Reduce/Eliminate Pollution for Compliant Composite Manufacturing and Repair

A•P2-1
A•P2-11

Potential Cost Avoidance of $241M w/an Investment of $2M*

* See Page B-1

Description:

Objective:

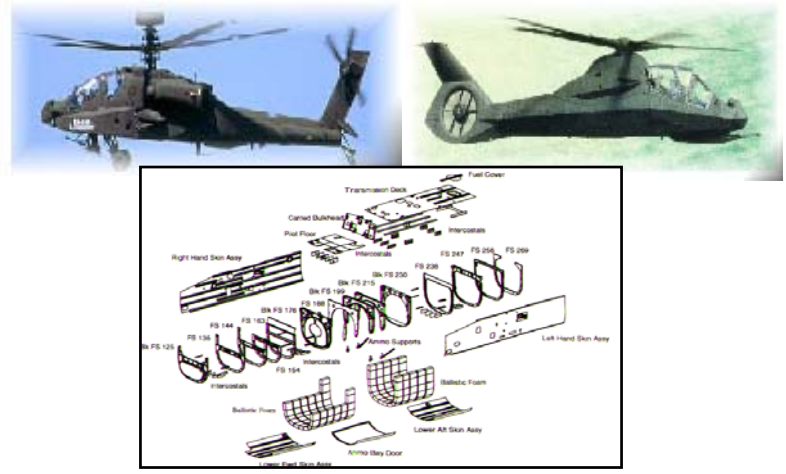
Develop, validate, and implement new technologies that will reduce the use of hazardous materials in sealants, adhesives and bonding agents and in the manufacture and repair of composites and textiles.

Approach:

- Develop radiation curing techniques and resins for extension of shelf-life for raw materials.
- Develop thermoplastic bonding techniques as non-hazardous material replacement for thermosetting resins.
- Develop primerless RTV silicone sealants/adhesives.
- Develop biomimetic ceramic processing basic technology.
- Develop aqueous fiber processing basic technology.

How this project responds to need:

Addresses AERTA requirements 3.2.j/2.1.h and 3.10.f for reducing hazardous impacts of composites and associated adhesives and bonding agents.



Entire Weapons Systems are Manufactured with Composite Materials

FY02 Performance Objectives:

Develop basic and applied technologies for alternative materials and processes for current methods.

FY02 Performance Review:

Met performance objective for FY02.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Biomimetic Ceramic Processing	171					
Aqueous Fiber Processing	260					
Manufacture/Repair of Composites	280					
Primerless RTV	276					
Total $(K):	987					
RDT&E BA1 (0601102A H67)	RDT&E BA3 (0603716D SERDP)					

Milestones/Accomplishments:

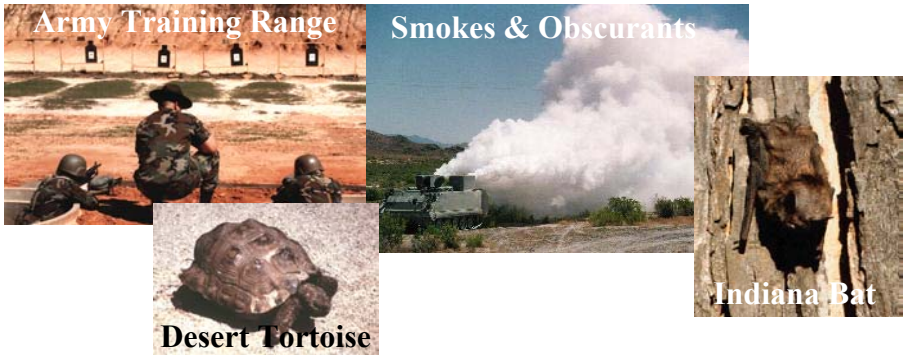
- In FY02, basic technology for aqueous fiber processing progressed to demonstrating ability to spin good quality fibers. Final Technical Report expected January 2003.
- In FY02, potential alternative materials and technologies developed and demonstrated on test bed components for repair of composites for Army ground vehicle applications and aircraft superstructures.
- By FY03, transition results of biomimetic processing of ceramics basic research to Army Science and Technology Objectives (STO) for Lightweight Soldier/Ballistic Protection. Final Technical Report expected January 2003.
- By FY03, transition to demonstration/validation.

Reducing Impacts of Threatened and Endangered Species (T&ES) on Military Readiness

A•CN-1

Potential Cost Avoidance of $111M w/an Investment of $25M*

* See Page B-1



Description:

Objective:

To provide trainers, regulators, and military land managers the information they need to effectively identify, prevent and mitigate the impacts of maneuver training, military smokes and obscurants, military-generated noise and other land management activities on Threatened and Endangered Species (T&ES).

Approach:

- Efforts reflect an iterative, adaptive management approach to impact assessment.
- Research and technology demonstration activities are planned to allow development and refinement of impact assessment protocols and models to address high-profile species affecting military operations.

How this project responds to need:

Threshold impacts and protocols to minimize impacts on training, while reducing effects of maneuver training, noise and smokes and obscurants on high priority T&ES as described in AERTA requirement 4.6.a.

FY02 Performance Objectives:

- Complete noise study on red-cockaded woodpecker (RCW).
- Complete studies on effects of smokes and obscurants on RCW.
- Complete maneuver impact study on RCW.
- Complete prioritization report for noise studies on T&ES.
- Complete smoke dispersion model.

FY02 Performance Review:

- Met all performance objectives for FY02.
- Completely revised EQT Management Plan.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Mitigation and Management Technologies for the RCW	121	175	175			
Impact Threshold and Mitigation for Bats/Tortoises	198	650	1,082	1,775	2,129	2,271
Threshold and Impact Analysis Protocols for Priority Species		1025	840	941	950	350
Mitigation Technologies for Habitat Fragmentation		478	500	165		
Total $(K):	319	2,328	2,597	2,881	3,079	2,621

RDT&E BA2 (0602720A 896)

Milestones/Accomplishments:

- By FY03, complete population viability analysis tools for T&ES.
- By FY05, develop techniques to translate impact assessment protocols to T&ES bat and tortoise species.
- By FY06, develop population goal analysis tools to determine defensible population goals for T&ES.
- By FY08, quantify impacts of military training an identify mitigation plans for select T&ES.
- By FY08, quantify effects of military land management and identify mitigation plans for selected T&ES.

Baseline T&ES Surveys and Monitoring

A•CN-2

Potential Cost Avoidance of $1.9B w/an Investment of $13M*

* See Page B-1

Description:

Objective:

To develop protocols for both inventory and monitoring programs for threatened and endangered species (T&ES) and populations to reduce cost and meet regulatory standards.

Approach:

- Identify inventory and monitoring data uses and efficiencies that can be followed across the Army and that are acceptable to regulators.
- Help installations determine, for their specific circumstance, "how much is enough" in terms of level of inventorying and monitoring activities.

How this project responds to need:

Inventory and monitoring technique evaluation for T&ES will reduce the cost of performing required inventories while maintaining compliance under the Endangered Species Act as identified in AERTA requirement 4.6.c.

FY02 Performance Objectives:

No planned performance objectives for FY02.

FY02 Performance Review:

Initiated research on relationships between habitat characteristics and reproductive parameters.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Population Viability Analysis	250	260				
Inventory and Monitoring	110	410	721	770	806	430
Total $(K):	360	670	721	770	806	430
RDT&E BA2 (0602720A 896)						

Milestones/Accomplishments:

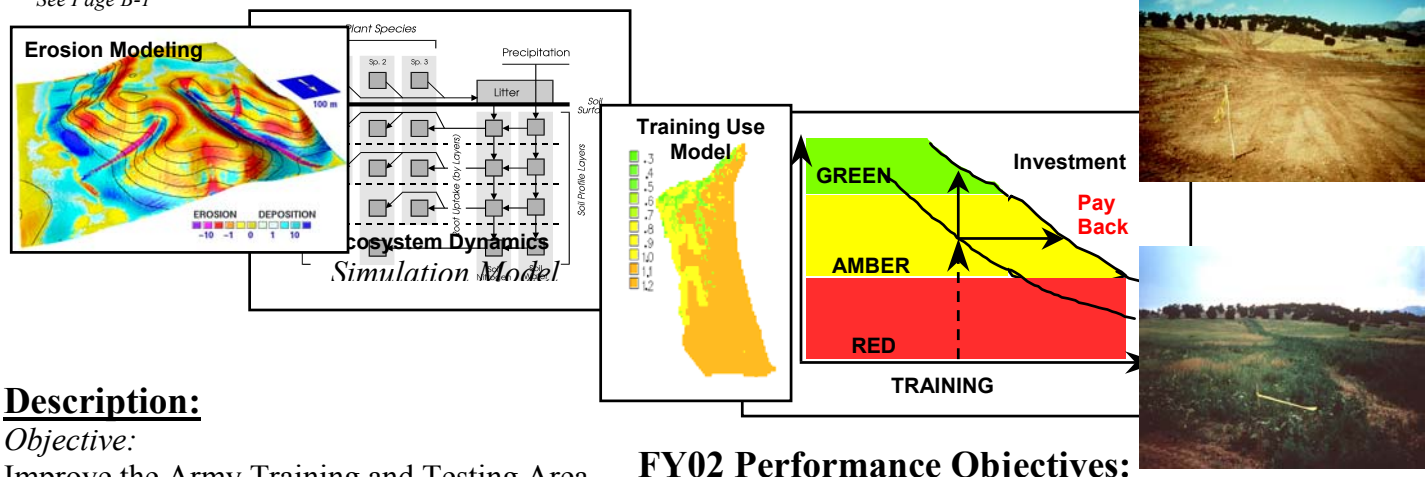
- By FY03, develop a set of protocols for identifying viable T&ES populations and habitat
- By FY04, develop minimum survey and monitoring protocol, approved by regulators, standardized by groups and regions, and applicable Army-wide, for all species on the top priority list.
- By FY05, standardize protocols for surveying and monitoring long-term trend analysis of populations.
- By FY06, complete spatial assessment technology for all major T&ES habitat, Army-wide.
- By FY07, produce population and population goal analysis protocol, designed with encroachment factors considered, for the preservation and protection of Army training needs.

Land Capability/Characterization

A•CN-3

Potential Cost Avoidance of $1B w/an Investment of $27M*

* See Page B-1



Description:

Objective:

Improve the Army Training and Testing Area Carrying Capacity (ATTACC) methodology to more accurately assess the extent given parcels of land are suitable and contain the carrying capacity for sustaining specific training and testing activities. Provide improvements that address installation level requirements.

Approach:

Design, develop, and test improved measures for condition assessment of lands that are compatible with mission requirements and spatial use of terrain. Extract and validate "spatial and temporal use models" for mission activities that will allow comparisons of training events and land capacity.

How this project responds to need:

Addresses AERTA requirement 4.2.a for better estimation of land carrying capacity and characterization.

FY02 Performance Objectives:

Develop a protocol for installation use that improves land rehabilitation prescriptions based on impacts.

FY02 Performance Review:

Met performance objective for FY02.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Multiple Measures of Land Condition	528	671	100	50		
	200					
Improved Mission Impact Factors and Distribution	178					
		317	587	595	550	275
Total $(K):	1068	988	687	645	550	275
RDT&E BA1 (0601102A T25)			RDT&E BA2 (0602720A 896)			
RDT&E BA3 (0603716D) SERDP						

Milestones/Accomplishments:

- In FY02, completed land rehabilitation and maintenance model protocols that identify installation land requiring rehabilitation and prioritize land repair activities based on the severity of the impact and the probability of rehabilitation success
- By FY03, develop ATTACC protocols that incorporate scientific improvements in wind erosion and soil compaction factors.
- By FY04, develop protocols, tools and/or factors for installation-level use that account for changes in plant species composition associated with mission activity to optimize land use for training.
- By FY05, develop protocols addressing event severity factors and installation specific land condition assessment.

Land Rehabilitation

A•CN-4

Potential Cost Avoidance of $37M w/an Investment of $14M*

* See Page B-1

Description:

Objective:

To develop erosion and sediment control technologies and prediction models to support planning, design, execution, and management of land rehabilitation and maintenance activities on military lands.

Approach:

- Develop/evaluate advanced erosion control methods and materials.
- Identify more effective plant species for revegetation.
- Develop design factors for land rehab technology selection.
- Develop erosion and deposition models to support technology selection.
- Develop decision support system to integrate appropriate technology, guidance, costing info, etc, into an easily accessible, logical framework.

How this project responds to need:

Erosion control methods and materials address range design and land rehabilitation needs identified by FORSCOM and TRADOC range managers as described in AERTA requirement 4.2.i.

FY02 Performance Objectives:

No performance objectives planned for FY02.

FY02 Performance Review:

No performance review conducted.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Land Rehabilitation Design Process	3					
Erosion Control Improvement Techniques	26	125	140	210	124	200
Erosion Control Prioritization Tools		125	150	185	137	200
Improved Cost/Benefit Analysis for Land Rehab			92	90	135	175
Total $(K):	29	250	290	485	396	575
RDT&E BA2 (0602720A 896)						

Milestones/Accomplishments:

- By FY03, enhance capability to select and emplace cost-effective erosion control.
- By FY05, complete prototype web-based tools for identification, prioritization, design and monitoring of land rehabilitation projects.
- By FY06, conduct cost benefit analysis for land rehabilitation projects.

Non-Invasive Species Control for Army Installations & Operations

A•CN-5

Potential Cost Avoidance of $65M w/an Investment of $16M*

* See Page B-1

Description:

Objective:

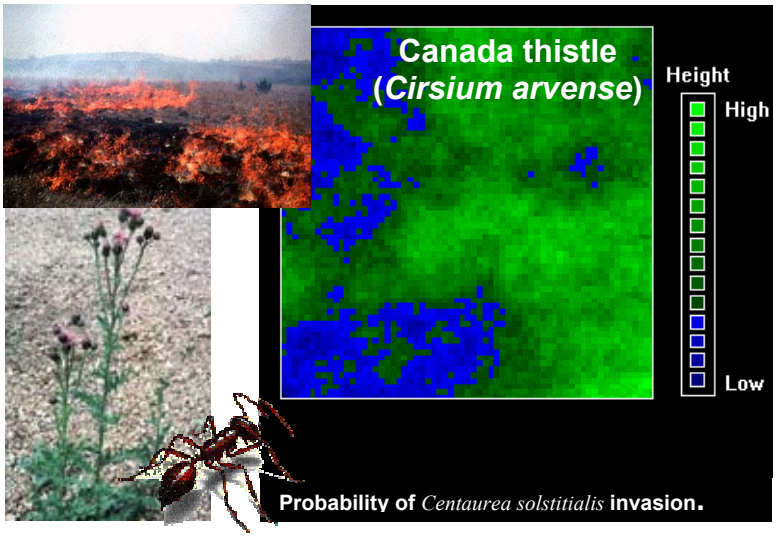
To assist Army training and natural resources managers in meeting the conservation and compliance challenges posed by non-native invasive species. Assessment of the effects of military operations on invasive species establishment and spread will provide the necessary framework for developing cost effective prevention, management, and control technologies which are compatible with the military mission.

Approach:

- Develop protocols for rapid identification and mapping of invasive species.
- Identify pathways for introduction and spread of invasive species.
- Identify innovative invasive species control technologies.

How this project responds to need:

Invasive species identification, mapping, and control technologies address MACOM identified needs as described in AERTA requirement 4.3.e.



imported red fire ant
(*Solenopsis invicta*)

FY02 Performance Objectives:

Conduct initial assessments of knapweed biocontrol agents.

FY02 Performance Review:

Met performance objective for FY02.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Assessment/Control of Cheatgrass and Knapweed	213	144				
Invasive Species Survey		35				
Total $(K):	213	179				
RDT&E BA2 (0602720A 896)		RDT&E BA3 (0603716D SERDP)				

Milestones/Accomplishments:

- In FY02, conducted assessments of insect biocontrol agents and damage to host knapweed plants.
- By FY03, analyze results, across experimental sites, to determine impact of knapweed biocontrol agents.

Electrokinetic Remediation of Contaminated Soils

See Page B-1

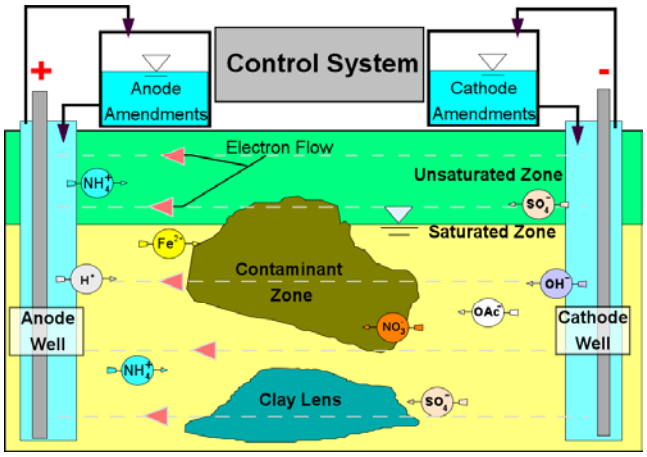
Description:

Objective: To transition laboratory based technology to a field scale demonstration of electrokinetic (EK) treatment for extraction of Cadmium contamination from soil at a NATO hand grenade training range in Bergen, Germany. Conducted under the auspices of the US/Germany Data Exchange Agreement (DEA) for Environmental Technology, Annex 1520 (Soils), the actual remediation for this project is being funded by the German Ministry of Defense (MOD). Site soil was shipped to the USACE Engineer Research and Development Center (ERDC) in Vicksburg MS, and a feasibility study was performed showing the potential of the technology. A Scientific Advisory Board (SAB) composed of U.S. and German technical experts reviews and evaluates the work of the contractor conducting the pilot demonstration.

Approach:

- A feasibility study using Bergen site soil was performed at ERDC labs.
- A series of scoping experiments were performed by the German MOD contractor to determine field scale design.
- Soil excavation, construction of the remedial system and operation of the EK metals removal system will be performed on site at Bergen.
- During the course of the two years of operation, the system will be monitored for Cadmium removal rates and efficiencies.
- Following completion of the EK removal of heavy metals from the soil, the reduction of heavy metals concentrations to below regulatory limits will be verified and the soil used for beneficial purposes.

How this project responds to need: This project responds to the need to solve heavy metals contamination at training ranges, and will transition an innovative technology for the remediation of range soils from the laboratory phase to full scale field implementation.



FY02 Performance Objectives:

- ERDC feasibility study on electromigration of Cadmium from Bergen range soils.
- German MOD contractor finishes lab studies for field design.
- SAB meets to review lab results and system design (Nov 2001).
- German MOD contractor completes plans for treatment system.
- SAB meets to review final design and visit site to observe construction (October 2002).

FY02 Performance Review:

Met all performance objectives for FY02.

German Ministry of Defense Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Exchange tech data						
Establish SAB						
Develop detail plan						
SAB Review						
Assist MOD contractor						
SAB Evaluation						
Assist with design						

German Ministry of Defense (MOD) schedule and funding

Milestones/Accomplishments:

- Feasibility study demonstrated the electromigration of Cd, Cr, and Pb from Bergen grenade range soil.
- Scientific Advisory Board met to review final lab reports and visit project site in November 2001.
- Science Advisory Board met to review final design and visit site to observe construction in October 2002.

Legend for reading the Congressional Interest Project one page Fiscal Year 2002 summaries.

Program Title:
Congressional Project Title

Congressional Interest

Waste Minimization and Pollution Prevention Research (EM1)

Index Page is C-1

Photograph:
Graphical depiction of the program

Description:

Objective:
The objectives of Waste Minimization and Pollution Prevention Research are to:

Description:
Verbal definition of Program objective, approach and the program's expected response to environmental need.

- Develop/demonstrate innovative environmental quality and industrial waste treatement technologies.

Approa
Validat
field op

Annual Performance Review:
Assessment of FY02 performance against stated objectives

How this project responds to need:
Supports overall goals of the Environmental Quality Compliance and Pollution Prevention, by funding demonstration and technology transfer aspects for developing technologies.

FY02 Performance Objectives:

Demonstrate and transition technologies from Army Compliance and Pollution Prevention research and

Performance Objectives:
Performance Objectives for FY02

FY02 Performance Review:

Met all performance objectives for FY02 including:
aterial control and

- Determine process design for red phosphorous demil alternatives at Crane Army Ammunition Activity.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Compliance/P2 technologies at troop facilities	452					
Compliance te industrial facili						
Total $(K):						
RDT&E BA2						

Program Schedule:
Graphically depicts program schedule by FY, task and type of money

Milestones/Accomplishments:

- FY03, determine the optimum design for hazardous material reduction from the removal of carbonized synthetic oil deposits on engine parts and Anniston Army Depot.
- etermination of correlations between storm water runoff

or reduction of acid discharge at Radford Army

Milestones/Accomplishments:
Defines Program Milestones and Accomplishments by Fiscal Year

Waste Minimization and Pollution Research (EM1)

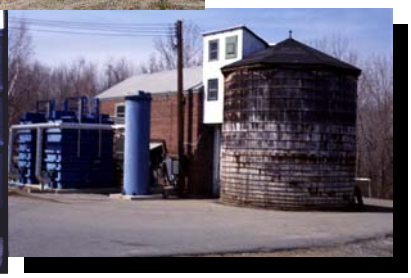
Index Page is C-1

Description:

Objective:
The objectives of Waste Minimization and Pollution Research are to:
- Provide Army Environmental Compliance and Pollution Prevention technologies that reduce operational costs.
- Develop/demonstrate innovative environmental quality and industrial waste treatement technologies.

Approach:
Validate innovative technologies in field operations.

How this project responds to need:
Supports overall goals of the Environmental Quality Compliance and Pollution Prevention, by funding demonstration and technology transfer aspects of developing technologies.



FY02 Performance Objectives:

Demonstrate and transition technologies from Army Compliance and Pollution Prevention research and development programs to Army installations including Army Ammunition Plants and Troop Installations.

FY02 Performance Review:

Met all performance objectives for FY02 including:
- Evaluation of hazardous material control and reduction.
- Determine process design for red phosphorous demil alternatives at Crane Army Ammunition Activity.
- Evaluation of commercial environmental management system software.
- Improved methodologies for determining sediment loading and storm water runoff contamination.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Compliance/P2 technologies at troop facilities	**452**					
Compliance technologies at industrial facilities	**1,467**					
Total $(K):	**1,919**					

RDT&E BA2 (0602720A EM1)

Milestones/Accomplishments:

- By FY03, determine the optimum design for hazardous material reduction from the removal of carbonized synthetic oil deposits on engine parts at Anniston Army Depot.
- By FY03, demonstrate methodology for determination of correlations between storm water runoff and downstream sedimentation at Ft. Bragg.
- By FY03, determine process improvements for reduction of acid discharge at Radford Army Ammunition Plant.

Molecular and Computational Risk Assessment (EN8)

Index Page is C-1

Description:

Objective:

- To develop molecular and computational approaches for quantifying environmental risk of exposure to hazardous chemicals.
- To enhance the capability and increase the experience level of under-represented faculty and students in the scientific and technical workforce.

Approach:

- Detect and monitor exposure routes of dinitrotoluenes employing an integrated multidisciplinary approach.
- Identify and elucidate the cellular and molecular mechanisms affected by exposure to dinitrotoluenes.
- Develop biologically based computational models that integrate risk assessment studies relative to chemical, kinetics, and biological information on dinitrotoluenes.
- Implement strategies to prevent, control and remediate health risks associated with dinitrotoluenes exposure.
- Attract, educate and mentor under-represented students and faculty to address problem solving and develop methods/ technology in risk assessment.

How this project responds to need:
Addresses AERTA Requirement 1.5.g to Support Risk/Hazard Assessment, Fate/Effects, and Transport Predictability Models for Military Unique Compounds, Explosives, and Depleted Uranium.

Student investigating the presence and distribution of bacterial genes known to be involved in trinitrotoluene (TNT) degradation

FY02 Performance Objectives:

Develop consortium of Universities that will address current concerns of potential environmental effects of dinitrotoluene (DNT).

FY02 Performance Review:

Met all performance objectives for FY02.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Toxicology and Risk Assessment	550					
Computational Modeling	350					
Analytical Chemistry	443					
Total $(K):	1,343					
RDT&E BA2 (0602720A EN8)						

Milestones/Accomplishments:

- In FY02, developed a consortium of Universities to address current concerns of potential environmental effects of dinitrotoluene (DNT).
- In Aug 2002, contracted with Historically Black Colleges and Universities (HBCU). Primary contract to Jackson State University (JSU). JSU has subcontracted to the University of Maryland Biotechnology Institute, University of Maryland Eastern Shore, and the University of Southern Mississippi Gulf Coast Research Lab.
- By FY03, complete equipment and educational training of HBCU students in risk assessment technologies.
- By FY03, develop computer model of DNT.
- By FY03, conduct risk assessment and toxicity of DNT on vertebrates.

RangeSafe Technology Demonstration (F28)

Index Page is C-1

Description:

Objective:
Develop and execute innovative technology solutions to environmental challenges associated with the life-cycle management of armament systems.

Approach:

- Characterize sites of interest for possible contamination, determine contaminant transport modes and assess risks.
- Research and develop state-of-the-art technologies for control/management/ remediation of contaminated media, as required.
- Conduct laboratory and field-scale demonstrations of innovative remediation/maintenance technologies.
- Project sites include: training site in NM; Picatinny Arsenal, NJ; Ft. Dix, NJ; Aberdeen Proving Grounds, MD, and the National Training Center, Ft. Irwin, CA.

How this project responds to need:
Aids in maintaining acceptable environmental regulatory compliance and demonstrates sound stewardship of Army resources through the development of advanced technologies and processes. This work will contribute to ensuring continued access to weapons and munitions manufacturing, testing and training facilities vital to the nation's military readiness. Addresses AERTA Requirements 1.2.a and 1.3.e.

Indoor Firing Range Technology Test Bed at Picatinny Arsenal, NJ

FY02 Performance Objectives (Cont.):

- Continue development and demonstration of advanced technologies and processes for sustainable operation of small arms firing ranges.
- Continue characterization of Thorium-seeded radiation training site and develop sustainable site management technologies.
- Continue development and demonstration of a mobile soil washing system for treatment of heavy metal contaminated soils.
- Conduct small-scale demonstration of filtration of gun range berm rainwater runoff.
- Continue lead gun range maintenance demonstration.

FY02 Performance Review:

Met all performance objectives for FY02.

FY02 Performance Objectives:

- Develop a low-cost effective replacement for GAC treatment of RDX contaminated groundwater.
- Complete second year of field demonstration and establish Best Management practices demonstration for phytoextraction of arsenic.
- Design and implement an indoor lead bullet firing range technology test bed.
- Develop on-site/real-time measurement system for horizontal thorium transport in soils.
- Complete bioremediation of Tetryl Pit, explosives contaminated soil study.
- Conduct a demonstration of innovative UXO detection technology.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Base Hydrolysis of RDX GW	450					
Phytoextraction of Arsenic	300					
Explosives Bioremediation, Tetryl Pit	300					
Thorium Characterization and Stabilization	270					
Indoor Gun Range Test Bed	681					
UXO Detection Tech Demo	616					
Lead at NTC, Ft. Irwin, CA	386					
Rad Training Site Management Tool	385					
Mobile Soil Washing System	378					
Gun Range Rainwater Runoff Demo at Ft. Dix	195					
Lead at Range 25, Ft. Dix, NJ	159					
Total $(K):	4,120					
RDT&E BA2 (0602720A F28)						

Milestones/Accomplishments:

- Completed lab-scale evaluation of ex-situ treatment of RDX contaminated groundwater.
- Initiated Indoor Gun Range Test Bed, UXO Detection Technology and Gun Range Berm Rainwater Runoff Filtration demonstration projects.
- Continued making progress on other technology demonstrations at Picatinny and Ft. Dix, NJ, Ft. Irwin, CA, and NM.

Proton Exchange Membrane (PEM) Fuel Cells (EM3)

Index Page is C-1

Description:

Objective:
Demonstrate Proton Exchange Membrane (PEM) fuel cells in support of critical loads on DoD installations, particularly, during extended outages of the existing electrical grid. PEM fuel cells will operate for a minimum of one year at capacities from 1 to 20 kW achieving individual availability of at least 90%. PEM fuel cells will operate on using hydrogen, natural gas, propane, and potentially diesel fuel and JP8.

Approach:
Install, demonstrate and assess performance of PEM fuel cells under the following conditions:

- Fuel type - natural gas, propane, hydrogen, other.
- Fuel options - fuel switching, no fuel switching, fuel blending.
- Electrical interface - grid-connected, grid-independent, both (alternating).
- Thermal interface - cogeneration, no cogeneration.
- Unit configurations – individual, multiple units.

How this project responds to need:
PEM fuel cells are cleaner and more efficient than current grid power production techniques. PEM fuel cell systems use an electrochemical process as opposed to combustion to generate electricity; they are energy efficient and have an extremely clean exhaust consisting mainly of air and water vapor. PEM fuel cells provide power at the required point of use serving as an alternate power source.

PEM fuel cells operating at Watervliet Arsenal, NY (FEB 02)

FY02 Performance Objectives:

- Install 11 fuel cells.
- Award six contracts to install 21 cells at nine military installations.
- Select sites for FY03 installation.

FY02 Performance Review:

Met all performance objectives for FY02.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
PEM Fuel Cell R&D	**3,358**					
Total $(K):	**3,358**					
RDT&E BA3 (0603728 EM3)						

Milestones/Accomplishments:

In FY02, installed 11 fuel cells.
In FY02, selected six contractors to install 21 fuel cells at nine DoD related sites. These fuel cells will operate for at least one year, and will be required to achieve at least 90% availability.

Plasma Energy Pyrolysis System (PEPS) (EN4)

Index Page is C-1

Description:

Objective:

The objective of this project is to efficiently destroy and eliminate military waste streams and to deploy, test, and assess the reliability, maintainability, and overall effectiveness of the Army Mobile PEPS unit to treat wastes on site.

Approach:

- Demonstrate and verify mobile PEPS unit meets all State and Federal environmental requirements for air emissions; liquid and solid waste disposal, Destruction and Removal Efficiencies (DREs), and Toxicity Characteristic Leaching Procedure (TCLP) testing of the vitrified residual slag.
- Conduct testing on DoD and commercial wastes to validate the utility, effectiveness and economic feasibility for future users at military installations.

How this project responds to need:

Increased efficiency of the destruction and elimination of military waste streams is needed. PEPS supports the goals of the Army Environmental Quality Technology Compliance and Pollution Prevention pillars by funding demonstration and technology transfer of waste minimization technologies.

Mobile PEPS Equipment

FY02 Performance Objectives:

- Verify system performance against Anniston Army Depot wastes.
- Settle "Request for Equitable Adjustment" claims from the Contractor with coordination from Defense Contract Audit Agency and Defense Contract Command – Washington.

FY02 Performance Review:

Project contract award pending in FY 03.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Mobile PEPS Demonstration	**5,748**					
Total $(K):	**5,748**					

RDT&E BA4 (0603779A EN4)

Milestones/Accomplishments:

- By FY03, identify expanded waste stream matrix from military and commercial industrial operations that can be destroyed by the modified Mobile PEPS.
- By FY03, characterize the operational and mobility requirements of the Mobile PEPS and determine any retrofits necessary to the existing system to deploy it to the selected sites for the efficient destruction of the selected waste streams.
- By FY04, complete two demonstrations of Mobile PEPS unit at DoD installations through the National Defense Center for Environmental Excellence (NDCEE).

Fort Ord Clean-Up Demonstration (EN2)

* See Page C-1

Description:

Objective:
Identify, develop, and demonstrate innovative technologies and procedures to remediate and manage the disposition of building and operational materials that pose barriers to civilian reuse of military properties.

Approach:
- Develop model grading and site design as a demonstration for the reuse of remediated inland range areas.
- Develop and demonstrate model procedures linking remediation of hazardous building materials during building removal and management of habitats to enable sustainable land redevelopment.
- Develop and validate the process of removing surplus buildings in an environmentally and economically sound fashion while maximizing the recovery of the used building materials.
- Develop and demonstrate procedures for the long-term monitoring and remediation of groundwater contaminated with non-aqueous liquids.

How this project responds to need:
Supports Army EQT program goals by funding demonstrations of promising technologies, processes, and/or practices to remediate and manage building and operational materials problematic to the future reuse of affected properties.

FY02 Performance Objectives:

Identify and prioritize critical projects and tasks to address reuse objectives.

FY02 Performance Review:

Program will execute in FY03-04 as FY02 funding was not released to U.S. Army Engineer Research and Development Center until the end of FY02.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Linking Remediation with Reuse on Former Military Bases (FORA)	**485**					
Strategies for Deconstruction and Materials Recycling (CSUMB)	**938**					
Groundwater Remediation (UCSC)	**496**					
Total $(K):	**1,919**					

RDT&E BA4 (0603779 EN2)

NOTE: This Congressional interest project leverages against another Congressional interest initiative (i.e., Non-Hazardous Solid Waste).

Milestones/Accomplishments:

- Develop models to assist in site-specific remediation and disposal of buildings and land contaminated with certain hazardous building or operational materials. Demonstration of models to enable sustainable reuse will be completed in FY04.
- Demonstration of building deconstruction strategies and materials recovery will commence in FY03 and will be completed in FY04.
- Evaluate potential of monitoring and treating contaminated groundwater. This demonstration will be completed in FY03 with longer-term demonstrations possible pending additional funding.

Vanadium Technology Program (EN7)

Index Page is C-1

Description:

Objective:

To increase the mobility and fuel economy of Army materiel by identifying, redesigning, developing and deploying replacement lightweight steel components for Army materiel using high-strength Vanadium Microalloyed Steels (VMS).

Approach:

- Evaluate, document, and down select specific Army materiel and logistic support systems as case studies.
- Substitute VMS for carbon steels in these down selected systems, evaluate their technical performance, and perform economic analysis of replacement host material.
- Produce small, affordable demonstration hardware.

How this project responds to need:

This project addresses the pollution prevention requirement for waste minimization in current activities as well as compliance with Local, State, Federal and Army regulations. The extra increment in strength of VMS relative to low carbon steels will allow reduced weight in materiel without increasing cost. This weight reduction will increase mobility, increase fuel economy and reduce exhaust emissions.





Examples of Potential Army Applications

FY02 Performance Objectives:

- Select case study topics.
- Release Request for Quotations (RFQs) for short case study projects.
- Select sources and award case study projects.
- Perform case studies with documented technical and economic analyses for the use of VMS.
- Hold a case study conference to present findings
- Perform a Senior Executive Review to "down select" the best candidates for the next phase where full-scale demonstration articles can be designed, built and evaluated.

FY02 Performance Review:

Program execution began with contract award 1Oct 2002.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Contract Award	**1,254**					
Total $(K):	**1,254**					

RDT&E BA4 (0603779A EN7)

Milestones/Accomplishments:

- By FY03, evaluate, document, and down select case studies for substitution of VMS for low carbon steels.
- By FY04, design, fabricate and demonstrate VMS components.
- By FY04, fabricate full-scale component(s) and sub-system(s) from VMS.
- By FY04, complete cost/weight/logistics/life-cycle environmental benefit analysis of component(s) and subsystem(s).

Porta Bella Environmental Cleanup (EN5)

Index Page is C-1

Description:

Objective:
Demonstrate pilot scale technologies for safe and cost effective remediation of unexploded ordnance (UXO) contamination found in waste landfills.

Approach:
- Form working group to address high priority UXO requirements at the Porta Bella site.
- Select proposed landfill remediation technology to develop, test and demonstrate.
- Conduct on-site demonstration to identify/quantify technology operational characteristics.
- Certify technology for operational application at site.
- Transition separation technology for full scale site use as appropriate.

How this project responds to need:
Addresses Army Environmental Quality Restoration Requirement 1.6.b for Soil and Sediment UXO Removal and/or Remediation.

Aerial View of Landfill Remediation Site at Porta Bella, CA

FY02 Performance Objectives:

- Demonstrate advanced UXO contaminated landfill cleanup technology.
- Document cost parameters for cleanup technology.

FY02 Performance Review:

Met all FY02 performance objectives. Pilot studies expanded to incorporate a larger quantity of landfill materials.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Work Plans and DTSC Review	**150**					
Technology Pilot Plant Design, Installation, Operation	**1,998**					
Operational Review and Evaluation	**250**					
Total $(K):	**2,398**					

RDT&E BA2 (0603779A EN5)

Milestones/Accomplishments:

- In June 2002, California Department of Toxic Substances Control (DTSC) approved revised work plan.
- In FY02, successfully conducted three public meetings.
- In July 2002, initiated field installation and operation.
- In September 2002, completed pilot scale technology prototyping and evaluation.

Transportable Detonation Chamber Validation (E12)

* See Page C-1

Description:

Objective:

To demonstrate operability of the proposed Donovan Blast Chamber (TC-20) system. To demonstrate and validate the use of transportable detonation chamber technology in the disposal of recovered chemical warfare materiel (CWM).

Approach:

- Evaluate Belgium test data on Donovan T-10 Blast Chamber.
- Prepare safety, test and data collection documentation.
- Perform demonstration and validation of TC-20 at Defense Science and Technology Laboratory in Salisbury, Wiltshire, UK.
- Prepare test report.

How this project responds to need:

To supplement the need for onsite destruction of CWM-filled munitions. To enhance the existing capabilities of the Non-Stockpile Chemical Materiel Program with the addition of this transportable destruction system.

Transportable Detonation Chamber

FY02 Performance Objectives:

- Determine the data needs from Belgium testing.
- Identify test objectives and plan test.

FY02 Performance Review:

Met all performance objectives for FY02.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Independent Evaluation	212					
Safety/Environmental Test Evaluation	212					
Documentation, Data Collection, Test Support, Consumables and Equipment Shipment	2,329					
Demonstration/Validation Test Support of DBC	1,270					
Project Oversight, Equipment Operation, Air Monitoring and Technical Support	1,760					
Total $(K):	5,784					

RDT&E BA4 (0603779A E12)

Milestones/Accomplishments:

By FY04, demonstrate/validate the Donovan Blast Chamber TC-20 with recovered chemical warfare materiel.

Commercialization of Technology to Lower Defense Costs Initiative

Index page is C-1

Description:

Objective:

Lower U.S. Defense procurement costs and meet DoD Environment, Safety and Occupational Health (ESOH) and Installations needs by:

- Accelerating commercial and military market penetration for ESOH technologies under development.
- Sharing costs with industry.

Approach:

- Utilize disciplined, structured 3-phased process for sourcing and assessing technologies that will reduce defense costs associated with ESOH needs.
- Phase I - identify and screen ("Exploratory Technical Investigation") new opportunities culminating in Phase I matching of technologies to defense needs. Evaluate potential to lower defense costs.
- Phase II - perform in-depth technical, market, economic analyses, development of business strategy and commercialization plan that includes identification of corresponding commercial opportunities to ensure costs are shared with industry and increase chances for commercialization.
- Phase III - implement commercialization plans developed in Phase II, perform demonstration / validation testing for DoD and industry to ensure highest probability of meeting performance requirements necessary for market entry; potential for early stage financing through program Pre-Commercialization Fund (PCF).

How this project responds to need:

End result for selected candidates is facilitation of commercialization transactions for demonstrated technologies to lower defense costs.

FY02 Performance Objectives:

- Diversify portfolio to include evaluation of ESOH technologies.
- Evaluate 60-80 technology candidates with Phase I Assessments
- Identify 15 candidates for Phase II in-depth assessments and commercialization development.
- Implement 3-5 demonstration and commercialization plans.

FY02 Performance Review:

Project contract award pending second quarter of FY03.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Phase I: Outreach, Technology and Needs Identification, Screening and Evaluation	**1,733**					
Phase II: Assessments; Demonstration and Commercialization Planning	**1,652**					
Phase II: Demonstration / Validation and Commercialization Implementation	**1,934**					
Total $(K):	**5,319**					

RDT&E BA4 (0603779 04F)

Milestones/Accomplishments:

- In June 2002, structured a systematic approach to technology portfolio development, eliminating any duplication of efforts or perception of organizational approach inconsistencies.
- In July 2002, incorporated technologies assessment into a database enabling better future technologies screening criteria and methodology.
- In July 2002, instituted subcontract management for California State university participation to source and evaluate technologies within the program.
- By January 2003, five additional technologies transitioned from Phase I into Phases II and III of the current program, expanding the promotion rate of commercial technologies considered under the program.

Casting Emission Reduction Program (CERP) (EN1)

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Description:

Objective:

Sustain the U.S. metal casting industry and support the Army's industrial base by evaluating, qualifying and testing replacement materials, manufacturing processes and validating technologies in the metal casting industry.

Approach:

- Research lightweight casting materials and processes (titanium and thin wall iron) that shorten production cycle times for weapon systems maintenance and manufacturing.
- Develop and demonstrate pilot scale manufacturing processes. Test replacement materials that show a cost saving and decreasing environmental impact.
- Work with manufacturing suppliers to evaluate alternative process materials that contribute to the affordability of weapon system components.
- Serve as a catalyst in transitioning new technologies from research and development to production.

How this project responds to need:

The development of improved methods and processes is key to strengthening the metal casting industry in the U.S. The strength and stability of this basic domestic industry is critical for national security (military vehicles, ordnance, and ship components). Improved technologies will reduce the environmental hazards associated with the metal casting industry and sustain the capability to support national objectives.

Casting Emission Reduction Operations and Activities

FY02 Performance Objectives:

- Establish Baseline Hazardous Air Emissions from three metal casting processes.
- Test one low emitting binder product and compare this to baseline product emissions.
- Present results of CERP testing at three industrial conferences.

FY02 Performance Review:

Project contract award expected in early FY03.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Metals Technology Research	3,190					
Emission Measurement Technology	278					
Results Dissemination	383					
Casting Requirements Forum	84					
Determine Casting Industry Contribution to DoD	80					
Improve the Quality of the Testing Process	634					
Reduced Weight Casting Technology Development	223					
Project Management	273					
Total $(K):	5,145					

RDT&E BA4 (0603779A EN1)

Milestones/Accomplishments:

- By FY03, establish Baseline Emissions for two metal casting processes and optimize two processes to produce minimum emissions.
- By FY03, test seven low emitting binder product and compare to baseline product emissions.
- By FY03, install a field demonstration site for the development and testing of environmentally friendly core resin systems in a production facility.
- By FY03, develop and verify two new air emission collection procedures and/or methods.
- By FY03, hold an Industrial Forum to define the requirements needed to sustain the metal casting industry for the future.

Unexploded Ordnance in support of Military Readiness (EN6)

Index Page is C-1

Description:

Objective:
To expand the Department of Defense (DoD) knowledge base and capabilities while improving mission readiness for safety and cost effectively remediating unexploded ordnance (UXO).

Approach:
The Concurrent Technologies Corporation (CTC) UXO Team will coordinate with a group of experienced technical stakeholders in executing each of the technical subtasks to accomplish program requirements.

How this project responds to need:
The UXO 2001 Report to Congress estimates that over 11 million acres of property in the U.S. may be contaminated with UXO, including approximately 763 Formerly Used Defense Sites (FUDS), and 23 Base Realignment and Closure (BRAC) installations, which must be cleared for reuse. A combination of political, regulatory, and budgetary drivers forces the need to improve the DoD's ability to more effectively remediate UXO sites.

FY02 Performance Objectives:

- Identify and report on UXO neutralization technologies.
- Identify and report on UXO remediation technologies.
- Develop a database for UXO recovery data and information.
- Evaluate and document quality control protocols for UXO technology operators.
- Document state-of-the-art for engineering and institutional land use controls to protect human health and the environment.
- Assess and evaluate the potential impact and hazards of electromagnetic induction (EMI) on electronic fuses.
- Assess and evaluate the potential for "surface migration" of buried UXO.

FY02 Performance Review:

Met all performance objectives for FY02.

Milestones/Accomplishments:

- Partnered with Aberdeen Test Center and Dahlgren to draft a test plan for EMI/Fuse testing.
- Partnered with US Army Cold Regions Laboratory to provide technical support on UXO migration studies.
- Identified technical stakeholders to support the FY02 funded tasks.
- In-Process Review expected in the second quarter of FY03.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Program Management	985					
Neutralization Technologies	191					
Remediation Technologies	217					
Recovery Database	203					
QC Protocols	194					
Land Use Controls	203					
EMI Effects on Electronic Fuses	472					
UXO Migration	582					
Total $(K):	3,263					

RDT&E BA4 (0603779A EN6)

Managing Army Technologies for Environmental Enhancements (MANATEE) (EN3)

Index Page is C-1

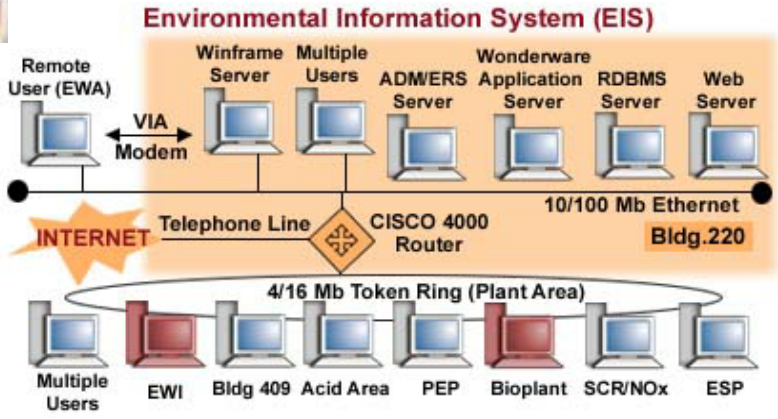
Description:

Objective:
Further develop and enhance the module-based environmental management system implemented at Radford Army Ammunition Plant under Task N.125 and N. 225, RFAAP Environment Development and Management Program (REDMAP).

Approach:

- Designed to reduce the risk sometimes associated with implementing new technologies.
- The MANATEE Team includes: Office of the Deputy Assistant Secretary of the Army – Environmental Safety and Occupational Health (ODASA/ESOH), Executive Agent Team, Army Environmental Center, RFAAP, and the NDCEE.
- Uses a proven approach for transferring technology to the Department of Defense (DoD), which consists of six key elements: Baseline Analysis, Identify Alternatives, Technology Demonstration, Technology Justification, Technology Implementation, and Follow-up.

How this project responds to need:
Continues improving RFAAP's environmental posture by implementing real-time sensors, communications technologies and defining pollution prevention opportunities**.**



FY02 Performance Objectives:

Performance objectives established for FY03 and FY04.

FY02 Performance Review:

The project was initiated at the end of FY02.

Program Schedule:

Milestone/Product	FY02	FY03	FY04	FY05	FY06	FY07
Program Mgmt	110					
Fume Incinerator Controls Upgrade	110					
Ammonia Pressure Controls Upgrade	55					
Outfall 007 Controls Upgrade	57					
Tie-in Monitor to REDMAP	69					
SCR Unit Controls Upgrade	100					
Activated Carbon Controls	108					
Ethanol Mass Balance	153					
Biodegrade Propellant Contamin	72					
Siren Controls Upgrade	130					
Total $(K)	964					

RDT&E BA4 (0603779A EN3)

Milestones:

- By FY03, complete the 100% designs for upgrading the control systems for the NAC/ SAC Fume Incinerator; Ammonia Pressure at Tank Farm; Outfall 007; Powerhouse Opacity Monitor; SCR Unit; Activated Carbon and Emergency Sirens.
- By FY03, complete plant-wide ethanol mass balance.
- By FY03, complete biodegradation of propellant constituents test report.
- By FY04, implement upgraded control systems for NAC/ SAC Fume Incinerator; Ammonia Pressure at Tank Farm; Outfall 007; Powerhouse Opacity Monitor; SCR Unit; Activated Carbon, Emergency Sirens.
- By FY04, complete preliminary design for upgraded ethanol distillation column.

FY 2001 Army EQT (Planned FY 2002 Milestones)	FY 2002 Army EQT (Completed FY 2002 Milestones)	FY 2002 Army EQT (Technology Products)
Unexploded Ordnance (UXO) Identification and Discrimination		
✓ Develop and validate UXO signature models of emerging sensors to support multi-sensor systems development and formulation of improved analysis techniques.	✓ Developed final program for UXO advanced development and technology demonstration in accordance with UXO Screening, Detection, and Discrimination EQT Management Plan and Operational Requirements Document (ORD).	✓ "The Army Environmental Quality Technology Program A(1.6.a) UXO Screening, Detection, and Discrimination Management Plan," April 2002. ✓ "The Army Environmental Quality Technology Program A(1.6.a) UXO Screening, Detection, and Discrimination EQT-ORD," April 2002.
	✓ Developed and validated UXO signature models of emerging sensors to support multi-sensor systems development and improved analysis techniques. ✓ Performed fundamental studies of sensor performance for detection and discrimination of UXO.	✓ Developed new algorithms for data acquisition and processing using physics-based modeling and formal geophysical inversion. ✓ Improved the probability of detection and reduced false alarms through new sensor technologies and processing algorithms. ✓ Acquired datasets with advanced sensor systems at standardized test sites to support joint inversion developments. ✓ ERDC Technical Report, "UXO Discrimination and Identification using Magnetometry." ✓ Symposium on Application of Geophysics to Environmental and Engineering Problems, "UXO 101: An Introduction to Unexploded Ordnance—*Short Course*," 2002. ✓ *IEEE-Transactions Geosciences and Remote Sensing,* "Investigation of Broadband Electromagnetic Induction Scattering by Highly Conductive, Permeable, Arbitrarily Shaped 3-D Objects." ✓ Paper/Technical Presentation for UXO/Countermine Forum '02, "Magnetic Discrimination that will Satisfy Regulators?" 2002.
Hazard/Risk Assessment of Military Unique Compounds (MUC)		
✓ Complete version 2.0 of the Army Risk Assessment Management System (ARAMS), demonstrating accurate prediction of contaminant fate and transport in 3-D surface model; predicting spatial and temporal risk of effect to specific endpoint organisms; and reducing costs associated with the risk assessment by an additional 20%. *Per EQT Management Plan for Hazard/Risk Assessment Tools for MUC, completion of version 2.0 of the ARAMS has been rescheduled FY 2004.*	✓ Developed final program for Hazard/Risk Assessment advanced development and technology demonstration in accordance with Environmental Quality Technology Management Plan for Hazard/Risk Assessment Tools for MUC.	✓ "Environmental Technology Management and Execution Plan Hazard/Risk Assessment Tools for Military Unique Compounds," 2002.
	✓ Released version 1.0 of ARAMS with process descriptors for explosives fate and transport, aquatic explosives uptake, and *in vitro* bioavailability data for humans.	✓ Developed (for integration with ARAMS v 1.1): o Tropic Trace Beta Version for estimating transfer of contaminants to ecological and human receptors. o Terrestrial Toxicity Database. o Predictive Food Chain Model. o Interactive information systems to evaluate risk and toxicity of mixtures. o Methods to evaluate exposure in spatially heterogeneous landscapes. ✓ ERDC Technical Report and developed database on "Physicochemical Properties and Human Toxicity Benchmarks for Training/Firing Range Chemicals." ✓ ERDC Technical Report, "Environmental Fate and Transport Process Descriptors for Explosives." ✓ ERDC Technical Report, "Dissolution Kinetics of High Explosive Compounds." ✓ *The Science of the Total Environment,* "The Use of Spatial Modeling in an Aquatic Food Web to Estimate Exposure and Risk." ✓ *Journal of Environmental Toxicology and Chemistry,* "Toxicity of the Explosives 2,4,6-trinitrotoluene, hezahydro-1,3,5-trinitro-1,3,5-triazine, and octahydro-1,3,5,7-tetranitro-1-3-5-7-tetrazocine in Sediments to Chironomus Tentans and Hyalella Azteca: Low-Dose Hormesis and High-Dose Mortality." ✓ *Journal of Environmental Toxicology and Chemistry,* "Dietary Oral Exposure to 1,3,5-trinitro-1,3,5-triazine in the nNorthern Bobwhite." ✓ *Toxicology and Applied Pharmacology,* "Percutaneous Absorption of Explosive and Related Compounds: an Empirical Model of Bioavailability of Organic Nitro Compounds." ✓ *Chemosphere,* "Dissolution Rates of Three High Explosive Compounds: TNT, RDX, and HMX." ✓ *Journal of Chemical and Engineering Data,* "Effects of Component Interactions on the Aqueous Solubilities and Dissolution Rates of the Explosive Formulations Octol, Composition B, and LX-14." ✓ *Thermochimica Acta,* "Environmental Fate of Explosives." ✓ Paper/Technical Presentation (Brownfield's Conference) "Use of ARAMS for Health Impacts Assessment."

FY 2001 Army EQT (Planned FY 2002 Milestones)	FY 2002 Army EQT (Completed FY 2002 Milestones)	FY 2002 Army EQT (Technology Products)
Enhanced Alternatives and In Situ Treatment Technologies for Explosives, Organics and Solvents in Groundwater		
✓ Program to be restructured based on user-communities reprioritization of user requirements.	✓ Program restructured based on user-communities reprioritization of user requirements.	
	✓ Isolated and characterized common acetogens capable of Cyclotrimethylenetrinitramine (RDX) degradation.	✓ Isolation and characterization of common acetogens capable of RDX degradation. ✓ Assessment of the competitive effects of electron acceptors on the degradation of RDX. ✓ ERDC Technical Report, "UV-Vis Spectroscopy of TNT/Hydroxide Reaction." ✓ ERDC Technical Report, "Treatability Study for Biologically Active Zone Enhancement (BAZE) for In Situ RDX Degradation in Groundwater." ✓ *Chemosphere,* "UV-Vis Spectroscopy of 2,4,6-Trinitrotoluene-Hydroxide Reaction."
	✓ Assessed the competitive effects of electron acceptors on the degradation of RDX.	
Innovative and In Situ Treatment Technologies for Soils Contaminated with Inorganics		
✓Program to be restructured based on user-communities reprioritization of user requirements.	✓ Restructured program based on user-communities reprioritization of user requirements.	✓ Basic research activities identified potential techniques for placing subsurface sorptive iron and manganese oxide barriers for interception of heavy metals in groundwater.
Particulate Matter/Dust Control		
✓ No program milestones scheduled in FY 2002.	✓ Completed draft technology verification reports detailing the short-term (100 day) performance, durability, and environmental effects associated with chemical dust suppressants that were applied to unsurfaced roads at Fort Leonard Wood.	
Training and Testing Range Noise Control		
✓ Basic research results on the feasibility of blast noise absorbers.	✓ Completed field experiments with encouraging preliminary results on the feasibility of using blast noise absorbers for large weapon firing positions for which standard noise attenuation techniques are not feasible. Final analysis and conclusions expected in FY 2003.	
	✓ Obtained complete year of field noise data from Small Arms Training Ranges (SATR). This data will be useful for improved noise modeling and mitigation.	✓ Incorporated small arms range field noise data into the SARNAM model.
Hazardous Air Pollutant (HAP) and Volatile Organic Compound (VOC) Emission Control		
✓ Develop new technologies for controlling and/or recycling inorganic HAP emissions.	✓ Completed developmental testing of Zero Emission Cr Electroplating System at Anniston Army Depot (AD).	✓ System Installation at Anniston Ammunition Depot for plating quality tests.
	✓ Completed demonstration of continuous emission monitor (XCEM) at Tooele Army Depot, meeting U.S. Environmental Protection Agency (EPA) Performance Specification for five metals.	✓ XCEM technology on the APE 1236 Deactivation Furnace at Tooele Army Depot. The monitor has already helped Tooele identify a solution for reducing lead emissions more than 90%. ✓ Paper/Technical Presentation, 18th Annual Waste Testing & Quality Assurance Symposium, August 2002.
	✓ Improved Mobile Zone Spray Booth Recirculation exceeding the 81% VOC removal efficiency requirement for control devices.	✓ Second Patent awarded for rotating biofilter technology. ✓ Published Research in journals of "Water Environment Research" and "Biodegradation." ✓ Paper/Technical Presentation, 2002 Real World Clean Air Symposium, May 2002. ✓ Paper/Technical Presentation, American Water Management Association, June 2002. ✓ Mobile Zone Spray Booth Recirculation technology at Ft. Hood with VOC Control Capabilities: Controlled CARC at 93% and Western Auto paint (W959) at 96%.
Treatment Techniques for Wastewaters from Munitions Production		
✓ No program milestones scheduled in FY 2002.	✓ Verified the anaerobic biodegradation of explosives in reactors by replacing the activated carbon with sand.	
Sustainable Army Live-Fire Range Design and Maintenance		
✓ Identify range load and condition durability factors associated with environmental compliance.	✓Developed range risk and design assessment methodology.	✓ Developed methodology.

FY 2001 Army EQT (Planned FY 2002 Milestones)	FY 2002 Army EQT (Completed FY 2002 Milestones)	FY 2002 Army EQT (Technology Products)
Removal, Treatment, and Disposal Technologies for Lead-Based Paint (LBP) Contamination		
✓ Demonstrate in-situ extraction technologies for lead in soil to reduce lead level below US EPA level of concern 400 parts per million (ppm).	✓ Demonstrated feasibility of removing lead originating from lead-based paint from soil using electromigration to reduce lead level below US EPA's level of concern of 400 ppm.	
	✓ Demonstrated environmentally acceptable chemical strippers and thermal spray for removal of LBP and decision tree for optimal selection of technologies for control and abatement of LBP hazards on steel structures.	✓ ERDC-CERL Technical Report, "Decision Tree for Lead-Based Paint Hazard Control and Abatement for Steel Structures." ✓ ERDC-CERL Technical Report, "Overcoating of Lead-Based Paint on Steel Structures." ✓ ERDC-CERL Technical Report, "Technology Demonstration of Nontoxic Chemical Stripper for Steel," August 2002. ✓ ERDC-CERL Technical Report, "Technology Demonstration of Thermal spray Vitrification Process at Fort Drum, NY," August 2002.
Sustainable Painting Operations for the Total Army (SPOTA)		
✓ No program milestones scheduled in FY 2002. New program.	✓ Begin baseline assessment of procedures, documentation, and validation of coatings, solvents, cleaners, and de-painters.	✓ Developed a methodology to asses commercial alternatives to military coatings technologies.
	✓ Begin gap analysis for HAP-free rubber-to-metal bonding materials.	
	✓ Initiated qualification and validation of rubber-to-metal bonding technologies.	
Solid Waste Diversion		
✓ Demonstrate military solid waste (MSW) conversion technologies resulting in useful end products.	✓ Evaluated and validated solid waste conversion technology.	✓ Land application at Ft. Benning is complete.
	✓ Tested & evaluated solid waste (SW) conversion technology by-products: cellulose pulp from Ft. Campbell SW grinding project.	
	✓ Developed a decision tree for determine recyclability/reusability of contaminated structures slated for demolition to achieve maximum benefit-economic, waste reduction, compliance with RCRA.	✓ Organized and compiled a Web-ready decision tree matrix.
	✓ Developed guidance to deconstruct WWII buildings to maximize recycle/reuse potential including performance metrics to forecast recyclable materials and resources needed to implement the guidance.	✓ Guidance document for deconstructing WWII structures is complete.
Develop a NESHAP Chemical Agent Resistant Coating (CARC) System		
✓ No program milestones scheduled in FY02.	✓ Validation of water-dispersible CARC.	✓ Finalized Military Specification MIL-DLT-64159, "Water dispersible chemical agent resistant coating," January 2002. ✓ Paper/Technical Presentation: EPA NESHAP committee meeting: San Diego CA. presented update of water dispersible effort. ✓ Paper/Technical Presentation: CARC commodity Management for DoD, Corrosion Summit, St Petersburg Fla., February 2002. ✓ Paper/Technical Presentation: Sherwin Williams Corporation Water Dispersible Formulations, August 2002. ✓ Paper/Technical Presentation: Ft Hood Texas Implementation of Water Dispersible CARC, June 2002. ✓ Air Force Office of Scientific Research Nanocoatings workshop, Provide Detailed Efforts of Army Coatings Program and Novel Coating Systems (Water dispersible coatings) to Air Force and North Dakota State University. Invitation from P. Trulove, Director of AFOSR, August 2002. ✓ Paper/Technical Presentation at TARDEC for PEOs and PMs: "Policy, Doctrine and Water Dispersible Formulation," September 2002.

FY 2001 Army EQT (Planned FY 2002 Milestones)	FY 2002 Army EQT (Completed FY 2002 Milestones)	FY 2002 Army EQT (Technology Products)
Ordnance Manufacture, Maintenance, Use, and Surveillance to Enable Sustainable Ranges		
✓ Demonstrate technology for toxic-free material/solvents for solid propellant components.	✓ Demonstrated performance of laser ignited medium ammunition (30mm) as part of foundation research effort that will eliminate lead/toxic components for M230 automatic cannon and ammunition.	✓ Laser ignited medium-caliber ammunition (30mm) eliminating toxic components in M230 cannon.
	✓ Researched and identified new, environmentally benign explosive and propellant formulations based on ammonium nitrate.	✓ Energetics with environmentally benign decomposition products.
Reduce/Eliminate Pollution for Compliant Plating Processes		
✓ No program milestones scheduled in FY 2002.	✓ Began initial deposition technologies on large caliber samples. Satisfied nine of the original ten deposition performance program metrics for the material tantalum.	✓ Demonstrated the following manufacturing technology critical parameters on deposited barrels: Zone T and better coating morphology, achieved desirable Alpha-Ta phase formation, achieved desired hardness, achieved desired coating cohesion, achieved the desired coating thickness uniformity over length as well as circumference, achieved a chrome (Cr)-like deposition rate, achieved desired coating thickness, and demonstrated ability to deposit coatings over long lengths.
	✓ Fired projectiles through one tantalum coated 45mm gun barrel.	✓ Demonstrated a 50% improvement in barrel life over 2001 tests. ✓ Matched erosion profile at origin of bore of Cr plated barrels (thus a good environmental replacement).
Reduce/Eliminate Pollution for Compliant Composite Manufacturing and Repair		
✓ Basic technology for aqueous fiber processing will be ready for transition to applied research for demonstration of technology for use in production of high performance fibers.	✓ Basic technology for aqueous fiber processing progressed to demonstrating ability to spin good quality fibers. Final Technical Report expected January 2003.	✓ Processed and spun silk fibers under aqueous conditions. ✓ Progressed from just spinning fibers to spinning good fibers. ✓ Tensile data analyzed to identify most important variables. ✓ *Proc. Nat. Acad. Sc*i, "Segmented nano-fibers of spider dragline silk: Atomic Force Microscopy and Single-molecule Force Spectroscopy," v99: Suppl 2, 2002. ✓ *Macromolecules,* "Aqueous Processing and Fiber Spinning of Recombinant Spider Silks," v35, 2001. ✓ *Science* "Spider Silk Fibers Spun from Soluble Recombinant Silk Produced in Mammalian Cells," v295, 2002. ✓ *Escherichia Coli. Protein Expression and Purification, "*A Rapid Selective Extraction Procedure for the Outer Membrane Protein (OmpF)," v25, 2002. ✓ US Patent Application. Methods for the Purification and Aqueous Fiber Spinning of Spider Silks and Other Structural Proteins.
✓ Potential alternative materials and technologies will be developed and demonstrated on test bed components for repair of composites for Army ground vehicle applications and aircraft superstructures.	✓ Potential alternative materials and technologies developed and demonstrated on test bed components for ground vehicle applications and aircraft superstructures.	✓ Demonstrated composite repair using induction heating and electron beam processing to restore performance in aircraft and ground vehicle structures. ✓ Developed models for processing of composite platforms using EB and induction methods. ✓ Developed thermosetting adhesive alternatives that cure by EB or induction processing. ✓ Developed thermally controllable processing adhesives for induction based field repair of military structures. ✓ Designed and transitioned to industry a series of thermosetting prepreg system that cure by EB irradiation. ✓ Developed test articles for asymmetric laminate structures of dissimilar fabrics and single ply carbon laminates with 100% retention of tooling tolerances when cured using EB. ✓ *Clean Products and Processes,* "Environmental Issues for Polymer Matrix Composites and Structural Adhesives," v2, 2001. ✓ *Journal of Applied Polymer Science,* "Synthesis and Properties of Elastomer-Modified Epoxy-Methacrylate Sequential Interpenetrating Networks," v81, 2001. ✓ SERDP Report, "Non-polluting Composites Repair and Remanufacture for Military Applications, " v1109.
Reducing Impacts of Threatened and Endangered Species (T&ES) on Military Readiness		
✓ No program milestones scheduled in FY 2002.	✓ Completed noise study on red-cockaded woodpecker (RCW).	✓ Developed dose-response relationships, assessing noise impacts o individuals and populations of RCW using three seasons of noise and behavior data, with data indicating no significant impact on reproductive success of the RCW.
	✓ Completed studies on effects of smokes and obscurants on RCW.	✓ Web Interface for modeling fog oil dispersion during military training. ✓ ERDC Technical Report, Acute Inhalation Toxicity of Fog Oil Smoke in the Red-Winged Blackbird, a Size-specific Inhalation Surrogate for the RCW.

FY 2001 Army EQT (Planned FY 2002 Milestones)	FY 2002 Army EQT (Completed FY 2002 Milestones)	FY 2002 Army EQT (Technology Products)
	✓ Completed maneuver impact study on RCW.	✓ ERDC Technical Report, "Assessment of Effects of Maneuver Training Activities on Red-Cockaded Woodpecker Populations on Ft. Stewart, GA"
	✓ Completed smoke dispersion model	✓ Completed revisions on smoke dispersion model examining the effects of smokes and obscurants on the red-cockaded woodpecker.
Baseline T&ES Surveys and Monitoring		
✓ No program milestones scheduled in FY 2002.	✓ Completed population viability with applicability to avian T&ES.	✓ Defined survey techniques for five avian T&ES that are suitable to all Army installations.
Land Capability/Characterization		
✓ Develop a protocol for installation use that improves land rehabilitation prescriptions based on impacts.	✓ Completed land rehabilitation and maintenance model protocols that identify installation land requiring rehabilitation and prioritize land repair activities based on severity of the impact and probability of rehabilitation success.	✓ "Army Training and Testing Area Carrying Capacity (ATTACC) Vehicle Severity Factor (VSF) and Local Condition Factor (LCF) Calculator User Manual" Version 1. ✓ "Army Training and Testing Area Carrying Capacity (ATTACC) LS Calculator User Manual" Version 1.
Land Rehabilitation		
✓ No program milestones scheduled in FY 2002.	✓ No program milestones to complete in FY 2002.	
Non-Invasive Species Control for Army Installations & Operations		
✓ Conduct initial assessments of knapweed biocontrol agents.	✓ Conduct assessments of insect biocontrol agents and damage to host knapweed plants.	✓ Technical Report, Illinois Natural History Survey. "Investigation of the potential for Red Imported Fire Ant (*Solenopsis invicta*) impacts on rare karst invertebrates at Fort Hood, Texas: Literature survey and study design." ✓ Public Works Technical Bulletin, "Guidance for Non-Native Invasive Plant Species on Army Lands: Western United States," v200-1-18. ✓ Public Works Technical Bulletin, "Guidance for Non-Native Invasive Plant Species on Army Lands: Eastern United States," v200-1-19.
Electrokinetic Remediation of Contaminated Soils (US/German DEA Project)		
✓ No program milestones scheduled in FY 2002.	✓ Scientific Advisory Board met to review final design. ✓ Scientific Advisory Board visited project site in Bergen Germany.	✓ Demonstrated electromigration of Cadmium (Cd), Chromium (Cr) and Lead (Pb) from range soil in Bergen Germany.

AAP	Army Ammunition Plant
ACS	Army Claim Service
ACSIM	Assistant Chief of Staff for Installation Management
AD	Army Depot
AEC	Army Environmental Center
AERTA	Army Environmental Requirements and Technology Assessments
AFOSR	Air Force Office of Scientific Research
AMC	U.S. Army Materiel Command
AR	Army Regulation
ARAMS	Army Risk Assessment Management System
ARDEC	Armament Research, Development & Engineering Center, U.S. Army Tank-automotive and Armament Command
ARNG	Army National Guard
ARO	Army Research Office
ASAIE	Assistant Secretary of the Army for Installations and Environment
ASAALT	Assistant Secretary of the Army for Acquisition, Logistics, and Technology
ASP	Ammunition Supply Points
ASTMIS	Army Science and Technology Management Information System
ASTMP	Army Science and Technology Master Plan
ASTWG	Army Science and Technology Work Group
ATTACC	Army Training and Testing Area Carrying Capacity
BaNO3	Barium Nitrate
BA	Budget Activity
BNOISE	Blast Noise Model
BPR	Business process reengineering
BRAC	Base Realignment and Closure
BTAG	U.S. Army Biological Technical Assistance Group
Cd	Cadmium

Cr	Chromium
CAA	Clean Air Act
CAA	Center for Army Analysis
CAAA	Clean Air Act Amendments
CARC	Chemical Agent Resistant Coating
CCAD	Corpus Christi Army Depot
C/D	Construction and Deconstruction
CEAC	Cost Economic and Analysis Center, U.S. Army
CEM	Continuous Emission Monitor
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CERL	Construction Engineering Research Laboratory, U.S. Army Corps of Engineers Engineer Research and Development Center
CERP	Casting Emission Reduction Program
CHP	Certified Health Professional
CHPPM	Center for Health Promotion and Preventive Medicine, U.S. Army
COE	U.S. Army Corps of Engineers
CON	Conservation
COM	Compliance
COTS	Commercial Off-The-Shelf
CRADA	Cooperative Research and Development Agreements
CTC	Cost to Complete
CVIR	Cost Avoidance to Total Investment Ratio
CWA	Clean Water Act
CWM	Chemical Warfare Munitions
DA	Department of the Army
DASA	Deputy Assistant Secretary of the Army
Dem/Val	Demonstration/Validation
DEA	Data Exchange Agreement

DENIX	Defense Environmental Network and Information Exchange
DEP	Director, Army Environmental Programs
DISC4	Director of Information Systems for Command, Control, Communications and Computers
DLC	Diamond Like Coatings
DNT	Dinitrotoluene
DoD	Department of Defense
DoE	Department of Energy
DPA	Diphenylamine
DPG	Defense Planning Guidance
DSB	Defense Science Board
DSERTS	Defense Sites Environmental Restoration Tracking System
DTO	Defense Technology Objective
DTSC	California Department of Toxic Substances Control
DU	Depleted Uranium
EA	Environmental Assessment
EB	Electron Beam
EIS	Environmental Impact Statement
EK	Electrokinetic
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPR	Environmental Program Requirements
EQT	Environmental Quality Technology
EQT-ORD	Environmental Quality Technology – Operational Requirements Document
ERA	Ecological Risk Assessment
ERDC	Engineer Research and Development Center, U.S. Army Corps of Engineers
ESA	Endangered Species Act
ESOH	Environment, Safety and Occupational Health

ESTCP	Environmental Security Technology Certification Program
ESTRG	Environmental Security Technology Requirements Group
ETIPT	Environmental Quality Technology Integrated Process Team
ETTC	Environmental Technology Technical Council
FEA	Functional Economic Analysis
FIRE	Firing Information and Range Execution
FORSCOM	Forces Command, U.S. Army
FOUO	For Official Use Only
FUDS	Formally Used Defense Sites
FY	Fiscal Year
GBCUP	Green Building Criteria Update Program
GPR	Ground Penetrating Radar
HAP	Hazardous Air Pollutants
HAZMAT	Hazardous Material
HBCU	Historically Black Colleges and Universities
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HQ	Headquarters
HQDA	Headquarters Department of the Army
HSLA	High Strength Low Alloy
ILE	Installations, Logistics, and the Environment
IM	Installation Management
IMRO	Installation Management Regional Offices, U.S. Army
INRMP	Integrated Natural Resources Management Plan
IOC	Industrial Operations Command or Initial Operational Capability
ISO	International Standards Organization
ITAM	Installation Training and Maintenance
JSU	Jackson State University
LAP	Load, Assembly, and Pack

LBP	Lead-Based Paint
LEAD	Letterkenny Army Depot
LRAM	Land Rehabilitation and Maintenance
MACOM	Major Command
MAIS	Major Automated Information System
MANATEE	Managing Army Technologies for Environmental Enhancements
MDAP	Major Defense Acquisition Programs
MEK	Methyl Ethyl Ketone
MIBK	Methyl Isobutyl Ketone
MIM	Maneuver Impact Miles
MNS	Mission Need Statement
MOUT	Military Operations in Urban Terrain
MRC	Military Relevant Compounds
MRE	Meals Ready to Eat
MRED	Managing Research in Environmental Decision making
MSC	Major Subordinate Commands
MSN/ENV	Mission/Environmental
MSW	Military Solid Waste
MUC	Military Unique Compound
NAC	National Automotive Center, U.S. Army Tank- automotive and Armaments Command
NBC	Nuclear, Biological, and Chemical
NCP	National Contingency Plan
NDCEE	National Defense Center for Environmental Excellence
NDI	Non-Destructive Inspection
NESHAP	National Emission Standards for Hazardous Air Pollutants
NGB	National Guard Bureau
NOV	Notice of Violation

NPDES	National Pollution Discharge Elimination System
NPV	Net Present Value
NTC	National Training Center
OACSIM	Office of the Assistant Chief of Staff for Installation Management
OASA	Office of the Assistant Secretary of the Army
OB/OD	Open Burning / Open Detonation
ODASA	Office of the Deputy Assistant Secretary of the Army
ODC	Ozone Depleting Chemicals
ODCSLOG	Office of the Deputy Chief of Staff for Logistics
ODCSOPS	Office of the Deputy Chief of Staff for Operations and Plans
ODEP	Office of the Director Environmental Programs
OEM	Original Equipment Manufacturers
OF	Objective Force
OMA	Operations and Maintenance, Army
ORD	Operational Requirements Document
O&M	Operations and Maintenance
O&S	Operations and Support
OSD	Office of the Secretary of Defense
OSHA	Occupational Safety and Health Administration
OTS	Off-the-Shelf
OTSG	Office of the Surgeon General, U.S. Army
P2	Pollution Prevention
Pd	Probability of detection
PCF	Pre-Commercialization Fund
PE	Program Element
PEG	Program Evaluation Group
PEM	Proton Exchange Membrane
PEO	Program Executive Officer

PEP	Propellants, Explosives, and Pyrotechnics
PEPS	Plasma Energy Pyrolysis System
PM	Particulate Matter
PM	Program Manager
POC	Point of Contact
POL	Petroleum, Oils, and Lubricants
POM	Program Objective Memorandum
PPBE	Planning, Programming, Budgeting, and Execution
PPBES	Planning, Programming, Budgeting, and Execution System
PPE	Personal Protective Equipment
QOL	Quality of Life
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RCW	Red-Cockaded Woodpecker
R&D	Research and Development
RDA	Research, Development, Acquisition
RDEC	Research, Development, and Engineering Center
RDT&E	Research, Development, Test, and Evaluation
RDX	Royal Demolition Explosive (Hexahydro-1,3,5-trinitro-1,3,5-triazine)
REDMAP	Radford Army Ammunition Plant Environmental Development and Management Program
RES	Restoration
RFAAP	Radford Army Ammunition Plant
RFMSS	Range Facility Management Support System
RFQ	Request for Quotation
ROI	Return On Investment
RRAD	Red River Army Depot
RTLP	Ranges and Training Land Program

RTV	Room Temperature Vulcanizing
SAC	Security and Assistance Command, U.S. Army
SARNAM	Small Arms Range Noise Assessment Model
SATR	Small Arms Training Ranges
SECARMY	Secretary of the Army
SedSpec	Standard Erosion Design Specifications model
SERDP	Strategic Environmental Research and Development Program
SIR	Savings to Investment Ratio
SPOTA	Sustainable Painting Operations for the Total Army
SSCOM	Soldier Systems Command
S&T	Science and Technology
STO	Science and Technology Objectives
STRAC	Standards and Training Commission
SW	Solid Waste
SWDA	Solid Waste Disposal Act
TACOM	Tank - automotive and Armaments Command, U.S. Army
TARDEC	Tank Automotive Research, Development, and Engineering Center, U.S. Army
	Tank – automotive and Armaments Command
TCLP	Toxicity Characteristic Leaching Procedure
TDC	Transportable Detonation Chamber
T&ES	Threatened and Endangered Species
TETF	Total Enclosed Treatment Facility
TNS	Technology Needs Survey
TNT	Trinitrotoluene
TOAD	Toelle Army Depot
TOC	Total Ownership Costs
TRADOC	Training and Doctrine Command, United States Army
TSCA	Toxic Substances Control Act

TT	Technology Team
TTIP	Technology Transfer Implementation Plan
U.S.	United States of America
USA	United States of America
USAR	United States Army Reserve
USACE	United States Army Corps of Engineers
USACERL	United States Army Construction Engineering Research Laboratory
USAEC	United States Army Environmental Center
USAF	United States Air Force
USEPA	United States Environmental Protection Agency
USMC	United States Marine Corp
UXO	Unexploded Ordnance
VMS	Vanadium Microalloyed Steels
VOC	Volatile Organic Compound
WES	Waterways Experiment Station, U.S. Army Corps of Engineers Engineer Research and Development Center
WETO	Western Environmental Technology Office
XCEM	Continuous Emission Monitor demonstrated at Toelle Army Depot