
Department of the Army
Environmental Quality Technology Program
Addressing Defense Requirements with Tomorrow's Technology
Restoration
Compliance
Conservation
Pollution Prevention
Annual Report to Congress Fiscal Year 2002
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Report To Congress For Fisc
Environmental Quality Te
On behalf of the Department of the
pleasure to present the annual repo
and accomplishments of the Army's
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Secretary of the Army
May 2002
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Unexploded Ordnance (UXO)
Identification & Discrimination
Conservation
Pollution Prevention
Environmental Quality Technology (EQT)
Annual Report to Congress
Fiscal Year 2003

Report To Congress For Fiscal Year 2003
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 demonstrate our commitment to solving the Army's most pressing environmental quality needs by inserting technological solutions to meet those needs. Finally, we recommend a priority and funding structure within the Department of Defense budget formulation process to implement these solutions.

This year's report emphasizes leadership through environmental sustainability and stewardship by providing the Army with the tools to support Army installations and training missions for the 21st century modular force. One new tool, the Army Risk Assessment Modeling System provides credible ecological risk assessment. In demonstrations at Army sites, the model has provided trainers and resource managers the information needed to sustain training while preserving the environmental health of Army training lands.

Army EQT Program successes have resulted in survivability, environmental, and combat readiness improvements at home and on the battlefield. These include: managing Halon 1301 shipments to Operation Iraqi Freedom ensuring solider survivability and Abrams/Bradley readiness; developing new combat proven fire suppression system implementation on the Stryker; reducing Total Ownership Costs and soldier risks with the unexploded ordnance (UXO) detection, identification, discrimination and recovery system; and developing Army training and test range sustainability technology to allow indefinite range use and improving combat readiness.

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 2003.

R.L. Brownlee
Acting Secretary of the Army

July 2004

Executive Summary

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 of FY 2000 (Public Law 106-65), amends Section 2706 of Chapter 160 of Title 10, United States Code, to require the Secretary of Defense to ensure the technology planning process provides for an investment control process for the selection, prioritization, management, and evaluation of environmental technologies by DoD, military departments, and Defense agencies. This report provides the status of The Army Environmental Quality Technology (EQT) Program and an overview of The Army FY 2003 environmental quality research, development, test and evaluation (RDT&E) efforts through 30 September 2003.

The Army's environmental vision, as an integral part of its mission, is to be a leader in environmental, natural and cultural resource stewardship for present and future generations. The Army strives to go beyond mere compliance with laws and regulations. To succeed in its commitment to mission readiness and the environment, the Army seeks to manage available resources wisely to enhance the readiness of the modular force including quality of life initiatives. The Army EQT Program provides a systematic approach to program development, management, and oversight that supports the Army's commitment to environmental leadership. Through focused RDT&E investments in effective and efficient technological solutions, the Army EQT Program strives to resolve these environmental challenges faced by the Army and reduce the Army's total program costs. Major FY 2003 highlights include:

- Awarded multi-year $350M National Defense Center for Environmental Excellence (NDCEE) Indefinite Delivery Indefinite Quantity contract;
- Established ordnance target repository at U.S. Army Aberdeen Test Center and demonstrated six UXO detection technologies at two Standardized UXO Technology Demonstration Sites;
- Implemented Sustainable Army Live-Fire Range Design and Maintenance Management Plan and EQT-Operational Requirements Document (EQT-ORD);
- Validated The Army Risk Assessment Modeling System (ARAMS) version 1.2 to assist installations in determining appropriate exposure and toxicity levels during production, storage, transportation, use and disposal of military unique compounds (MUC) with demonstrations at five Military Sites;
- Demonstrated a number of Lead-Based Paint (LBP) removal, treatment and disposal technologies for buildings and other structures;
- Demonstrated a number of Hazardous Air Pollutants (HAP) and Volatile Organic Compound (VOC) emission control technologies;
- Formulated twenty RDT&E programs for FY 2006-FY 2011 Program Objective Memorandum (POM) including six fully funded programs; and
- Produced and/or published 160 products as referenced in appendix D.

Environmental and operational sustainability represents a vital component of the Army's mission. This sustainability supports mission readiness by complying with environmental laws, maintaining the availability of training lands, cleaning up and, when practicable, preventing

pollution, ensuring relevant environmental information is available to land managers, improving soldier/family quality of life, and strengthening community relationships. Compliance and restoration continue to be vital components of The Army EQT Program, reflecting our commitment to comply with environmental standards and to clean up contaminated land or property. Continued investments in pollution prevention and conservation offer opportunities to reduce long-term operating costs and liabilities in compliance and clean up without restricting training or readiness activities.

The Army EQT Program is based on a rigorous bottom-up identification and validation of user requirements. Following the Army's planning, programming, budgeting, and execution process, 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. The Army's FY 2003 budget request was $43.2M in Environmental Quality Technology applied research, advanced technology development, demonstration validation, and management support. Congress appropriated $73M that included Congressional interest projects, which the Army exploited to the fullest extent possible to resolve its highest prioritized requirements. Additionally, the Army invested $8.7M to Environmental Quality Technology basic research in areas that included processes in pollution abatement technologies, military pollutants and health hazards, and environmental restoration. The Army's EQT Program continues to provide 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 sustainability and stewardship responsibilities.

Fiscal Year 2003 Army Environmental Quality Technology Programs

Army EQT Programs	Program Pillar[1]	Defense Planning Guidance		Cost Avoidance[2]	Leveraging Sources					Appendix B page #
		Army High Priority	Projected Payback		SERDP[3]	ESTCP[4]	NDCEE[5]	Navy/AF[6]	Federal Agency[7]	
Unexploded Ordnance (UXO) Identification and Discrimination	RES	●	●	●	●	●	●	●		B-2
Hazard/Risk Assessment of Military Unique Compounds (MUC)	RES	●	●	●	●	●			●	B-3
Enhanced Alternative and In Situ Treatment Technologies for Explosives and Organics in Groundwater	RES	●	●	●	●	●		●		B-4
Innovative In Situ and/or On-site Ex Situ Treatment Technologies for Soils Contaminated with Inorganics	RES	●	●	●	●	●				B-5
Characterization, Evaluation, and Remediation of Distributed Source Contamination (UXO-(C)) on Army Ranges	RES	●	●	●	●	●				B-6
Long Term Monitoring for Military Unique Compounds	RES	●	●	●	●	●		●	●	B-7
Particulate Matter (PM)/Dust Control	COM	●	●	●	●	●			●	B-8
Training and Testing Range Noise Control	COM	●	●	●		●		●	●	B-9
Hazardous Air Pollutant (HAP) and Volatile Organic Compound (VOC) Emission Control	COM	●	●	●		●	●			B-10
Improved Treatment Techniques for Wastewaters from Munitions Production	COM	●	●	●					●	B-11
Sustainable Army Live-Fire Range Design and Maintenance	COM	●	●	●						B-12
Removal, Treatment, and Disposal Technologies for Lead-Based Paint (LBP) Contamination	COM	●	●	●		●				B-13
Sustainable Painting Operations for the Total Army (SPOTA)	P2	●	●	●	●		●	●		B-14
Solid Waste Diversion	P2	●	●	●	●		●			B-15
Compliant Ordnance Lifecycle for the Readiness of the Transformation and Objective Forces	P2	●	●	●	●	●				B-16
Reduce/Eliminate Pollution for Compliant Plating Processes	P2	●	●	●	●	●		●		B-17
Reducing Impacts of Threatened and Endangered Species (T&ES) on Military Readiness	CON	●	●	●	●				●	B-18
Maintain Readiness by Improving Threatened and Endangered Species (T&ES) Monitoring Capabilities	CON	●	●	●	●				●	B-19
Land Capability/Characterization	CON	●	●	●						B-20
Land Rehabilitation	CON	●	●	●						B-21
Non-Invasive Species Control for Army Installations & Operations	CON	●	●	●	●					B-22
Electrokinetic Remediation of Contaminated Soils (U.S./German DEA Project)										B-23

Table ES- 1. Fiscal Year 2003 Army Environmental Quality Technology Programs

1. Army EQT Program Pillars: RES – Restoration; COM – Compliance; P2 – Pollution Prevention; CON – Conservation.
2. Payback within 5 years of demonstration and/or validation completion IAW DPG.
3. SERDP – Leveraged Strategic Environmental Research and Development Program funding.
4. ESTCP – Leveraged 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, page C-#)
C-2; Waste Minimization and Pollution Research
C-3; Range Safety Technology Demonstration (Rangesafe)
C-4; Proton Exchange Membrane (PEM) Fuel Cell Demonstration
C-5; Vanadium Technology Program
C-6; Transportable Detonation Chamber Validation
C-7; Commercialization of Technologies to Lower Defense Costs Program
C-8; Casting Emission Reduction Program (CERP)
C-9; Unexploded Ordnance in Support of Military Readiness
C-10; Managing Army Technologies for Environmental Enhancements (MANATEE)
C-11; Environmental Response and Security Protection (ERASP) Program
C-12; Technologies to Reduce Non-Hazardous Waste

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Army Environmental Quality Technology Program

1. Introduction

1.1 Background

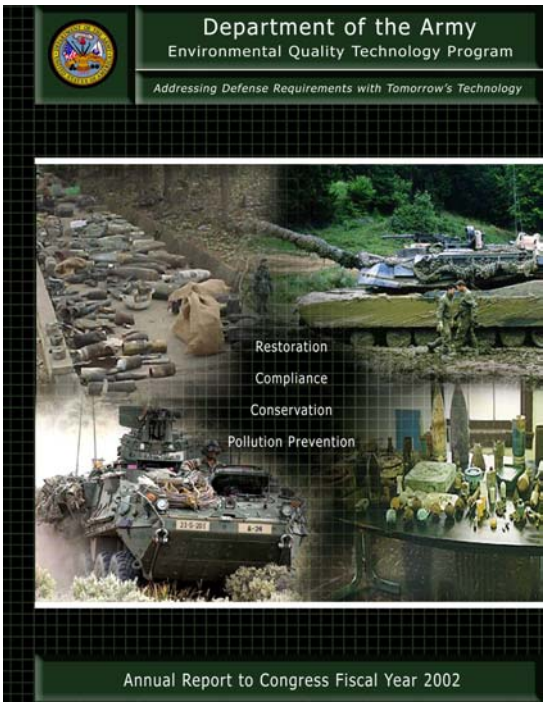


Figure 1-1. FY 2002 Army EQT Annual Report

In April 2003, the Army published the fourth 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) 2002 as required by Section 323 of the National Defense Authorization Act for FY 2000.

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 EQT Program control processes are structured to adhere to this requirement with a management and oversight process responsive to the Defense Planning Guidance (DPG). Working within the multi-year planning, programming, budgeting, and execution cycle, the Army Environmental Quality Technology 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 the identification, exploitation, development, demonstration/validation, and transfer of technology to resolve these AERTA requirements.

The Army's FY 2003 budget request was $43.2M in Environmental Quality Technology applied research, advanced technology development, demonstration/validation, and management support. Congress appropriated $77M that included Congressional interest projects, which the Army exploited to the fullest extent possible to resolve its highest prioritized requirements. Additionally, the Army invested $8.7M to Environmental Quality Technology basic research in areas that included processes in pollution abatement technologies, military pollutants and health hazards, and environmental restoration.

The FY 2003 Army EQT Program systematically address the highest priority environmental requirements, preserve our natural and cultural resources, reduce future program costs, and be prepared for future wars and their aftermath.

1.2 Army EQT Program Overview

The Army's environmental vision is to be a leader in environmental, natural and cultural resource stewardship for present and future generations as an integral part of its mission. The Army will strive to go beyond mere compliance with laws and regulations. To succeed in its commitment to environmental stewardship, the Army seeks to wisely manage available resources to enhance the readiness of the objective forces including quality of life initiatives. The Army Environmental Quality Technology Program provides a systematic approach to program development, management, and oversight that supports the Army's environmental vision and results in environmental technologies that reduce the Army's total program costs following validation, qualification, and implementation of technology solutions in the field.

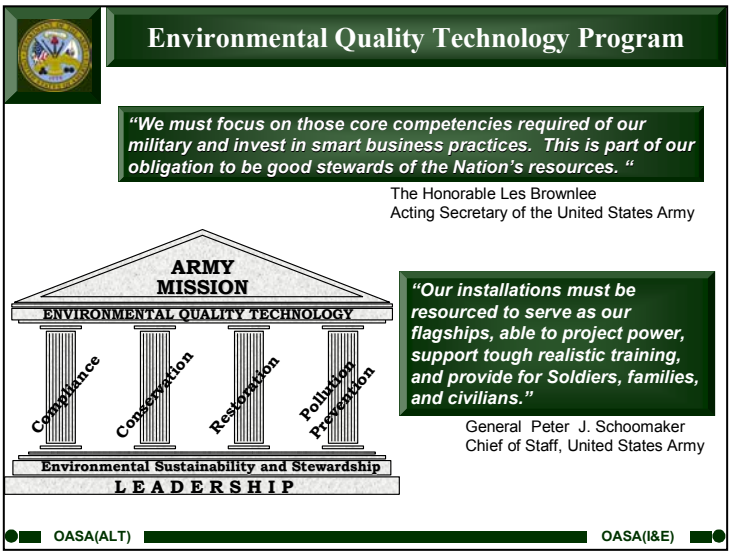


Figure 1-2. The Army's Environmental Leadership

The Army EQT Program supports focused investments in, and exploitation of, technology that begins with high-priority validated user requirements, which drive the research, development, test, and evaluation (RDT&E) program developments. With the intent of reducing the Army's environmental impacts and total program costs, the Army EQT Program executes environmental stewardship by supporting investments in effective and efficient technological solutions to challenges in restoration, compliance, conservation, and pollution prevention. Compliance and restoration continue to be vital components of the Army Environmental Program, reflecting the Army's commitment to comply with environmental standards and to clean up contaminated land or property. Continued investments in pollution prevention and conservation offer opportunities to reduce and/or eliminate long-term operating costs and liabilities in compliance and clean up without restricting training and other readiness activities.

1.3 Army EQT Program Goal and Objectives

The Army's overall goal in the Environmental Quality Technology Program is to enable mission readiness through the identification, 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 validated user requirements;
- Implement the development of technology when technology is not commercially available;
- Provide an adequate science and engineering base for the future; and

- Integrate EQT efforts to support technology transfer.

The EQT Program identifies and develops meaningful products by:

- Identifying and validating user requirements;
- Formulating programs to resolve requirements;
- Defining and measuring performance against program objectives;
- Producing quality results; and
- Supporting users.

1.4 Army EQT High-priority RDT&E Programs

During 2002, the Army reviewed existing Army Environmental Requirements and Technology Assessments (AERTA) requirements to support program formulations for the FY 2006–FY 2011 Program Objective Memorandum (POM). The Army's user community, as advocates for the AERTA requirements, identified needed adjustments to the AERTA requirements. The Army technology teams identified user advocate teams, which were utilized for review of selected requirements and compiled updated cost information for forty-two requirements which are summarized in Appendix A. Twenty prioritized Army EQT multi-year RDT&E programs were executed in FY 2003 focusing on resolving the Army's highest priority environmental requirements. Six Army EQT programs were fully funded. Descriptions of these programs are provided in Appendix B of this report. These program descriptions contain the potential cost avoidance for the fully funded RDT&E investment, the technical objective, approach, and the requirement, FY 2003 performance objectives, FY 2003 accomplishments and planned outyear milestones, FY 2003 performance review, actual RDT&E dollars executed in FY 2003, and expected RDT&E funding through FY 2008.

1.5 Congressional Interest Projects

Congressional interest projects typically address the application of technologies to resolve specific problems. FY 2003 Congressional interest projects are comprised of eleven independent efforts, which Congress mandated and funded the Army to address. Examples include indoor lead bullet firing range environmental stewardship, unexploded ordnance detection (UXO), assessing surface migration of buried UXO, bio-threat detection system, detonation chamber for disposal of recovered chemical warfare materiel, and validating metal casting technology for Army's industrial base. A detailed description of each of these projects is

FY 2003 Congressional Interest Projects
Waste Minimization and Pollution Research, @ DOE WETO
Range Safety Technology Demonstration (Rangesafe)
Proton Exchange Membrane (PEM) Fuel Cell Demonstration
Vanadium Technology Program
Transportable Detonation Chamber Validation
Commercialization of Technologies to Lower Defense Costs Program
Casting Emission Reduction Program (CERP)
Unexploded Ordnance in Support of Military Readiness
Managing Army Technologies for Environmental Enhancements (MANATEE)
Environmental Response and Security Protection (ERASP) Program
Technologies to Reduce Non-Hazardous Waste

Table 1-1. FY 2003 Congressional Interest Projects

found in Appendix C of this report.

1.6 National Defense Center for Environmental Excellence

In 1991, Congress established the National Defense Center for Environmental Excellence (NDCEE) as a national joint-service resource for developing and disseminating advanced environmental quality technologies. Since then, the NDCEE has provided technology evaluation, verification, implementation, and other services to multiple DoD installations, DoD prime contractors, other government agencies, and industry. In FY 2003, the NDCEE successfully demonstrated and validated 31 technologies and transitioned 20 technologies to DoD facilities and the defense industrial base.

As a leader in transitioning materials and processes, providing training and performing research to accelerate new technologies in meeting DoD requirements, the NDCEE has become stronger in building and enhancing key knowledge areas addressing DoD's environmental initiatives. Recently the NDCEE has addressed high priority needs in environmental areas such as range sustainability, UXO, non-hazardous solid waste (NHSW), and environmental management and compliance. The NDCEE has successfully field-demonstrated particle separation and stabilization technologies for small arms firing ranges at Ft. Dix, NJ, reducing leachable lead concentrations by over 98%. Working cooperatively with numerous DoD stakeholders in support of environmental munitions and explosives constituents (MECs) restoration requirements, NDCEE teams have directed the placement and study of inactive UXO in order to assess and evaluate the potential for "surface migration" of buried UXO. In FY 2003, the NDCEE conducted a full-scale demonstration of municipal solid waste (MSW) conversion processes in support of addressing this high priority pollution prevention (P2) requirement. At Radford Army Ammunition Plant (RFAAP), the NDCEE implemented new monitoring and control systems to reduce NOx emissions in support of enhancing overall environmental security and compliance.

FY 2003 NDCEE Successes
Nonchromate Conversion Coating Line
Lead-Free Surface finishes and Low-VOC Conformal Coatings
Web-based Training Program for Corrosion Control and Prevention
Hand-held PDAs – for Corrosion Assessment and Prevention
Corrosion Service Center
Electronic Equipment Demanufacturing Modules
Microfiltration for Electroplating Bath Life Extension
Ultrahigh Pressure Waterjet
Municipal Solid Waste Conversion System
Lead Based Paint Removal – Auburn Milling Equipment
Lactate Ester – for Cleaning Parts
Non-ODC Oxygen Line Cleaner
Ink Stenciling – Low VOC Identification Marking
Thermal Label Printer – Low VOC Identification Marking
Electromagnetic Induction Fuze Testing
Environmental Technology Verification
UXO Recovery Database
Evaluation of UXO Migration
Particulate Separation and Stabilization Technology
Wireless Local Area Network (WLAN)
Selective Catalytic Reduction (SCR)

Table 1-2. FY 2003 NDCEE Successes

Table 1-2 lists the FY 2003 NDCEE projects successes. Additional information on these projects is contained in section 7, National Defense Center for Environmental Excellence (NDCEE).

2. Army EQT Program Accomplishments

2.1 Army EQT Program Successes

The Removal, Treatment, and Disposal Technologies for the Lead-Based Paint (LBP) Contamination program completed several technology demonstrations through FY 2003. Such as the:

- Thermal Spray Vitrification for Steel Structures (Ft. Drum, NY)
- Environmentally Acceptable Chemical Strippers for Steel Structures (Ft. Campbell, KY)
- Overcoating for Steel (Holston AAP, TN)
- Membrane Chemical Stripper for LPB removal from Plaster (Ft. Riley, KS)
- Self-healing Overcoating for Wood (Presidio of Monterey, CA)
- Microwave Assisted paint Removal of LBP on Wood (Ft. Lewis, WA)
- Blastox for Removal of Lead-Based Paint on Concrete Masonry Unit (Ft. Carson, CO)
- Hazardous Asbestos and Lead Optimal (HALO) Management System (8TH Army Korea).
- Hands-On-Skills-Training (HOST) (multiple users)

Two patents for LBP removal from wood and steel structures demonstrated under this program include:

- Microwave Assisted Paint Stripping, U.S. Patent # 5,268,548, demonstrated at Ft. Lewis, WA showed a potential cost avoidance of $12/square foot (SF).
- Thermal Spray Vitrification, U.S. Patent # 5,292,375, showed a potential cost avoidance of $4.50/SF by producing non-hazardous waste as the by-product and not requiring a containment enclosure.

The program was also responsible for break-thru LBP treatment and repair technologies such as self-healing microcapsules.

Figure 2-1. Patented LBP removal processes.

The Hazardous Air Pollutant (HAP) and Volatile Organic Compound (VOC) Emission Control program demonstrated hazardous organic solvent emissions technologies to remove 95% of HAPs at a 20% cost reduction for hazardous weapon system painting operations. The Activated Carbon Fiber Cloth (ACFC) Vapor Recovery System [US Patent # 6,364,936] was installed at Fort Hood, TX. This system combines adsorption, desorption, and recovery in the same processes, and results in a very efficient and economical electrothermal regeneration control/recovery system for hazardous organic solvents. When ACFC is combined with the earlier developed Mobile Zone system, the total system efficiency rises to 99%...far exceeding the 81% required by the National Emission Standards for Hazardous Air Pollutants (NESHAP).

A Rotating Drum Biofilter [US Patent # 6,171,853 and 6,403,366] installed at Iowa AAP, IA, on paint drying treatment effluent. This new technology reduces excess biomass buildup, which typically clogs systems, by providing an even distribution of nutrients, VOC's and the biomass itself. The result is a very cost effective and reliable system suitable for low VOC loading rate applications. Both the ACFC system and biofilter pilot demonstrations are on schedule to be completed in FY 2004.

Figure 2-2. Rotating Drum Biofilter at Iowa AAP, IA.

Figure 2-3. Geophex GEM-3 Demonstration, APG Standardized UXO Tech. Demo. Site, MD.

Figure 2-4. Geonics EM-63 Demonstration, YPG Standardized UXO Tech. Demo. Site, AZ.

The UXO Identification and Discrimination program established an ordnance target repository at the U.S. Army Aberdeen Test Center, Aberdeen, MD to distribute (loan) standard target sets to government, commercial, and academic UXO detection / discrimination technology developers. Standardized UXO Technology Demonstration Sites at Aberdeen Proving Ground (APG), MD, and Yuma Proving Ground (YPG), AZ, performed field demonstrations for six UXO detection systems.

The Hazard/Risk Assessment of Military Unique Compounds (MUC) program released version 1.1 (v1.1) of the Army Risk Assessment Modeling System (ARAMS) model including demonstrations at five Military Sites:

- Massachusetts Military Reservation, MA, in support of the Army National Guard Bureau and Army Environmental Center.
- RDECOM-ARDEC (Rangesafe environmental program), Picatinny Arsenal.
- United States Military Academy, West Point.
- Langley Air Force Base, Virginia.
- Pueblo Chemical Depot, Colorado.

ARAMS v1.1 incorporates process descriptors for range compounds (propellants, smokes, illuminants) fate and transport, terrestrial explosives uptake, and expanded fate/transport and toxicology databases from v1.0. Completion of this program is expected in FY 2005.

The SPOTA program is a technology based Pollution Prevention effort that focuses on alternative product implementation, reformulation, and/or process change to achieve NESHAP required emissions reduction. In FY 2003, the SPOTA program successfully implemented the following specification and protocol guidance documents: Ammunition Coating Specification, MIL-DTL-11195G in July of 2003, and Application Specification for Chemical Agent Resistant Coating (CARC), MIL-C-53072, in June of 2003 that includes all HAP-free updates and

products. These documents serve as procurement approval documents for DoD for ammunition for the 155mm and 120mm rounds and for all CARC related systems.

This SPOTA program is seeking to prepare for the requirements of the upcoming surface coating NESHAPs, including the military specific Defense Land Systems and Miscellaneous Equipment (DSLME) NESHAP, Area Source Rules and National Emissions Standard for Volatile Organic Compounds (NVOCES). The Army has been working cooperatively with the EPA to support the development of the pending DLSME NESHAP and Area Source Rules. Plans for continued cooperation with the EPA include resolving the surface coating of munitions from NESHAP affected processes without the need to add-on emission controls. These efforts and the SPOTA program will ensure that the emissions from Army surface coating operations will improve while having minimal impact on Army operations.

Figure 2-5. Stryker Infantry Carrier Vehicle Paint Reformulation

The Solid Waste Diversion (SWD) Program was critically reviewed in FY 2003. A working group within the Army Integrated Process/Product Team (IPT) reviewed and updated the SWD requirement based on the latest technological advancements to reflect current user needs resulting in a total program reduction of 25%. This review included the leveraging of existing technologies/processes to recycle/reuse concertina wire, scrap track, and tires and eliminating the Military Unique thrust area from the SWD Program. In FY 2003, the SWD program developed two standard publications for use by installations, one a Army Public Works Technical Bulletin (PWTB) on concrete reuse, and the second an Army World War II temporary building deconstruction manual.

2.2 Army Environmental Requirements and Technology Assessments

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 the basis for formulating Army EQT RDT&E programs. The Army's EQT process requires rigorous validation and adjustments to the existing AERTA requirements every two years. Annually, the Army reviews these existing requirements and revalidates performance data. During 2002, the Army required a review of the of the existing Army Environmental Requirements and Technology Assessments (AERTA) requirements to support program formulations for the FY 2006–FY 2011 POM. The Army's user community, as advocates for the AERTA requirements reviewed the existing AERTA requirements and identified needed adjustments to them. The Army technology teams identified user advocate teams, which were utilized to review selected requirements and compiled updated cost information for the requirements described in Appendix A.

Twenty prioritized multi-year RDT&E EQT programs were executed in FY 2003 focused on resolving high priority AERTA requirements. Six of the twenty Army EQT programs are fully funded addressing requirements in Restoration and Compliance. A description of these programs is provided in Appendix B of this report. These descriptions contain technical objective and approach, performance objectives, accomplishments, performance review, and actual dollars executed in FY 2003 and future planned milestones and expected RDT&E funding through FY 2008.

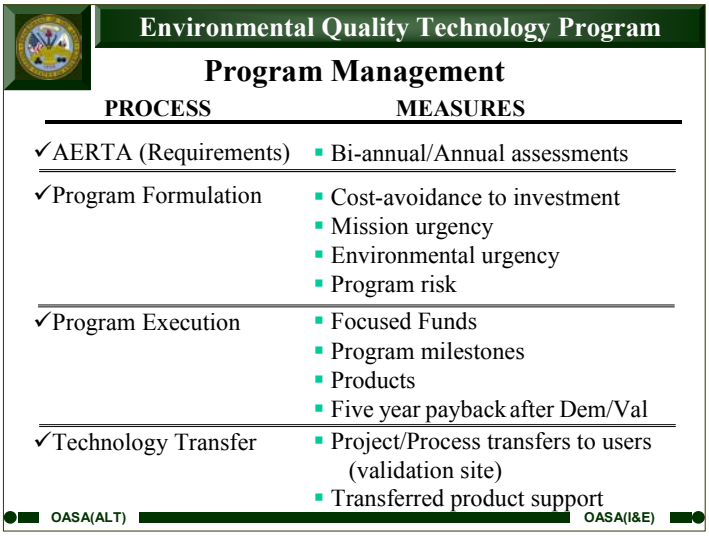


Figure 2-6. Program Management Measures of Performance.

2.3 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 the 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 2003. The process achievements and completed technology products are discussed further in this report.

2.4 Other FY 2003 Program Accomplishments

Fiscal and leadership decisions made in FY 2003 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.

Highlights of the major Army FY 2003 EQT Program include:

- Awarded a multi-year $350M NDCEE Indefinite Delivery Indefinite Quantity contract;
- Established a ordnance target repository at U.S. Army Aberdeen Test Center and demonstrated six UXO detection technologies at two Standardized UXO Technology Demonstration Sites;
- Validated the Army Risk Assessment Modeling System (ARAMS) version 1.2 to assist installations with determining appropriate exposure and toxicity levels during production, storage, transportation, use and disposal of military unique compounds (MUC) with demonstrations at five Military Sites;

- Implemented Sustainable Army Live-Fire Range Design and Maintenance Management Plan and EQT-Operational Requirements Document (EQT-ORD);
- Demonstrated several Lead-Based Paint (LBP) removal, treatment and disposal technologies for buildings and other structures;
- Demonstrated a number of Hazardous Air Pollutants (HAP) and Volatile Organic Compound (VOC) emission control technologies;
- Formulated twenty RDT&E programs for FY 2006-FY 2011 Program Objective Memorandum (POM) to include six fully funded programs; and
- Produced and/or published 160 products as referenced in appendix D.

3. Army EQT Program Investment and Historical Perspective

3.1 Environmental Quality RDT&E Program Investment

The Army's confidence in this program was reflected again in its continued commitment in FY 2003 with full support of EQT RDT&E programs. The Army's FY 2003 budget request was $43.2M in Environmental Quality Technology applied research, advanced technology development, demonstration validation, and management support. Congress appropriated $77M that included Congressional interest projects, which the Army exploited to the fullest extent possible to resolve its high-priority requirements. Additionally, the Army invested $8.7M to Environmental Quality basic research in areas that included processes in pollution abatement technologies, military pollutants and health hazards, and environmental restoration.

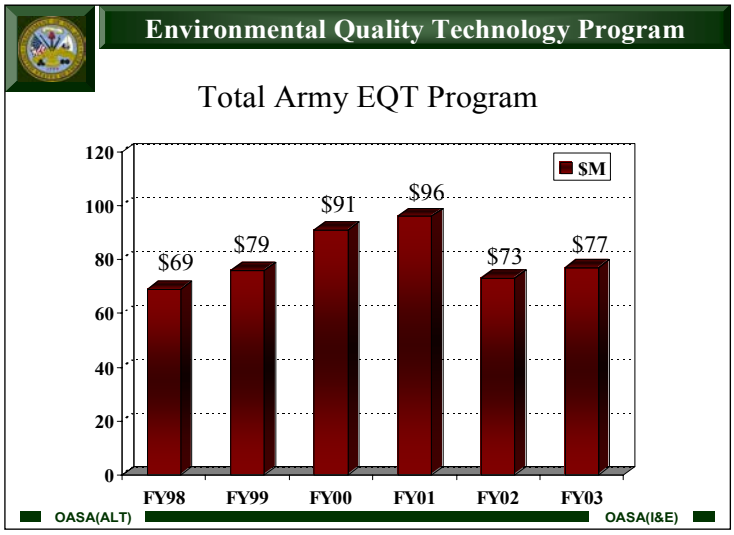


Figure 3-1. Army EQT Program Funding.

3.2 Historical Perspective of the Army EQT Program Investment Strategy

In May 1997, the Assistant Secretary of the Army for Research, Development, and Acquisition (now the Assistant Secretary of the Army for Acquisition, Logistics and Technology) and the Assistant Secretary of the Army for Installations, Logistics and the Environment (now the Assistant Secretary of the Army for Installations and Environment) jointly established an Army EQT management oversight process and council. This management structure affords senior leadership the ability to set priorities for user needs, focus resources, and ensure cost-efficient investments that reduce program costs and fulfill the Army's environmental stewardship responsibilities.

Four annual reports have depicted the Army EQT program's investment to resolve high priority Army environmental requirements. In 1998, the management oversight process was established and twenty RDT&E programs were analyzed with the potential to avoid up to $4 billion. In the formulation of the FY 2000-2005 Program Objective Memorandum (POM) senior leadership endorsed the EQT Program resulting in full funding for two programs; Removal, Treatment and Disposal Technologies for Lead-Based Paint (LBP) Contamination, and Hazardous Air Pollutant (HAP) and Volatile Organic Compound (VOC) Emission Control. In 1999, the program was further refined and gained valuable exposure and experience as it went through its second iteration of the Army Budget Process. During the formulation of the FY 2002-2007 Program Objective Memorandum (POM) two additional programs were endorsed Unexploded Ordnance (UXO) Identification and Discrimination and Hazard/Risk Assessment of Military Unique Compounds (MUC). Also, in 1999 the Army Secretariat was named the executive agent for the

National Defense Center for Environmental Excellence. The Army completed a full review of user needs, which led to the formulation and execution of thirty-three RDT&E programs and the production and publication of sixty products. In 2001, the Army EQT Operating Principles and the NDCEE Operating Principles were fully implemented. Senior leadership endorsed a $39M Sustainability Range Program Initiative for the FY 2004-2009 POM, and targeted $47M for pollution prevention technologies, which included the formulation of a fully funded Solid Waste Diversion program endorsed for $30.5M by the Army Installation Program Evaluation Program (IPEG). In 2002, The Army EQT Management Plan (ETMP) and EQT-ORD for UXO Screening, Detection, and Discrimination and the Army ETMP for Hazard/Risk Assessment for MUC were formalized and implemented. Currently, there are six fully funded RDT&E programs that are providing a virtual toolbox of innovative technologies to resolve the Army's highest priority validated user environmental requirements.

Multi-year Congressional Interest Projects

Project	FY99	FY00	FY01	FY02	FY03
Waste Minimization and Pollution Research, @ DOE WETO					
Commercialization of Technology to Lower Defense Costs Program					
Electronic Equipment Demanufacturing for Reuse and Recycling					
Sustainable Green Manufacturing					
Plasma Energy Pyrolysis System (PEPS)					
Range Safety Technology Demonstration (Rangesafe)					
Corrosion Measurement Control					
Proton Exchange Membrane (PEM) Fuel Cell Demonstration					
Vanadium Technology Program					
Transportable Detonation Chamber Validation					
Casting Emission Reduction Program (CERP)					
UXO in Support of Military Readiness					
Managing Army Technologies for Environmental Enhancements (MANATEE)					
Technologies to Reduce Non-Hazardous Waste					

Table 3-1. Multi-year Congressional Interest Projects

During the past four years, Army-managed Congressional interest projects remain a considerable portion of the total Army EQT program. From 1999 through 2003, the investment for Congressional interest projects ranged from a high of $66M in 1999 to a low of $43M in 2002. These projects are funded annually; however, Congress has directed several to be funded in increments of two to five years. Waste Minimization and Pollution Research focused on installation industrial waste treatment. Commercialization of Technology to Lower Defense Costs Initiative transfers technologies to reduce defense procurement costs and meet ESOH needs. Electronic Equipment Demanufacturing for Reuse and Recycling demonstrated methods to design electronic equipment for the environment (DfE). Sustainable Green Manufacturing addressed pollution prevention and life-cycle environmental quality issues that impact the Army. Rangesafe Technology Demonstration focused on sustainable range issues. Proton Exchange Membrane (PEM) Fuel Cell Demonstration installed, demonstrated and assessed the performance of PEM fuel cells to support critical grid loads on installations. Several other Congressional interest projects have provided support to high-priority Army requirements, and support the Army's industrial base such as Casting Emission Reduction Program (CERP) that focused on metal casting technology. Details of the FY 2003 Congressional interest projects are in Appendix C.

4. Army EQT Program Process

The Army's EQT Program formalized its operating processes with the EQT Operating Principles implemented in FY 2001. The Army's EQT Operating Principles define and document the Army EQT Program operating and approval processes by Army leadership. These processes include EQT management, generation and validation of requirements, program formulation, program prioritization, and technology transfer of environmental programs to resolve user needs.

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 Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology. The Environmental Technology Integrated Process Team (ETIPT) integrates programs and addresses issues supporting the ETTC.

Technology Teams are the foundation for the formulation and execution of the EQT Program. These Teams 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 that 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.

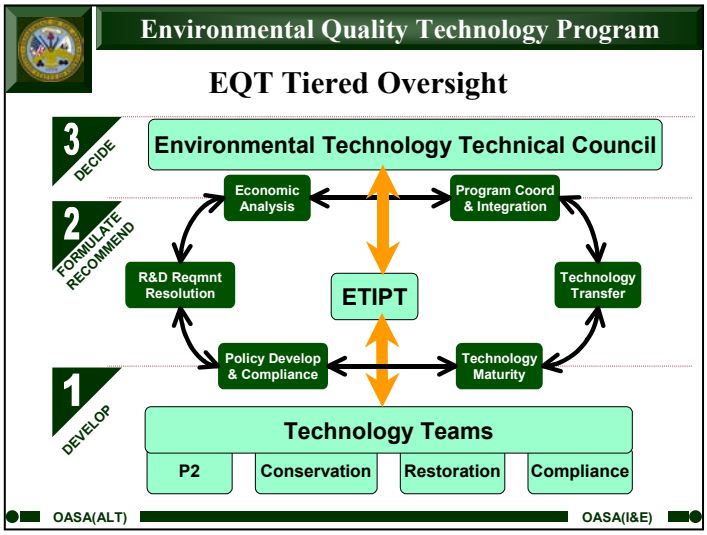


Figure 4-1. Army EQT Tiered Oversight.

	Pollution Prevention
1	Sustainable Painting Operations for the Total Army [3.2.j/2.1.h]
2	Solid Waste Reduction [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	Compliant Ordnance Lifecycle for the Readiness of the Transformation and Objective Forces [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	Emissions and Alternatives for Open Burning/Open Detonation (OB/OD) of 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 Compatible Lubricants and Fluids [3.7.l]
14	Alternatives to Ozone-Depleting Refrigerants for Military Unique Applications [3.4.b]
15	Alternative Products in Cleaning and Degreasing Processes [3.1.a Interim]
	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	Remediation of Distributed Source Unexploded Ordnance-Related Contamination (UXO(C) on Army Ranges [1.6.f]
5	Innovative In-Situ and/or On-site Ex-Situ Treatment Technologies for Soils Contaminated with Inorganics [1.3.e]
6	Develop Long-Term Monitoring, Standard Analytical, and Groundwater Monitoring Techniques for Military Unique Compounds [1.1.i]
7	Soil, Sediment, and Shallow Water Unexploded Ordnance (UXO) Neutralization/Removal/Remediation [1.6.b]
8	Unexploded Ordnance (UXO) Identification [1.6.c]
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 to Support Risk/Hazard Assessment, Fate/Effects, and Transport Predictability Models for Non-Military Unique Compounds (non-MUCs) [1.5.b]
12	UXO Screening, Detection, and Discrimination in Shallow Water [1.6.d]
13	Develop Toxic Effects and Exposure Data and Conduct of Risk Assessments for Ordnance-Related Compounds (ORCs), Explosives in Groundwater, Surface Water and Soil [1.5.p]
	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	Develop a Quick Analysis Test Kit for Military Unique Compound Detection [2.3.p]
8	Removal, Treatment and Disposal Technologies for Lead-Based Paint Contamination [2.3.k]
9	Develop New Technologies for Treatment, Monitoring, and Quality Control/Quality Assurance of Army Wastewaters [2.2.f]
	Conservation
1	Reducing Impacts of Threatened and Endangered Species (T&ES) on Military Readiness [4.6.a]
2	Maintain Readiness by Improving Threatened & Endangered Species (T&ES) Monitoring Capabilities [4.6.c]
3	Land Capacity and Characterization [4.2.a]
4	Rehabilitation of Natural Resources (Land Conservation and Protection) [4.2.i]
5	Non-Native Invasive Species Control for Army Installations and Operations [4.3.e]

Table 4-1. Army Environmental Quality Technology Requirements.

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 the 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.

4.3 Program Development

Once AERTA requirements are validated they are sent to the ETTC and 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. Currently, there are five approved Army EQT Management Plans (ETMPs) for LBP, HAP, UXO, MUC, and Sustainable Range programs.

4.4 EQT Operational Requirements Document

An Environmental Quality Technology Operational Requirements Document (EQT-ORD) is prepared for distribution among 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 user requirements 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, operable 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. Currently, there are two Army endorsed EQT-ORDs for UXO and Sustainable Range programs.

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 an 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.

At the point of 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 continued improvement of the process.

5. Army EQT Program Details

5.1 Army EQT Prioritized Programs

The AERTA process established forty-two high-priority requirements for the FY 2006 – FY2011 POM. In addition to the six fully funded EQT programs the Army formulated, fourteen RDT&E programs to address AERTA requirements in the FY 2006 - 2011 POM.

The Army FY 2003 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 user needs, available resources, and cost-effective investment needs.

Program priority is based upon:

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

FY 2003 Army EQT RDT&E Programs
Removal, Treatment, and Disposal Technologies for Lead-Based Paint (LBP) Contamination
Hazardous Air Pollutant (HAP) and Volatile Organic Compound (VOC) Emission Control
Unexploded Ordnance (UXO) Identification and Discrimination
Hazard/Risk Assessment of Military Unique Compounds (MUC)
Sustainable Army Live-Fire Range Design and Maintenance
Solid Waste Diversion
Maintain Readiness by Improving Threatened and Endangered Species (T&ES) Monitoring Capabilities
Sustainable Painting Operations for the Total Army (SPOTA)
Particulate Matter (PM)/Dust Control
Reducing Impacts of Threatened and Endangered Species (T&ES) on Military Readiness
Training and Testing Range Noise Control
Enhanced Alternative and In Situ Treatment Technologies for Explosives and Organics in Groundwater
Land Capability/Characterization
Innovative In Situ and/or On-site Ex Situ Treatment Technologies for Soils Contaminated with Inorganics
Compliant Ordnance Lifecycle for the Readiness of the Transformation and Objective Forces
Characterization, Evaluation, and Remediation of Distributed Source Contamination (UXO-C) on Army Ranges
Improved Treatment Techniques for Wastewaters from Munitions Production
Land Rehabilitation
Reduce/Eliminate Pollution for Compliant Plating Processes
Long Term Monitoring for Military Unique Compounds

Note: Gray highlight indicates Fully Funded Programs.

Table 5-1. FY 2003 Army EQT RDT&E Programs

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 General Officer 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.

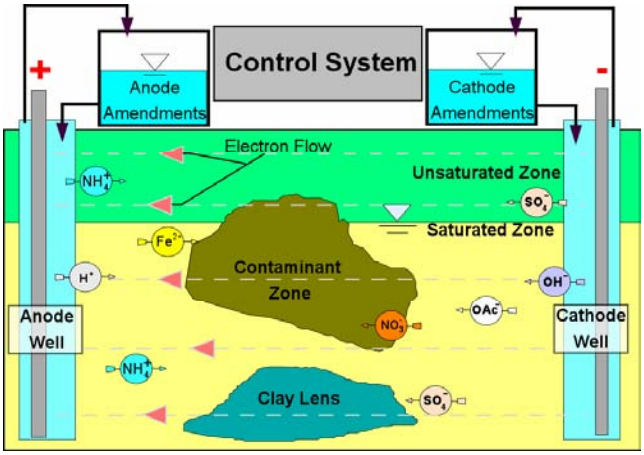


Figure 6-1. US/Germany DEA Project: Contaminated Soil Electrokinetic Remediation.

As an example, heavy metal contamination is a concern at U.S. military training ranges as well as at German sites. Through this DEA, U.S. Army expertise has been 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," demonstrated the ability to remediate soils contaminated with heavy metals.

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 Data Exchange Agreement 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

The ultimate goal of the NDCEE is to implement and transfer cost-effective technologies, methods, and processes to the field and technology user community. In FY 2003 alone, the NDCEE successfully demonstrated and validated 31 technologies and transitioned 20 to DoD facilities and the defense industrial base. Since its inception, the NDCEE has transferred more than 300 tools, products, technologies, and methodologies to the DoD and its facilities. Technology transfer success within the NDCEE is attributed to its disciplined and rigorous approach to field insertion. The NDCEE 15-step approach to task execution recognizes opportunities for both vertical and horizontal technology promotion and transfer within the DoD. In short, the 15-step study approach assures a clear understanding of transition objectives and exit strategies; allows an opportunity to work with client needs as well as identify and evaluate alternatives through a systematic process. This approach also allows for laboratory and bench-scale testing; affords for field demonstration and validation prior to transition; and, promotes technology insertion and the development of a technology transfer data package to assure all interested can leverage lessons learned in a cost-effective manner. Through its consistent approach, the NDCEE's goal is to maximize the DoD's overall return on investment, while avoiding duplication within the joint services or other programs.

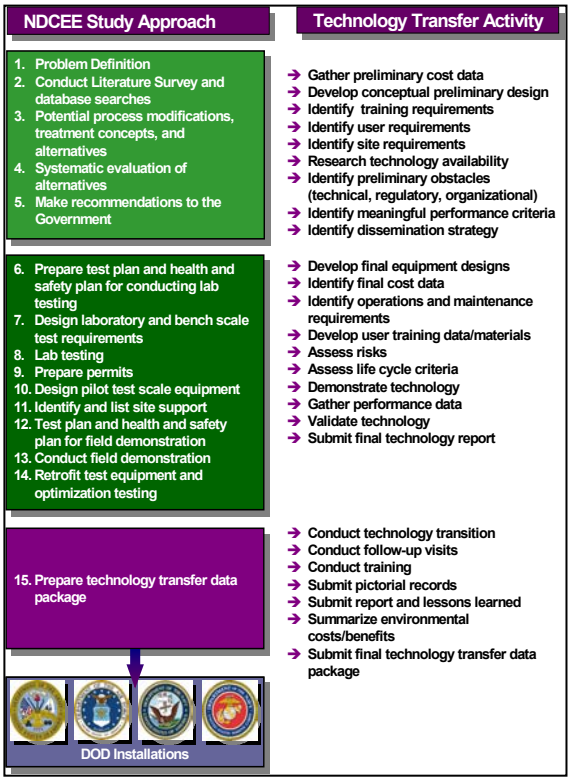


Figure 7-1. NDCEE 15-Step Approach.

The Demanufacturing of Electronic Equipment for Reuse and Recycling (DEER2) process exemplifies the NDCEE's capability and success at technology transfer in support of environmental stewardship. In the fall of 2003, the NDCEE successfully transitioned the DEER2 processes to Lone Star Army Ammunition Plant (LSAAP), Texarkana, Texas. The NDCEE-validated DEER2 technologies facilitate the receiving, testing, and disassembly of electronic equipment and the recovery of metal, plastic, glass, and various components for reuse and recycling. The process benefits include reducing hazardous material and waste in DoD facilities, reducing future procurement costs and landfill disposal costs for electronic equipment, and complying with Executive Order 13101. Currently, the DoD submits 30 million pounds of electronic equipment annually to demanufacturing processes.

The DEER2 process is comprised of eight unique modules—receiving/storage/shipping, material handling, disassembly, testing, component recovery, glass recovery, metal recovery, and plastics recovery. Applicable waste streams include a wide variety of electronics equipment, from basic desktop computers/monitors to sophisticated, but outdated, military communications and radar equipment. The NDCEE assembled, installed, tested, evaluated, and demonstrated each module and its components. The NDCEE also examined the process as a single working unit.

Validation testing of a pilot process was initiated on November 14, 2002. Testing concluded on May 28, 2003, with a total of 76 tests completed. Test results showed that the scrap military electronics equipment was successfully processed to recover valuable electronic components for reuse and to generate recyclable glass, metal, and plastics.

Figure 7-2. Plastics Shredder.

As part of technology transfer assistance, the NDCEE prepared a Technology Transfer Package that contained a training course, equipment and operations manual, and a pictorial record of the demonstration testing. In addition, the NDCEE conducted hands-on training in the use and operation of the process to LSAAP personnel. The pictorial record consisted of a compact disk with still photos and approximately 30-minutes of video with voiceover that showed the process operating in real time, with close-up views on the working equipment.

The NDCEE is conducting a technology transfer task; this task is to benchmark government and industry best practices resulting in effective technology transfer. NDCEE has developed a draft list of 15 top determinants critical for technology transfer success that are evaluated in order to increase the probability for successful technology transfer and field implementation. The recognition and understanding of potential barriers, as well as the NDCEE's ability to manage these factors, helps the NDCEE reduce the risk to technology transfer and maximizes the return on investment to the DoD. These types of determinants for Technology Transfer Success will ultimately be considered in the Technology Transfer Task to build a Technology Transfer Model. This Model, which is being developed through a five-phased process, began with identifying potential technology transfer opportunities and will conclude with the application of the model on select NDCEE and EQT technologies to assess the model's effectiveness and efficiency.

7.1 NDCEE Project Highlights

It is the goal of the NDCEE that program efforts lead to the application of innovative technologies that resolve high priority needs while increasing DoD capabilities to meet both current and future environmental standards. Moreover, it is also the goals of NDCEE that program results minimize future operational and maintenance investments, and enables the DoD to meet environmental objectives with minimal impact to other operational and training requirements. Overall, the NDCEE's results benefit the DoD task stakeholders and target sites, but through further information dissemination efforts, the NDCEE Program results ultimately feed back to, the DoD and joint services NDCEE Operating Principles parties, and the DoD ESOH Technology Board.

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 that reduce total ownership costs related to sustaining the environment, assisting with DoD transformation, and supporting the DoD mission.

In FY 2003, the NDCEE evaluated among others a number of technologies and tools for corrosion protection and avoidance, UXO response and restoration, environmental monitoring and control, surface finishing, firing range cleanup, solid waste recycling, solvent and hazardous air pollutant replacement, and heavy metals replacement.

Figure 7-3. Top; Corrosion Service Center Ft. Carson, CO. Below; hand-held corrosion data collection system.

Corrosion significantly impacts the readiness, reliability and cost of ownership of weapons systems, support equipment, and infrastructure. Its estimated cost to the DoD is $400M per week, of which approximately one third is avoidable through the use of new and improved corrosion prevention or control techniques. As part of the Corrosion Measurement and Control Program, NDCEE specialists designed and installed a portable Corrosion Service Center (CSC). Demonstrated at Ft. Hood, TX, and slated for transition to Ft. Carson, CO, the CSC is a new, automated corrosion inhibitor application system that will provide 100% coverage to each processed vehicle. Moreover, the CSC will cut process time by 30 minutes, include a pre-wash, and reduce servicing costs by approximately $37 per vehicle. Because the new CMC is a close-looped system, it will reduce staffing needs by 50% while increasing the number of vehicles serviced daily by almost 200%. In addition, NDCEE personnel designed and implemented data entry software for use on commercially available personal digital assistants. The handheld corrosion data collection system allows field technicians to easily collect and transfer corrosion data to a database. The facility can use the database to efficiently detect the onset of corrosion-related maintenance issues of its vehicles and weapon systems. As a result, facilities will be able to conduct condition-based maintenance, including preventive maintenance, and thereby reduce life-cycle costs.

Figure 7-4. Munitions manufactured in compliance with the military NESHAP munitions rules.

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 military 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, depainting, solvent usage, bonding, and munitions coating operations. Facilities may face fines and other penalties if they fail to comply with the new NESHAPs. The NDCEE is helping the Army to define the extent of its NESHAP problem, identify available solutions, transition pollution prevention alternatives, and highlight research gaps in support of sustainability.

Figure 7-5. NDCEE installed ultrahigh-pressure waterjet for dry-dock and vessel maintenance at the USAKA/RTS marine center.

The NDCEE also is supporting the Army to design a Vehicle Paint and Preparation Facility for the U.S. Army Kwajalein Atoll/Reagan Test Site (USAKA/RTS). The USAKA/RTS is

located in the Republic of Marshall Islands, and 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 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.

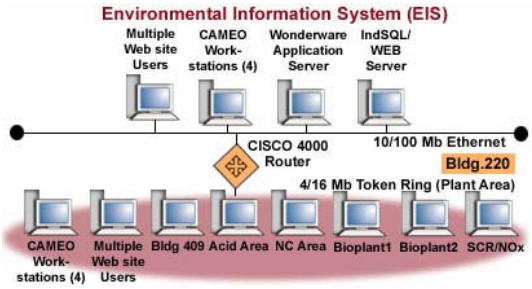


Figure 7-6. RFAAP EIS enhancing process control and early warning capabilities.

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.

Figure 7-7. UXO Recovery Database.

UXO potentially impacts millions of acres of DoD controlled land. These UXO-containing properties have a significant impact on military readiness. The NDCEE is supporting 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. The NDCEE-led team will continue to conduct literature reviews, develop a dual-mode navigation tool, field deploy the UXO database, research shallow water and geological issues, research corrosion and low order detonation issues, and conduct UXO migration and detection research.

More than 30 million pounds of DoD electronic equipment must be disposed annually. Demanufacturing of Electronic Equipment for Reuse or Recycling (DEER2) is a pollution prevention effort focused on the life-cycle management of electronic equipment. Under this program, an Electronic Equipment Demanufacturing Recycling and Reuse process was designed for demanufacturing facilities to process electronic equipment into reusable or recyclable components. The NDCEE assembled, installed, tested, evaluated, and demonstrated each module and its components. After validation in FY 2003, the system was transitioned to the Lone Star Army Ammunition Plant (LSAAP) in Texas.

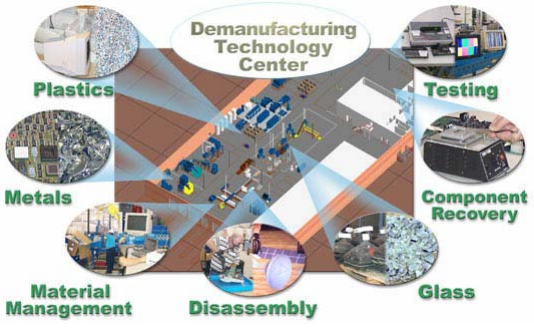


Figure 7-8. DEER2 Process Modules.

For several years the NDCEE has been assisting the Joint Group on Pollution Prevention (JG-PP) with its mission of reducing or eliminating hazardous materials or processes within the acquisition and sustainment communities. Chartered by the Joint Logistics Commanders, JG-PP is a partnership among the Military Services, NASA, and Defense Contract Management Agency. During FY03 the NDCEE assisted JG-PP with several tasks. For instance, the NDCEE helped identify and validate cleaning options that can potentially be utilized to clean virtually any type of line (hydraulic, fuel, coolant, environmental, etc.) on several different applications, such as tanks, machinery, aircraft, and hospital oxygen lines. Since these options do not contain ozone-depleting substances (ODSs), they will help DoD meet its mandate to eliminate the usage of ODSs throughout the Services.

Figure 7-9. Thermal Transfer Printing (TTP) System.

Figure 7-10. U.S. Army RangeSafe Program.

As part of an FY 2003 effort funded by the U.S. Army RangeSafe Technology Demonstration Initiative, the NDCEE successfully completed demonstrating and validating a treatment-train approach using modified placer-mining technologies and phosphate-induced metal stabilization to reduce total and leachable lead concentrations from small arms firing range (SAFR) soils. A total of 7,576 tons of lead-contaminated SAFR soil from Fort Dix, New Jersey, was processed in 19 days, with reductions of 93% in total soil lead concentrations and more than 98% in leachable lead concentrations. A total of 10.6 tons of particulate lead (i.e., bullets and bullet fragments) were removed from the soil and sent to a smelter for recycling.

At Red River Army Depot (RRAD) in Texarkana, Texas the NDCEE helped implement a nonchromate pretreatment technology. Henkel Surface Technologies' Alodine® 5200 replaced a hexavalent chromium conversion coating process, which RRAD was using to treat aluminum roadwheels. Alodine® 5200 is a chromium-free pretreatment specifically formulated for treating nonferrous alloys. As part of its technology evaluation, the NDCEE prepared a cost-benefit analysis comparing the nonchromated pretreatment process to the hexavalent chromium conversion coating process. The analysis indicated that the alternative process would decrease RRAD's annual operating and support costs by $17,328. The payback period was 2.5 years and the net present value (discounted) was $168,000.

The DoD is not the only one benefactor of NDCEE technology validation activities. Specifically, the NDCEE is operating the Environmental Technology Verification (ETV) Coatings and Coating Equipment Center (CCEP) on behalf of the U.S. Environmental Protection Agency (EPA). This testing center verifies the environmental impact and performance of alternative coatings and coating equipment technologies, thereby helping stakeholders to obtain a fair, objective evaluation of a technology prior to purchase. Technologies have included high-transfer efficiency application equipment, ultraviolet-curable coatings, powder coatings, and high-volume, low-pressure paint spray guns.

The tasks described above depict ways in which the NDCEE is directly supporting DoD's environmental technology management efforts. To date, more than 226 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 300 technology product tools and products (e.g., cost analyses, databases, workshops, and training) 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 savings and improved efficiency. The following table highlights some of the key NDCEE successes from FY 2003.

Figure 7-11. Abrams M1A1 Main Battle Tank roadwheels use a chromate conversion coating pretreatment at RRAD.

Summary of FY 2003 NDCEE Successes		
Technology(ies) / Activity(ies)	**Results**	**Demonstration (D) / Transition (T) Site**
Coatings		
Nonchromate Conversion Coating Line – For Road Wheels and Track Blocks		
	▪ Increases worker safety ▪ Eliminates hexavalent chromium	▪ Red River Army Depot, Rubber Products Division Texas (T)
Lead-Free Surface Finishes and Low-VOC Conformal Coatings – Immersion		
	▪ Offers cost avoidance of $3M yearly ▪ Lowers VOC emissions ▪ Reduces waste management costs	▪ Rockwell Collins (T)
Corrosion Control		
Web-based Training Program – For Corrosion Control and Prevention		
	▪ Offers the first formal training program on the prevention, measurement and control of corrosion	▪ DoD via the Internet (D)
Hand-held PDAs – For Corrosion Assessment and Prevention		
	▪ Reduces cost and/or improves safety and readiness ▪ Improves accuracy and precision of information observed ▪ Assures data remains consistent regardless of entry location	▪ Ft. Hood, TX (D) ▪ Ft. Shafter, HI (T)
Corrosion Service Center		
	▪ Provides 100% coverage to each vehicle ▪ Cuts process time by 30 minutes ▪ Cuts staffing needs in half ▪ Increases daily servicing of vehicles by 200%	▪ Ft. Hood, TX (D) ▪ Ft. Carson, CO (T)
Recycling/Waste Reduction (Hazardous/Non-Hazardous)		
Electronics Equipment Demanufacturing Modules – For Metals, Plastics and Glass		
	▪ Reduces hazardous material and waste throughout the DoD ▪ Supports compliance with EO 13101 ▪ Reduces future procurement costs and landfill disposal costs	▪ Lone Star Army Ammunition Plant, TX (T)

Summary of FY 2003 NDCEE Successes		
Technology(ies) / Activity(ies)	**Results**	**Demonstration (D) / Transition (T) Site**
Microfiltration – For Electroplating Bath Life Extension		
	▪ NPV (15 Years) of $209,624 ▪ IRR (15 years) of 28% ▪ Payback Period of < 4 years ▪ Estimated annual savings of $25,684	▪ Tobyhanna Army Depot, PA (T)
Ultrahigh-Pressure Waterjet – For Dry-Dock and Vessel Maintenance		
	▪ Reduces abrasive blast media consumed by the Marine Center ▪ Reduces pollution entering the lagoon	▪ U.S. Army Kwajalein Atoll / Reagan Test Site (T)
Municipal Solid Waste Conversion System – Bouldin and Lawson Municipal Solid Waste Conversion Process Equipment		
	▪ Processes up to 1.1 tons of MSW per hour ▪ Processes over 90% of available unsegregated waste ▪ Reduces disposal costs, transportation costs, and liability costs ▪ Preserves landfill space via volume reduction ▪ Avg 2.8 tons cellulose fluff for 10 tons raw MSW	▪ Ft Benning, GA (D)
Lead-Based Paint Removal – Auburn Milling Equipment		
	▪ Reduces disposal costs ▪ Provides feedstock for marketable reuse products ▪ Reduces hazardous wastes ▪ Offers a reuse product that can be shaped into tongue and groove flooring, wainscoting or new tapered siding	▪ Ft. Ord, CA (D)
Cleaning Processes		
Lactate Ester – For Cleaning Parts		
	▪ Is 100 % Biodegradable ▪ Offers nontoxic and noncarcinogenic option ▪ Offers a payback period < 1Year	▪ Anniston Army Depot Piece-Part Line, AL (T)
Non-ODC Oxygen Line Cleaner		
	▪ Eliminates CFC-113 and HCFC 141b ▪ Cleans any type of lines ▪ Eliminates residue remains after flushing ▪ Is nonvolatile	▪ Tinker AFB, OK (D) ▪ Robbins AFB, GA (D) ▪ Oklahoma Air National Guard, OK (D) ▪ Tulsa Air National Guard, OK (D)

Summary of FY 2003 NDCEE Successes		
Technology(ies) / Activity(ies)	**Results**	**Demonstration (D) / Transition (T) Site**
Low VOC Identification Marking		
Ink Stenciling		
	▪ Reduces VOC emissions ▪ Offers cost avoidance of $1M	▪ Tobyhanna Army Depot, PA (T)
Thermal Label Printer		
	▪ Offers cost avoidance of $1M/year ▪ Provides NPV (15 years) of $11M ▪ Offers potential to eliminate 1,300 lb/year VOC emissions and 9,800 lb/yr hazardous waste	▪ Pt. Mugu, CA (T) ▪ Naval Air Depot, Jacksonville, FL (T)
Testing and Verification		
EMI Fuze Testing		
	▪ Identifies fuzes most susceptible to EMI and used in commonly found UXO ▪ Completes detector characterization testing and captures output signal characteristics ▪ Generates EMI signals focused on the fuzes to evaluate initiation	▪ Naval Surface Warfare Center, Dahlgren Division, MD (D)
Environmental Technology Verification – For The U.S. EPA		
ETV	▪ Provides third-party verification testing ▪ Developed four Generic Verification Protocols per the EPA for one UV-curable coating, one UV fluorescent additive, and high Transfer Efficiency spray equipment ▪ Developed Testing and Quality Assurance Project Plans for multiple spray guns per the EPA	▪ NDCEE Demonstration Facility, Johnstown, PA (D)
UXO and Range Sustainability		
UXO Recovery Database		
UXO Recovery Database	▪ Doubles the number of records in the previous spreadsheet to 32,000 records ▪ Allows the understanding of the true nature of UXO	▪ U.S. Army Corps of Engineers, Huntsville, AL (T)
Evaluation of UXO Migration		
	▪ Offers the first migration study to evaluate UXO movement as a function of soil type, depth, ordnance size and orientation ▪ Ensures risk assessments include actual migration potential ▪ Identifies clearance effectiveness over time	▪ Yuma Proving Ground, AZ (D) ▪ Fort McCoy, WI (D)

Summary of FY 2003 NDCEE Successes		
Technology(ies) / Activity(ies)	**Results**	**Demonstration (D) / Transition (T) Site**
Particle Separation and Stabilization Technology – For Small Arms Firing Ranges		
	▪ Reduces leachable lead concentrations by > 98%	▪ Ft. Dix (Range 25), NJ (D)
Environmental Management System		
Wireless Local Area Network (WLAN)		
	▪ Enhances the module-based Environmental Management System (EMS) ▪ Increases coverage of indoor and outdoor areas for tracking, retrieval, storage and reporting of environmental management operations	▪ Radford Army Ammunition Plant, VA (T)
Selective Catalytic Reduction (SCR)		
	▪ Reduces NOx emissions ▪ Improves the performance of the SCR process	▪ Radford Army Ammunition Plant, VA (T)

8. Summary

The Army 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. Through focused RDT&E investments in effective and efficient technological solutions, the Army EQT Program strives to resolve these environmental challenges faced by the Army and reduce the Army's total program costs. The EQT Program's ultimate 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.

The NDCEE has demonstrated and validated 31 technologies and transitioned 20 technologies to DoD facilities and the defense industrial base. This year the NDCEE has proven the Army is committed to being a leader in environmental sustainability and stewardship for its installations, facilities, training areas, and weapon systems. The NDCEE will continue to wisely meet military and civil responsibilities without compromising its role as a steward of the environment.

The Army's EQT Program continues to provide a virtual toolbox of innovative technologies to resolve high-priority environmental quality technology requirements, while reducing total program costs, enhancing mission capabilities, and fulfilling the Army's environmental sustainability and stewardship responsibilities. 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.

Appendix A

US Army Environmental Requirements and Technology Assessments (AERTA)

The Army Environmental Quality Technology Requirements represent the critical research, development, test, and evaluation (RDT&E) needs for accomplishing the Army's mission with the least impact to the environment. These requirements are Army-level requirements and include installation- or weapon-specific needs only when that need is critical to the execution of the Army's mission. All Army Major Commands (MACOMs), major sub-commands, the Office of the Assistant Chief of Staff for Installation Management, the Office of the Deputy Chief of Staff for Operations, and the Office of the Deputy Chief of Staff for Logistics were involved in establishing this validated list. These requirements were reviewed for impacts to readiness and quality of life, impact or threat to the environment, and timeliness needed for the Army to maintain compliance with environmental regulations.

These abbreviated requirement descriptions are taken from the "FY02 Army Environmental Requirements and Technology Assessments (AERTA) Final Report," October 2002. The full descriptions including current cost and extent of the problem, exit criteria/performance metrics, and points of contact are contained in the above referenced report.

The AERTA website containing the Army's environmental quality technology requirements is located on the DoD-restricted Defense Environmental Network and Information eXchange (DENIX) website at:

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

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

As part of the DoD's UXO Environmental Remediation Mission, the Army has the responsibility to ensure that a significant number of Formerly Used Defense Sites (FUDS) and Base Realignment and Closure (BRAC) sites are fully characterized and remediated to a condition that is consistent with the intended future use. Also, the Army is making significant investments, under the Range and Training Land Program (RTLP), to improve its live-training infrastructure. 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. Improvements in sensing (magnetometers, electromagnetic induction sensors, and ground penetrating radar) as well as analysis and systems integration are required to address this need.

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

The Army currently has explosives contaminated groundwater, which is affecting both on- and off-post drinking water supplies. 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 propellants, explosives, and pyrotechnics (PEP) manufacturing. Many remedial actions undertaken in the past for solvent contaminated groundwater specified pump and treat operations in conjunction with other technologies. 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. Currently available remediation technologies require enhancement, and improved alternative forms of groundwater remediation. 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.

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

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 military-unique compounds and the environment. 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 for sites attributed to the production, storage, transportation, use and disposal of military-unique compounds. As a second focus under this requirement, the Army needs an approved methodology to integrate all approved models that results in more efficient and valid determinations of toxicity, contaminant attenuation, exposure pathways, and risks associated with explosives and other military-unique contaminants.

A (1.6.f) Remediation of Distributed Source Unexploded Ordnance-Related Contamination (UXO(C)) on Army Ranges

As part of the DoD's UXO Environmental Remediation Mission, the Army has the responsibility to ensure that a significant number of FUDS and BRAC sites are fully characterized and remediated to a condition that is consistent with the intended future use. This requirement focuses on the ordnance-related chemical contaminants generated and distributed around impact points as a result of range firing activities. This would include a broad combination of contaminants that would fall into the following categories:

- Explosives and other ordnance constituents that have not undergone oxidative decomposition, but have become widely distributed in the impact area as a results of low order detonation or leaked from cracked UXO in the impact area.
- Combustion byproducts generated by the detonation at the impact point.

The technologies needed in connection with this requirement, involve producing the means to treat contaminated soil, sediment, and shallow surface water media so that adverse risks are reduced or eliminated. The remediation technologies would have to be such that they could be implemented in the presence of UXO without risking the potential occupational hazards of unplanned detonation.

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. As a short-range approach, enhancements to existing forms of inorganic contamination treatment technology should be evaluated and utilized. As a long-range approach, innovative and cost-effective in-situ and/or ex-situ remediation technologies that eliminate the need for off-site treatment and disposal are required.

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

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 EPA 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 programs 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. Innovative, cost effective, and reliable techniques are needed to enable the Army to utilize long-term groundwater monitoring devices, subsurface characterization techniques (geologic and chemical characterization); and/or rapid field analyses that are "real-time", reproducible, and regulatory acceptable for military-unique compounds, chemical agents, pyrotechnics, propellants, and their degradation products.

A (1.6.b) Soil, Sediment, and Shallow Water Unexploded Ordnance (UXO) Neutralization/Removal/Remediation

As part of the DoD's UXO Environmental Remediation Mission, the Army has the responsibility to ensure that a significant number of FUDS and BRAC sites are fully characterized and remediated to a condition that is consistent with the intended future use. Also, the Army is making significant investments, under the Army Range and Training Land Program (RTLP), to improve its live-training infrastructure. Some Army installations and FUDS have Unexploded Ordnance (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. The current neutralization/recovery/removal of UXO are mainly accomplished by manpower, which poses a significant safety concern. Identification, excavation, removal, and disposal activities associated with UXO and contaminated soils/sediments are very expensive, labor intensive, and dangerous. Research is needed to develop safe and cost effective methods to remove buried UXO from a variety of scenarios including impact areas, shallow water ranges and demolition areas.

A (1.6.c) Unexploded Ordnance (UXO) Identification

As part of the DoD's UXO Environmental Remediation Mission, the Army has the responsibility to ensure that a significant number of FUDS and BRAC sites are fully characterized and remediated to a condition that is consistent with the intended future use. Also, the Army is making significant investments, under the Range and Training Land Program (RTLP), to improve its live-training infrastructure. The effectiveness of UXO characterization and remediation efforts must meet ever increasing regulatory and stakeholder standards. In 1998, the 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), with the result that approximately 75 percent of the costs to remediate a UXO site are currently spent on excavating these false alarms. Further, research and development is needed to correctly distinguish characteristics of an anomaly and alert an operator to specific characteristics of that anomaly as a pre-defined target, given receipt of a measurable and discrete signal from the anomaly.

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 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. 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 not require extensive disturbance of land during remedial efforts.

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

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.

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. Risk assessment for Army installations are regulated. Currently, two confounding factors lead to inaccurate risk assessment calculations on Army Installations: 1) insufficient exposure data (i.e. fate, transport, degradation, availability), and 2) surrogate based effects data. To improve the accuracy of risk assessment predictions, relevant exposure and effects information (e.g., toxicological, physical and chemical fate and transport, and bioavailability/bioaccumulation) is needed to accurately predict both human exposure and trophic transfer potential necessary for protection of human health and the environment. To fully utilize the additional data sets necessary to support credible risk assessments, an enhanced integration tool is needed. All data identified and developed must be fully integrated within the Army Risk Assessment Modeling System (ARAMS). 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 for sites.

A (1.6.d) Unexploded Ordnance (UXO) Screening, Detection and Discrimination in Shallow Water

Some Army installations and FUDS have Unexploded Ordnance (UXO) contamination in shallow (<8 feet) and/or deep water (>8 feet depth). 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. Also, the Army is making significant investments, under the RTLP, to improve its live-training infrastructure. The effectiveness of

UXO characterization and remediation efforts must meet ever increasing regulatory and stakeholder standards. In 1998, the 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), with the result that 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. Improvements in sensing (magnetometers, electromagnetic induction sensors, and ground penetrating radar) as well as analysis and systems integration are also required to address this need.

A (1.5.p) Develop Toxic Effects and Exposure Data and Conduct of Risk Assessments for Ordnance-Related Compounds (ORCs), Explosives in Groundwater, Surface Water and Soil

Currently, two confounding factors lead to inaccurate risk assessment calculations on Army Installations: 1) insufficient exposure data (i.e. fate, transport, degradation, availability), and 2) surrogate based effects data, conservative (generally overly conservative) uncertainty factors are used to ensure protection of target receptors and human populations. To fully utilize the additional data sets necessary to support credible risk assessments an enhanced integration tool is needed. To improve the accuracy of risk assessment predictions, relevant exposure and effects information (e.g., toxicological, physical and chemical fate and transport, and bioavailability/bioaccumulation) is needed to accurately predict both human exposure and trophic transfer potential necessary for protection of human health and the environment. All data identified and developed must be fully integrated within the Army Risk Assessment Modeling System (ARAMS). 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 for sites attributed to the production, storage, transportation, use and disposal of ordnance-related compounds, their breakdown products, explosives, smokes and pyrotechnics, and chemical agents. Integrating regulatory agencies into data development and validation will accelerate regulatory acceptance of the above-described data and risk assessment tools resulting in more efficient decision-making.

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. 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. Loud training noise in the community results in complaints, damage claims and political and/or legal action. Army activities affected by operational noise impacts include large caliber (25 mm and greater) ranges, air to ground gunnery, munitions demolition/disposal, small arms ranges, military training routes, helicopter ground maintenance and run-up pads, and power generators. Numerous helicopter noise complaints also are generated by helicopter training activities near the installation boundary and from off-post low level flying. 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. Noise predictive and analysis models need to be developed to ensure good range siting and planning prior to construction, and to enable effective, unrestricted training while minimizing noise impacts.

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 VOC producing activities. Processes, including painting, cleaning/degreasing, paint stripping, cleaning between coatings, adhesives, stenciling and marking, post painting clean-up 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.

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

VOC sources are regulated by Title I of the Clean Air Act (CAA) and specific HAP sources are regulated by Title III of the CAA. The largest sources of Army HAP emissions are (1) fuel transfer operations, (2) painting and depainting operations, and (3) boilers and other combustion sources. 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. Three anticipated NESHAPs affecting Army fuel and combustion activities will also have impacts on the major Army VOC producing activities. Identification/evaluation of technologies/methods is required to control, reduce, or recycle HAP emissions from Army sources.

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

Munitions production is threatened by increasingly stringent Federal and state environmental regulations. 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. 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. 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.

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. 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. 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. 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. 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 (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. 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. 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 Lead-Based Paint (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 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. Cost-effective technologies are needed by the Army to control or abate sources of lead exposure and contamination as well as to safely remove, characterize, handle, store, transport, and dispose of LBP contaminated debris. In addition, the Army needs a standard methodology for managing LBP.

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. The Army needs to identify, develop and implement cost-effective water treatment or pre-treatment technology that ensures compliance with environmental laws and regulations (Clean Water Act 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. Processes, including painting, cleaning/degreasing, paint stripping, cleaning between coatings, adhesives, stenciling and marking, post painting clean-up 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.

A (3.5.c) Solid Waste Reduction

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. 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. 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. There are 17 active C/D landfills on Army installations and they are rapidly filling and causing some installations to rely on community landfills that can charge high tipping fees or require long hauls from the installation. There are commercial technologies available for material processing and recycling, however the applicability to Army demolition debris in terms of effectiveness and cost efficiency is not known. Technologies are needed to

improve metal recovery, reduce size and volume of demo debris, and identify and remove contaminates. The need focuses on examining large volume solid waste streams and identifying better, more cost effective ways to manage them, or alternative technologies/processes. Additional Army unique solid waste streams are deployed base camp waste, field rations.

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. 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.

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

By 1 Jan 94, the Clean Air Act Amendments of 1990 mandated the domestic phaseout of Halon production. 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. Additionally, Halon 1301 is used extensively in fixed fire protection systems in Army facilities. 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. 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) Compliant Ordnance Lifecycle for Readiness of the Transformation and Objective Forces

Many materials contained in the energetic and non-energetic components of ordnance may affect human health and the environment at some point during the lifecycle of the ordnance RDT&E; manufacturing; use; demilitarization; and ultimate cleanup as unexploded ordnance (UXO) or munitions constituents on ranges). The continuing use of current munitions that contain or generate environmentally regulated constituents severely jeopardizes the continued operations and use of Army operational ranges, production and demilitarization facilities. Based on the Environmental, Safety and Health (ESH) impacts of these materials, EPA and DoD regulations and presidential Executive Orders have regulated the reduction or elimination of such materials. The following four munitions-related materiel issues have been identified, by the Army, as primary environmental technology needs:

- Current materials and manufacturing processes: The current materials and processes used to manufacture ordnance require hazardous materials and create hazardous and energetic wastes, which contribute significantly to the overall environmental life cycle cost of a weapon system.
- Less/non-toxic energetics: The energetic materials used in current munitions contaminate groundwater, surface water, soil, and air when they are used in training and testing. High-order, low-order, and dud munitions leave varying levels of contamination. In order to prevent this contamination, new energetic materials must be developed with less hazardous properties.

- Pyrotechnics/smokes: Toxic chemicals in pyrotechnic formulations need to be replaced to improve to reduce environmental, safety and occupational health risks.
- Initiators/primers/fuzes: Elimination of duds and low orders, caused primarily by use of less than 100 percent reliable fuzes, is needed to reduce this long-term impact on Army ranges.

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 FY 1997. 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 COE guide specifications need to be examined to determine which sustainable design concepts should be implemented, promoted further, and incorporated into more comprehensive guidance.

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 Resource Conservation and Recovery Act (RCRA). 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.

A (3.3.a) Emissions and Alternatives for Open Burning/Open Detonation (OB/OD) of Munitions

Historically, OB/OD had proven to be a safe and cost-effective method for munitions demilitarization. Safety, health and environmental hazards associated with OB/OD have become a liability due to the resulting air, soil and water pollution. OB/OD emissions cause the release of HAPs (e.g., lead, HCl), which has contributed to Army installations being designated as major sources of HAPs under the Clean Air Act and has the potential to significantly impact many Army ranges. The Army needs better methods

and techniques to identify, quantify, and model OB/OD emissions. Tracking of residues from OB/OD (e.g., RDX and AP dispersion, fate and transport) and reduction, reutilization, and recycling process is of secondary concern. Best Management Practices (BMP) need to consider reduction of use of off-spec materials and reutilize and/or recycle unused energetics and munitions components at the unit level. Techniques and methodologies for reduction, reutilization, and recycling of selected munitions-related items, compounds (e.g., AP recovered from rocket motor propellants), and waste explosives and propellants are needed as alternatives to OB/OD. New demilitarization technologies are being developed to 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 (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. The Army needs to implement new, more efficient and environmentally-safer procedures and methods for chemical agent decontamination. 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. 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.

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. 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 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.

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

By 1 Jan 94, the Clean Air Act Amendments of 1990 mandated the domestic phase-out of all CFC production. 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. These replacements must satisfy Army performance and safety requirements and the procedures for retrofit of existing refrigeration systems must be developed.

A (3.1.a) Alternative Products in Cleaning and Degreasing Processes

Federal, state, and local regulations have strict requirements for hydrocarbon-based cleaning solvents that limit their use, storage, and disposal. Hydrocarbon-based solvents are often toxic, flammable, and contain hazardous air pollutants and/or other hazards to the environment. Currently, many of the cleaning agents used by the Army are hydrocarbon-based. In order to comply with pollution prevention mandates, Installation environmental staff's have advocated the use of alternative cleaners to replace PD680 solvents. In many cases this would result in the application of a cleaner upon a tactical system without approval from the commodity command responsible for the tactical system. An Army Alternative Cleaners Program has been developed with the intent to provide material compatibility data to enable commodity command decision makers to evaluate alternative cleaners for application on their specific weapon systems. The current program path stops at providing material compatibility data to the commodity commands. Unfortunately answering the materials compatibility issue alone does not provide the Army commodity commands enough information to make a substitution decision due to questions regarding alternative cleaner performance and logistics. Answers to these questions also have a potential impact on readiness. Without answering these questions, supplying material compatibility data to the commodity commands is not going to lead to approval for use on tactical systems. In short, there is an interoperability problem. Installation Environmental Offices have a regulatory obligation to implement P2. The Commodity Commands have an obligation to the readiness and effectiveness requirements for their system. Making environmentally friendly product substitutions to accepted and proven operation and maintenance procedures creates a potential readiness risk to some of our legacy systems.

A (4.6.a) Reducing Impacts of Threatened and Endangered Species on Military Readiness

There is an urgent need to know the impact of military-unique actions on Threatened and Endangered (T&E) species and Species of Concern (SOC), their habitats, and associated ecosystems to effectively carry out military readiness missions and comply with the legal requirements to conserve the species. The knowledge of the effects of military activities will allow conservation efforts to be directed toward mitigation of real, not speculative, training impacts. Without this knowledge, the Endangered Species Act regulators are forced to hold the Army to the most stringent standards to protect T&E species on Army lands, thus regulatory restrictions are more severe. It is likely that many training restrictions have been imposed due to a lack of knowledge of the effects of military activities on individuals or populations. The

focus of this requirement will be on the military impacts of noise, smokes and obscurants, maneuver (including excavation), and environmental contaminants.

A (4.6.c) Maintain Readiness by Improving Threatened and Endangered Species Monitoring Capabilities

There is an urgent need to have effective Threatened and Endangered (T&E) species and Species of Concern (SOC) survey, inventory, and monitoring protocols. They are essential to retain military mission capabilities by complying with the Endangered Species Act (ESA) and the requirements of ESA regulators. Protocols identified or developed can also be used to help evaluate the effectiveness of T&E species conservation and mitigation measures as well as overall T&E species recovery. While substantial focus will remain on priority, listed T&E species, attention must be paid to those species that may be listed in the future, with priority given to those having the greatest potential to affect the Army mission. Prospective research and application of innovative management techniques for those species may avoid costly future restrictions on Army testing and training activities. Developing standardized protocols acceptable to the scientific community, the installations and the regulators, and helping to promulgate them throughout the Army is by far the more cost effective approach. All Army land use actions (such as operational training events, test missions, and site selection of ranges) involving lands inhabited by T&E species must be made in consultation with the U.S. Fish and Wildlife Service or the National Marine Fisheries Service. It is essential that the Army have reliable population information to assess impacts and conserve species.

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. Soil erosion is a serious issue on Army lands. Accordingly, Army needs to develop a "Soil Erosion and Sediment Control" component to the INRMP.

A (4.2.i) Rehabilitation of Natural Resources (Land Conservation and Protection)

The Army has a serious ground mission. Accordingly, there are intensive and repeated impacts to the vegetation and soil surface. As a result, 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. To support this requirement, research and development is needed:

- To assess the technological requirements needed for more effective land rehabilitation (roadside soil erosion control, routine maintenance, repair of impacts from training/testing, Notices of Violation (NOVs) for excessive soil sediment, and NEPA mitigation);
- To evaluate the applicability of existing techniques and technologies, and their modifications, to more effectively rehabilitate continually used lands for Army mission requirements;
- To identify, assess, and validate innovative, emerging, and other techniques and technologies currently unavailable to the Army, against their ability to rehabilitate Army land impacted by mission requirements;
- To develop and validate a systematic approach for identifying and prioritizing land rehabilitation and maintenance projects; and

- To develop and validate new techniques and technologies that are required to rehabilitate Army land due to Army-unique training impacts or configuration.

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." Army lands are subject to disturbances unique on Federal lands, including repeated high intensity fires on ranges and repeated soil disturbance in maneuver boxes. There is also a need to focus R&D on new mission sustainment issues. 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 (e.g., 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 readiness and soldier well-being.

Appendix B

Legend for reading the Army Environmental Quality Technology (EQT) FY2003 Program one pagers.

Unexploded Ordnance (UXO) Identification and Discrimination

A●R-1

Potential Cost Avoidance of $1.1B w/an Investment of $30M*

* See Page B-1

Program Title:
EQT Program Title

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

Photograph:
Graphical depiction of the program

Description:

Objective:

- Develop
- and can a
- ordnance
- that identi
- ordnance.

Potential Cost Avoidance:
A net present value of the difference in current operations and operations based on employing the environmental technology program submitted and computed based on a fully funded program.

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

negative rate of 0.5%.

Approach:

Annual Performance Review:
Assessment of FY03 performance against stated objectives

- Develop and evaluate enhanced sensors for buried UXO detection/discrimination.
- Develop advanced multi-sensor technologies for false alarm reduction.
- Validate technologies at Standardized 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.

FY03 Performance Objectives:

Performance Objectives:
Performance Objectives for FY03

- Validate UXO signature models of emerging sensors to
- elopment improved
- ms/systems.
- sor prototype systems.
- Demonstrate new hardware and discrimination algorithms at Standardized UXO test sites.

FY03 Performance Review:

Met all performance objectives for FY03 in accordance with The Army EQT Management Plan and EQT-ORD.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Site Characterization and Screening Approaches	550	100				
		220	80			
UXO/Sensor	180	197				
	1,800					
Systems Design	400	200				
	1,979	1,570	2,009			
Technology Transfer						
Total $(K):	7,733	6,664	3,456			
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

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 FY03, established ordnance target repository.
- In FY03, determi
- In FY03, initiate
- By FY04, demon
- By FY04, optimi

imized UXO detection/discrimination system.
nologies.
dvanced discrimination algorithms to users.
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 $30M*

* See Page B-1

Description:

Objective:

- Develop technologies that are non-intrusive and can accurately discriminate unexploded ordnance (UXO) from scrap and shrapnel and that identify the configuration and type of ordnance.
- The Army EQT Operational Requirements Document (EQT-ORD) UXO objective goal of 98% UXO detection rate and a rejection rate of 90% of emplaced non–UXO clutter at standardized site with a maximum false negative rate of 0.5%.

Approach:

- Develop models of electromagnetic, magnetic, and ground penetrating radar (GPR) 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 Standardized 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.

FY03 Performance Objectives:

- Validate UXO signature models of emerging sensors to support multisensor systems development improved analysis/discrimination algorithms/systems.
- Demonstrate/validate multisensor prototype systems.
- Demonstrate new hardware and discrimination algorithms at Standardized UXO test sites.

FY03 Performance Review:

Met all performance objectives for FY03 in accordance with The Army EQT Management Plan and EQT-ORD.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Site Characterization and Screening Approaches	425	100				
		220	80			
UXO/Sensor Modeling, Analysis and Processing	180	197				
	1,325					
	495	400				
	325	580	250			
Sensor Design and Enhancement	1,156	200				
	900	3,087	1,005			
UXO Multi-Sensor Systems Design	294					
	400	200				
	1,860	1,570	2,009			
Technology Transfer	106	110	112			
Total $(K):	7,466	6,664	3,456			

RDT&E BA1 (0601102A T25) | RDT&E BA2 (0602720A F25)
RDT&E BA3 (0603728A 03E) | RDT&E BA4 (0603779A 04E)
RDT&E BA6 (0605857A 06E)

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 FY03, established ordnance target repository.
- In FY03, determined performance specifications for an optimized UXO detection/discrimination system.
- In FY03, initiated baseline demonstrations of existing technologies.
- By FY04, demonstrate handheld sensor technologies and advanced discrimination algorithms to users.
- By FY04, optimize UXO sensors for multisensor systems development and improved analysis techniques.
- By FY05, field demonstrate an UXO sensing and analysis capability which will achieve The Army EQT-ORD prescribed threshold of 95% UXO detection rate and a rejection rate of 75% of emplaced non–UXO clutter at Standardized UXO test site with a maximum false negative rate of 5%.

Hazard/Risk Assessment of Military Unique Compounds (MUC)

A•R-2

Potential Cost Avoidance of $1.4B w/an Investment of $28M*

* See Page B-1

Description:

Objective:

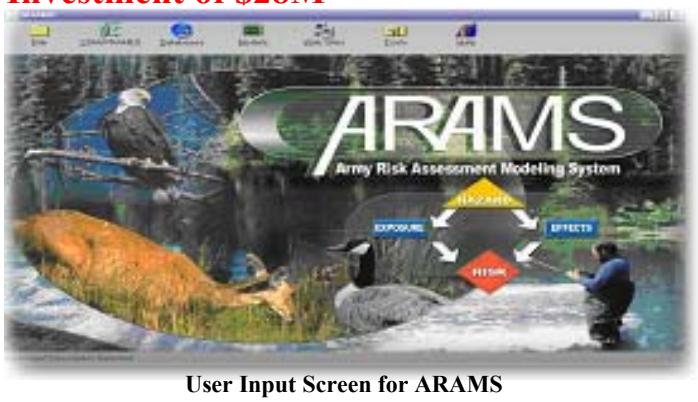
- Develop an Army Risk Assessment Modeling System (ARAMS) to provide consistent and verifiable procedures to assess human and ecological health risks of Military Unique Compounds (MUC) at Army environmental restoration sites.
- Integrate fate/transport models for exposure with effects databases/models.
- Develop methods to establish "How-Clean-is-Clean."
- Reduce time, cost, and uncertainty in risk assessment.
- Reduce cost by evaluating treatment/management alternatives.

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.

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 1.5.g.



User Input Screen for ARAMS

FY03 Performance Objectives:

- Release version 1.1 of Army Risk Assessment Modeling System (ARAMS).
- Integration of multiple new links including:
  - –Toxicity Terrestrial Database
  - –Trophic Trace
  - –Environmental Residues Effects Database
- Development of process descriptors and expanded effects descriptors for lead and other MUCs.

FY03 Performance Review:

Met all performance objectives for FY03.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Link screening level fate/transport models/algorithms	345	188				
	639					
	900	750	500			
Ecological exposure models and effects databases	441	474	233			
	2,000					
	200	1,512	600			
Comprehensive Fate/Transport & ecological exposure	245					
	710	950	550			
Modify F/T & Effects models for multi contaminant exposures.	248	494	498			
	450					
		450	250			
Release intermediate & final versions of ARAMS and documentation	198					
	2,029	1,701	1,458			
Technology Transfer		50	50			
Total $(K):	8,405	6,569	4,139			

RDT&E BA1 (0601102A S04/T25) | RDT&E BA2 (0602720A F25/835)

RDT&E BA3 (0603728A 03E) | RDT&E BA6 (0605857A 06E)

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 leveraging substantial SERDP/ESTCP funding.

Milestones/Accomplishments:

- In FY03, released 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 1.2 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 1.3 with tutorials and case studies of cost effectiveness for enhanced tech transfer.
- By FY06, develop enhanced user decision support system integrating ARAMS into range sustainability efforts.
- By FY07, provided revised/enhanced data elements for fate/transport and effects.

Enhanced Alternative and In Situ Treatment Technologies for Explosives and Organics in Groundwater

A●R-3

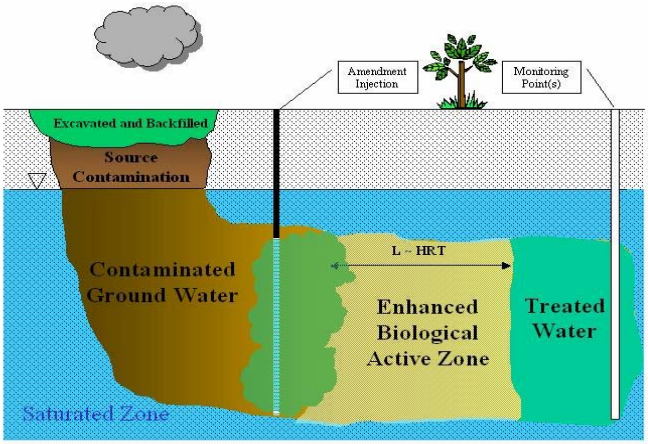
Potential Cost Avoidance of $589M w/an Investment of $18M*

* See Page B-1

Description:

Objective:

- Develop improved, cost effective, alternative forms of groundwater remediation for explosives and other organics contaminants.
- Increase treatment efficiency and flexibility.
- Reduce project life cycle time and cost by half.



In Situ Groundwater Treatment Model

Approach:

- Develop technologies and engineering processes for enhanced biological destruction of contaminants in groundwater.
- Develop new in situ treatment technologies focusing on mixed contaminants (RDX & perchlorate).
- Combine chemical/biological techniques to accelerate and improve treatment effectiveness for explosives and other organics in groundwater.
- Develop in situ electro-chemical & base hydrolysis treatment processes for RDX and perchlorate.

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.

FY03 Performance Objectives:

Optimize in situ bioremediation scheme for explosives degradation in groundwater.

FY03 Performance Review:

Met all performance objectives for FY03 and revised/ focused milestones/products from previous year.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Explosives Zero Valent Iron	250					
	400					
		290	150			
RDX In Situ Bioremediation	495	521	245			
	300					
		280	150	100	75	
RDX In Situ Chemical Oxidation	300	130				
		295	193	150	100	
RDX Electrokinetics	500	200				
		454	385	150	100	
Alkaline Wall Remediation of RDX Contaminated Groundwater		300				
			340	275	262	
Total $(K):	2,245	2,470	1,463	675	537	

RDT&E BA1 (0601102A H68/T25) RDT&E BA2 (0602720A F25/835)
RDT&E BA3 (0603728A 03E)

The Army EQT Program and DoD SERDP/ESTCP programs coordinate efforts to enhance the explosives/organics focus area in addressing AERTA requirement 1.2.a. This coordinated effort results in the Army leveraging substantial SERDP/ESTCP funding.

Milestones/Accomplishments:

- In FY03, optimized in situ bioremediation scheme for explosives and organics in groundwater.
- By FY05, 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 at the bench-scale.
- 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 In Situ and/or On-site Ex Situ Treatment Technologies for Soils Contaminated with Inorganics

A●R-4

Potential Cost Avoidance of $554M w/an Investment of $16M*

* See Page B-1

Description:

Objective:

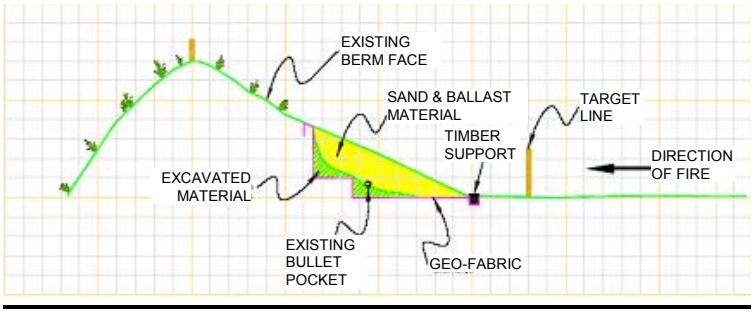
- Reduce costly regulatory problems from lead, copper, antimony, and tungsten from small arms ranges.
- Develop understanding of the environmental hazards and the engineering approaches to eliminate/reduce these hazards.
- Develop and validate cost effective management and remediation technologies.
- Develop low cost alternatives to current containment and cleanup practices.

Approach:

- Soil amendments for minimization of the volume of soil with heavy metals and compliance with environmental regulations.
- Predictive software tools for identification of environmental hazards and the engineering approaches to eliminate/reduce these hazards.
- Engineered systems that eliminate lead discharges from range areas.

How this project responds to need:

Innovative In Situ and/or On-site Ex Situ Treatment Technologies for Soils Contaminated with Inorganics is addressed as stated in AERTA requirement 1.3.e.



Typical Range Berm Cross Section

FY03 Performance Objectives:

Quantify fate and transport properties of metals associated with small arms range training activities and verify existing migration and weathering models.

FY03 Performance Review:

Met all performance objectives for FY03 and revised/ focused milestones/products from previous year.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Quantify Fate/Transport Properties & Verify Migration Models	241	215				
	1,329	215	365			
Validate Baseline Risk Assessment Protocols		248	246	243		
		500	400	325		
Life Cycle Evolution of Phytoremediation & Chemical Stabilization Mechanisms		300				
Identify/Describe Berm Design, Construct, & Maintenance Factors		525	367	325	300	
Predictive Environmental Tradeoff Analysis Model for SATR BMP		554	470	377	334	
Total $(K):	1,570	2,557	1,848	1,270	634	

RDT&E BA1 (0601102A T25) RDT&E BA2 (0602720A F25)
RDT&E BA3 (0603728A 03E)

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 FY03, developed 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.

Characterization, Evaluation, and Remediation of Distributed Source Contamination (UXO-C) on Army Ranges

A•R-5

Potential Cost Avoidance of $752M w/an Investment of $40M*

* See Page B-1

Description:

Objectives:

- Develop, validate, and field cost-effective remediation and best management technologies for propellants, explosives and pyrotechnics (PEP) sources at firing points, tank, anti-tank, and grenade ranges associated with blow-in place procedures.
- Identify fundamental knowledge concerning the occurrence, transport, and fate of PEP in soil, surface and ground water.
- Improve science of risk assessment for distributed sources of PEP on ranges.

Approach:

- Geo-statistical analysis to reduce uncertainty in heterogeneous PEP distribution across range landscapes.
- Quantify relevant chemical/physical processes for PEP.
- New risk assessment paradigm for episodically loaded environments.
- Innovative range remediation processes.
- Significantly reduced time/cost to characterize, analyze, treat, and maintain Army training and test ranges.

How this project responds to need:

AERTA requirement 1.6.f focuses on the remediation of distributed sources of unexploded ordnance-related constituents (UXO(C)) on Army ranges.

Characterization, evaluation, and remediation of UXO on active ranges

FY03 Performance Objectives:

- Evaluate PEP distribution in soils at multiple scales: point source, target, and landscape scales.
- Quantify efficacy of topical lime and other amendments for remediation at bench and pilot scales.
- Quantify PEP transport and fate through vadose zone.

FY03 Performance Review:

Met all performance objectives for FY03 (new start).

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Topical Chemical Treatment Processes	200					
	350	256	50		200	400
		823	915	1,300	725	465
Near-Surface Bioremediation	246	310	50	60	100	
			300	300	300	170
Phytoremediation Technologies		302	600	575	646	500
Statistics Based Site Characterization & Risk Assessment Tools/Processes	164					
	904	2,076	2,376	2,107	726	500
		635	815	600	474	600
Total $(K):	1,864	4,402	5,106	4,942	3,171	2,635

RDT&E BA1 (0601102A S04/T25) RDT&E BA2 (0602720A F25/835)
RDT&E BA3 (0603728A 03E)

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

Milestones/Accomplishments:

- In FY03, defined program goals to relate research technologies to range management applications.
- By FY04, complete acquisition of remotely sensed data (electromagnetic, LIDAR) at Ft. Bliss to relate soil PEP concentrations with range landscape characteristics.
- By FY04, initiate field-scale applications of chemical and near-surface biological treatments for PEP.
- By FY05, complete bench-scale demonstrations of topical chemical and near-surface biological treatments for PEPs at varied active range types (artillery, tank, anti-tank, grenade) and different soil and climate regimes.
- By FY06, optimize field-scale applications of chemical and near-surface biological treatments for PEP at active range sites.
- By FY07, complete development of statistics-based site characterization and coordinate characterization to development of risk assessment tools for sustainable management of active ranges.
- By FY08, complete demonstrations/validation of Distributed Source technologies for PEP.

Long Term Monitoring for Military Unique Compounds

A•R-6

Potential Cost Avoidance of $41M w/an Investment of $23M*

* See Page B-1

Description:

Objective:

To develop cost effective "real-time", reproducible, and regulatory acceptable long term monitoring technologies for military-unique compounds (3NT, 4NT, HMX, 1,3-DNB, and NB), chemical agents, pyrotechnics, propellants, and their degradation products.

Approach:

- Enhance commercial off-the-shelf (COTS) technologies.
- Develop novel Military Unique Compounds (MUC) detection systems and measurement protocols for near-real-time, on-site monitoring.
- Combine sampling, data acquisition, quality control, processing, and transmission to meet time-critical customer requirements.
- Demonstrate quality field analytics as compared to traditional laboratory analysis.

How this project responds to need:

AERTA requirement 1.1.i. focuses on the development of analytical methods and/or equipment for extensive sampling and chemical analysis to address long term monitoring of contamination for military-unique compounds at Army installations.

Development of Micro-sensors and Other Field Technologies for MUC

FY03 Performance Objectives:

- Evaluate and select commercial off-the-shelf technologies, sensors and miniaturized systems for further development.
- Develop guidance on off-the-shelf field analytical technologies.
- Develop and evaluate new analytical methods for MUC.

FY03 Performance Review:

Met all performance objectives for FY03 (new start).

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Develop/Demonstrate New Analytical Methods	166	157	60			
New Monitoring and QA Processes & Protocols	135	70	26			
Develop/Implement Interim Monitoring Devices	150	360	528	655	258	
			333	396	362	470
Develop/Implement Emerging bench-scale Sensor Systems		396	411	415		
		228	304	557	335	
		450	565	400	500	505
Develop/Implement Promising Miniaturized Systems		194	232	359	157	
		137	365	600	530	470
Total $(K):	451	1,992	2,824	3,382	2,142	1,445

RDT&E BA1 (0601102A S04/T25) RDT&E BA2 (0602720A F25/835)
RDT&E BA3 (0603728A 03E)

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

Milestones/Accomplishments:

- In FY03, evaluated/selected technologies to customize for MUC, developed analytical methods for perchlorate and nitrocellulose (NC) in soil, and developed quality assurance (QA) protocols for field analysis.
- By FY04, develop/demonstrate new analytical methods for perchlorate and NC in soil, and field QA protocols, modify/demonstrate COTS for interim detection of MUC, and assess miniaturized/emerging technologies for MUC analysis.
- By FY05, develop/implement new monitoring QA protocols and perchlorate and NC analytical methods, develop/demonstrate modified COTS devices, and develop/demonstrate miniaturized/emerging technologies.
- By FY06, complete demonstration of miniaturized and emerging bench-scale sensor systems.
- By FY07, develop and implement on-site miniaturized detection and data transmittal systems.
- By FY08, implement near-real time on site monitoring systems for detection of MUC.

Particulate Matter (PM)/Dust Control

A•CM-1

Potential Cost Avoidance of $790M w/an Investment of $12M*

* 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 the focus of this effort.

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

FY03 Performance Objectives:

- Determine long-term performance of innovative chemical dust palliatives applied to unpaved roads.
- Develop engine emission source characterization data for Army combat/tactical vehicles.

FY03 Performance Review:

Met all performance objectives for FY03.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Tactical Vehicle Engine Emission Model for PM	95					
Chemical/Physical PM Mitigation Technologies	188					
PM Measurement Technologies for Opacity	145	148				
Receptor Modeling Method for Army Unique PM Source	120	90				
Biological PM Mitigation Technologies		74	334			
Technology for Field Measurement of PM Concentrations	105	204	215			
Total $(K):	653	516	549			

RDT&E BA2 (0602720A 896)

Milestones/Accomplishments:

- In FY03, completed draft technology verification reports detailing the long-term performance of palliatives applied to unsurfaced roads at Fort Leonard Wood to ascertain potential environmental effects from palliative application.
- In FY03, completed High Mobility Multipurpose Wheeled Vehicle (HMMWV) engine usage field tests and engine exhaust emission testing for PM, the polycyclic aromatic hydrocarbon components of the PM, and gaseous criteria air pollutants.
- In FY03, developed 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 and PM concentration measurement technologies.

Training and Testing Range Noise Control

A•CM-2

Potential Cost Avoidance of $1B w/an Investment of $29M*

* 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.

Noise Contour Analysis: Ft. Stewart, GA

FY03 Performance Objectives:

- Complete basic research feasibility analysis of blast noise absorbers for large caliber (artillery) firing positions for which standard noise attenuation techniques are not feasible.
- Investigate noise mitigation and modeling techniques for new weapons.

FY03 Performance Review:

- Met all performance objectives for FY03.
- In a collaborative project with SERDP, data was obtained that will serve to validate, and improve the application of, noise assessment software for range operations.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Improved Utility Noise Software		629	1,041			
				690	476	274
		180	144	144		
Source Characterization	200					
				656	1,280	1,170
New Blast Noise Complaint Criteria	200	561	415	250		
						555
Noise Mitigation via Ground Treatment	275	350	250	300		
					196	
Total $(K):	675	1,720	1,850	2,040	1,952	1,999

RDT&E BA2 (0602720A 896/048) RDT&E BA3 (0603728A 002)
RDT&E BA3 (0603716D) SERDP

Milestones/Accomplishments:

- In FY03, completed analysis of basic research on the feasibility of using blast noise absorbers for large weapon firing positions, for which standard noise attenuation techniques are not feasible.
- In FY03, obtained field noise training data for large caliber guns (artillery and main tank). Data will be used to improve noise modeling and mitigation.
- By FY04, investigate utility of forests for blast noise mitigation.
- By FY05, develop noise prediction and mitigation tool for simple range operations.
- By FY06, investigate human response to infrequent noise events.

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

A•CM-3

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

* See Page B-1

Description:

Objective:

Develop and test cost effective Hazardous Air Pollutant (HAP) and Volatile Organic Compound (VOC) emission control technologies that impact Army activities and operations regulated by the National Emissions Standards for Hazardous Air Pollutants (NESHAPs), OSHA and States.

Approach:

Develop and test technologies for controlling and/or recycling:

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

How this project responds to need:

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

Zero Emission Chromium Electroplating System at Anniston Army Depot, AL

Mercury CEM

FY03 Performance Objectives:

- Test new technologies for controlling and/or recycling inorganic HAP emissions.
- Test new technologies for controlling and/or recycling hazardous organic solvent emissions.

FY03 Performance Review:

- Met all performance objectives for FY03.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Combustion Source HAP Development	222	228				
Hazardous Organic HAP Technology Demonstrations	291					
Combustion Source HAP Demonstration	645	1,360	657			
Inorganic HAP Technology Demonstration	173					
Total $(K):	1,331	1,588	657			
RDT&E BA2 (0602720A 896)	RDT&E BA3 (0603728A 002)					

Milestones/Accomplishments:

- In FY03, tested zero emission chromium electroplating system at Anniston Army Depot and met OSHA and NESHAPs requirements (e.g., chromium<0.015 mg/dscm).
- In FY03, successfully developed and tested the Mercury Continuous Emission Monitor (CEM) at an EPA sponsored site.
- In FY03, conducted a variety of tests on hazardous organic solvent emissions technologies designed to remove 95% of HAPs and 20% cost reduction (baseline -10,000 cfm unit at $65/cfm).
- By FY04, develop combustion source HAP control technologies for hazardous waste incinerators (chemical and conventional demilitarization) and non-natural gas boilers to meet NESHAP requirements.
- By FY05, test combustion source HAP control technologies for hazardous waste incinerators (chemical and conventional demilitarization) and non-natural gas boilers to meet NESHAP requirements.

Improved Treatment Techniques for Wastewaters from Munitions Production

A•CM-5

Potential Cost Avoidance of $445M w/an Investment of $8M*

* 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.

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.

Wastewater Treatment Plant, Picatinny Arsenal, NJ

FY03 Performance Objectives:

Complete protocol for energetic compound biological treatment under anaerobic conditions and transfer results to field.

FY03 Performance Review:

Met performance objective for FY03.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Pollution Prevention for future munitions production	26	175	136	72		
Biosorbents for Metals Removal from Munitions Wastewater	64	150	213	112		
Protocol for Energetic Compound Biological Treatment - Perchlorate	107	225	315	165		
Develop Physiochemical Treatment Protocols - Perchlorate (FY04 start)	280	137	188	98		
Total $(K):	477	687	852	447		

RDT&E BA2 (0602720A 048)

Milestones/Accomplishments:

- In FY03, completed protocol for energetic compound biological treatment under anaerobic conditions and transferred results to the field.
- By FY04, identify new destructive techniques to cost-effectively mineralize hazardous wastes that impacting munitions production.
- By FY05, identify bench scale protocols for nitrate and perchlorate destruction.

Sustainable Army Live-Fire Range Design and Maintenance

A•CM-6

Potential Cost Avoidance of $935M w/an Investment of $10M*

* See Page B-1

Description:

Objective:

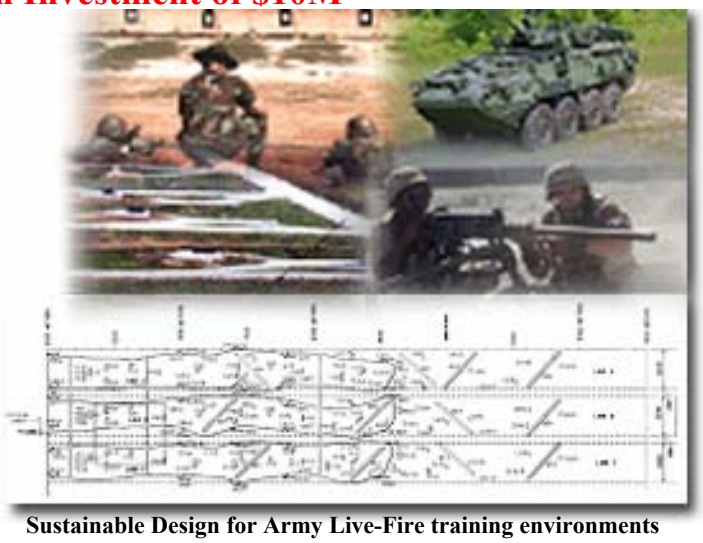
Provide range risk assessment and management techniques integrating explosive safety, environmental compliance, and natural resources management with the objective of ensuring operational capability of the live-fire training environment. Technologies will target range planning, design and maintenance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

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 for the Current and Future Force.



Sustainable Design for Army Live-Fire training environments

FY03 Performance Objectives:

Evaluated range design, construction, and maintenance requirements against current and future environmental compliance requirements.

FY03 Performance Review:

Met performance objective for FY03 with development of risk parameters and assessment of range design elements.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Range Risk Assessment Model	511	554	412			
Range Design Specifications	1,150	1,398	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):	2,598	4,216	3,532	695	174	

RDT&E BA2 (0602720A 896) RDT&E BA4 (0603779A 04E)
RDT&E BA6 (0605857A 06E)

Milestones/Accomplishments:

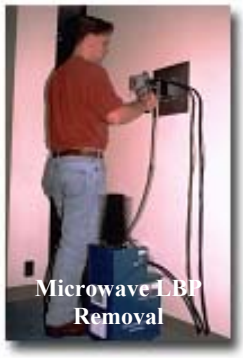
- In FY03, completed study design for water quality monitoring to measure training impacts on newly constructed ranges.
- By FY04, complete development of a range design risk assessment model.
- By FY05, identify range design specification requirements and best management practices, incorporating environmental 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



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

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.

FY03 Performance Objectives:

- 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.

FY03 Performance Review:

Met all performance objectives for FY03.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Demonstrate Lead Abatement Technologies for Non-Residential Buildings	431					
Demonstrate Lead Abatement Technologies for Family Housing & Child Occupied Facilities	185					
Total $(K):	616					

RDT&E BA3 (0603728A 002)

Milestones/Accomplishments:

- In FY03, demonstrated lead hazard removal technologies for buildings that result in non-hazardous waste that leaches less than 5 ppm lead and produces no hazardous pollutants.
- In FY03, developed 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 $982M w/an Investment of $34M*

* See Page B-1

Potential NESHAPs regulated coatings

Description:

Objective:

Implement reformulated paints, sealants, adhesives, etc. that comply with forthcoming Clean Air Act (CAA) regulations, including the surface coating National Emission Standard for Hazardous Air Pollutants (NESHAPs), 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.

FY03 Performance Objectives:

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

FY03 Performance Review:

- Partially met performance objectives for FY03.
- Completion of technological gap analysis delayed pending results of baseline assessments and will complete in FY04.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Develop baseline for current materials and processes. Develop and staff test protocols for technology development, qualification, validation, and approval	815*					
Perform gap analysis, technology demonstration, and evaluation of HAP-free Solvent/Thinners/Cleaners	139	572	496	113		
Perform gap analysis, technology demonstration, and evaluation of MMPP-compliant non-CARC	265	572	197	372		
Perform gap analysis, technology demonstration, and evaluation of Depainting Materials and Processes	100	538	774	453		
Qualify, validate and approve all Coatings, Solvents, Cleaners, and De-Painters	1,165*					
Total $(K)	**2,484**	**1,682**	**1,467**	**938**		

RDT&E BA3 (0603728A 025)
RDT&E BA4 (0603779A 035)

* Portions of BA4 are FY02 funding committed in FY03.

Milestones/Accomplishments:

- In FY03, completed baseline assessments at 14 military facilities.
- In FY03, developed solvent substitution methodology with Joint Solvent Substitution Working Group.
- In FY03, identified Army handwipe cleaning requirements and immersion cleaning requirements.
- By FY04, establish test protocols for technology development, qualification, validation and approval for all materials.
- By FY04, complete gap analysis and begin qualification and validation of alternatives for rubber-to-metal bonding.
- By FY05, complete qualification and evaluation of alternatives for rubber-to-metal bonding.
- By FY05, demonstrate alternatives for CARC and non-CARC solvents/thinners/cleaners and coatings.
- By FY06, technology demonstration, qualification and evaluation of alternatives for de-painting.
- 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 $467M w/an Investment of $24M*

* See Page B-1

Description:

Objective:

Identify, demonstrate, and develop technologies to provide Army installations and deployed forces with environmentally safe and cost effective technologies and/or processes to achieve maximum diversion, minimization, or volume reduction of the Army's solid waste (SW) stream such as construction/demolition (C/D), energetics contaminated buildings, and base camp/field solid waste.

Approach:

- Develop/demonstrate technologies that maximize C/D debris diversion by addresssing materials that are not diverted through current deconstruction such as concrete, masonry and LBP wood.
- Develop/demonstrate new energetic material detection and treatment technology that improves contaminated building material classification to maximize deconstruction and minimize current burning pratcices.
- Develop/ demonstrate waste minimization technology through redesigned packaging materials and waste reuse equipment that enhances the safety and logistical ability of the deployed soldier.

How this project responds to need:

These efforts meet the primary focus areas of AERTA requirements 3.5.c/3.5.k.

Military Solid Waste Debris

FY03 Performance Objectives:

- Investigate implications of lead coated components on masonry structures in reuse/recycle technologies.
- Investigate lamination and coextrusion techniques for nanocomposite materials.

FY03 Performance Review:

Met all performance objectives for FY03.

NOTE: Two demos include leveraged Congressional funds to evaluate technologies to reduce and allow reuse of deconstruction/demolition debris and military SW.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Zero Footprint	315	310	355	812	356	
	126	486	398	730	600	1,166
	126	282	126			
Construction/ Demolition	360	340	110	1,395	979	100
	142	100	94	790	1,337	835
Total $(K):	1,069	1,518	1,083	3,727	3,272	2,101

RDT&E BA2 (0602720A 896/048) RDT&E BA3 (0603728A 025)

RDT&E BA3 (0603716D SERDP)

Milestones/Accomplishments:

- In FY03, conducted sampling and analysis of lead paint on concrete in Army family housing and wood siding on WWII barracks.
- In FY03, leveraged technologies/processes to recycle/reuse concertina wire, scrap track, and tires and eliminated thrust area from program focus.
- In FY03, continued assessment of salvageable building materials from Badger AAP, WI.
- In FY03, prepared an Army public works technical bulletin on concrete reuse, Army deconstruction manual and a report on interaction of energetics with structural materials.
- In FY03, optimized polymer/clay compatibility for polyhydroxyalkanoates (PHA), a biodegradable polymer.
- By FY04, develop guidance document to deconstruct masonry structures to maximize recycle/reuse technologies.
- By FY05, begin development of right-sizing of field rations to reduce waste produced in the field, replacements for #10 tin cans, and ration-package reconfiguration.
- By FY08, transition environmentally friendly packaging materials to demonstration/validation.

Compliant Ordnance Lifecycle for the Readiness of the Transformation and Objective Forces

A●P2-5

Potential Cost Avoidance of $738M w/an Investment of $137M*

* 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.

FY03 Performance Objectives:

Novel alternatives to toxic propellants:

- Predict energy increase, decreased sensitivity and enhanced tailorability vs. existing formulations.
- Project producibility.

FY03 Performance Review:

Met all performance objectives for FY03.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Novel Initiatives to Eliminate Toxics: Case less Ammunition, Green Synthesis, and Laser Ignition		539	548			
						641
Modeling, Design, and Experimentation of New Environmentally Benign Energetics			854	2,551	4,642	5,097
Technology Demonstration of Non-Energetic Ordnance Components						150
					321	417
Technology Demonstration of New Propellant Technologies			335	1,080	1,701	
			829	794	1,143	1,065
Total $(K):	**0**	**539**	**2,566**	**4,425**	**7,807**	**7,370**

RDT&E BA1 (0601102A H67) RDT&E BA2 (0602720A 895)
RDT&E BA3 (0603728A 025)

Milestones/Accomplishments:

- In FY03, identified nano-energetic materials technology to increase thermal conductivity to propellant eliminating $BaNO_3$ as toxic ingredient.
- 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.
- By FY07, demonstrate re-crystallization of recovered Ammonium Perchlorate for reuse.
- By FY07, transition basic technology for caseless ammunition to applied research.
- By FY08, demonstrate alternatives to hydrazine fuels for technology insertion into PEO Tactical Missiles programs.
- By FY08, complete modeling and experimentation of environmentally benign missile propellants.
- By FY08, complete performance evaluation of novel energetic materials.
- By FY08, begin technology demonstration of caseless ammunition.

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

FY03 Performance Objectives:

- Begin conducting vented combustor tests to expose lab samples to the firing environment to solve final adhesion challenges.
- Demonstrate electroplated chrome alternative for medium caliber gun barrels through test firings.
- Model the cylindrical magnetron sputtering (CMS) system and increase fundamental understanding for target development for larger gun barrel applications.

FY03 Performance Review:

Partially met performance objectives for FY03:

- Completed vented combustor tests and modeling of the cylindrical magnetron sputtering system.
- Basic research precluded transition of electroplated chrome alternative demonstration for medium caliber gun barrels and biomimetic processing of ceramics.

Milestones/Accomplishments:

- In FY03, began vented combustor tests.
- In FY03, demonstrated electroplated chrome alternative for medium caliber gun barrels through test firings.
- In FY03, published technical report on *Biomimetic Processing of Ceramics*.
- By FY04, model cylindrical magnetron sputtering system and increase fundamental understanding for target development for larger gun barrel.
- 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, NY.
- By FY05, demonstrate Cd and Cr elimination through alloy and design changes.
- By FY06, demonstrate Diamond like Coatings (DLC) as a hard chromium replacement.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Modeling the CMS System	263	54				
In situ Sputtering	98					
Ultrasonic Measurement to determine Thermodynamic & Elastic properties of Coatings	100	100	311			
Innovative Enhancement of Sputtered Coatings	115	100				
High rate, High-temp Green Propellant Gas-Metal Kinetics	115	100	100			
Total $(K):	691	354	411			

RDT&E BA1 (0601102A H67)

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

A•CN-1

Potential Cost Avoidance of $754M w/an Investment of $20M*

* See Page B-1

Description:

Objective:

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

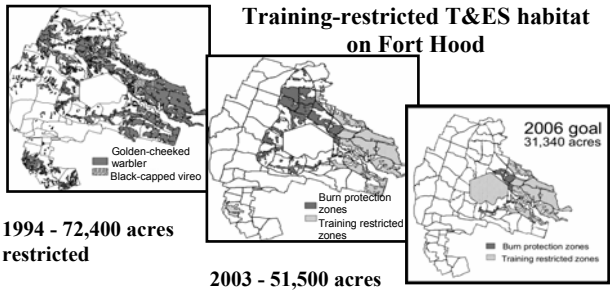
Approach:

- 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.

Training-restricted T&ES habitat on Fort Hood



1994 - 72,400 acres restricted

2003 - 51,500 acres restricted

2006 Goal - 31,340 acres restricted

FY03 Performance Objectives:

- Complete risk analysis of military-specific contaminants for T&ES.
- Complete de-listing guidance
- Complete inventory of smokes and obscurant usage
- Develop database of research related to high priority species
- Develop protocol for assessing impacts of invasive species on T&ES.
- Complete assessment of smoke and obscurant effects on aquatic vegetation

FY03 Performance Review:

- Met all performance objectives for FY03.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Develop Fragmentation Tools	250	250	165			
Quantify Military Training Impacts	1,801	1,816	2,325	2,429	2,371	500
Quantify Military Land Management Techniques	275	310	391	650	250	
Total $(K):	2,328	2,376	2,881	3,079	2,621	500

RDT&E BA2 (0602720A 896)

Milestones/Accomplishments:

- In FY03, completed identification of risk parameters for possible chemical hazards to T&ES.
- By FY04, quantify effects of military training on avian T&ES.
- By FY05, develop tools to quantify/predict ecosystem fragmentation.
- By FY06, quantify effects of military training on desert and gopher tortoises.
- By FY07, quantify impacts of military land management on T&ES.

Maintain Readiness by Improving Threatened & Endangered Species Monitoring Capabilities

A•CN-2

Potential Cost Avoidance of $810M w/an Investment of $12M*

* 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.

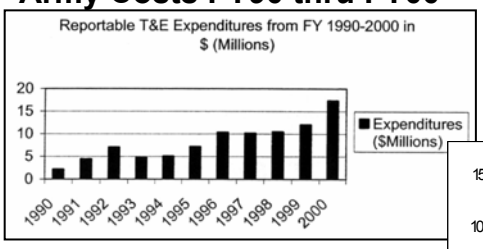
Approach:

- 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.

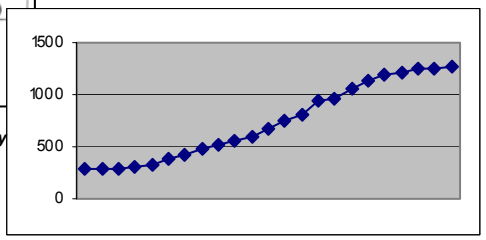
Army Costs FY90 thru FY00



Source: AEC *Installation Summaries From the 2000 Survey of Threatened and Endangered Species.* January 2002.

256 Species are now Candidates

Listed Species 1980-2002



Source: U.S. Fish and Wildlife Service website (23 Dec 03)

FY03 Performance Objectives:

- Complete framework for development of viable population goals.
- Complete review of inventory techniques for high priority species.
- Complete review of Red-cockaded Woodpecker inventory and monitoring methods.

FY03 Performance Review:

Met all performance objectives for FY03.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Population Viability Analysis Tools	260					
Standardized Survey and Monitoring Tools	100	100				
Spatial Assessment Techniques & Population goals	310	471	570	325		
Develop New Inventory and Monitoring Techniques		150	200	481	430	500
Total $(K)	670	721	770	806	430	500
RDT&E BA2 (0602720A 896)						

Milestones/Accomplishments:

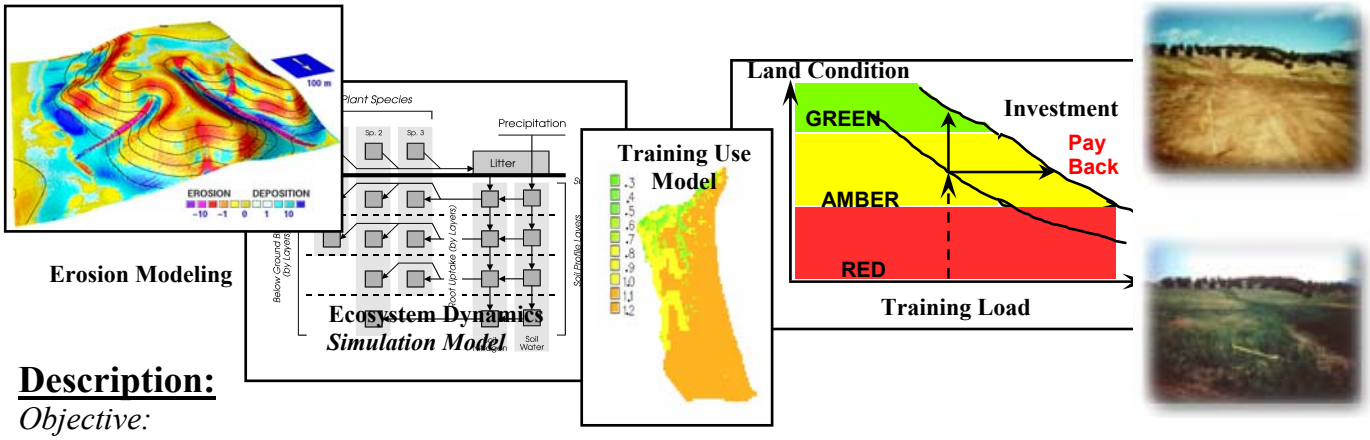
- In FY03, developed a set of protocols for identifying viable T&ES populations and habitat.
- By FY04, develop protocols for analyzing population viability related to various levels of data.
- By FY05, develop regulator approved, minimum survey and monitoring protocols for high priority species.
- By FY06, develop spatial assessment technology for seven high priority species on Army lands and produce refined population and population goal analysis protocols that are region-based.
- By FY08, develop techniques to conduct survey and monitoring in impact areas.
- By FY08, develop survey and monitoring techniques to improve accuracy and reduce costs.
- By FY10, develop framework for extending technology developed under this program to other classes of T&ES.

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.

FY03 Performance Objectives:

Develop ATTACC protocols that incorporate scientific improvements in wind erosion and soil compaction factors.

FY03 Performance Review:

Met performance objective for FY03.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Multiple Measures of Land Condition	654	95	50			
Improved Mission Impact Factors and Distribution	309	478	514	550	275	
Total $(K):	963	573	564	550	275	

RDT&E BA2 (0602720A 896)

Milestones/Accomplishments:

- In FY03, developed 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.
- By FY07, develop ATTACC improvements that incorporate non-military land and natural resource stressors.

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 capability 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.

Typical Land Rehabilitation/ Erosion Control Measures
Ex: Revegetation and Sediment Control

FY03 Performance Objectives:

Enhance capability to select and emplace cost-effective erosion control.

FY03 Performance Review:

Met the performance objective for FY03.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Erosion Control Improvement Techniques	62	105	100	210	200	250
Erosion Control Prioritization Tools	63	110	98	215	200	250
Improved Cost/Benefit Analysis for Land Rehabilitation		87	90	135	135	200
Total $(K):	125	302	288	560	535	700
RDT&E BA2 (0602720A 896)						

Milestones/Accomplishments:

- In FY03, developed prioritized protocol for optimizing revegetation and structural erosion control actions.
- 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:

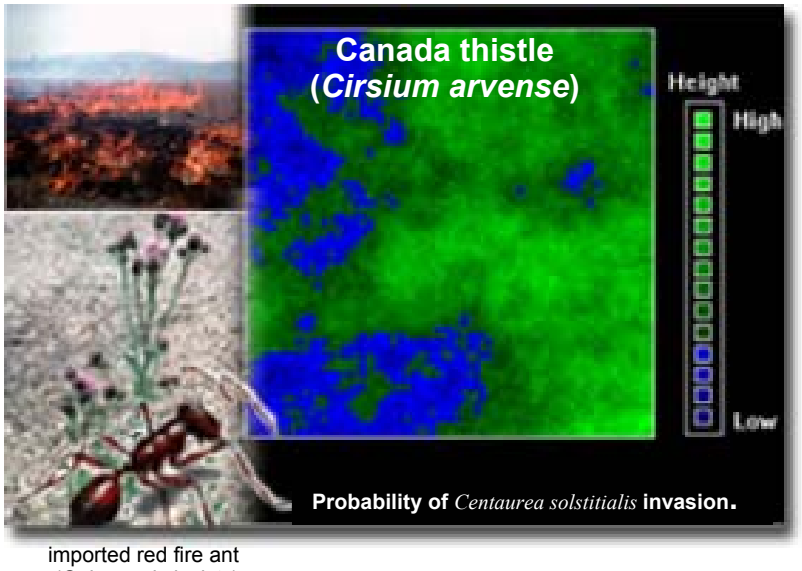
To assist Army training and natural resources managers in meeting the conservation and compliance challenges posed by non-native invasive species. Assessment of the effects of military operations on invasive species establishment and spread will provide the necessary framework for developing cost effective 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*)

FY03 Performance Objectives:

Conduct initial assessments of knapweed biocontrol agents.

FY03 Performance Review:

Met the performance objective for FY03.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Assessment/Control of Cheatgrass and Knapweed	144					
Invasive Species Survey	35					
Total $(K):	179					
RDT&E BA2 (0602720A 896)	RDT&E BA3 (0603716D SERDP)					

Milestones/Accomplishments:

- In FY03, analyzed results, across experimental sites, to determine impact of knapweed biocontrol agents.

Electrokinetic Remediation of Contaminated Soils

See Page B-1 for legend

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 U.S./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 U.S. Army Corps of Engineers' 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:

- Feasibility study using Bergen site soil was performed at ERDC labs.
- 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 planned at Bergen site.
- Two year operational test will monitor Cadmium removal rates and efficiencies.
- Post EK removal of heavy metals from the soil will be verified against regulatory limits and the soil will be considered for reuse.

How this project responds to need:

Heavy metals contamination at training ranges remains a problem. This innovative technology supports remediation of contaminated soils at ranges and responds to AERTA requirement 1.3.e.

EK System Pool 2 Vertical Electrode Placement, Bergen Site, GE

FY03 Performance Objectives:.

- SAB meets to review final design and visit site to observe construction.
- Continuous operation of EK system on site with electrical, hydraulic, and pH-adjustment working well.
- SAB meets to discuss operational details for ongoing metals extraction.

FY03 Performance Review:

Met all performance objectives for FY03.

German Ministry of Defense Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Exchange tech data						
Assist MOD contractor						
SAB Evaluation						
Assist with design						

German Ministry of Defense (MOD) schedule and funding

Milestones/Accomplishments:

- Science Advisory Board reviewed final design, visited project site, and observed construction in Oct 2002.
- Science Advisory Board discussed operational status via teleconference in May and August 2003.
- In FY04, monitor on-going efforts and co-author peer review journal article on EK feasibility study.

Appendix C

Legend for reading the Congressional Interest Project one page Fiscal Year 2003 summaries.

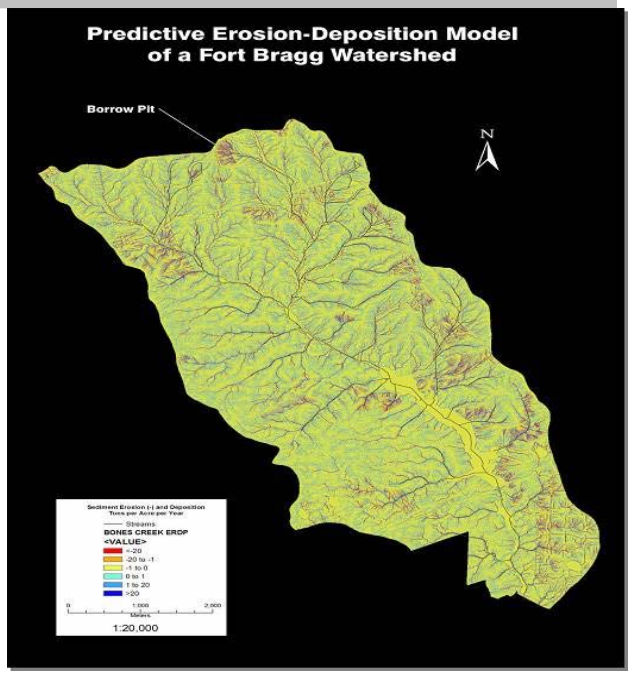
Program Title:
Congressional Project Title

Congressional Interest

...on and Pollution Prevention Research

Index Page is C-1

Photograph:
Graphical depiction of the program



Description:

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

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

environmental quality and industrial waste treatement technologies.

Approach:
Validate innovative technologies under field operational conditions.

How this project responds to need:
Supports Army Environmental Quality Compliance and Pollution Prevention through demonstration and technology transfer of de...

FY03 Performance Objective

Demonstrate and transition technologies from Army Compliance a... development ...g Army Ammunition Plants and Troop Installations.

Performance Objectives:
Performance Objectives for FY03

FY03 Performance Review

Met performance objective for FY03 including:
...ign for hazardous material
...carbonized synthetic oil deposits on engine parts at Anniston Army Depot.
–Demonstrated methodology for determination of correlations between storm water runoff and downstream sedimentation at Ft. Bragg.

Annual Performance Review:
Assessment of FY03 performance against stated objectives

Milestones/Accomplishments:

- By FY04, monitor and control fugitive emissions from the APE 1236 deactivation furnace at Tooele AD.
- By ... chlo... sma... Brag...
- By FY04, evaluate alternative methods for disposal of two specific waste streams to reduce air pollution emissions caused by current incineration practices at Ft. Bragg.
- By FY04, evaluate and demonstrate Porous Load Bearing Systems to improve storm water quality and management at Ft. Hood.

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

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Compliance P2 technologies at troop facilities	1,324					
Compliance techn... industrial facilities						
Total $(K):						
RDT&E BA4 (060...						

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

Waste Minimization and Pollution Research

See page C-1 for legend

Description:

Objective:

- 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 under field operational conditions.

How this project responds to need:

Supports Army Environmental Compliance and Pollution Prevention through demonstration and technology transfer of developing technologies.

FY03 Performance Objective:

Demonstrate and transition technologies from Army compliance and pollution prevention research and development programs to Army installations including Army ammunition plants and troop installations.

FY03 Performance Review:

Met the performance objective for FY03.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Compliance/P2 technologies at troop facilities	**1,324**					
Compliance technologies at industrial facilities	**395**					
Total $(K):	**1,719**					

RDT&E BA4 (06043779A 04K)

Milestones/Accomplishments:

- In FY03, determined the optimum design for hazardous material reduction from the removal of carbonized synthetic oil deposits on engine parts at Anniston Army Depot.
- In FY03, demonstrated methodology for determination of correlations between storm water runoff and downstream sedimentation at Ft. Bragg, NC.
- In FY03, determined process improvements for reduction of acid discharge at Radford Army Ammunition Plant.
- By FY04, monitor and control fugitive emissions from the APE 1236 deactivation furnace at Tooele Army Depot, UT.
- By FY04, investigate alternatives to chlorine disinfections and perform a small-scale demonstration at Ft. Bragg, NC.
- By FY04, evaluate alternative methods for disposal of two specific waste streams to reduce air pollution emissions caused by current incineration practices at Ft. Bragg, NC.
- By FY04, evaluate and demonstrate Porous Load Bearing Systems to improve storm water quality and management at Ft. Hood, TX.

Range Safety Technology Demonstration (RangeSafe)

See page C-1 for legend

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 of field-scale applications include: Picatinny Arsenal, NJ; Ft. Dix, NJ; Concord, MA; 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.

FY03 Milestones/Accomplishments:

- Completed on-site characterization of Thorium-seeded radiation training site at Kirtland AFB, NM.
- Completed bioremediation of Tetryl contaminated soil at Picatinny, NJ.
- Completed demonstration of innovative UXO detection technology.
- Completed small-scale demonstration of gun range berm rainwater runoff filtration at Ft. Dix, NJ.

FY03 Performance Objectives:

- Demonstrate the feasibility of base hydrolysis for replacement of granular activated carbon for RDX removal from ground water.
- Evaluate the potential for in situ perchlorate treatment using biologically active zone enhancement.
- Conduct follow-on field demonstration of phytoextraction of Arsenic from soils at Picatinny, NJ.

Demonstration of gun range rainwater runoff filtration using "mini-berms" at Range 26, Ft. Dix, NJ

- Participate in multi-state regulatory council to enable technology transfer to and from the Army.
- Investigate physiochemical and biological processes for treatment of energetic contaminant in aqueous streams.
- Continue implementation of indoor lead bullet firing range health, safety and environmental technology test bed at Picatinny Arsenal, NJ.
- Set-up for demonstration of innovative arsenic filtration system to treat contaminated groundwater at Ft. Irwin, CA.
- Develop alternative chemical washing technologies for mobile soil washing system laboratory applications.
- Develop gun range environmental stewardship document as part of ARDEC's NJ Environmental Technology Initiative partnership with NJ DEP.
- Continue lead gun range maintenance demonstration at Range 25, Ft. Dix NJ.

FY03 Performance Review:

Met all performance objectives for FY03.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Phytoextraction of Arsenic	47					
In situ biological perchlorate transformation	350					
Processes for Treatment of Contam in Aqueous Streams	187					
Indoor Gun Range Test Bed	448					
ITRC Tech Transfer	195					
RDX flow through base hydrolysis for GW treatment	317					
Lead at NTC, Ft. Irwin, CA	119					
Mobile Soil Washing System	225					
NJ DEP Active Range Manual	63					
Lead at Range 25, Ft. Dix, NJ	52					
Total $(K):	2,003					

RDT&E BA2 (0602720A F28)

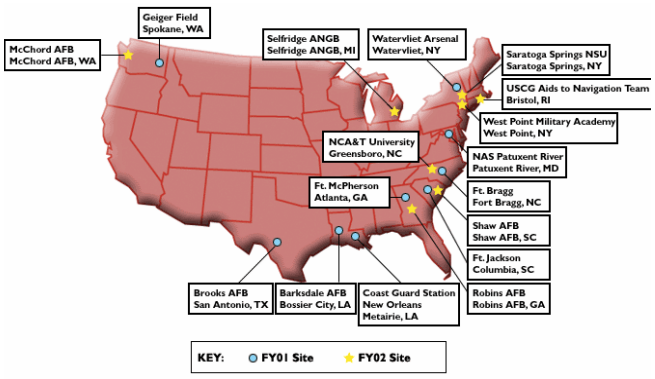
Proton Exchange Membrane (PEM) Fuel Cell Demonstration

See page C-1 for legend

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.

FY03 Performance Objectives:

- Award 5 FY02 contracts for 19 fuel cells at 8 military facilities.
- Install 19 fuel cells.
- Select sites for FY03 Program.
- Initiate 10 contracts to install 29 cells at 15 military installations.

FY03 Performance Review:

Met all performance objectives for FY03.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
PEM Fuel Cell R&D	4,289					
Total $(K):	4,289					

RDT&E BA3 (0603728 EM3)

Milestones/Accomplishments:

- In FY03, installed, monitored, and analyzed performance for 19 fuel cells.
- In FY03, received and evaluated 10 proposals to install 29 fuel cells at 15 DoD related sites. These fuel cells will operate for at least one year, and will be required to achieve at least 90% availability.
- By FY04, contract award and installation of fuel cells at selected sites.

Vanadium Technology Program

See page C-1 for legend

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).

Examples of Potential Army Applications

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.

FY03 Performance Objectives:

- Downselect demonstration projects from FY02 case studies
- Release Requested for Quotations (RFQs) for demonstration projects
- Select sources and award demonstration projects.
- Release Requested for Quotations (RFQs) for additional case studies in selected applications
- Hold an annual review of demonstration projects

FY03 Performance Review:

Met all performance objectives for FY03.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Contract oversight & supervision	135					
Tech. demonstration of Vanadium components	550					
Case studies to support technology transition	509					
Total $(K):	1,194					

RDT&E BA4 (0603779A EN7)

Milestones/Accomplishments:

- In FY03, evaluated, documented, and down selected 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).

Transportable Detonation Chamber Validation

See page C-1 for legend

Description:

Objective:

- To demonstrate operability and explosive safety of the proposed Donovan Blast Chamber (DBC) system.
- To demonstrate and validate the use of the 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, training, operations/ maintenance, test and data collection documentation for Phase I Demonstration/ Validation (Dem/Val) Test.
- Perform Phase I Dem/Val of the TC-25 at Defense Science and Technology Laboratory Salisbury, Wiltshire UK.
- Prepare Phase I Dem/Val test report.
- Conduct independent evaluations for safety effectiveness.
- Determine required equipment and procedural modifications for Phase II Dem/Val.
- Modify equipment and do Phase II. Results to be reviewed by independent evaluations.

How this project responds to need:

- To enhance the existing capabilities of the Non-Stockpile Chemical Materiel Program with the addition of this transportable destruction system.
- To expand the throughput and size weapon that can be processed on-site in a contained device.

Transportable Detonation Chamber System

FY03 Performance Objectives:

- Determine the data needs from the Phase I Dem/Val test.
- Conduct Phase I Dem/Val testing of the TC-25 Donovan Blast Chamber with actual CWM.
- Prepare Phase I Final Test Report.

FY03 Performance Review:

Met all performance objectives for FY03.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Independent Evaluation	112					
Safety/Environmental Test Evaluation	109					
Documentation, Data Collection, Test Support, Consumables and Equipment Shipment	1,443					
Demonstration/Validation Test Support of DBC	755					
Project Oversight, Equipment Operation, Air Monitoring and Technical Support	924					
Total $(K):	3,343					

RDT&E BA4 (0603779A E12)

Milestones/Accomplishments:

- In FY03, conducted Phase I Dem/Val with explosives and chemical agent.
- In FY03, initiated independent evaluations of the Phase I data.
- By FY04, complete independent evaluations of the Phase I data and conduct Phase II Dem/Val with chemical agents, explosives, and actual recovered chemical munitions.
- By FY05, complete independent test evaluation report and an independent safety analysis on the Phase II Dem/Val data.
- By FY05, demonstrate/validate sustained operation of the Transportable Detonation Chamber with recovered chemical warfare materiel.

Commercialization of Technologies to Lower Defense Costs Program

See Page C-1 for legend

Description:

Objective:

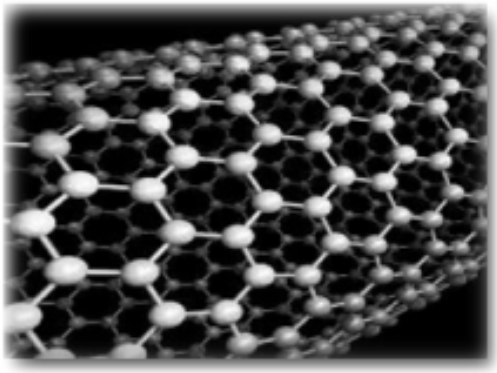
- Reduce the acquisition, operation, and maintenance costs of new emerging technologies to solve DoD environmental, safety, and occupational health (ESOH).
- Identify, evaluate, and commercialize all applicably developed technologies, materials, and processes into DoD use.
- Accelerate market penetration of ESOH targeted technologies.

Approach:

- Work with DoD stakeholders to target unmet need, including cost and timing stakeholder is willing to support for potential solutions.
- Search for technologies with the potential to meet those needs.
- Identify, assess and evaluate candidate technical solutions from private sector, university, and federal laboratories.
- Evaluate technology alternatives in a phased assessment process with the objective of concentrating commercialization efforts on strongest candidates for which dem/val and commercialization plans are developed.
- Use Pre-Commercialization Fund (PCF) fund to partially underwrite most promising dem/val candidates, especially for small, emerging enterprises to penetrate the federal procurement market.
- Assist technology developers transition and disseminate successfully confirmed technologies into DoD use.

How this project responds to need:

- A disciplined commercialization process that seeks suppliers of innovative technologies.
- Matches technical merits of these inventions with emerging DoD ESOH needs.
- Adopts and disseminates technologies into DoD to lower cost and improve sustainability.



Nanomesh Filtration, one of the technologies being validated under this program, is capable of eliminating 100% of all bacteria and other waterborne pathogens, without the use of chemicals or other additives

FY03 Performance Objectives:

- Conduct outreach and scouting to establish joint service ESOH needs.
- Identify candidate technical solutions from private sector, university, and federal laboratories.
- Process the most promising technical solutions through a disciplined assessment process to assure successful adoption into DoD and commercialization into a private sector supplier which will lower the acquisition cost to the military.

FY03 Performance Review:

- Project contract award pending second quarter of FY04.
- Sourced 66 technology candidates.
- Completed 55 exploratory technical investigations.
- Submitted 19 Phase 1 assessments.
- Transitioned 6 technologies to Phase 2 with 3 more in process.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Project Management	415					
Confirmation of DoD needs & Phase 1 Assessments	773					
Phase 2 Assessments	921					
Phase 3 Dem/Val & Commercialization	899					
Total $(K):	3,008					

RDT&E BA4 (0603779A 04F)

Milestones/Accomplishments:

- In FY03, identified a wide array of innovative technologies, which included a portable halogenated solvent and bio-threat detection systems, a nanomesh water purification system for deployed troops, and an ethanol removal process for waste streams.
- By FY04, 1) implement PCF tracking tool to improve fund allocations; 2) source/analyze 50+ technologies; 3) conduct 20+ assessments; and 4) dem/val 3+ technologies.

Casting Emission Reduction Program (CERP)

See page C-1 for legend

Description:

Objective:

Sustain 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 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 national objectives.

FY03 Performance Objectives:

- Establish baseline hazardous air emissions from five metal casting processes.
- Test seven low emitting binder products and compare them to baseline product emissions.
- Present CERP testing results at 8 industrial conferences.
- Assist Army/DoD facilities and warfighters in achieving Transformation goal of using lighter materials.

FY03 Performance Review:

Met performance objectives for FY03.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Metals Technology Research	2,341					
Emission Measurement Technology	578					
Results Dissemination	801					
Casting Requirements Forum	187					
Determine Casting Industry Contribution to DoD	302					
Improve the Quality of the Testing Process	625					
Reduced Weight Casting Technology Development	655					
Project Management	816					
Total $(K):	6,305					

RDT&E BA4 (0603779A EN1)

Milestones/Accomplishments:

- In FY03, completed baseline emissions for five metal casting processes and optimized two.
- In FY03, tested seven low emitting binder products and compared to baseline product emissions.
- In FY03, started field demonstration site for the development and testing of environmentally friendly core resin systems in a production facility. This highlighted DoD components' suppliers participation.
- In FY03, developed two new air emission collection procedures.
- In FY03, held industrial forum to better define requirements to sustain metal casting industry for DoD.
- In FY03, provided assistance to Rock Island Arsenal for their foundry modernization effort and initiated a joint research effort with Army Material Laboratory.

Unexploded Ordnance In Support of Military Readiness

See Page C-1 for legend

Description:

Objective:

- Coordinate with the Department of Defense (DoD) UXO Project Team to execute research and testing activities.
- Investigate & report on several areas related to munitions and explosives of concern (MECs):

–Active Electromagnetic Induction (EMI) Effects on Electronic Fuzes
–UXO Migration and Migration Chamber Testing
–UXO Neutralization and Remediation Technologies
–UXO Recovery Database and Hand-held Data Collection System
–Land Use Controls as a UXO Response Dual-Mode Navigation Tool
–Assessment of Munitions Design and Corrosion Susceptibility
–Enhanced Munitions Detectability Time and Cost Trade-off Tool

Approach:

- Team and coordinate with the Army Environmental Center (AEC), Aberdeen Test Center (ATC), U.S. Army Engineer Research and Development Laboratory (ERDC), Joint Unexploded Ordnance Coordination Office (JUXOCO), U.S. Army Engineering and Support Center, Huntsville, and other test centers to meet task requirements.
- Conduct literature reviews, develop a dual-mode tool, field deploy the UXO database, research shallow water and geological issues, research corrosion and low order detonation issues, and conduct UXO migration and detection research.

How this project responds to need:

- UXO is the number one U.S. Army AERTA restoration requirement. The UXO 2002 DERP Report to Congress estimates that total costs to address UXO risks at over 2,307 sites with known or suspected UXO contamination will range upwards of $165 billion.

UXO Migration Testing During FY03

FY03 Performance Objectives:

- Initiate the UXO FY03 program and maintain the NDCEE-led UXO Stakeholder Teams.
- Initiate surveying shallow water ranges and the environmental settings of munitions response areas (MRAs).
- Develop a UXO Recovery Database for field deployment through a hand held system.
- Assess and evaluate the potential for "surface migration" of buried UXO through field and chamber testing.
- Assess/evaluate munitions design and the rate of corrosion to prevent contamination from MECs.

FY03 Performance Review:

Met all performance objectives for FY03.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Program Management	340					
EMI effects on Electronic Fuses	236					
Shallow Water Assessment	361					
Survey of UXO Sites	349					
Dual-Mode Navigation Tool	514					
Electronic Database	290					
Environmental Chamber Migration Testing	308					
Munitions Design/Rate of Corrosion	343					
Dud Rates vs. Environmental Factors	308					
Enhanced Munitions Detectability	381					
Low Order Detonation Study	303					
Use of Old Ammo Inventory	175					
Tradeoff Tool	152					
Total $(K):	4,060					

RDT&E BA4 (0603779A EN6)

Milestones/Accomplishments:

- By FY04, assess and evaluate through testing the potential for "surface migration" of buried UXO.
- By FY04, assess and evaluate munitions design and rate of corrosion to prevent environmental contamination from MECs.
- By FY04, assess and evaluate dud rates, low order detonation rates, and use of old ammunition for avalanche control.
- By FY04, develop spreadsheet tool to assess time and cost tradeoffs associated with variety of UXO response scenarios.

Managing Army Technologies for Environmental Enhancements (MANATEE)

See page C-1 for legend

Description:

Objective:

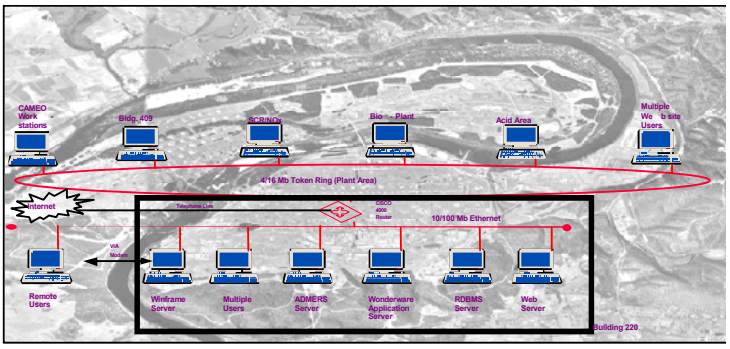
Enhance environmental compliance, pollution prevention (P2), process control, and security capabilities at Radford Army Ammunition Plant (RFAAP). Implement and integrate commercial off-the-shelf technologies into the existing RFAAP Environmental Management and Development Program (REDMAP).

Approach:

- Determine requirements, design systems, and implement technologies for:
  - –Permitted outfalls to the New River
  - –Reducing emissions from coal-fired power boilers
  - –Nitrogen oxide (NOx) removal
  - –Chemical recovery unit processes
  - –Environmental security.
- Integrate systems, including wireless hand-held (HH) devices, to existing real-time, web-based communications backbone.
- Identify/quantify ethanol losses plant-wide.
- Identify waste treatment technology alternatives and perform bench-scale biological treatment study for propellant materials to reduce reliance on open burning (OB).

How this project responds to need:

Implement/integrate real-time environmental sensor and communication technologies under MANATEE to improve/enhance environmental security and compliance, pollution prevention, conservation, and health and occupational safety for RFAAP.



At the heart of MANATEE is an Environmental Information System that supports an integrated modular local area network that connects over 55 sites across the facility

FY03 Performance Objectives:

Protect the New River watershed through environmental stewardship activities at RFAAP, the largest propellant producer in North America. This was a response to stricter environmental regulations.

FY03 Performance Review:

Met the performance objective for FY03.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Project Management	103					
Vertical Integration of REDMAP Information	656					
Air Pollution Control Systems Studies & Alternatives	27					
ESP Modifications	75					
Environmental Cost Analysis	74					
Pictorial Record	20					
Total $(K)	955					

RDT&E BA4 (0603779A EN3)

Milestones/Accomplishments:

- In FY03, implemented monitoring and control system at selective catalytic reduction (SCR) unit to reduce NOx emissions.
- In FY03, completed plant-wide ethanol mass balance, which quantified losses, and prepared preliminary design for upgrading ethanol distillation column to improve performance and reduce ethanol losses - saving $145K/yr.
- In FY03, upgraded control systems for ammonia pressures at tank farm, outfall 007, and powerhouse opacity monitor.
- By FY04, 1) implement/integrate wireless HH for improving process control and reducing wastes; implement/integrate environmental security system into REDMAP system; 2) complete cost benefit analysis for all REDMAP implemented modules and MANATEE programs; 3) identify compliance options & design emissions control upgrade for power boilers; and 4) identify & evaluate alternative waste treatment technologies to replace OB of waste propellants.

Environmental Response and Security Protection (ERASP) Program

See page C-1 for legend

Description:

Objective:

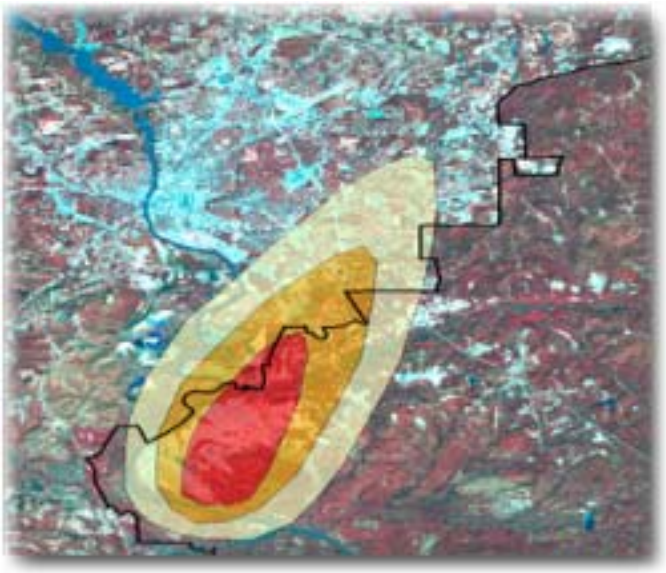
Develop and demonstrate Geospatial Risk Assessment Modeling System (GeoRAMS) for the assessment of sub-chronic health risks resulting from the release of toxic and industrial chemicals and materials (TICS and TIMS) through terrorist activities, accidental releases, or spills.

Approach:

- Form working group to address high priority model and database requirements fo methods to assess intermediate, sub-chronic health risks
- Select proposed site to develop, test and demonstrate geospatial modeling system
- Utilize and develop pertinent models and databases to assess risks associated with exposure to air, surface water, land/soil, and water supply systems that may be contaminated through a release.
- Incorporate models and databases into comprehensive modeling system ported to a geospatial reference.
- Validate ERASP by assessing "what if" release incidents in a realistic geospatial scenario.

How this project responds to need:

Provides readily available method for quickly assessing sub-chronic health risks from release of TICS and TIMS.



Example model output using colors to depict degrees of human health risk associated with deposition from an air release

FY03 Performance Objectives:

- Develop initial GeoRAMS modeling system.
- Develop preliminary demonstration of modeling system at Ft. Benning, GA.

FY03 Performance Review:

Met all performance objectives for FY03.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Model, model driver, and database development	1,326					
Comprehensive software system development	1,070					
Demonstration of modeling system	940					
Total $(K):	3,336					

RDT&E BA2 (0602720A F39)

Milestones/Accomplishments:

- In FY03, formed a group of experts to establish requirements to assess sub-chronic human health risks.
- In FY03, initiated development of models, model drivers, and databases for incorporation into comprehensive software modeling system (GeoRAMS).
- In FY03, initiated demonstration of GeoRAMS at Ft. Benning, GA.
- By FY04, finalize GeoRAMS modeling system for Ft. Benning, GA.
- By FY04, complete documentation for software use.

Technologies to Reduce Non-Hazardous Waste

See page C-1 for legend

Description:

Objective:

- The management and disposal of non-hazardous solid waste (NHSW) is a high priority issue within the DoD because of mounting volume, diminishing landfill capacity, and stringent environmental regulations.
- The Army has identified NHSW as its top pollution prevention mission need, prompted by E.O. 13101, and DUSD Pollution Prevention Measure of Merit Memorandum - 13 May 1998, which requires a 40% reduction of landfilled solid waste by 2005.

Approach:

- Characterize DoD waste streams, management practices, regulatory barriers, and disposal costs.
- Evaluate material recovery technologies for lead-based paint (LBP).
- Develop waste material diversion models by resale, conversion, and/or reuse in new construction.
- Identify, develop, and demonstrate technologies capable of rapid, on-site volume reduction, conversion, decomposition, and/or transformation of waste materials into useful products; achieve a diversion rate (from landfill and incineration) of greater than 40%.
- Demonstrate and validate the Bouldin & Lawson (B&L) proprietary waste conversion process performance on municipal solid waste.

How this project responds to need:

Provides technical outreach from lessons learned throughout the program while developing a GAP analysis of joint service agency needs for current and future solid waste issues and includes conferences, MACOM visits, and Information Exchanges. Helps determine military requirements for NHSW processing technologies while exploring diversion/disposal options, costs, and constraints. Provide collaboration with California State University and USACE-CERL during the deconstruction of buildings on the Fort Ord property to compile site planning, permitting, preparation, and contract structure data for the project.

Manual Deconstruction of Army Barracks at Ft. Ord, CA, to divert reusable construction materials from landfills

FY03 Performance Objectives:

- Demonstrate Auburn Industries' Wood Planning System for removal of LBP from wood siding and subsequent conversion to reusable products.
- Validate an interactive demolition waste estimating model.
- Conduct a full-scale demonstration of the B&L MSW process.
- Prove the marketable value of WWII-era wood products, validating the payback value of recovery vs full demolition.

FY03 Performance Review:

Met all performance objectives for FY03.

Program Schedule:

Milestone/Product	FY03	FY04	FY05	FY06	FY07	FY08
Program Management	152					
Future Awareness Activities	340					
Waste Tire Recycling	481					
Deconstruction Evaluation	650					
Total $(K):	1,623					

RDT&E BA4 (0603779A 04I)

Milestones/Accomplishments:

- By FY04, deliver a solid waste diversion technology transfer tool describing concepts, techniques, technologies, and equipment capable of reducing cost of solid waste handling and disposal; optimizing recycling and reuse in addition to P2.
- By FY04, deliver an interactive, multimedia training and educational tool for effectively implementing the recommended principles of solid waste management and landfill conservation developed by this project.
- By FY04, develop the first ever 15-year projection for future DoD-wide solid waste generation rates.

Appendix D

FY 2002 Army EQT (Planned FY 2003 Milestones)	FY 2003 Army EQT (Completed FY 2003 Milestones)	FY 2003 Army EQT (Technology Products)
Unexploded Ordnance (UXO) Identification and Discrimination		
✓ Provide technical and performance specifications for an optimized UXO detection/discrimination system.	✓ Established ordnance target repository.	✓ Established Ordnance Target Repository at the U.S. Army Aberdeen Test Center, Aberdeen, MD to distribute (loan) standard target sets to government, commercial, and academic UXO detection/ discrimination technology developers.
	✓ Determined performance specifications for an optimized UXO detection/discrimination system.	✓ Designed and fabricated prototype bench-scale multi-sensor handheld and man-portable systems. ✓ Developed and evaluated prototype navigation/visualization Ordnance Detection System with Hexamite Ultrasonic, GPS, Electronic Compass and real-time visualization. ✓ Fabricated prototype Sub-Audio Magnetic (SAM) receiver system. ✓ Developed simulations and algorithm development for new discrimination techniques using both electromagnetic induction (EMI) and ground penetrating radar (GPR); completed new instrument designs and design algorithms. ✓ Developed algorithms for total field magnetic (TFM) and time domain electromagnetic (TDEM) constrained, cooperative, and joint inversion. ✓ Developed software test bed for evaluating and testing TFM inversion and discrimination algorithms. ✓ UXO data acquisition/data analysis system (DAQ/DAS) base platform awarded to Geosoft Oasis Montaj and provided flexible import procedures, mapping, data management, and other utilities needed for DAQ/DAS. ✓ Developed "Guidelines for UXO Detection Survey Planning," currently in review. ✓ *Applied Computational Electromagnetics Society Journal*, "A fast forward model for simulating EMI scattering with realistic sensors and elongated objects", Volume 18, no. 4, pp. 97-106, 2003. ✓ Technical paper/presentation, "Dual mode UWB remote sensing and processing for enhanced subsurface discrimination and inversion," *Proc. Tyrrhenian International Workshop Remote Sensing*, pp. 283-295, 15-18 Sept 2003. ✓ Technical paper/presentation, "Model-based Inversion for Enhanced UXO Detection and Discrimination," *Proceedings of the Detection of Mines and Mine-like Targets Conference*, Aero Sense 2003, Society of Professional Optical Engineers (SPIE), pp. 959-969, Orlando, FL, 21-25 April 2003. ✓ Technical paper/presentation, "Fast direct and inverse EMI algorithms for enhanced identification of buried UXO with real EMI data," *Proceedings of the International Geoscience. & Remote Sensing. Symposium*, Vol 7, pp.4160-4162, Toulouse, 21-25 July 2003. ✓ Technical paper/presentation, "Analysis of GPR scattering by multiple subsurface metallic objects to improve UXO discrimination," *Proceedings of the International Geoscience. & Remote Sensing. Symposium*, Vol 7, pp.4163-4165, Toulouse, 21-25 July 2003. ✓ Technical paper/presentation, "Application of TSA formulation for inversion of a metallic object's electromagnetic properties from EMI data," *Proceedings of the International Geoscience. & Remote Sensing. Symposium*, Vol 6, pp.3860-3862, Toulouse, 21-25 July 2003. ✓ Technical paper/presentation, "Application of Bayesian inversion of scatterer shape from EMI data," *IEEE AP-S Int'l Symp. & USNC/CNC/URSI Nat'l Radio Sci. Mtg*, Columbus, OH, 22-27 June 2003. ✓ Technical paper/presentation, "Investigation of side looking EM field scattering from a buried metallic object to support UXO discrimination," *IEEE AP-S Int'l Symp. & USNC/CNC/URSI Nat'l Radio Sci. Mtg*, Columbus, OH, 22-27 June 2003. ✓ Technical paper/presentation, "Semi-analytical calculation of Jacobian in the electromagnetic inverse scattering problem," *IEEE AP-S Int'l Symp. & USNC/CNC/URSI Nat'l Radio Sci. Mtg*, Columbus, OH, 22-27 June 2003. ✓ Technical paper/presentation, "Application of Bayesian inversion of electromagnetic induction data for UXO discrimination," *Proceedings of Symposium Application Geophysical Engineering & Environmental Problems (SAGEEP),*pp. 1469-1478, San Antonio, TX, 6-10 April 2003.

FY 2002 Army EQT (Planned FY 2003 Milestones)	**FY 2003 Army EQT** (Completed FY 2003 Milestones)	**FY 2003 Army EQT** (Technology Products)
		✓ Technical paper/presentation, "Discrimination and classification of UXO using magnetometry: Inversion and error analysis using robust statistical norms," *Proceedings of Symposium Application Geophysical Engineering & Environmental Problems (SAGEEP),*, San Antonio, TX, 6-10 April 2003. ✓ Technical paper/presentation, "Joint and cooperative inversion of magnetic and time-domain electromagnetic data for the characterization of UXO," *Proceedings of Symposium Application Geophysical Engineering & Environmental Problems (SAGEEP)*, San Antonio, TX, 6-10 April 2003. ✓ Technical paper/presentation, "Interaction between highly conducting and permeable metallic objects in the low frequency EMI range," *Proceedings of Applied Computational Electromagnetics Symposium*, pp.625-631, Monterey CA, 24-28 Mar 2003. ✓ Technical paper/presentation, "Dealing with clutter in inversion and classification schemes," *Proceedings of the Detection of Mines and Mine-like Targets Conference*, Aero Sense 2003, Society of Professional Optical Engineers (SPIE), pp. 916-927, Orlando, FL, 21-25 April 2003. ✓ Technical paper/presentation, "Analysis of EMI scattering to support UXO discrimination: heterogeneous and multiple objects," *Proceedings of the Detection of Mines and Mine-like Targets Conference*, Aero Sense 2003, Society of Professional Optical Engineers (SPIE), pp. 928-939, Orlando, FL, 21-25 April 2003. ✓ Technical paper/presentation, "Model-based Inversion for Enhanced UXO Detection and Discrimination," *Proceedings of the Detection of Mines and Mine-like Targets Conference*, Aero Sense 2003, Society of Professional Optical Engineers (SPIE), pp. 959-969, Orlando, FL, 21-25 April 2003. ✓ Technical paper/presentation, "Analytical solutions for EMI scattering from general spheroids with application in signal inversion for UXO discrimination," *Proceedings of the Detection of Mines and Mine-like Targets Conference*, Aero Sense 2003, Society of Professional Optical Engineers (SPIE), pp. 1035-1045, Orlando, FL, 21-25 April 2003. ✓ Technical paper/presentation, "Automatic detection of position and depth for potential UXO using continuous wavelet transforms," *Proceedings of the Detection of Mines and Mine-like Targets Conference*, Aero Sense 2003, Society of Professional Optical Engineers (SPIE), Orlando, FL, 21-25 April 2003. ✓ Technical paper/presentation, "A hybrid time domain method to calculate electromagnetic induction scattering from targets with arbitrary skin depths," *Proceedings of Applied Computational Electromagnetics Symposium*, pp.390-396, Monterey CA, 24-28 Mar 2003. ✓ Technical paper/presentation, "Application of prolate spheroid solutions in simulation of EMI scattering with realistic sensors and objects," *Proceedings of Applied Computational Electromagnetics Symposium*, pp.531-537, Monterey CA, 24-28 Mar 2003. ✓ Technical paper/presentation, "A combined MAS-TSA algorithm for low frequency broadband electromagnetic induction problems," *Proceedings of Applied Computational Electromagnetics Symposium*, pp.566-572, Monterey CA, 24-28 Mar 2003. ✓ Technical paper/presentation, "Interaction between highly conducting and permeable metallic objects in the low frequency EMI range," *Proceedings of Applied Computational Electromagnetics Symposium*, pp.625-631, Monterey CA, 24-28 Mar 2003.
	✓ Initiated baseline demonstrations of existing technologies.	✓ Baseline technology field demonstrations for six UXO detection systems at the Standardized UXO Technology Demonstration Sites at Aberdeen Proving Ground (APG), MD, and Yuma Proving Ground (YPG), AZ. Scoring records for each system were generated for APG Blind Grid, Open Field, Moguls, and Wooded areas and for YPG Blind Grid, Open Field, Moguls, and Desert Extreme areas. • GEM-3 Cart • G-858 Cart • TM-4 Mag Sling • TM-5 EMU Handheld • EM61 Cart • EM61 Sling

FY 2002 Army EQT (Planned FY 2003 Milestones)	FY 2003 Army EQT (Completed FY 2003 Milestones)	FY 2003 Army EQT (Technology Products)
Hazard/Risk Assessment of Military Unique Compounds (MUC)		
✓ Complete and release version 1.1 of the Army Risk Assessment Modeling System (ARAMS) with process descriptors for range compounds (propellants, smokes, and illuminants) fate and transport, terrestrial explosives uptake, and expand fate and transport and toxicology databases.	✓ Released version 1.1 of the ARAMS with process descriptors for range compounds (propellants, smokes, and illuminates) fate and transport, terrestrial explosives uptake, and expand fate/transport and toxicology databases.	✓ Released version 1.1 of the Army Risk Assessment Modeling System (ARAMS) including demonstrations at Military Sites • Massachusetts Military Reservation in support of the Army National Guard Bureau and Army Environmental Center. • ACOM-ARDEC (Rangesafe environmental program). • United States Military Academy, West Point. • Langley Air Force Base • Pueblo Chemical Depot ✓ Developed "Trophic Trace" enabling capability to trace contaminant transfer through food chains and RAMAS Ecorisk for population level assessments. Tools were transferred through linkage to the ARAMS platform beginning with version 1.1. ✓ Revised Toxicity Wildlife Exposure Model (TWEM, version 2) and the Spatially Explicit Exposure Model (SEEM) for wildlife. ✓ Integrated into ARAMS the DoD Range Database for physicochemical properties and toxicity reference values of explosives, propellants, smokes illuminants, and other range compounds. ✓ Developed trophic transfer factors for TNT in freshwater systems. ✓ Developed "Decision Analysis Review and Methodology for Contaminated Sites." ✓ Evaluated and documented TNT, RDX, HMX, DNT toxicity to fish. ✓ Integrated new data parameters into EPA's Ecotox database for military unique compounds. Ecotox will be used as core data for screening media concentrations within ARAMS. ✓ Developed Source term fate and transport model for explosives and UXO and validated through peer review acceptance and integration into ARAMS platform. Models and parameters are being integrated into ARAMS modules. ✓ Established linkage to populate Environmental Residue-Effects Database (ERED) with current and future publications describing toxicology data for MUCs. Results published in *Environmental Toxicology and Chemistry* in three separate peer reviewed technical articles. ✓ Developed Terrestrial Toxicity Database (TTD) for SEEM/TWEM and integration into ARAMS. ✓ Developed framework for addressing uncertainty in Risk Projection. ✓ *Journal of Contaminant Hydrology* , "An exploratory approach to modeling explosive compound persistence and flux using dissolution kinetics," Volume 66, Issues 3-4, pp. 147-159, November 2003. ✓ *Journal of Contaminant Hydrology,* "An exploratory approach to modeling explosive compound persistence and flux using dissolution kinetics," Volume 66, Pages 147-159, November 2003. ✓ *Society of Toxicology*, "Developmental Toxicity of Thiodiglycol in Rats," Volume 72, Number S-1, March 2003. ✓ *Environmental Toxicology and Chemistry* , "Dietary Oral Exposure to 1,3,5-trinitro-1,3,5-triazine in the northern bobwhite (Colinus virginianus)," Vol. 22, No. 2, 2003. ✓ *Environmental Toxicology and Chemistry* , "Dietary Oral Exposure to 1,3,5-Trinitro-1,3,5-Triazine in the Northern Bobwhite (Colinus Virginianus)," Vol. 22, No. 2, 381-387, 2003. ✓ Technical paper/presentation, "Differential gene expression of Caenorhabditis elegans when exposed to 2,4,6-Trinitrotoluene (TNT)," SETAC 23rd Annual Meeting Abstract Book, 16-20 November 2002. ✓ Technical paper/presentation. "RDX Degradation Product Toxicity Screening: Algal and Bacterial Assays," SETAC 23rd Annual Meeting Abstract Book, 16-20 November 2002. ✓ Developed software: Spatially Explicit Exposure Module (SEEM), Version 1.0, Nov 2002. ✓ Published *TrophicTrace User's Manual: A Tool for Assessing Risks from Trophic Transfer of Sediment-Associated Contaminants*, 2003.

FY 2002 Army EQT (Planned FY 2003 Milestones)	FY 2003 Army EQT (Completed FY 2003 Milestones)	FY 2003 Army EQT (Technology Products)
Enhanced Alternatives and In Situ Treatment Technologies for Explosives and Organics in Groundwater		
✓ Optimize in situ bioremediation scheme for explosives and organics in groundwater.	✓ Optimized in situ bioremediation scheme for explosives and organics in groundwater.	✓ *J. Chem. Technol. Biotechnol.*, "RDX biodegradation column study: Influence of ubiquitous electron acceptors on anaerobic biotransformation of RDX," 78(10), 1082-1092, 2003. ✓ ERDC Technical Report, "Biologically Active Zone Enhancement (BAZE) Supplemental Study: Mass Balance of RDX Biotransformation and Influence of Aquifer Temperature on RDX Biodegradation in Groundwater," ERDC/EL TR-03-11, U.S. Army Engineer Research and Development Center, Vicksburg, MS, 2003. ✓ ERDC Technical Report, "Influence of Ubiquitous Electron Acceptors on In Stiu Anaerobic Biotransformation of RDX in Groundwater", ERDC/EL TR-03-17, U.S. Army Engineer Research and Development Center, Vicksburg, MS, 2003. ✓ Technical paper/presentation, "Biologically induced in situ reductive transformation of RDX groundwater: A treatability study," *Seventh International In-Situ and On-Site Bioremediation Symposium.* Battelle Press, Columbus, OH, 2003. ✓ Technical paper/presentation, "Analysis of RDX and RDX breakdown products in environmental samples," *Division of Environmental Chemistry, 225th American Chemical Society National Meeting*, New Orleans, LA, 2003. ✓ Technical paper/presentation, "Anaerobic bioremediation of RDX contaminated groundwater at the Former Nebraska Ordnance Plant," *Southern States Environmental Conference and Exhibition*. Biloxi, MS, 2003.
Innovative In Situ and/or On-site Ex Situ Treatment Technologies for Soils Contaminated with Inorganics		
✓Develop cost/benefit evaluation manuals for lead stabilization/extraction technologies for small arms ranges.	✓ Developed cost/benefit evaluation manuals for lead stabilization/ extraction technologies for small arms ranges.	✓ First Patent awarded, "COE-557, Bullet Trapping Medium and System," serial no. 10/307,427. ✓ *Public Works Digest*, "Using Ferns for Arsenic Removal at Picatinny Arsenal," Vol XIV, No.3, pp 21-22. ✓ Book Chapter, *Phytoremediation: Degradation and Control of Contaminants*, "Plant Tolerances to Contaminants and Implications for Phytoremediation,"Wiley Interscience, Inc. ISBN 0-471-39435-1. pp. 173-214, 2003. ✓ Book Chapter, *Phytoremediation: Degradation and Control of Contaminants*, "Phytoremediation of munitions in water: pathways, kinetics, pilot investigations, and limitations in the field," Wiley Interscience, Inc. ISBN 0-471-39435-1. pp. 429-480, 2003. ✓ ERDC Technical Report, "Chemical Stabilization of Lead in Small Arms Firing Range Soils", ERDC/EL TR-03-20, 2003. ✓ Technical paper/presentation, "Enhanced Pilot-Scale Remediation of Chromium by Electrokinetics," 4th International Conference on Environmental Geotechnics, Brazil Summer 2003. ✓ Technical paper/presentation, "Phyto-Engineering of Arsenic Contaminated Soil With Brake Fern at Picatinny Arsenal," ITRC Conference, Chicago, IL, February 2003. ✓ Technical paper/presentation, "Enhancement of Perchlorate Analysis Using Solid Phase Extraction (SPE) Cartridges," Symposium on Perchlorate Contaminated Groundwater, Groundwater Research Associates of California, Sacramento, CA, 2003.

FY 2002 Army EQT (Planned FY 2003 Milestones)	FY 2003 Army EQT (Completed FY 2003 Milestones)	FY 2003 Army EQT (Technology Products)
Characterization, Evaluation, and Remediation of Distributed Source Contamination (UXO-C) on Army Ranges		
✓No program milestones scheduled in FY 2002. (FY03 new start)	✓ Defined program goals to relate research technologies to range management applications.	✓ *Chemosphere*, "TNT particle size distributions from detonated 155-mm howitzer rounds", December 19, 2003. ✓ Developed Guidance document for "Point Source Energetics Detection Sensor Evaluation: Initial Report," 2003. ✓ ERDC Technical Report, "Proposed Development of a Multi-Dimensional Physically-Based Distributed Sources Watershed Assessment Model," 2003. ✓ ERDC Technical Report, "Topical Lime Treatment for Containment of Source Zone Energetics Contamination," ERDC/EL TR-03-19, USA-ERDC, Vicksburg MS, 2003. ✓ ERDC Technical Report, "Lime Treatment of 2,4,6-Trinitrotoluene Contaminated Soils: Proof of Concept Study," ERDC/EL TR-03-15, USA-ERDC, Vicksburg MS, 2003.
Long Term Monitoring for Military Unique Compounds		
✓ No program milestones scheduled in FY 2002. (FY03 new start)	✓ Evaluated/selected technologies to customize for Military Unique Compounds (MUC).	✓ Held technologies workshop with users and researchers and produced proceedings of technologies workshop, Jan 2003. ✓ Identified COTS/GOTS for applicability to Long Term Monitoring
	✓ Developed analytical methods for perchlorate and nitrocellulose (NC) in soil.	✓ Optimized ion chromatography method for detection of perchlorate. ✓ Contributed to DoD comments on EPA's perchlorate method. ✓ Developed selective differential solubility method for determination of nitrocellulose. ✓ Identified sources of firing point soils for determination of nitrocellulose.
	✓ Developed quality assurance (QA) protocols for field analysis.	✓ Identified essential quality assurance parameters for definitive data. ✓ Proposed modified quality assurance practices for field analytical methods. ✓ Guidance document, "Technical and Regulatory Guidance for the Triad Approach: A New Paradigm for Environmental Project Management", contributed, document in review to be published. ✓ Technical paper/presentation, "U.S. Army Corps of Engineers Focus on Long Term Monitoring," 19th Annual National Environmental Monitoring Conference, Washington, DC, 2003.
Particulate Matter (PM)/Dust Control		
✓ Develop source characterization technologies and chemical/physical PM mitigation.	✓ Completed draft technology verification reports detailing the long-term performance of palliatives applied to unsurface roads at Fort Leonard Wood to ascertain potential environmental effects from palliative application.	✓ Environmental Technology Verification (ETV) reports detailing the results of the dust palliative study as part of the USEPA ETV program, in review. ✓ *Federal Facilities Environmental Journal*, "New method to measure control performance of dust palliatives on unpaved roads at federal facilities," Volume 14, pp. 23-33, 2003.
	✓ Completed High Mobility Multipurpose Wheeled Vehicle (HMMWV) engine usage field tests and engine exhaust emission testing for PM, the polycyclic aromatic hydrocarbon components of the PM, and gaseous criteria air pollutants.	✓ Conducted High Mobility Multipurpose Wheeled Vehicle (HMMWV) engine usage field tests and engine exhaust emission testing for PM, the polycyclic aromatic hydrocarbon components of the PM, and gaseous criteria air pollutants. Technical report details results of HMMWV engine usage and emission testing, in review. ✓ Technical paper/presentation, "Tailpipe Emission Estimation for Army Off-Road Sources," *Proceedings of the 2003 Real World Clean Air Symposium*, Seattle WA, 19-22 May 2003.
	✓ Developed source characterization technologies and chemical/physical PM mitigation technologies.	✓ Technical paper/presentation, "Particulate Matter/Dust Control and Measurement Tools for Ranges and Training," *Ranges and Training Land Program (RTLP) Symposium 2003*, Hampton, Virginia, 6-8 May 2003.

FY 2002 Army EQT (Planned FY 2003 Milestones)	FY 2003 Army EQT (Completed FY 2003 Milestones)	FY 2003 Army EQT (Technology Products)
Training and Testing Range Noise Control		
✓ Investigate noise mitigation and modeling techniques for new weapons.	✓ Completed analysis of basic research on the feasibility of using blast noise absorbers for large weapon firing positions, for which standard noise attenuation techniques are not feasible.	✓ *Noise Control Engineering Journal,* Six peer-reviewed journal articles published in a special issue of Vol. 50, No. 6, Nov.-Dec. 2002. • "Shock wave reflection measurements on porous materials" • "High Amplitude pulse propagation and reflection form a rigid porous layer" • "Simulations of follows in porous media with a flux corrected transport method" • "Numerical simulations of strong shocks" • "Reduction of blast noise by a snow cover" • "Absorption of blast sound close to the source"
	✓ Obtained field noise training data for large caliber guns (artillery and main tank). Data will be used to improve noise modeling and mitigation.	✓ Developed noise assessment software applications to assess and mitigate noise impacts on range operations, distributed and in use.
Hazardous Air Pollutant (HAP) and Volatile Organic Compound (VOC) Emission Control		
✓ Demonstrate hazardous organic solvent emissions technologies to remove 95% of HAPs and 20% cost reduction (baseline – 10,000 cfm unit at $65/cfm).	✓ Tested zero emission chromium electroplating system at Anniston Army Depot and met OSHA and NESHAPs requirements (e.g., chromium<0.015 mf/dscm).	✓ Tested zero emission Chromium Electroplating process at Anniston Army Depot, AL, and met all NESHAP and OSHA emission requirements.
	✓ Successfully developed and tested the Mercury Continuous Emission Monitor (CEM) at an EPA sponsored site.	✓ Tested Mercury CEM on a coal fired boiler with encouraging results so it can be tested at an Army installation for demilitarization furnaces and coal boilers.
	✓ Conducted a variety of tests on hazardous organic solvent emissions technologies designed to remove 95% of HAPs and 20% cost reduction (baseline -10,000 cfm unit at $65/cfm).	✓ Developed Activated Carbon Fiber Cloth Vapor Recovery System. This new system, which combines adsorption, desorption, and recovery in the same vessel, results in a very efficient and economical electrothermal regeneration control/recovery system for hazardous organic solvents generated during weapon system and vehicle painting operations for Chemical Agent Resistant Coating [CARC] and W959. When combined with the Mobile Zone control system, the total system efficiency for rises to 99%, which far exceeds 81% required by the NESHAP. ✓ Developed pilot Rotating Drum Biofilter at Iowa AAP for paint drying operation. This new technology reduces excess biomass buildup, that typically clogs systems, by providing an even distribution of nutrients, VOC's and the biomass itself. The result is a very cost effective and reliable system suitable for low VOC loading rate applications.
Improved Treatment Techniques for Wastewaters from Munitions Production		
✓ Complete protocol for energetic compound biological treatment under anaerobic conditions and transfer results to field.	✓ Completed protocol for energetic compound biological treatment under anaerobic conditions and transfer results to field.	✓ ESTCP Cost and Performance Report, "Mineralization of TNT, RDX By-Products in an Anaerobic Granular Activated Carbon-Fluidized Bed Reactor, April 2003. ✓ System transferred to McAlester Army Ammunition Plant, OK, as part of their normal daily operations.
Sustainable Army Live-Fire Range Design and Maintenance		
✓ No planned program milestones in FY03.	✓ Completed study design (placement and design criteria) for water quality monitoring to measure training impacts on newly constructed ranges.	✓ Report documenting water quality study design for measuring baseline and cumulative effects on training at Camp Atterbury, IN, for the new multipurpose training range (MPTR). ✓ Report documented security technology review of 244 security companies and their technologies for applicability to range needs. ✓ Developed searchable database of vendor, technology type, product, and applicability to training ranges.

FY 2002 Army EQT (Planned FY 2003 Milestones)	FY 2003 Army EQT (Completed FY 2003 Milestones)	FY 2003 Army EQT (Technology Products)
Removal, Treatment and Disposal Technologies for Lead-Based Paint (LBP) Contamination		
✓ Demonstrate lead hazard removal technologies for buildings that result in non-hazardous waste that leaches less than 5 parts per million (ppm) lead and produces no hazardous pollutants.	✓ Demonstrated lead hazard removal technologies for buildings that result in non-hazardous waste that leaches less than 5 ppm lead and produces no hazardous pollutants.	✓ ERDC Technical Report, "Technology Demonstration of Thermal Spray Vitrification Process at Fort Drum, NY," ERDC/CERL-TR-03-4, January 2003. ✓ ERDC Technical Report, "Technology Demonstration of Nontoxic Chemical Stripper for Steel," ERDC/CERL-CR-03-1, January 2003. ✓ ERDC Technical Report, "Overcoating of Lead-Based Paint on Steel Structures," ERDC/CERL TR-03-5, March 2003. ✓ ERDC Technical Report, "HALO Management System Demonstration of Lead Hazard Management Plan Generation," ERDC/CERL-SR-03-1, March 2003. ✓ ERDC Technical Report, Technology Assessment of Liquid Encapsulants for Lead-Based Paint Abatement," ERDC/CERL-TR03-Draft, March 2003. ✓ ERDC Technical Report, Technology Demonstration of a Microwave Assisted Paint Lead-Based Paint Removal Process, ERDC/CERL-TR03-Draft, July 2003. ✓ ERDC Technical Report, "Technology Demonstration of Wet Abrasive Blasting for Removal of Lead- and Asbestos-Containing Paint," ERDC/CERL-TR03-Draft, August 2003. ✓ ERDC Technical Report, "Technology Demonstration of Membrane Chemical Strippers for Removal of Lead-Based Paint on Plaster," ERDC/CERL-TR-03-Draft, September 2003. ✓ ERDC Technical Report, Technology Demonstration of Self-Healing Coatings for In-Place Management of Lead Based Paint Hazards, ERDC/CERL-TR03-Draft, September 2003.
✓ Develop a decision tree for lead hazard control on steel structures based on field demonstrations for optimum selection of cost effective technologies.	✓ Developed a decision tree (for lead hazard control on buildings) based on field demonstrations for optimum selection of cost effective technologies.	✓ ERDC Technical Report, "Decision Tree for Lead-Based Paint Hazard Control and Abatement for Steel Structures," ERDC/CERL TR-03-3, January 2003. ✓ ERDC Technical Report, "Decision Tree for Lead-Based Paint Management on Buildings," ERDC-CERL-TR03-Draft, June 2003. These and other reports available http://www.cecer.army.mil/pl/painterl
Sustainable Painting Operations for the Total Army (SPOTA)		
✓ Finalize a baseline of materials and processes that will be affected by NESHAPs.	✓ Completed baseline assessments (painting efforts of materials and processes) at 14 military facilities.	✓ Evaluated two products with enhanced corrosion resistance that exceed performance of MIL-P-53030 water based primer. ✓ Paper/technical presentation titled "Sustainable Painting Operations for the Total Army (SPOTA)" on February 11, 2003 for the U.S. Army Corrosion Summit, Clearwater Beach, Florida. View at www.armycorrosion.com. ✓ Military Specification implemented: • Ammo spec, MIL-DTL-11195G July 2003. • Application document for CARC includes all HAP free updates and products, MIL-C- 53072, June 2003. ✓ For the CARC family of coatings, 699 production batches representing 719,000 gallons of paint with zero or reduced HAP and Low VOC were validated for both water and solvent based chemical agent resistant product applications and used by end user. ✓ Approved 18 Qualified Product Lists (QPLs) for new zero-Hazardous Air Pollutant (HAP) products and 4 experimental samples with zero HAPs and enhanced durability. Each QPL can represent hundreds of batches. ✓ Army response to Baseline Assessment & Technology Gap Assessment.
✓ Develop and staff test protocols to begin technology development, qualification, validation and approval for all materials.	✓ Developed solvent substitution methodology with Joint Solvent Substitution Working Group.	✓ Established Charter and Distribution Listserve for protocol review for Army Solvent Substitution Working Group (ASSWG). ✓ Developed Joint Services Solvent Substitution Working Methodology, in review.
	✓ Identified Army handwipe cleaning requirements and immersion cleaning requirements	✓ Developed Army handwipe cleaning requirements document, in review. ✓ Developed Army immersion cleaning requirements document, in review.

FY 2002 Army EQT (Planned FY 2003 Milestones)	**FY 2003 Army EQT** (Completed FY 2003 Milestones)	**FY 2003 Army EQT** (Technology Products)
Solid Waste Diversion		
✓ Investigate implications of lead coated components on masonry structures in reuse/recycle technologies.	✓ Conducted initial sampling analysis and analysis of lead paint on concrete in Army family housing and wood siding on WWII barracks.	✓ Technical paper/presentation, "ALTERNATIVES TO DEMOLITION Opportunities to Deconstruct, Reuse, & Recycle Materials from Army Building, (DoD Deconstruction Training)," Joint Services Annual Solid Waste and Recycling Conference, September 2003. ✓ Technical workshop, University of Florida Center for Construction and the Environment 11th Annual International Rinker Conference, May 2003 • Fort McClellan Mechanical Deconstruction • LEAD-BASED PAINT: An Introduction to the Issues • Options for the Reuse, Recycling, and Disposal of Building Materials Coated with Lead-Based Paints • Deconstruction at Fort Campbell; A Pilot Project ✓ Technical paper/presentation, "Fort Campbell Pilot Deconstruction Project and other C&D Debris Diversion Research," U.S. Green Building Council '03 session #204, 2003. ✓ Technical paper/presentation, "Recovery of Lead-Based-Painted Building Materials into High-Value Products," U.S. Green Building Council '03, 2003. ✓ *Recycling Today Online*, "Crushers Filled with Unleaded," 2003-08-20, http://www.recyclingtoday.com/News/news.asp?Id=4491, 2003. ✓ ERDC Technical Report, "Wood-framed Building Deconstruction," ERDC-CERL –TR-03-XX, in review. ✓ ERDC Technical Report, "Semi-Mechanized Deconstruction of Wood Framed Buildings," ERDC-CERL-TR-03-XX, in review. ✓ Developed Course "CEE 398 Sustainability In Housing," University of Illinois, Department of Construction And Environmental Engineering. ✓ *Federal Facilities Environmental Journal,* "Deconstruction and Reuse: Return to True Resource Conservation and Sustainability," Autumn 2003.
	✓ Leveraged technologies/processes to recycle/reuse concertina wire, scrap rack, and tires and eliminated focus area from program scope.	✓ Conducted preliminary investigations and identified technology to satisfy user need and eliminated research focus area.
	✓ Continued assessment of salvage building materials from Badger AAP, WI.	✓ Draft Forest Products Laboratory Research Report "Building Deconstruction and Lumber Salvage at Badger Army Ammunition Plant: An Opportunity for Responsible Building Material Reuse" Department of Agriculture, U.S. Forest Service, Forest Products Laboratory, Madison WI. Set for June 2004 publication) available on web www.fpl.fs.fed.us under Publications link**.**
	✓ Prepared a Army public works technical bulletin (PWTB) on concrete reuse, Army deconstruction manual and a report on interaction of energetics with structural materials.	✓ Public Works Technical Bulletin 200-1-27, "Reuse of Concrete Materials from Building Demolition," September 2003. ✓ *Deconstruction Manual for Military Installations*, Kentucky Pollution Prevention Center, 2003. ✓ ERDC Technical Report, "Effect of Energetics on Structural Materials," ERDC-CERL-TR-03-XX, in review.
✓ Investigate lamination and coextrusion technologies for nanocomposite materials.	✓ Optimized polymer/clay compatibility for polyhydroxyalkanoates (PHA), a biodegradable polymer.	✓ Processed PHA nanocomposite films using twin-screw extrusion techniques and analyzed by X-ray diffraction and transmission electron microscopy. ✓ Technical paper/presentation, "A Processing and Characterization Study of a Biodegradable Nanocomposite", Materials Research Society, December 2003. ✓ Technical paper/presentation, "Effect of Coupling Agent on the Dispersion of PETG Montmorillonite Nanocomposite Films", Materials Research Society, December 2003. ✓ Technical paper/presentation, "Polymer/Montmorillonite Layered Silicate Nanocomposites for Military Food Ration Applications, Partners in Environmental Technology Symposium & Workshop, December 2003.

FY 2002 Army EQT (Planned FY 2003 Milestones)	FY 2003 Army EQT (Completed FY 2003 Milestones)	FY 2003 Army EQT (Technology Products)
Compliant Ordnance Lifecycle for the Readiness of the Transformation and Objective Forces (formerly Ordnance Manufacture, Maintenance, Use, and Surveillance to Enable Sustainable Ranges)		
✓ Demonstrate technology to replace BaNO3 and DPA (toxic propellant ingredients) with non-toxic nano-structured additives to formulations.	✓ Identified nano-energetic materials technology to increase thermal conductivity to propellant eliminating BaNO3 as toxic ingredient.	✓ Performed chemical characterization of these materials. ✓ Identified carbon nano-tube structures that may be chemically functionalized with amine groups that can replicate the behavior of DPA allowing for its replacement. ✓ Developed new nano-energetics methodology to synthesize replacement ingredients & characterize ingredients using Atomic Force instrumentation. ✓ Technical paper/presentation, "Spherulite Structures of ETPES," JANNAF PDCS Meeting, Charlottesville, VA, March 2003. ✓ Technical paper/presentation, "Mechanical Properties of Thin Disk Propellants", JANNAF PDCS Meeting, Charlottesville, VA, March 2003. ✓ Technical paper/presentation, "Ultra-High Resolution Imaging of Energetic Modifiers, ", JANNAF PDCS Meeting, Charlottesville, VA, March 2003.
Reduce/Eliminate Pollution for Compliant Plating Processes		
✓ Begin conducting vented combustor tests to expose lab samples to the firing environment to solve final adhesion challenges.	✓ Began vented combustor (VC) tests.	✓ Tests validated that an interlayer of environmentally-friendly sputtered chromium will greatly enhance the adhesion of an erosion-resistant tantalum top-coat to the steel gun barrel material. Successful simulation of one hundred vented combustor shots.
✓ Demonstrate electroplated chrome alternative for medium caliber gun barrels through test firings.	✓ Demonstrated electroplated chrome alternative medium caliber gun barrels through test firings.	✓ Demonstrated difficulty with using physical vapor deposition (PVD)-based processes for smaller ID barrels (under 45mm). Larger gun barrels have been more successful using PVD-based erosion mitigating technologies.
✓ Model the cylindrical magnetron sputtering system and increase fundamental understanding for target development for larger gun barrel applications.	✓ Expected to complete milestone in FY04. (Basic research precluded transition in FY03.)	✓ Extensive modeling has yielded increased knowledge of the process and has enhanced large caliber application of the technology. ✓ Patent Disclosure #2002-020 was submitted.
✓ Transition results of biomimetic process of ceramics to Army Lightweight Soldier/Ballistic Protection Science and Technology Objective (STO).	✓ Published technical report on *Biomimetric Processing of Ceramics*. (Basic research precluded transition in FY03.)	✓ Investigated fundamental research of biomimetic processing of ceramics. ✓ Published technical report on *Biomimetic Processing of Ceramics*, January 2003.
Reducing Impacts of Threatened and Endangered Species (T&ES) on Military Readiness		
✓ Complete population viability analysis tools for T&ES.	✓ Completed identification of risk parameters for possible chemical hazards to T&ES.	✓ ERDC Technical Report, "Mitigate Invasive Species Effect on T&E Species", ERDC-CERL-TR-03-XX, in review. ✓ ERDC Technical Report, "Procedures for Delisting Species Pursuant to the Endangered Species Act", ERDC-CERL-TR-03-XX, in review.
Maintain Readiness by Improving Threatened and Endangered Species Monitoring Capabilities (formerly Baseline T&ES Surveys and Monitoring)		
✓ Develop a set of protocols for identifying viable T&ES populations and habitat.	✓ Develop a set of protocols for identifying viable T&ES populations and habitat. ✓	✓ ERDC Technical Report, "Procedures for Developing Population Viability Analysis," ERDC-CERL-TR-03-XX, in review.
Land Capability/Characterization		
✓ Develop ATTACC protocols that incorporate scientific improvements in wind erosion and soil compaction factors.	✓ Developed ATTACC protocols that incorporate scientific improvements in wind erosion and soil compaction factors.	✓ *Journal of Arid Environments* , "Wind Erosion From Military Training Lands in the Mojave Desert, California," in press. ✓ *Transaction in GIS* , "Spatial Simulation and Fuzzy Threshold Analyses for Allocating Restoration Areas," in press. ✓ *Journal of Geographic Information and Decision analysis*, "Integrating Multi-criteria Analysis and GIS for Land Condition Assessment: Part I," Volume 6(1), pp.1-16, 2003. ✓ *Journal of Geographic Information and Decision analysis*, "Integrating Multi-criteria Analysis and GIS for Land Condition Assessment: Part II," Volume 6(1) pp.17-30, 2003.

FY 2002 Army EQT (Planned FY 2003 Milestones)	**FY 2003 Army EQT** (Completed FY 2003 Milestones)	**FY 2003 Army EQT** (Technology Products)
Land Rehabilitation		
✓Enhance capability to select and emplace cost-effective control.	✓ Developed prioritized protocol for optimizing revegetation and structural erosion control actions.	✓ Developed initial version of a land rehabilitation prioritization model. ✓ Demonstrated initial version of an erosion control technology selection tool.
Non-Native Invasive Species Control for Army Installations & Operations		
✓ Analyze results, across experimental sites, to determine impact of knapweed biocontrol agents.	✓ Analyzed results, across experimental sites, to determine impact of knapweed biocontrol agents.	✓ Analyzed results, across experimental sites, to determine impact of knapweed biocontrol agents. • Documented long-term establishment and survival of knapweed biocontrol agents across multiple experimental sites. • Documented significant negative effects of biocontrol agents on knapweed abundance and vigor.
Electrokinetic Remediation of Contaminated Soils (U.S./German DEA Project)		
✓ Science Advisory Board (SAB) meet to review electrokinetic (EK) system final design and visit demonstration site to observe construction in October 2002.	✓ SAB reviewed final design, visited project site, observed construction, and monitored operational status via teleconference.	✓ Demonstrated full scale continuous operation of EK system for removal of cadmium (Cd), chromium (Cr), and Lead (Pb) from range soil at Bergen, Germany. Operating parameters (voltage, current, and amendment addition) were similar to laboratory tests and electrical, hydraulic, and pH-adjustment working well.

Appendix E

AAP	Army Ammunition Plant
ACFC	Activated Carbon Fiber Cloth
ACSIM	Assistant Chief of Staff for Installation Management
AD	Army Depot
AEC	Army Environmental Center
AEPI	Army Environmental Policy Institute
AERTA	Army Environmental Requirements and Technology Assessments
AFB	Air Force Base
AMC	U.S. Army Materiel Command
AP	Ammonium Perchlorate
APG	Aberdeen Proving Ground
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 Point
ASSWG	Army Solvent Substitution Working Group
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
ATC	Aberdeen Test Center
B&L	Bouldin and Lawson
BaNO3	Barium Nitrate

BA	Budget Activity
BAZE	Biologically Active Zone Enhancement
BMP	Best Management Practices
BNOISE	Blast Noise Model
BPR	Business process reengineering
BRAC	Base Realignment and Closure
Cd	Cadmium
Cr	Chromium
CAA	Clean Air Act or Center for Army Analysis
CAAA	Clean Air Act Amendments
CARC	Chemical Agent Resistant Coating
CCAD	Corpus Christi Army Depot
CCEC	Coatings and Coating Equipment Center
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
CFC	Chlorofluorocarbon
CHP	Certified Health Professional
CHPPM	Center for Health Promotion and Preventive Medicine, U.S. Army
CMS	Cylindrical Magnetron Sputtering
CMU	Concrete Masonry Unit
COE	U.S. Army Corps of Engineers
CON	Conservation
COM	Compliance

COTS	Commercial Off-The-Shelf
CRADA	Cooperative Research and Development Agreement
CSC	Corrosion Service Center
CTC	Cost to Complete
CVIR	Cost Avoidance to Total Investment Ratio
CWA	Clean Water Act
CWM	Chemical Warfare Materiel
DA	Department of the Army
DAQ	Data Acquisition
DAS	Data Analysis System
DASA	Deputy Assistant Secretary of the Army
DBC	Donovan Blast Chamber
Dem/Val	Demonstration/Validation
DEA	Data Exchange Agreement
DEER2	Demanufacturing of Electronic Equipment for Reuse and Recycling
DENIX	Defense Environmental Network and Information Exchange
DEP	Director, Army Environmental Programs
DERP	Defense Environmental Restoration Program
DfE	Design for the Environment
DISC4	Director of Information Systems for Command, Control, Communications and Computers
DLA	Defense Logistics Agency
DLC	Diamond Like Coatings
DLSME	Defense Land Systems and Miscellaneous Equipment
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
DUSD	Deputy Under Secretary of Defense
EA	Environmental Assessment
EB	Electron Beam
EIS	Environmental Impact Statement or Environmental Information System
EK	Electrokinetic
EL	Environmental Laboratory (ERDC)
EMI	Electromagnetic Induction or Electromagnetic Interference
EMS	Environmental Management System
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPR	Environmental Program Requirement
EQT	Environmental Quality Technology
EQT-ORD	Environmental Quality Technology – Operational Requirements Document
ERA	Ecological Risk Assessment
ERASP	Environmental Response & Security Protection Program
ERDC	Engineer Research and Development Center, U.S. Army Corps of Engineers
ERED	Environmental Residue-Effects Database
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

ETMP	Environmental Quality Technology Management Plan
ETTC	Environmental Technology Technical Council
ETV	Environmental Technology Verification
FEA	Functional Economic Analysis
FIRE	Firing Information and Range Execution
FORSCOM	Forces Command, U.S. Army
FOUO	For Official Use Only
FRP	Facilities Reduction Program
FUDS	Formally Used Defense Site
FY	Fiscal Year
GBCUP	Green Building Criteria Update Program
GeoRAMS	Geospatial Risk Assessment Modeling System
GIS	Geographic Information System
GOTS	Government Off-The-Shelf
GPR	Ground Penetrating Radar
GPS	Global Positioning System
HALO	Hazardous Asbestos and Lead Optimal (HALO)
HAP	Hazardous Air Pollutant
HAZMAT	Hazardous Material
HBCU	Historically Black Colleges and Universities
HCFC	Hydrochlorofluorocarbon
HH	Hand-Held
HMMWV	High Mobility Multipurpose Wheeled Vehicle
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HOST	Hands-On-Skills-Training
HQ	Headquarters
HQDA	Headquarters Department of the Army
HSLA	High Strength Low Alloy

ILE	Installations, Logistics, and the Environment
IM	Installation Management
IMA	Installation Management Agency, U.S. Army
IMRO	Installation Management Regional Offices, U.S. Army
INRMP	Integrated Natural Resources Management Plan
IOC	Industrial Operations Command or Initial Operational Capability
IPEG	Installation Program Evaluation Group
IPT	Integrated Process Team or Integrated Product Team
IRR	Internal Rate of Return
ISO	International Standards Organization
ITAM	Installation Training and Maintenance
JG-PP	Joint Group on Pollution Prevention
JUXOCO	Joint UXO Coordination Office
K	thousand
LAP	Load, Assembly, and Pack
LBP	Lead-Based Paint
LEAD	Letterkenny Army Depot
LIDAR	Light Detection and Ranging
LRAM	Land Rehabilitation and Maintenance
LSAAP	Lone Star Army Ammunition Plant
LTM	Long Term Monitoring
M	million
MACOM	Major Command, U.S. Army
MAIS	Major Automated Information System
MANATEE	Managing Army Technologies for Environmental Enhancements
MDAP	Major Defense Acquisition Program
MEC	Munitions and Explosives of Concern
MEK	Methyl Ethyl Ketone

MIBK	Methyl Isobutyl Ketone
MIM	Maneuver Impact Miles
MMR	Massachusetts Military Reservation
MNS	Mission Need Statement
MOD	Ministry of Defense, German
MOUT	Military Operations in Urban Terrain
MPTR	Multipurpose Training and Range
MRA	Munitions Response Area
MRC	Military Relevant Compound
MRE	Meals Ready to Eat
MRED	Managing Research in Environmental Decision making
MSC	Major Subordinate Command
MSN/ENV	Mission/Environmental
MSW	Municipal Solid Waste
MUC	Military Unique Compound
NAC	National Automotive Center, U.S. Army Tank- automotive and Armaments Command
NBC	Nuclear, Biological, and Chemical
NC	Nitrocellulose
NCP	National Contingency Plan
NDCEE	National Defense Center for Environmental Excellence
NDI	Non-Destructive Inspection
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NGB	National Guard Bureau
NHSW	Non-Hazardous Solid Waste
NOx	Nitrogen Oxide
NOV	Notice of Violation

NPDES	National Pollution Discharge Elimination System
NPV	Net Present Value
NT	Nitrotoluene
NTC	National Training Center
NVOCES	National Emissions Standard for Volatile Organic Compounds
O&M	Operations and Maintenance
O&S	Operations and Support
OACSIM	Office of the Assistant Chief of Staff for Installation Management
OASA	Office of the Assistant Secretary of the Army
OB	Open Burning
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
ODS	Ozone Depleting Substance
OEM	Original Equipment Manufacturers
OF	Objective Force
OMA	Operations and Maintenance, Army
ORC	Ordnance-Related Compound
ORD	Operational Requirements Document
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
Pb	Lead

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
PHA	Polyhydroxyalkanoates
PM	Particulate Matter or 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
PVD	Physical Vapor Deposition
PWTB	Public Works Technical Bulletin
QA	Quality Assurance
QOL	Quality of Life
QPL	Qualified Product List
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	Range and Training Land Program, U.S. Army
RTV	Room Temperature Vulcanizing
S&T	Science and Technology
SAB	Scientific Advisory Board
SAC	Security and Assistance Command, U.S. Army
SAM	Sub-Audio Magnetic
SARNAM	Small Arms Range Noise Assessment Model
SATR	Small Arms Training Range
SAFR	Small Arms Firing Range
SCAPS	Site Characterization and Penetrometer System
SCR	Selective Catalytic Reduction
SECARMY	Secretary of the Army
SedSpec	Standard Erosion Design Specifications model
SERDP	Strategic Environmental Research and Development Program
SIR	Savings to Investment Ratio
SOC	Species of Concern
SPIE	Society of Professional Optical Engineers
SPE	Solid Phase Extraction
SPOTA	Sustainable Painting Operations for the Total Army

SSCOM	Soldier Systems Command
STO	Science and Technology Objective
STRAC	Standards and Training Commission
SAM	Sub-Audio Magnetic
SW	Solid Waste
SWR	Solid Waste Reduction
SWD	Solid Waste Diversion
SWDA	Solid Waste Disposal Act
T&E	Threatened and Endangered
T&ES	Threatened and Endangered Species
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
TDEM	Time Domain Electromagnetic
TETF	Total Enclosed Treatment Facility
TFM	Total Field Magnetic
TIC	Toxic and Industrial Chemical
TIM	Toxic and Industrial Material
TNS	Technology Needs Survey
TNT	Trinitrotoluene
TOAD	Tooele Army Depot
TOC	Total Ownership Costs
TR	Technical Report
TRADOC	Training and Doctrine Command, U. S. Army
TRI	Toxic Release Inventory
TSCA	Toxic Substances Control Act

TSV	Thermal Spray Vitrification
TT	Technology Team
TTD	Terrestrial Toxicity Database
TTIP	Technology Transfer Implementation Plan
TWEM	Toxicity Wildlife Exposure Model
U.S.	United States of America
USA	United States of America or United States Army
USAR	United States Army Reserve
USAREUR	United States Army Reserve, Europe
USARPAC	United States Army Reserve, Pacific
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
UV	Ultraviolet
UXO	Unexploded Ordnance
UXO(C)	Unexploded Ordnance-Related Constituents
VC	Vented Combustor
VMS	Vanadium Microalloyed Steel
VOC	Volatile Organic Compound
WES	Waterways Experiment Station, U.S. Army Corps of Engineers Engineer Research and Development Center
WETO	Western Environmental Technology Office
WLAN	Wireless Local Area Network
XCEM	Continuous Emission Monitor demonstrated at Tooele Army Depot
YPG	Yuma Proving Ground