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FISCAL YEAR 2007

from the
Strategic Environmental Research and Development Program

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EXECUTIVE SUMMARY

The Strategic Environmental Research and Development Program (SERDP) is the Department of Defense's environmental science and technology program. To fulfill its mission to address environmental problems through innovative research and share that information across federal and private organizations, SERDP executes the program in partnership with the Department of Energy and the Environmental Protection Agency. Further, SERDP fully leverages complementary programs within the Department of Defense and solicits participation from other public and private research organizations. This report provides a summary of SERDP's activities and its most significant accomplishments for FY 2007, its plans for FY 2008, and new research activities to be addressed in FY 2009. It responds directly to the requirements as stated in Title 10, U.S.C. section 2902, as modified.

The organization and management of SERDP is described in Section I–SERDP Structure. As directed by the SERDP Council, the Executive Director and Program Office Staff implement the Program with the recommendations from the SERDP Scientific Advisory Board (SAB) and the support of SERDP technical committees (STCs) to meet high priority, DoD mission-related environmental needs. SERDP conducts and manages basic research through advanced technology development in four technology Focus Areas: Environmental Restoration, Munitions Management, Sustainable Installations, and Weapons Systems and Platforms. SERDP establishes clear technical goals and employs key metrics to assess and ensure the quality and success of the Program.

Section II–Investment Strategy and Performance describes Program accomplishments during FY 2007 within the two broad investment strategy areas: Sustainable Training and Testing Ranges and Reducing Current and Future Liabilities. Lists of specific projects funded in FY 2007 in these areas and those projects planned for funding in FY 2008 are also provided in Section II. Significant accomplishments for SERDP in FY2007 are represented by four projects that received the annual SERDP Project of the Year awards. The awards are presented at the annual Partners in Environmental Technology Technical Symposium & Workshop and were awarded for the following projects in each of the four Focus Areas: Environmental Restoration - *Identification and Characterization of Natural Sources of Perchlorate*; Munitions Management - *Improving Detection and Discrimination of UXO in Magnetic Environments*; Sustainable Infrastructure - *Riparian Ecosystem Management: Impacts, Restoration and Enhancement Strategies*; and Weapons Systems and Platforms - *Development of Chrome-Free Welding Consumables for Stainless Steels*. SERDP sponsored six technical workshops in FY2007 that have proven to be invaluable forums for identifying high-priority environmental needs. These workshops led to the identification of research topic areas for which proposals will be requested for projects to be funded in FY 2009.

In each fiscal year cycle, SERDP must manage ongoing research within the program, solicit and select new research projects, and plan future research initiatives and funding distribution for each Focus Area. Section III–Management Actions provides an overview of SERDP Program management actions in FY2007, including activities, achievements, and recommendations of the SERDP Council, Executive Director, and SAB, as well as the planned research initiatives for the Program in FY2008 and FY2009. In FY 2007, SERDP was appropriated $64.049 million for the funding and management of 167 research projects. The FY 2008 appropriation of $69.674 million will be used for at least 170 projects, including both continuing and new start projects.

TABLE OF CONTENTS

Table of Contents (continued)

List of Figures

Acronyms and Abbreviations

2,4-DNT	2,4-dinitrotoluene
BAA	Broad Agency Announcement
BAMAS	Bearing and Amplitude Measurement and Analysis System
BOD	biological oxygen demand
BRAC	base realignment and closure
CAAA	Clean Air Act Amendment
Cd	cadmium
ClO_4^-	perchlorate
COTS	commercial off the shelf
Cr6+	chromium
DCERP	Defense Coastal/Estuarine Research Program
DER	distributed energy resource
DNAPL	dense non-aqueous phase liquid
DoD	Department of Defense
DOE	Department of Energy
DSB	Defense Science Board
DTIC	Defense Technical Information Center
DUSD(I&E)	Deputy Under Secretary of Defense (Installations and Environment)
DUSD/S&T	Deputy Under Secretary of Defense for Science and Technology
EM	electromagnetic
EMI	electromagnetic induction
EPA	Environmental Protection Agency
ER	Environmental Restoration
ESA	Endangered Species Act
ESTCP	Environmental Security Technology Certification Program
EWG	Executive Working Group
FAA	Federal Aviation Administration
FUDS	formerly used defense site
FY	fiscal year
HAP	hazardous air pollutant
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HSS	high-strength steel
JSF	Joint Strike Fighter
LTM	long-term monitoring
MC	munitions constituent
MC/P	methylene chloride and phenol
MERIT	Materials of Emerging Regulatory Interest Team
MM	Munitions Management
MRP	Munitions Response Program
NAOC	National Association of Ordnance Contractors

Acronyms and Abbreviations (continued)

NBVC	Naval Base Ventura County
NDMA	N-nitrosodimethylamine
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NG	nitroglycerin
NQ	nitroguanidine
OB/OD	open burning/open detonation
ODS	ozone depleting substance
ODUSDE(I&E)	Office of the Deputy Under Secretary of Defense (Installations and Environment)
OSHA	Occupational Safety and Health Administration
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyls
PI	principal investigator
PM	particulate matter
R&D	research and development
RCRA	Resource Conservation and Recovery Act
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
S&T	Science and Technology
SAB	Scientific Advisory Board
SEED	SERDP Exploratory Development
SERDP	Strategic Environmental Research and Development Program
SERPPAS	Southeast Regional Partnership for Planning and Sustainability
SI	Sustainable Infrastructure
SON	Statement of Need
SRI	Sustainable Range Initiative
SROC	Senior Readiness Oversight Council
STC	SERDP Technical Committee
TCP	1,2,3-trichloropropane
TER-S	threatened, endangered, and at risk species
TES	threatened and endangered species
TNT	2,4,6-trinitrotoluene
UXO	unexploded ordnance
VOC	volatile organic compound
WAA	Wide Area Assessment
WP	Weapons Systems and Platforms

I. SERDP STRUCTURE

A. Background

Established in 1991, the Strategic Environmental Research and Development Program (SERDP) is the Department of Defense's (DoD) environmental Science and Technology (S&T) program. This report provides a summary of SERDP's activities and most significant accomplishments during fiscal year (FY) 2007, its plans for FY 2008, and new research initiatives to be addressed in FY 2009. It responds directly to the reporting requirements as stated in Title 10, U.S.C. §2902. The report also contains a summary of the actions and recommendations of the SERDP Scientific Advisory Board (SAB) during the preceding year.

i. Authorizing Legislation

In 1990, Public Law 101-510 (Title 10, U.S.C., §§2901-2904) established SERDP to be funded by the DoD and planned and executed in partnership with the Department of Energy (DOE) and the Environmental Protection Agency (EPA). SERDP fully leverages complementary programs found within the Army, Navy, and Air Force, and those of the DOE and the EPA. SERDP has taken full advantage of the intrinsic capabilities of the participating organizations. This feature makes SERDP unique, as it can tap the vast technical resources of the Federal research infrastructure to meet the needs of the Departments' most pressing environmental matters of concern. In addition, SERDP also has successfully engaged in directly funding the private sector and academia, further widening the spectrum of technological capability and innovation.

ii. Mission

SERDP's mission can be found in the statute and is paraphrased below. Specifically, the four purposes of SERDP are to:

SERDP addresses DoD and congruent DOE environmental matters of concern through cooperative research.

- Address environmental matters of concern to the DoD and the DOE through support for basic and applied research and development of technologies that can enhance the capabilities of the Departments to meet their environmental obligations.

- Identify research, technologies, and other information developed by the DoD and the DOE for national defense purposes that would be useful to governmental and private organizations involved in the development of energy technologies and of technologies to address environmental restoration, waste minimization, hazardous waste substitution, and other environmental concerns and to share such research, technologies, and other information with such governmental and private organizations.

- Furnish other governmental organizations and private organizations with data, enhanced data collection capabilities, and enhanced analytical capabilities for use by such organizations in the conduct of environmental research.

- Identify technologies developed by the private sector that are useful for DoD and DOE defense activities concerning environmental restoration, hazardous and solid waste minimization and prevention, and hazardous material substitution and provide for the use of such technologies in the conduct of such activities.

This mission, crafted more than 15 years ago, remains highly relevant, and while significant successes have been achieved, a number of difficult technical challenges remain and additional challenges are emerging.

iii. Requirements

SERDP is a "requirements-driven" program that responds directly to defense requirements generated by the Services and sanctioned by the Deputy Under Secretary of Defense (Installations and Environment) [DUSD(I&E)]. It is critical that the limited funds available for environmental technology research and development (R&D) be focused on the highest priority requirements of the Services. SERDP helps insure this focus in addition to avoiding duplication of efforts by cooperating with the Services and other military departments in the collection and review of technology requirements on a regular basis.

The DoD's environmental issues fall into two major categories. The first is the sustainability of the Department's Training and Testing Ranges. Many of these ranges are under restrictions due to environmental issues and, in a few extreme cases, a range has been unable to function. Access to adequate training ranges in perpetuity is essential to maintain military readiness. To assure this access, environmental issues associated with the ranges must be addressed. The second major driver is the reduction of current and future liabilities. Current liabilities are associated with the remediation of contamination from past practices. These liabilities are relatively well known and have been estimated to total nearly $14 billion. However, that estimate does not include the liability from emerging contaminants such as perchlorate (ClO_4^-). In addition, the estimated known current liability for unexploded ordnance (UXO) in the Munitions Response Program (MRP) exceeds $18 billion. Future liabilities are in the form of the toxic and hazardous materials used in and emissions from today's weapons and platforms. Through the aggressive development of new, benign materials and industrial processes as well as control technologies, the use and release of these materials to the environment can be reduced or eliminated while actually improving the performance of weapons systems and system components. Technology has proven to be capable of significantly reducing the cost of addressing all of these liabilities.

These two major categories of environmental issues have a direct impact on DoD's ability to perform its primary mission of maintaining military readiness for national defense. For the ease of managing the program, SERDP places all research efforts to address these issues into one of four focus areas: Environmental Restoration, Munitions Management, Sustainable Infrastructure, and Weapons Systems and Platforms. In the course of addressing DoD's highest priority environmental needs, SERDP also has sought opportunities to help solve other significant national and international environmental problems by applying DoD's technical capabilities, analytical systems, and information.

B. SERDP Management Structure

SERDP is a multiagency managed program funded by the DoD. Pursuant to Title 10, U.S.C. §§2901-2904, SERDP receives general oversight and policy guidance from the SERDP Council, which is composed of members from the DoD, DOE, and EPA. Also included in this authorizing language is a requirement for an Executive Director to lead the day-to-day Program activities, as well as an SAB that is charged with providing advice and recommendations to the SERDP Council on projects/proposals reviewed. Further, the SAB may advise the Council regarding other programmatic, funding, or technically related issues with respect to the Program. The organizational structure shown in Figure I-1 was established by the Council and Executive Director to support Program needs.

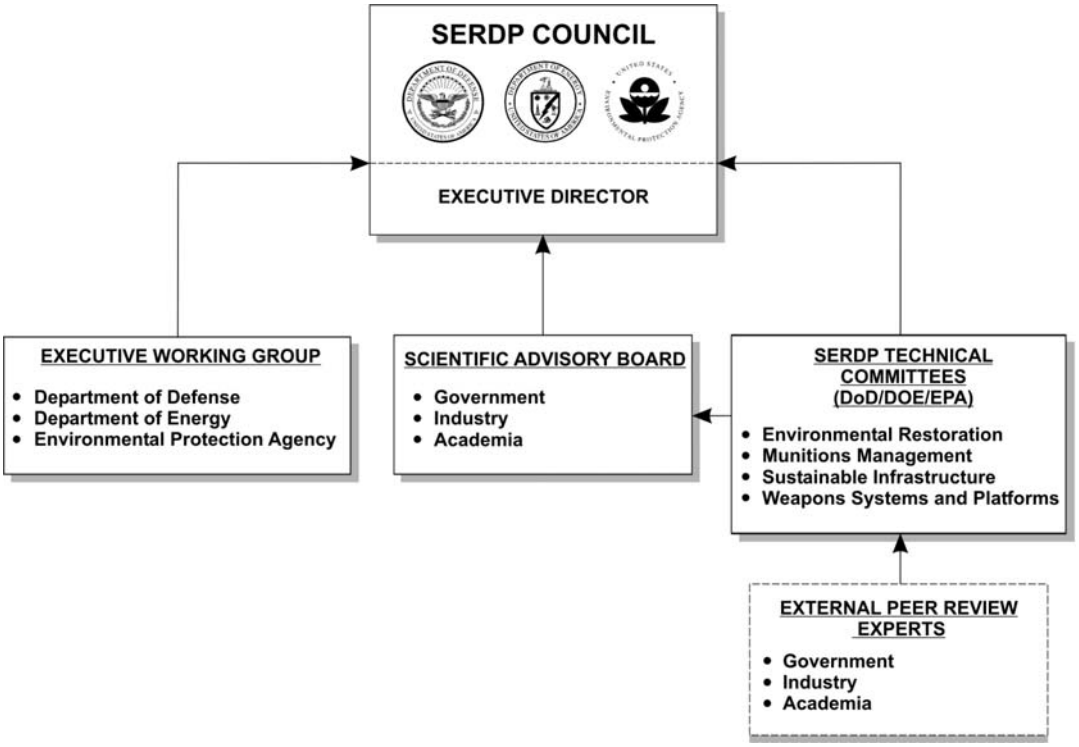

Figure I-1. SERDP Organization.

i. SERDP Council

Established by law, SERDP's multi-agency Council ensures integrated, nonduplicative research.

Title 10, U.S.C. §2902 established the SERDP Council to oversee the management of SERDP. Specifically, this Council prescribes policies and procedures to implement the Program and, uniquely, is the sole funding approval authority. As such, the Council may enter into contracts, grants, and other agreements in accordance with other applicable law to carry out the purposes of SERDP. Congress intended the Council to be a multiagency membership body to promote maximum exchange of information and to minimize duplication of environmentally related research, development, and demonstration activities through close coordination with the military departments and Defense agencies; the DOE; the EPA, other departments and agencies of the federal, state, and local governments; and other organizations engaged in environmentally related research.

DoD and DOE Council representatives alternate as Chair.

Consistent with the SERDP statute and with facilitating multiagency cooperation, the Secretary of Defense has designated the Deputy Under Secretary of Defense for Science and Technology (DUSD/S&T) as chairperson for each odd-numbered fiscal year, and the Secretary of Energy has designated the Director of the Office of Science to serve as chair for each even-numbered year. Other members are assigned per guidance provided in the SERDP statute. The following are the Council members who served during a portion of, or for the entire, FY 2007.

SERDP Council Members - FY 2007

Mr. Alex Beehler
Assistant Deputy Under Secretary of Defense
Environment, Safety, and Occupational Health
U.S. Department of Defense

Admiral Edmund Giambastiani
Vice Chairman
Joint Chiefs of Staff
U.S. Department of Defense

Dr. George Gray
Assistant Administrator
Office of Research and Development
U.S. Environmental Protection Agency

Mr. Mike Hanson
Office of Research & Development
U.S. Coast Guard

Dr. Walter Jones
Executive Director
Office of Naval Research
U.S. Navy

Dr. Dennis Kovar
Acting Principal Deputy Director
Office of Science
U.S. Department of Energy

Mr. Michael McGhee
Secretary of the Air Force
Environment
U.S. Air Force

Dr. John Parmentola
Office of the Assistant Secretary of the Army
Acquisitions, Logistics, and Technology
U.S. Army

Mr. Martin Schoenbauer
Principal Assistant Deputy Administrator
Defense Programs
National Nuclear Security Administration
U.S. Department of Energy

Dr. Andre van Tilborg
Deputy Under Secretary of Defense
Science & Technology
U.S. Department of Defense

Mr. Bradley P. Smith (Ex Officio Member)
Executive Director
Strategic Environmental Research and
Development Program
U.S. Department of Defense

ii. Executive Working Group

The Executive Working Group (EWG) is an extension of the Council and serves as a working-level representation of the Council. This body, while not established by law, facilitates SERDP policy preparation, investment strategy considerations, and annual program plan development.

iii. SERDP Scientific Advisory Board

SAB members focus on technical quality.

Established in accordance with the SERDP statute, the SERDP SAB assures that the Program maintains clear focus on technical quality. The SAB has the authority to make recommendations to the Council regarding technologies, research, projects, programs, activities, and, if appropriate, funding within the scope of SERDP. The SAB is composed of no more than 14 and no less than 6 members who are jointly appointed by the Secretary of Defense and the Secretary of Energy in consultation with the Administrator of the EPA.

To ensure that SERDP objectives are congruent with the Administration's goals, two members of the SAB are mandated in the statute—the Science Advisor to the President, or his/her designee, and the Administrator of the National Oceanic and Atmospheric Administration, or his/her designee. Similarly,

to ensure that regional and global environmental issues are appropriately addressed in SERDP, at least one member should represent the interests of State governments and one member should represent environmental public interest groups. The list below reflects SAB membership in FY 2007.

Scientific Advisory Board Members - FY 2007

Dr. Mary Barber
Private Consultant

Dr. Jeffrey Daniels
The Ohio Sate University

Dr. Sylvia Earle
Conservation International

Dr. Ronald Heck
RMH Consulting

Dr. Perry McCarty
Stanford University

Dr. James Mercer
GeoTrans, Incorporated

Dr. Ellen Mihaich, Chair
Environmental and Regulatory Resources, LLC

Dr. William Neff
National Oceanic and Atmospheric Administration

Dr. Jon Sandoval
Idaho Department of Environmental Quality

Dr. Jeffrey Siirola
Eastman Chemical Company

Dr. Gene Whitney
White House Office of Science and Technology

Dr. Lily Young
Rutgers University

The statute directs the SAB to review all projects with a value in excess of $1,000,000. Many years ago, the SERDP Council modified this direction by requesting that each new start project and every continuing project exceeding $900,000 be reviewed by the SAB.

iv. Executive Director and Program Office Staff

Title 10, U.S.C. authorizes an Executive Director to direct and focus the day-to-day efforts of SERDP, and Mr. Bradley P. Smith retained the position of Executive Director in FY 2007. The Executive Director is a non-voting member of the SERDP Council and a voting member of the EWG. Dr. Jeffrey Marqusee, the Environmental Security Technology Certification Program (ESTCP) Director, also served as the SERDP Technical Director. Colocation of SERDP and ESTCP has served to broaden the staff's technical skills and facilitate technology transition from one program to another. The balance of the federal staff consisted of four technical Program Managers and one Financial Officer who has been detailed from the military Services' R&D infrastructure. These individuals include:

- Dr. Anne Andrews - Program Manager for Munitions Management technologies
- Dr. Andrea Leeson - Program Manager for Environmental Restoration technologies
- Mr. Charles Pellerin - Program Manager for Weapons Systems and Platforms technologies (retired Summer 2007)
- Mr. Bruce Sartwell - Program Manager for Weapons Systems and Platforms technologies (beginning Summer 2007)
- Dr. John Hall - Program Manager for Sustainable Infrastructure technologies
- Ms. Jina Banks - Financial Officer.

v. SERDP Technical Committees

As evidenced by the small size of its staff, the breadth of technical knowledge demanded by SERDP far exceeds the limited staff in the SERDP Program Office. Consequently, SERDP must rely on the

technical skills offered by the participating Services and Agencies to assist in the technical aspects of program development, program monitoring, and technology transfer. For each of the technology focus areas, a SERDP Technical Committee (STC) was established to help solicit and review technical proposals, formulate and recommend the annual program plan, conduct technical reviews of the ongoing projects, and facilitate technology transfer according to the needs of their users in the field. STCs offer several advantages over conventional R&D management schemes. First, their members are selected by the Services and Agencies as represented on the Council. Second, they bring not only a wealth of understanding of the needs of their organization, but also knowledge of related completed or ongoing research efforts. This knowledge helps SERDP to avoid duplication of effort and promote joint and cooperative funding of projects.

vi. Peer Reviewers

SERDP supports an electronic proposal evaluation process via the Internet.

Assisting the STCs and the Program Office in their quest to select quality research proposals are independent Peer Reviewers. Following the model established by the National Science Foundation, SERDP proposals must undergo an independent Peer Review prior to receipt of initial funding. The results, scores, and evaluation comments from this review are provided directly to the STCs who use this information to develop their recommended list of new start projects. Further, these same results are provided to the SAB for consideration during their proposal review and deliberations.

C. SERDP Management Philosophy

The SERDP Council ensures that the Program focuses on the mission needs of the DoD and empowers the EWG with developing goals and an investment strategy that will help SERDP satisfy these mission needs successfully. The SERDP management goals and investment strategy then are shared with the STC and SAB. By leveraging complementary research programs, SERDP is able to avoid duplication of effort and to facilitate the transfer and implementation of innovative research and technology – maximizing advancements in the state of the science and engineering for DoD. SERDP establishes clear technical goals and employs four key metrics to assess the quality and success of the Program, as described here.

i. Technical Goals

In 1993, the EWG assembled to develop the broad framework within which to develop the annual SERDP program plan. Included in this document are the SERDP goals, which are to:

- Resolve environmental concerns in ways that enhance military operations, improve military systems' effectiveness, and help ensure the safety of personnel.

- Support technology and process developments that reduce operational and life-cycle costs, including those associated with environmental cleanup and costs of full compliance with environmental laws and regulations.

SERDP promotes cooperative environmental technology development and information transfer.

SERDP achieves its goals by promoting cooperative environmental technology development and by maintaining a strong effort in information dissemination. Specifically, SERDP succeeds by:

- Promoting the effective exchange of information regarding environmentally related research and development activities.

- Ensuring that SERDP R&D activities complement, but do not duplicate, Tri-Service R&D programs and other ongoing activities.

- Providing appropriate access to data under the control of, or otherwise available to, the DoD and DOE that are relevant to environmental matters.

- Facilitating the transfer of unclassified DoD and DOE environmental information and technology to other sectors of society that may be able to use them to advance national environmental objectives.

- Emphasizing multiservice, interdepartmental research and development projects and using the unique capabilities of the partnering federal agencies, private industry, and academia to solve the Departments' environmental problems.

ii. Key Metrics for SERDP Success

The following four key metrics are used to maintain the quality and enhance the success of the Program.

The Executive Director and his staff worked hand-in-hand with Office of the Deputy Under Secretary of Defense (Installations and Environment) [ODUSD(I&E)] to establish clear lines of communication, address effectively the Department's highest priority environmental requirements, and foster transition of technical efforts to field demonstration or implementation. Through focused Statements of Need (SON) in the Core and SERDP Exploratory Development (SEED) solicitations, the Executive Director sought cooperatively funded and executed projects to address high-priority multiservice needs.

1. Address the highest priority defense, mission-relevant environmental requirements, with emphasis on multiservice issues.

SERDP often holds workshops to explore the state-of-science, technology gaps, and opportunities for research in areas where it may be difficult to interpret this need. From these workshops, several key SONs can be identified. In FY 2007, SERDP sponsored or co-sponsored six workshops: Southeast Region TER-S, Southwest Region TER-S, Metal Finishing, DoD Southeast Regional Sustainability, Operational Range Assessment, and Underwater Munitions Response.

2. Pursue/achieve universal, world-class technical excellence.

World-class research is considered the cornerstone of SERDP projects. Continuing the successful solicitations of the past few years, SERDP solicited proposals from all sources, including the nonfederal sector. SERDP continued to use external Peer Reviewers in addition to the comprehensive multiagency review procedures to ensure that technically sound proposals performed by world-class researchers are selected for funding.

3. Emphasize and promote technology transfer.

Transfer of technology, from research to the DoD user community, is one of the key objectives of SERDP. This objective is achieved by supporting applied research and technology demonstrations that respond directly to high-priority, DoD mission-related environmental needs. The colocation of ESTCP with SERDP has helped to facilitate technology transitions between Programs, into other Agencies' certification programs, and to the DoD user community.

4. Ensure sound fiscal management.

Timely and complete financial reporting is one of the keys to SERDP's success. The SERDP Executive Director has continued to ensure that the Program complies with the DoD fiscal guidance. Effective controls include periodic fiscal review of projects, implementing aggressive

corrective actions to promote effective use of limited R&D resources, and using information management and monitoring tools that fully utilize state-of-the-art Internet capabilities.

II. INVESTMENT STRATEGY AND PERFORMANCE

A. Approach

As a leader in the field of environmental science and technology research and development, SERDP provides solutions to priority, environmental matters of concern to the DoD and the DOE. Since its inception in 1991, SERDP has developed a comprehensive outreach program and has conducted detailed science and technology gap analyses to identify high-priority and emerging environmental science and technology requirements. Through these efforts, the Program has supported hundreds of science and technology projects yielding innovative and cost-saving methods and tools that DoD installations have utilized to meet their environmental responsibilities.

SERDP's investment strategy aims to provide DoD with the best available solutions to its toughest environmental challenges, including (1) sustainable training and testing ranges and (2) reduction of current and future liabilities. This section describes the scope and provides an overview of each investment area and includes a listing of all SERDP projects funded in FY 2007, new projects funded for FY 2008, and initiatives planned for FY 2009. This section also highlights the SERDP FY2007 Projects of the year, which represent the major technical advances resulting from SERDP research and development projects and that also illustrate the potential cost savings and improved performance resulting from the implementation of these technologies. Finally, this section provides summaries of SERDP-sponsored technical workshops conducted in FY2007 that have proven to be invaluable forums for identifying high-priority environmental needs.

B. Sustainable Training and Testing Areas

The impacts of environmental regulation on military training and testing operations have slowly grown over time and the Department now faces serious limitations in its ability to provide realistic training. The DoD's Senior Readiness Oversight Council (SROC) recognizes six key environmental areas impacting the training and testing ranges: (1) Unexploded Ordnance (UXO) and Munitions Constituents (MC), (2) Threatened and Endangered Species (TES), (3) Maritime Sustainability, (4) Air Quality, (5) Noise, and (6) Urban Encroachment. As the number of available operational ranges decreases, existing ranges are being used more extensively. To ensure that the remaining ranges continue to provide realistic settings for training, installations need to be managed to support training without causing irreversible damage and to reduce restoration costs. Management tools and innovative technology are needed to enable maximum use of ranges while preserving mission capabilities into the future. SERDP is investing in science and technology research and development efforts to address these range issues, as well as those associated with military installations as a whole and pertinent, adjacent lands.

More recently it has become apparent that climate change in general and sea level rise in particular have potential ramifications for National Security. Draft legislation for the FY 2008 Defense Authorization Bill includes legislation that directs the Defense Department to provide guidance to military planners to assess the risks of potential climate change. SERDP is responding to this challenge by including assessments of the impact of sea level rise on military infrastructure in its investment strategy.

i. Munitions Constituents

Scope of Problem

The use of munitions is an integral part of the military's testing and training. Energetic materials, including propellants, explosives, and pyrotechnics, are widely used by DoD, and an estimated 500 million pounds of energetic materials are produced each year, generating millions of pounds of hazardous waste. The MC that are of primary environmental concern include TNT, RDX, HMX, and perchlorate, which have been identified in soil and groundwater at former and current ammunition manufacturing sites as well as on military testing and training ranges. There is also a growing concern that the accumulation of unexploded or unconsumed MC residues on military testing and training ranges represents a threat to human health and the environment. These residues, which can take the form of discrete "chunks" or very fine particles, can dissolve and leach into groundwater and may be transported off-site. The DoD requires range management practices that effectively reduce quantities of MC residuals and that minimize disruptions in testing and training activities. Other challenges include developing appropriate remedial actions to address site contamination and treating contaminated soil and groundwater to ensure regulatory compliance.

Overview of Investment

Investments in the area of MC span the Environmental Restoration and Weapons Systems and Platforms focus areas. SERDP seeks to provide range managers with techniques to assess potential soil or groundwater contamination, to remediate such contamination, and to reduce or eliminate future contamination. To achieve these goals, it is necessary to determine how these compounds are released into the environment. Data on the physical, chemical, and biological properties of MC are essential to understand the fate and transport of MC released in the environment. Through an understanding of how these materials move and are transformed in the environment, reliable and scientifically defensible risk assessments can be developed along with protocols to mitigate the impacts. This knowledge supports the development, design, and management of sustainable training and testing ranges.

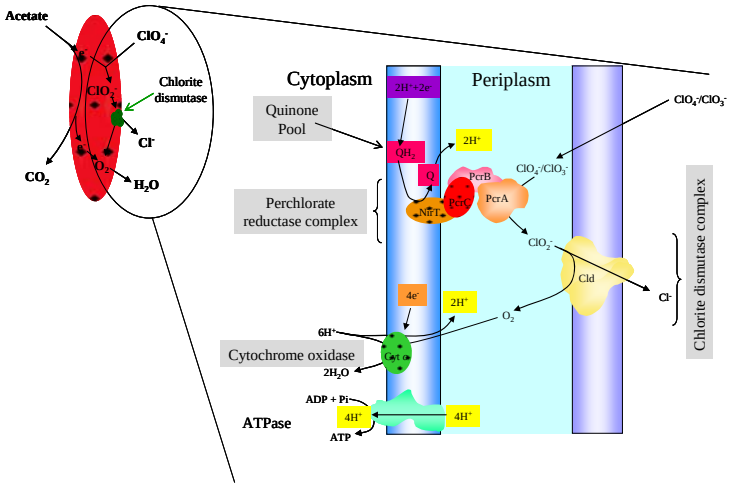

Figure II-1. The role of perchlorate reductase in the microbial reduction of perchlorate.

The distribution of MC contamination in soil and groundwater is highly heterogeneous, requiring unique sampling protocols and technologies to accurately characterize and monitor them. Further, when MCs are released into the environment, treatment or containment technologies for soil and groundwater are required to prevent exposure. Range managers require techniques that are applicable to small and large areas, as well as practices that prevent MCs from migrating off ranges. Finally, although technology developments have improved munitions manufacturing, there remains a small percentage of rounds that malfunction, resulting in low-order (incomplete) detonations or duds, which represent a continuing source of MC contamination on ranges. Elimination of toxic or hazardous materials from munitions will significantly reduce the cost of sustaining training and testing ranges for the military. The following initiatives have been funded by SERDP to accomplish the Program's objectives for MC:

FY 2007 Completed Projects

- Evaluation of Alternative Causes of Wide-Spread, Low Concentration Perchlorate Impacts to Groundwater (ER-1429), GeoSyntec Consultants
- Removal of Perchlorate from Water and Wastewater by Catalytic Hydrogen Gas Membrane Systems (ER-1430), University of Delaware (This project was canceled)
- Identification and Characterization of Natural Sources of Perchlorate (ER-1435), U.S. Air Force, Aeronautical Systems Center
- Characterization and Fate of Gun and Rocket Propellant Residues on Testing and Training Ranges (ER-1481), U.S. Army Corps of Engineers, Engineer Research and Development Center

FY 2008 Ongoing Projects

- Defining Munitions Constituent (MC) Source Terms in Aquatic Environments on DoD Ranges (ER-1453), U.S. Navy, Space and Naval Warfare Systems Center
- An Enzymatic Bioassay for Perchlorate (ER-1530), University of California at Berkeley
- Perchlorate Remediation Using New Nanoscale Dendritic Polymer Technology (ER-1599), Central Michigan University Research Corporation

FY 2008 New Start Projects

- A Portable Fiberoptic Surface Enhanced Raman Sensor for Real-Time Detection and Monitoring of Perchlorate and Energetics (ER-1602), Oak Ridge National Laboratory
- The Molecular Microbiology of Nitroamine Degradation in Soils (ER-1608), University of Washington

FY 2009 Initiatives

In the FY2009 solicitation, SERDP released four Statements of Need (SON) concerning **Munitions Constituents**.

Reduced Uncertainty and Costs for Managing Large, Dilute Contaminant Groundwater Plumes – The objective of this Statement of Need (SON) is to solicit fundamental and applied research designed to improve our ability to manage large, dilute groundwater plumes of key contaminants of concern to the Department of Defense. Improved monitoring and characterization tools to assess natural attenuation processes should allow faster and less expensive assessments of the long-term risks posed by large contaminant plumes. These tools should reduce the uncertainty regarding the risks and environmental fate of contaminants in such plumes and reduce the costs for their long-term management. Improved technologies for more cost-effective remediation of these plumes could substantially reduce the life cycle costs for managing these plumes. Results of this research are expected to reduce the uncertainty and costs associated with managing these plumes and allow for more informed decision-making. The research should focus on 1) developing more cost-effective techniques to remediate large, dilute groundwater plumes, 2) improving the ability to evaluate, demonstrate, and measure relatively slow attenuation processes that may contribute to chlorinated solvent plume stabililization, and 3) developing a better understanding and improved methods to evaluate and measure processes responsible for sustaining chlorinated solvent plumes following reduction of the contaminant influx.

Improved Identification of Munitions Constituent Source Zone Locations and Strength – The objective of this Statement of Need (SON) is to solicit fundamental and applied research that leads to improved identification of munitions constituent source zone location, strength, and potential impact on groundwater on operational testing and training ranges. Munitions constituent source zones on live fire ranges are dependent on the type of range and often are spatially widely distributed, highly

heterogeneous, and difficult to assess. Improving our ability to locate and quantify munitions constituent source zones will ultimately result in improved management practices for operational ranges that will minimize the environmental impact of testing and training with munitions. Such improvements in management practices will ultimately translate into improving our ability to achieve range sustainability. Specific research objectives include 1) developing remote sensing capabilities to rapidly screen operational ranges for the munitions constituents remnants of low order detonations that may result in a source of contamination, 2) improved understanding of our ability to utilize wide area assessment methodologies for characterizing munitions constituent sources, 3) developing guidelines for optimizing groundwater monitoring well placement and innovative groundwater sampling approaches relevant to characterizing munitions constituents on operational ranges, and 4) developing cost-effective sentinel systems to detect and quantify in situ low-level munitions constituents in groundwater or soil.

Improved Understanding of the Fate and Transport of Munitions Constituents on Operational Ranges – The objective of this Statement of Need (SON) is to solicit fundamental and applied research that leads to a better understanding of the fate and transport of munitions constituents (MC) under specific conditions. Improving our ability to predict the fate and transport of munitions constituents of concern will result in improved management practices for operational ranges that will minimize the environmental impact of testing and training with live munitions. Such improvements in management practices will ultimately translate into improving our ability to achieve range sustainability. Research will focus on 1) determining the rate of release of nitroglycerin (NG), 2,4-dinitrotoluene (2,4-DNT), and nitroguanidine (NQ) from propellant residues as a function of particle size, 2) determining the fate and transport properties of munitions constituents when deposited as military grade mixtures in the environment, and 3) improving our understanding of the fate and transport parameters of munitions constituents in multiple soil types that typically are found at operational ranges.

Improved Understanding of the Impact of Environmental Parameters and Sampling Methods on Measured Groundwater Contaminant Concentrations – The objective of this Statement of Need (SON) is to solicit fundamental and applied research that improves our understanding and ultimately allows for the prediction of which environmental parameters and sampling methods will provide accurate groundwater contaminant measurements for compliance sampling. Specifically, the SON seeks to gain a better understanding and predictive capability of how measured contaminant concentrations vary as a function of parameters such as hydrogeological conditions, geochemistry, well type, sampling method, contaminant type and concentration, or other key parameters. Reductions in the cost of LTM programs have the potential to greatly reduce the long-term liability for the DoD. Costs for LTM are increasing, and now represent a significant percentage of the total and future restoration costs. Research will focus on ultimately decreasing long-term monitoring (LTM) costs by improving our ability to utilize in-well field sensors, while maintaining an accurate representation of contaminant concentrations. The ability to reduce field mobilizations to collect compliance samples will have a substantial impact on long-term monitoring costs.

ii. Threatened, Endangered, and At-Risk Species

Scope of Problem

The DoD serves as steward for more than 29 million acres of land across the United States as well as for huge offshore operating areas and surrounding airspace over land and sea. Protection of threatened, endangered, and at-risk species (TER-S) inhabiting those areas also falls under DoD responsibility, and as a result, the agency is responsible for more TER-S per acre than any other federal land manager. DoD's TER-S responsibilities present daunting challenges for the military mission. Training activities, for example, frequently have been curtailed because of inadequate information about the impact of military operations on TER-S or their habitats. In these situations, the U.S. Fish and Wildlife Service is forced to act conservatively on the side of species protection, halting all military activities until it can determine an

appropriate response. Consequently, DoD requires a holistic and efficient approach that integrates land management, military training demands, and sound ecosystem responses on its installations to ensure that mission training activities and schedules are not unnecessarily impaired.

Overview of Investment

SERDP's goal is to provide DoD managers with the tools they need to fulfill their TER-S responsibilities while maintaining the military mission on their installations. New tools and methods are required to more rapidly and cost-effectively identify and monitor plant and animal TER-S, particularly in inaccessible areas (e.g., impact zones). Inventories and impact studies are needed especially for species that either are the source of restrictions or have the potential to cause restrictions. In addition, methodologies are needed to manage ranges as entire ecosystems that provide habitat for TER-S and other species. Finally, these management tools need to account for land outside the installation that contributes to and impacts the ecosystem on the base. The following initiatives have been funded by SERDP to accomplish the Program's goal.

Photo by Karly Moore

Figure II-2. The black-capped vireo is an endangered species of priority concern to the military.

FY 2007 Completed Projects

- Maximizing Sampling Efficiency and Minimizing Uncertainty in Presence/Absence Classification of Rare Salamander Populations (SI-1393), Oak Ridge National Laboratory
- Development and Application of a Physiological-Based Framework for Assessing the Biological Significance of Military Activities on Threatened and Endangered Animal Species (SI-1395), Oak Ridge National Laboratory
- The Identification of Military Installations as Important Migratory Bird Stopover Sites and the Development of Bird Migration Forecast Models: A Radar Ornithology Approach (SI-1439), U.S. Army Corps of Engineers, Engineer Research and Development Center

FY 2008 Ongoing Projects

- Impacts of Military Training and Land Management on Threatened and Endangered Species in the Southeastern Fall Line/Sandhills Community (SI-1302), Savannah River Ecology Laboratory
- Automated Acoustic Identification of Bats (SI-1394), Humboldt State University
- Physiological Response and Habituation of Endangered Species to Military Training Operations (SI-1396), U.S. Army Corps of Engineers, Engineer Research and Development Center
- Advanced Monitoring of Migratory Birds on Military Lands in Desert Environments (SI-1438), University of Wisconsin
- Habitat Connectivity for Multiple Rare, Threatened and Endangered Species On and Around Military Installations (SI-1471), University of North Carolina at Chapel Hill
- A Decision Support System for Identifying and Ranking Critical Habitat Parcels On and In the Vicinity of Department of Defense Installations (SI-1472), Virginia Polytechnic Institute

- Examination of Habitat Fragmentation and Effects on Species Persistence in the Vicinity of Naval Base Pt. Loma and Marine Corps Air Station Miramar, San Diego CA (SI-1473), U.S. Navy, Naval Facilities Engineering Command
- Managing Declining Pine Stands for the Restoration of Red-Cockaded Woodpecker Habitat (SI-1474), U.S. Department of Agriculture, Forest Service, Southern Research Station
- An Ecoinformatic Approach to Developing Recovery Goals and Objectives (SI-1475), University of Maryland, College Park
- A Risk Assessment Framework for Defining Scientifically-Defensible Recovery Goals for Listed Species (SI-1477), U.S. Geological Survey, Idaho Cooperative Fish and Wildlife Research Unit
- Forecasting the Relative and Cumulative Effects of Multiple Stressors on At-Risk Populations (SI-1541), University of Washington
- Identification and Management of Multiple Threats to Rare and Endangered Plant Species (SI-1542), Cornell University
- Population Viability Analysis of the Endangered Shortnose Sturgeon (*Acipenser brevirostrum*) (SI-1543), Oak Ridge National Laboratory

FY 2009 Initiatives

In the FY 2009 solicitation, SERDP released one SON concerning **Threatened Endangered and At-Risk Species**.

Accelerated Pine Forest Mortality in the Southeastern United States- The objective of this Statement of Need (SON) is to assess the prevalence and spatial extent of pine forest decline in the southeastern United States (U.S.) and, where decline can be documented, identify its causes. The outcomes of this research will be: (1) a determination of whether accelerated pine forest mortality and a generalized decline in forest health is an actual phenomenon; (2) an indication of which species are or are not affected and where; (3) if decline is occurring, an understanding of its causes; and (4) if decline is occurring, identification of best management practice recommendations for land managers to implement. This research will indicate the scope of a potentially significant issue affecting mission sustainability and listed species recovery and provide land managers guidance on how to proceed in making land management decisions.

iii. Maritime Sustainability

Scope of Problem

Although anthropogenic stressors of marine resources are primarily associated with commercial shipping and fishing operations, maritime military operations likely also have contributed to elevated stress levels in these systems. Marine mammals are protected under the Marine Mammal Protection Act (MMPA), Endangered Species Act (ESA), and National Environmental Policy Act (NEPA), and there is growing concern that anthropogenic sound may have detrimental effects on marine mammals. The Navy has a high priority requirement for (1) developing an understanding of the potential impacts of sonar on marine mammals as well as (2) collecting data on the locations and seasonal population densities of marine mammals within areas used for military training.

Other anthropogenic stressors on marine environments include ship hulls and their ballast water, which have been shown to be significant vectors for exotic species transport. The negative impacts of proliferating exotic species in non-native locations have been documented throughout the U.S. and abroad. Accordingly, the DoD has taken measures to minimize the introduction of such species resulting

from its maritime activities. DoD operations in aquatic environments can also impact coral reef and other benthic communities. Assessment of reef health and the distinction of anthropogenic and natural stressors on marine environments has helped in the formulation of adaptive management strategies for these aquatic systems.

Overview of Investment

SERDP provides an avenue to developing basic scientific understanding of the factors, both natural and anthropogenic, that hinder sustainable concurrent use of marine ecosystems by the military, marine mammals, sea turtles, coral reefs, and other marine resources. Additionally, SERDP research efforts aim to develop and demonstrate methods and technologies that can minimize the adverse impacts of those factors. The following projects have been funded by SERDP to accomplish to Program's objectives:

Figure II-3. Changes in live coral cover over a four-year period, Andros Island, Bahamas.

FY 2007 Completed Projects

- Predictive Spatial Analysis of Marine Mammal Habitats (SI-1390), Duke University, Marine Laboratory

FY 2008 Ongoing Projects

- Application of ROV-Based Video Technology to Complement Coral Reef Resource Mapping and Monitoring (SI-1333), University of Miami
- Analysis of Biophysical, Optical, and Genetic Diversity of DoD Coral Reef Communities Using Advanced Fluorescence and Molecular Biology Techniques (SI-1334), Rutgers University
- Predictive Modeling of Marine Mammal Density from Existing Survey Data and Model Validation Using Upcoming Surveys (SI-1391), National Oceanic and Atmospheric Administration, Southwest Fisheries Science Center
- Acoustic Response and Detection of Marine Mammals on Navy Ranges Using a Digital Acoustic Recording Tag (SI-1539), Woods Hole Oceanographic Institution

iv. Air Quality

Scope of Problem

Military ranges are under increasing public scrutiny with respect to potential environmental hazards to nearby communities. In urban centers along the east and west coasts, for example, military training activities are being scrutinized for contributing to local and regional air quality problems. Although DoD facilities and operations can be significant sources of air pollutants and fugitive dust emissions, complex meteorology creates considerable uncertainty in tracking and identifying pollutants or their sources. Because nonconformance with existing and proposed standards and regulations can curtail military testing, training activities, and ultimately affect mission readiness, a pressing need exists to obtain reliable information on air emissions from military activities in regard to their characterization, dispersion, impacts, monitoring, and mitigation.

Overview of Investment

SERDP is developing new scientific technologies that will measure air quality factors affected by military platforms, weapons, and operations on training ranges while taking into account varying atmospheric conditions and terrain. SERDP has also identified a need for technologies that can monitor, reduce, eliminate, or control the generation of air emissions from military operations. The following initiatives have been funded by SERDP to accomplish the Program's objectives:

Figure II-4. Helicopter-generated swirling dust clouds.

FY 2008 Ongoing Projects

- Particulate Matter Emissions Factors for Dust from Unique Military Activities (SI-1399), Desert Research Institute
- Development of Emission Factors for Dust Generated by Unique Military Activities (SI-1400), U.S. Army Corps of Engineers, Engineer Research and Development Center

FY 2008 New Start Projects

- Characterization of Emissions and Air Quality Modeling for Predicting the Impacts of Prescribed Burns at DoD Lands (SI-1647), Georgia Institute of Technology
- New Tools for Estimating and Managing Local/ Regional Air Quality Impacts of Prescribed Burns (SI-1648), University of California, Riverside
- Advanced Chemical Measurements of Smoke from DoD-Prescribed Burns (SI-1649), Pacific Northwest National Lab

v. Encroachment

Scope of Problem

When most of DoD's training installations were established, they were located in rural areas far from urban centers. In many cases, communities developed and grew near the base simply because the base existed. Today, that growth is becoming problematic. As communities grow toward the boundaries of ranges and installations, land use incompatibilities emerge that can compromise the health, safety, and welfare of both military and civilian communities. Frequently, these conflicts result in lawsuits that can curtail range operations (such as aircraft operations or weapons firing) or require that the installation compensate residents for declining property values. The ability to understand and predict how land use patterns may change or impact the mission of the installation is vital.

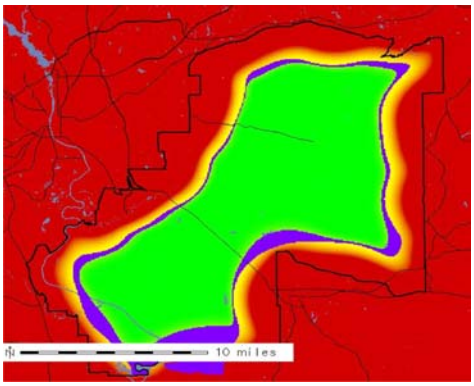

Figure II-5. The green plus the purple area represent currently available space for artillery training based on probability of noise complaints. The purple band represents potentially lost opportunities for artillery training based on a projected 50% increase in urban development.

Overview of Investment

SERDP provides installation managers with the tools they need to: (1) understand changing land use and demographics in the communities surrounding the installation, (2) predict the impact of that growth, and (3) work with the local community in developing plans for compatible growth that will accommodate both the needs of the installation and the community. The following projects have been funded by SERDP to accomplish the Program's objectives:

FY 2007 Completed Projects

- The Evolving Urban Community and Military Installations: A Dynamic Spatial Decision Support System for Sustainable Military Communities (SI-1257), U.S. Army Corps of Engineers, Engineer Research and Development Center, Construction Engineering Research Laboratory

- A Regional Simulation to Explore Impacts of Resource Use and Constraints (SI-1259), Oak Ridge National Laboratory

vi. Noise

Scope of Problem

The availability of airspace for military training and operations is a serious concern for the DoD. Military installations that were originally located in remote areas, far from public view, are now in the midst of densely populated areas, so noise caused by live fire training and flight operations may be considered increasingly incompatible with nearby communities. A July 2007 Report to Congress on Sustainable Ranges identified ten key issues that may impact the sustainability of DoD testing and training ranges. One of the key issues, airborne noise, is based on concerns of groups in the vicinity of these ranges at the local, regional, and state levels that may potentially lead to restrictions on military training including flight operations.

The ability to accurately model noise associated with flight operations has allowed the DoD to provide legally defensible noise assessments of its operations and to comply with requirements of the NEPA. However, the current environmental noise models used by the DoD are not appropriate for the newest generation of fighter aircraft, which have high performance engines and vectored thrust capabilities. New, updated noise models that include the new aircraft and take advantage of today's computational capabilities are needed to assess potential restrictions imposed on training activities and to protect bases and airspace for training. Additionally, DoD needs to characterize, evaluate, and predict noise generated by military activities that may adversely effect on structures. For example, shaking of civilian houses by military impulse noise events is alleged to result from earth-borne vibration. Additionally, powerful sound waves emitted by military training activities such as firing large guns and detonation of explosives can travel long distances in the atmosphere, are audible under some propagation conditions, and can even cause buildings to shake and rattle. Clearly, there is a growing need to reduce significantly the noise generated by DoD testing and training activities including military aircraft.

Overview of Investment

SERDP provides tools for predicting and monitoring noise levels from military operations and for understanding and mitigating impacts to humans, animals, and structures. Noise complaints from surrounding communities represent a growing issue impacting military operations, and to meet upcoming challenges, the DoD must keep abreast of the latest models and technologies to measure, monitor, and reduce noise impacts from its operations. In sum, development and refinement of noise models are needed

to (1) keep pace with new aircraft and weapons; (2) assess impacts on humans and animals; and (3) calibrate and predict how noise impacts man-made structures above the ground, travels from the air into and through the ground, and potentially damages foundations of structures. The noise generated by military aircraft has a direct impact on ground and shipboard crew health and safety issues, including pilot and ground crew comfort, in addition to the military requirement of low detectability. U.S. and international noise regulations and policies will also have an impact on operations and training unless steps are taken to reduce noise. Therefore, to reduce noise from military aircraft SERDP is developing promising noise reduction concepts for high-performance, supersonic military aircraft engines, assessing installation effects on supersonic military aircraft engine noise, improving our fundamental understanding of the source mechanisms in high-performance supersonic military aircraft engines, enhancing existing noise prediction models, and developing fluidically-based noise reduction techniques.

The following projects have been funded by SERDP to accomplish the Program's objectives:

FY 2007 Completed Projects

- Advanced Acoustic Models for Military Aircraft Noise Propagation and Impact Assessment (SI-1304), Wyle Laboratories, Inc.
- Impulse Noise Bearing and Amplitude Measurement and Analysis System (BAMAS) (SI-1427), Applied Physical Sciences Corp.

FY 2008 Ongoing Projects

- Development and Implementation of Metrics for Identifying Military Impulse Noise (SI-1585), University of Pittsburgh
- The Reduction of Advanced Military Aircraft Noise (WP-1583), Penn State University
- Mechanical Chevrons and Fluidics for Advanced Military Aircraft Noise Reduction (WP-1584), U.S. Navy, Naval Research Laboratory

FY 2008 New Start Projects

- Assessing Human Response to Military Impulse Noise (SI-1546), U.S. Army ERDC/CERL

vii. Ecosystem-Based Management

Scope of Problem

DoD's mission requires available maneuver, training, and testing land to maintain readiness through realistic training opportunities. However, repeated use of heavy vehicles (such as tanks) can have serious impacts on the land including loss of vegetation, soil destabilization, erosion, and invasion by non-native species. Development pressures in surrounding areas can further constrain military operations by compounding its environmental compliance requirements. Collectively, these factors affect the sustainability of military land and adjacent waters, marine ranges, and ultimately, the DoD's ability to meet mission requirements.

Figure II-6. Knapweed invasion in western U.S. landscape.

Ecosystem-based management encompasses a broad array of strategies, tools, and techniques including cross-boundary resource management; ecological process management; invasive species management; approaches and metrics for assessing ecosystem health at different, but relatable, spatial scales; hierarchical management approaches (versus single species management approaches); ecosystem dynamics; and restoration ecology. In addition, ecosystem-based management has a human community dimension as surrounding communities partner with military installations to attack system-level issues regionally.

Overview of Investment

SERDP provides technologies and tools that enable installations to actively manage the ecological systems that support the realistic training scenarios military training requires, while preserving the long-term viability of installation and regional ecosystem health. Two key SERDP research priorities in this area are (1) advancing management techniques that limit environmental damage and mitigate or minimize restoration requirements and (2) developing models that support successful adaptive management of DoD training and testing areas. The following initiatives have been funded by SERDP to accomplish these objectives:

FY 2007 Completed Projects

- SERDP Ecosystems Management Project (SI-1114), University of Georgia

FY 2008 Ongoing Projects

- Riparian Ecosystem Management at Military Installations: Determination of Impacts and Restoration and Enhancement Strategies (SI-1186), Oak Ridge National Lab
- Assessing the Impact of Maneuver Training on NPS Pollution and Water Quality (SI-1339), Kansas State University, National Institute for Land Management and Training,
- Allelochemical Control of Non-Indigenous Invasive Plant Species Affecting Military Testing and Training Activities (SI-1388), Colorado State University
- Effectiveness of Selected Native Plants as Competitors with Non-indigenous and Invasive Knapweed and Thistle Species (SI-1389), U.S. Army Corps of Engineers, Engineer and Research Development Center
- SERDP's Defense Coastal/Estuarine Research Program (DCERP) (SI-1413), RTI International
- Developing a Spatially Distributed Terrestrial Biogeochemical Cycle Modeling System to Support the Management of Fort Benning and its Surrounding Areas (SI-1462), U.S. Geological Survey Center for Earth Resources Observation and Science
- Developing Functional Parameters to Develop a Science-Based Vehicle Cleaning Program to Reduce Transport of Non-Native Invasive Plant Species (SI-1545), Montana State University
- Development of a Watershed Modeling System for Fort Benning Using the USEPA BASINS Framework (SI-1547), AQUA TERRA Consultants
- Realizing the Potential of the Effective Area Model: Refining the Software and Incorporating Recent Advances to Maximize Usefulness on Military Installations (SI-1597), Northern Arizona University

FY 2008 New Start Projects

- Understanding the Role of Typhoons, Fire, and Climate on the Vegetation Dynamics of Tropical Dry Forests: Looking to the Past to Develop Future Management Solutions (SI -1644), Woods Hole Oceanographic Institution
- The Potential for Restoration to Break the Grass/Fire Cycle in Dryland Ecosystems in Hawaii (SI-1645), USDA Forest Service
- Development and Use of Genetic Methods for Assessing Aquatic Environmental Condition and Recruitment Dynamics of Native Stream Fishes on Pacific Islands (SI-1646), Tulane University

FY 2009 Initiatives

In the FY 2009 solicitation, SERDP released two SONs concerning **Ecosystem-Based Management**.

Development of Science-Based Recovery Objectives for Ecological Systems in the Southeastern United States – The objective of this SON is to develop the science to define and support recovery objectives that result in ecologically appropriate, mission supportive, and achievable end states and trajectories for southeastern United States (U.S.) ecological systems at multiple spatial and temporal scales. The desired outcome is improved knowledge that provides a better understanding of recovery objectives for the ecological systems associated with Southeast DoD installations to: (1) increase their capacity to sustain military training and testing; (2) maintain habitat for listed and at-risk species; and (3) enable appropriate and achievable recovery of degraded ecological systems.

Managing and Restoring Southeast Coastal Ecosystems Under the Threat of Climate Change- The objective of this SON is to develop the science to support managing and restoring coastal ecosystems in the southeastern United States in the context of potential climate change. Of particular interest are the potential impacts of climate change and the attendant ecological response of already stressed ecological systems and their associated TER-S on military lands in the Southeast. The desired outcome is improved knowledge that provides a better understanding of restoring and managing coastal ecosystems associated with Southeast DoD installations to: (1) increase their capacity to sustain military training and testing; (2) maintain habitat for listed and at-risk species; and (3) enable appropriate and achievable restoration of degraded ecosystems.

viii. Cultural Resources

Scope of Problem

DoD administers 29 million acres of public land containing some of the nation's most significant historic and prehistoric cultural resources. More specifically, DoD owns or controls more than 115,000 archeological sites, 73 National Historic Landmarks, and nearly 600 entries listed on the National Register of Historic Places (encompassing over 19,000 individual historic properties). Management of these resources, in compliance with existing laws and regulations, has proven costly to the military, both financially and operationally. Training restrictions imposed by cultural resource regulations impact the DoD mission, and proper identification and assessment of such sites can require many man hours and significant financial resources.

Figure II-7. Example of historic property on a DoD installation.

Overview of Investment

SERDP research seeks to develop the science, tools, and techniques needed to manage cultural resources on installations and ranges. In particular, technologies for the rapid and cost-effective detection and evaluation of archeological and other cultural resources, such as historical properties, are needed by installation managers to reduce the potential for training restrictions due to possible disturbance of these assets.

FY 2008 New Start Projects

- Assessment of Historic Masonry and Concrete Structures by Broadband Vibration Testing (SI-1653), Penn State University
- Performance-Based Non-Destructive Load Assessment Tools for Historic DoD Buildings and Structures (SI -1654), Naval Facilities Engineering Service Center
- Structural Integrity Assessment Using Laser Measured Surface Vibration (SI -1655), Naval Research Laboratory

FY 2009 Initiatives

In the FY 2009 solicitation, SERDP released one SON concerning **Cultural Resources.**

Understanding Impacts of Military Activities on Archaeological Resources- The objective of this SON is to understand and quantify the potential impacts on subsurface archaeological resources of various types of land-based military activities, with a focus on vehicle impacts. An improved understanding and quantification of military impacts on archaeological resources will enable DoD cultural resource managers and the regulatory community to: (1) predict the impacts of military training and testing and related activities on known or suspended archaeological sites; (2) determine if and how these impacts will degrade the scientific and cultural value of diverse archaeological sites; (3) accord more effective protection to significant sites; and (4) reduce the restrictions on training and testing that result from unnecessary avoidance of sites. This information will ensure the protection of archaeological resources while ensuring the sustainability of military training and testing activities.

ix. Sustainability

Scope of Problem

Sprawling development patterns increasingly place restrictions on the military's ability to train on existing installations and limit DoD's ability to expand ranges. These development patterns also negatively impact local communities with increases in air and water pollution, greenhouse gas emissions, energy consumption, loss of biodiversity, abandonment of older built areas, and inequities among different population groups defined by class and race. The loss of working landscapes and critical natural areas caused by this type of development also restricts the military's ability to sustain lands compatible for training. Existing plans, institutions, and analysis tools employed by DoD and these communities generally are inadequate to manage the existing growth and development pressures.

Similarly, the driving force of an installation is meeting its assigned mission, and the continuation of this mission into the future is dependent upon the sustainability of that base. The sustainability of a base relates directly to the ability to provide continuing support to tenant commands to meet their missions. A base is most sustainable when it minimizes resource needs and environmental impact, possesses high

morale, maintains mutually beneficial community relationships, is adaptable to changing needs and situations, and anticipates twenty or more years into the future. Optimally, a base must also have the ability in emergencies to operate self-reliantly.

Overview of Investment

In April 2007, SERDP partnered with DoD's Sustainable Ranges Initiative (SRI) to sponsor a two-day Southeast Regional Planning and Sustainability Workshop. SERDP-funded workshops seek to (1) identify high-priority issues of shared concern among the military, academia, and other key stakeholders related to sustaining military training land, regional planning, and compatible land use and (2) explore collaborative approaches that engage the academic and research community and build on existing efforts to help address these high-priority issues.

Throughout FY2007, SERDP continued to pursue a sustainability assessment for Naval Base Ventura County (NBVC) that involves defining a baseline of installation-wide material inputs and outputs and developing a set of metrics to measure these material flows. SERDP will use this installation baseline and set of sustainability metrics to establish long-term sustainability goals for NBVC and foster efforts to meet these goals and measure progress towards achieving them. With only slight modification, these goals and metrics, once established for NBVC, should have applicability across all DoD installations. The expected outcomes of this sustainable installation study include: a set of metrics for measuring sustainability, a baseline analysis of those metrics, a starting point to develop sustainability goals, a better understanding of areas that have the largest potential for improvement or are the most problematic, a Sustainability Protocol that can be used at other bases, and a set of sustainability research topics for SERDP and ESTCP to pursue. These research initiatives will further DoD's ability to measure, monitor, and achieve sustainability goals.

x. Sea Level Rise

Scope of Problem

It is vital that DoD be able to continue to operate in coastal settings because of the unique and critical realistic training venues that coastal environments provide. However, because of the near certainty of climate change and subsequent sea level rise, many coastal DoD installations run the risk of losing operational capabilities as continued sea level rise impacts their current infrastructure and training regimes.

Overview of Investment

SERDP research seeks to develop analysis methods and assessments necessary to determine the impacts of various increases in sea level and associated phenomena including, but not limited to (1) inundation of land, (2) increased storm and flood damage, (3) loss of wetlands, (4) changes in erosion patterns and rates, (5) salt water intrusion in surface and ground waters, (6) rising water tables, and (7) changes in tidal flows and currents. These physical effects will impacts coastal DoD installations to a differing degree depending on the geomorphology of the installation and its surrounding area as well as the nature and location of the built infrastructure on the installation.

FY 2009 Initiatives

In the FY 2009 solicitation, SERDP released one SON concerning **Sea Level Rise**.

Assessment of the Impact of Sea Level Rise on Military Infrastructure- The objective of this SON is to develop analysis methods to assess the impacts of local mean sea level rise of 0.5 meters, 1.0 meters, 1.5 meters and 2.0 meters and associated phenomena on United States (U.S.) military infrastructure and to utilize these methods to assess the potential impacts to one or more of the military installations listed below. The outcomes of this research will be analysis methods that can be easily applied to military installations using available data to assess the potential impacts of sea level rise of a range of magnitudes. In addition, the work will result in a clear assessment of the potential impacts of various degrees of sea level rise, as well as storm frequency and intensity, on selected DoD installations. It is anticipated that this assessment will provide the basis for (1) identifying the specific installations or portions of installations that are significantly at risk, (2) identifying the impacts that may potentially be mitigated with existing technologies, and (3) identifying the need for the development of new adaptation technologies. This initial research will indicate the scope of a potentially significant issue affecting mission sustainability.

C. Reducing Current and Future Liabilities

Current and future environmental liability for the DoD involves the remediation of past practices and the elimination or mitigation of future issues. These liabilities frequently are associated with the industrial processes that are required to build, maintain, and repair military hardware as well as the operation of platforms and use of weapons. The preferred means to address these issues is to view systems in a total life-cycle management framework and to eliminate hazardous and toxic materials when possible. Future liabilities have been significantly reduced through the development and application of new, advanced environmental technologies that address specific areas of interest such as chlorinated solvents, heavy metals, contaminated sediments, air emissions, energetics, and hazardous materials/solid waste. Opportunities abound as well for further cost reductions.

In addition, Executive Order 13423 requires the all Federal Agencies to improve energy efficiency and reduce greenhouse gas emissions by reducing energy intensity and increasing the use of renewable energy sources. Both of these goals suggest that DoD diversify its current energy sources energy by exploring efficient, energy producing and energy conserving technologies. SERDP is responding to this challenge by developing technologies that can be applied to ranges, installations, and deployed forces.

i. Munitions Response

Scope of Problem

UXO presents a major challenge to DoD's efforts to conduct military munitions response actions at sites other than operational ranges. It also is a challenge for active military installations seeking to manage their operational ranges as sustainable assets. According to the Defense Science Board (DSB), there are nearly 3,400 military munitions response sites including active bases, base realignment and closure (BRAC) installations, and formerly used defense site (FUDS) properties that, collectively, encompass more than 27 million acres of land. The current projected DSB estimate to clean up this land is approximately $50 billion. Because current technology does not detect all UXO that may be present at a site and does not reliably discriminate between UXO and nonhazardous materials, UXO characterization and remediation activities conducted at DoD sites are extremely expensive and often yield unsatisfactory results. Field experience indicates that more than 99

Figure II-8. Potentially live ordnance remaining at former testing and training ranges.

percent of objects excavated in the course of a UXO remediation are nonhazardous (i.e., false alarms), and, as a result, most of the cost to remediate a UXO site is associated with excavating non-ordnance items. New technologies are needed that are capable of detecting UXO with much higher degrees of accuracy and reliability ensure that DoD receives the maximum return on investment for its UXO remediation efforts.

Overview of Investment

SERDP develops effective and efficient technologies, processes, and procedures for the reliable and cost-effective environmental remediation of UXO — all the while pursuing technologies that will reduce or eliminate the generation of UXO.

Detection and discrimination of UXO are the most difficult aspects of range clearance. Currently, production surveys rely on single-sensor or multi-sensor arrays to collect the data that are used to detect and locate UXO on land and or underwater. These data then are analyzed using computer modeling and simulation software to identify UXO. High false alarm rates are a costly, ongoing problem because of sensor imperfections, and there is a need to (1) increase detection probabilities and (2) better characterize subsurface UXO in order to quantify unavoidable risk and make defensible decisions in identifying UXO. New standards and protocols focused on the collection, management, and evaluation of geophysical data are needed for evaluating UXO technology performance and for selecting the most effective technologies for individual sites. Specifically, wide-area screening systems are needed to identify and locate concentrations of UXO, reduce the area required for intensive and intrusive surveys, define the boundaries of contaminated areas, and certify clean areas.

Surface and excavated inert items such as practice bombs normally must be treated as containing high explosives or other hazardous material because there are no reliable means of outwardly distinguishing them from actual UXO. These items generally are not determined to be inert until an attempt to detonate them has been made. New technologies that will permit the easy location and identification of UXO items, possibly via unique “tags,” would alert the range operator to the existence, type, and location of unexploded munitions. Further, development of new, inert ordnance that is easily recognizable, disintegrates, or is reusable and has no adverse environmental impact will reduce DoD remediation costs in the long term. Other options include further reducing the dud or partial detonation rate of munitions. To address this need, SERDP is examining technologies that will permit the external discrimination of inert practice munitions from live rounds.

Systems also are needed to safely remove, render safe, and dispose of UXO. The ultimate objective for heavily contaminated areas would be a system that excavates the soil, sorts the explosive ordnance, and breaks it down into inert components for scrap disposal. This scrap then must be tested for explosive residue for remediation prior to recycling. Finally, standard software and visualization tools are needed to provide regulatory and public visibility to and understanding of the analysis and decision process guiding UXO remediation activities.

In addition to the UXO found on training lands, many active and former military installations have ranges and training areas that include adjacent water environments such as ponds, lakes, rivers, estuaries, and coastal ocean areas. Modern geophysical surveying techniques can effectively characterize sites potentially contaminated with munitions on dry land, but the underwater environment restricts access to and may significantly impact the performance of established and emerging characterization technologies. Environmental concerns and safety considerations often restrict the underwater use of common munitions recovery and demolition technologies.

The following initiatives have been funded by SERDP to accomplish the Program’s objectives in the area of UXO:

FY 2007 Completed Projects

- Improving Detection and Discrimination of UXO in Magnetic Environments (MM-1414), Colorado School of Mines
- Characterization of Freshwater EM Subbottom Sediment Properties and target Responses for Detection of UXO with Ground Penetrating Radar (MM-1440), Engineering Research and Development Center
- Underwater UXO Multiple Sensor Data Base Collection (MM-1507), Naval Surface Warfare Center
- Statistical Methods for UXO Pattern Recognition (MM-1531), Carnegie Mellon University
- Development of Low Cost Technologies for Remote Detection of Unexploded Ordnance (MM-1567), Benet Laboratories
- Next Generation Data Collection System for Mobile Detection and Discrimination of Unexploded Ordnance (MM-1571), Sky Research, Inc.
- Processing for Clutter Evasion in UXO Discrimination (MM-1590), U.S. Army Engineering Research and Development Center

FY 2008 Ongoing Projects

- Detection and Classification of Buried Metallic Objects (MM-1225), Lawrence Berkeley National Laboratories
- Advanced UXO Discrimination Using Magnetometry: Understanding Remanent Magnetization (MM-1380), Sky Research, Inc.
- UXO Navigation Technology (MM-1441), Sky Research, Inc.
- Statistical and Adaptive Signal Processing for UXO Discrimination for Next-Generation Sensor Data (MM-1442), Duke University
- Compact, Low-Noise Magnetic Sensor with Fluxgate (DC) and Induction (AC) Modes of Operation (MM-1444), QUASAR, Inc.
- Advanced signal Processing and Classification: UXO Standardized Test Site Data (MM-1505), SAIC, Inc.
- Assessing Sonar Performance Against Underwater UXO (MM-1506), Naval Surface Warfare Center
- Man-Portable Magnetic Scalar Triangulation and Ranging system for Detection, Localization and Discrimination of UXO (MM-1511), Naval Surface Warfare Center
- Development of a micro-fabricated Total-Field Magnetometer (MM-1512), Geometrics, Inc.
- Wide Area Detection and Identification of Underwater UXO Using Structural Acoustic Sensors (MM-1513), Naval Research Laboratory
- Sensor Phenomenology and Feature Development for Improved Sonar-based detection and Discrimination of Underwater UXO (MM-1533), BAE Systems
- An EM System with Dynamic Multi-Axis Transmitter and Tensor Gradiometer Receiver (MM-1534), G&G Sciences

- Handheld Frequency Domain Vector EMI Sensing for UXO Discrimination (MM-1537), U.S. Army Corps of Engineers
- High-Accuracy Multisensor Geolocation Technology to Support Geophysical Data Collection at MEC Sites (MM-1564), Ohio State University
- Technical Assessment of IMU-Aided Geolocation Systems for UXO Detection (MM-1565), Ohio State University
- Miniature Wide-Band Atomic Magnetometer, (MM-1568), Geometrics, Inc.
- Machine Learning Approach for Target Selection and Threat Classification of Wide Area Survey Data (MM-1570), SAIC, Inc.
- A Complex Approach to UXO Discrimination: Combining Advanced EMI Forward and Statistical Signal Processing (MM-1572), Dartmouth University
- Simultaneous Inversion of UXO Parameters and background Response (MM-1573), Sky Research, Inc.
- Phenomenology and signal Processing for UXO/Clutter Discrimination (MM-1595), SAIC, Inc.
- EMI Using an Array of 3-Component Sensors for UXO Detection and Discrimination (BEAMOD) (MM-1598), Flagstaff Geoconsultants

FY 2008 New Start Projects

- Robust statistics and Regularization for Feature Extraction and UXO Discrimination (MM-1629), Sky Research, Inc.
- Detection of Underwater Military Munitions by a Synoptic, Airborne Multi-Sensor System (MM-1630), BAE Systems
- Marine UXO Characterization Based on Autonomous Underwater Vehicle Technology (MM-1631), Sky Research, Inc.
- EMI Modeling of UXO Detection and Discrimination Underwater (MM-1632), Dartmouth University
- Examination of Airborne FDEM System Attributes for UXO Mapping and Detection (MM-1633), Battelle
- Large-Moment EMI Array for UXO Detection and Discrimination (MM-1634), Geophex, Ltd.
- Timed Neutron Technique for UXO Discrimination (MM-1635), SAIC, Inc.
- Hierarchical Clustering for Delineating Items Highly Unlikely to be UXO (MM-1636), Signal Innovations Group
- Selecting Optimal Models for Inverting EMI Data (MM-1637), Sky Research, Inc.
- Advanced UXO Detection and Discrimination Using Magnetic Data Based on Extended Euler Deconvolution and Shape Identification Through Multi-pole Moments (MM-1638), Colorado School of Mines
- The Detection and Discrimination of Small Munitions Using Giant Magnetoresistive (GMR) Sensors (MM-1639) U.S. Army Corps of Engineers
- Enhancement of TEM Data and Noise Characterization by Principal Component Analysis (MM-1640) Colorado School of Mines

- Blow-in-Place Pressure Reduction (Covering Technology): Laboratory and Preliminary, Small-Scale Field Evaluations of Covering technology Effectiveness (MM-1641) Space and Naval Warfare Systems Center
- Enhancement of Magnetic Data by Stable Downward Continuation for UXO Application (MM-1642), Colorado School of Mines
- Precision Geolocation of Active Electromagnetic Sensors Using Stationary Magnetic Sensors (MM-1643), Sky Research, Inc.

FY 2009 Initiatives

In the FY 2009 solicitation, SERDP released four SONs concerning **Munitions Response**.

Improvements in the Detection and Remediation of Underwater Military Munitions – The goal of this SON is to significantly improve the ability of the DoD to characterize and remediate military munitions found in underwater sites. Particular interest is in technologies applicable to the following areas: 1) Wide Area Assessment (WAA)—to locate concentrations of munitions in the underwater environment and characterize their nature and extent, 2) Cost-effective recovery and disposal—to cost-effectively recover munitions in the underwater environment, 3) Underwater geolocation—for accurate underwater geolocation, 4) Improvements for detailed surveys, and 5) Acoustic response of munitions and environment.

Phenomenology of Military Munitions in Underwater Environments – The objective of this Statement of Need (SON) is to improve our understanding of the phenomenology of underwater munitions and the underwater site conditions that impact their detection and remediation. Proposals using existing sensor systems and or modeling approaches to explore munitions characteristics and site conditions that could affect technology performance or site management decisions will be considered.

Advanced Technologies for Detection, Discrimination, and Remediation of Military Munitions – The goal of this SON is to develop sensors, signal processing, platforms, systems, supporting technologies, phenomenology studies or remediation technologies to address the diverse challenges associated with the cleanup of DoD sites contaminated with UXO and related items. Capabilities are needed for a wide variety of site conditions, particularly those with difficult geology, terrain and vegetation, or complex ordnance and clutter distributions.

Advanced Technologies for Detection, Discrimination and Remediation of Military Munitions – The SERDP Exploratory Development (SEED) Program is a means for researchers to test proof of concept during an effort of one year or less. The objective of this SEED SON is to develop sensors, signal processing, platforms, systems, supporting technologies, phenomenology studies or remediation technologies to address the diverse challenges associated with the cleanup of DoD munitions-contaminated sites (sites contaminated with UXO and related items).

ii. Chlorinated Solvents – Dense Non-Aqueous Phase Liquids

Scope of Problem

Chlorinated solvents are by far the most pervasive group of contaminants at DoD facilities. A recent estimate indicates that DoD owns more than 3,000 sites in the United States that are contaminated with chlorinated solvents. These solvents often exist as dense, non-aqueous phase liquids (DNAPL) in the subsurface and serve as long-term sources of groundwater contamination. Historically, complete cleanup of these contaminant sources has been considered technically impracticable; therefore, the typical response action has been containment by pumping and treating the contaminated groundwater. New

technologies such as thermal treatment, chemical oxidation, bioremediation, and enhanced physical removal (e.g., using cosolvents or surfactants), however, are designed to remove the subsurface sources of DNAPLs. Under appropriate conditions, these technologies can remove a large fraction of the total DNAPL mass and accelerate remediation. However, there are still uncertainties regarding the benefits of using such technologies, and site managers need to ask themselves the following questions: Are the costs for source removal technologies justified in terms of the reduced need for, or duration of, active containment of the groundwater contaminant plume? How much DNAPL source removal is required to cease active containment at a given site and to ensure protection of human health and the environment? Will contaminants migrate outside the treatment zone?

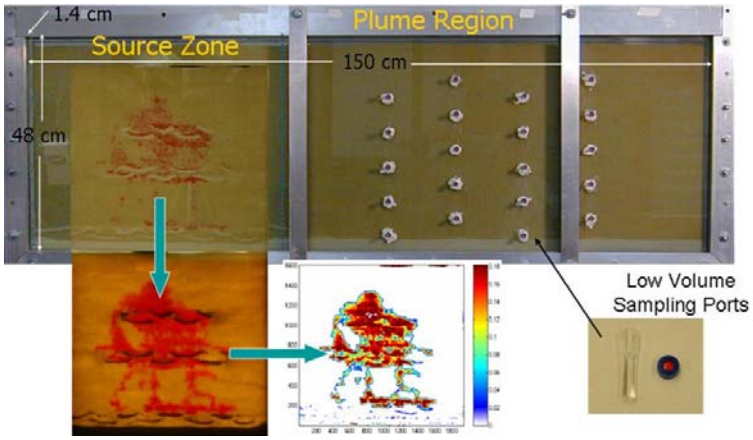

Figure II-9. Aquifer cell experiments measure abiotic and biotic transformations and transport processes within and down-gradient from a heated DNAPL source zone.

Overview of Investment

SERDP develops and promotes technologies to cost-effectively remediate chlorinated solvents in soil and groundwater. Technologies to detect and assess the presence and extent of both DNAPL source zones and dissolved plumes are essential. In addition, there is a need to understand the benefits of source zone treatment—particularly of in-situ technologies. The following initiatives have been funded by SERDP to accomplish these Program objectives:

FY 2007 Completed Projects

- Development of Assessment Tools for Evaluation of the Benefits of DNAPL Source Zone Treatment (ER-1293), Tufts University –Chlorinated Solents
- Fusion of Tomography Tests for DNAPL Source Zone Characterization: Technology Development and Validation (ER 1365), University of Iowa
- Hydraulic Tomography and High-Resolution Slug Testing to Determine Hydraulic Conductivity Distributions (ER-1367), University of Kansas
- Investigation of Chemical Reactivity, Mass Recovery and Biological Activity During Thermal Treatment of DNAPL Source Zones (ER-1419), Georgia Institute of Technology
- Large-Scale Physical Models of Thermal Remediation of DNAPL Source Zones in Aquifers (ER-1423), TerraTherm, Inc.
- Control of Manganese Dioxide Particles Resulting From In Situ Chemical Oxidation Using Permanganate (ER-1484), East Tennessee State University
- Improved Monitoring Methods for Performance Assessment During Remediation of DNAPL Source Zones (ER-1490), Colorado School of Mines
- Prokaryotic cDNA Subtraction: A Method to Rapidly Identify Functional Gene Biomarkers (ER-1563), University of Texas

FY 2008 Ongoing Projects

- In Situ Thermal Remediation of DNAPL Source Zones (ER-1458), Oregon Health and Science University

- Fundamental Study of the Delivery of Nano-iron to DNAPL Source Zones in Naturally Heterogeneous Field Systems (ER-1485), Carnegie Mellon University
- Multi-Scale Experiments to Evaluate Mobility Control Methods for Enhancing the Sweep Efficiency of Injected Subsurface Remediation Amendments (ER-1486), Colorado School of Mines
- Development and Optimization of Targeted Nanoscale Iron Delivery Methods for Treatment of NAPL Source Zones (ER-1487), Tufts University
- Enhanced Reactant-Contaminant Contact through the Use of Persulfate In Situ Chemical Oxidation (ISCO) (ER-1489), Washington State University
- Contaminant Mass Transfer During Boiling in Fractured Geologic Media (ER-1553), Clemson University
- DNAPL Dissolution in Bedrock Fractures and Fracture Networks (ER-1554), Shaw Environmental, Inc.
- A Comparison of Pump-and-Treat, Natural Attenuation, and Enhanced Biodegradation to Remediate Chlorinated Ethene-Contaminated Fractured Rock Aquifers (ER-1555), U.S. Geological Survey
- Characterization of Microbes Capable of Using Vinyl Chloride as a Sole Carbon and Energy Source by Anaerobic Oxidation (ER-1556), Clemson University
- Elucidation of the Mechanisms and Environmental Relevance of cis-Dichloroethene and Vinyl Chloride Biodegradation (ER-1557), GeoSyntec Consultants
- Microbial DCE and VC Oxidation and the Fate of Ethene and Ethane Under Anoxic Conditions (ER-1558), U.S. Geological Survey
- Cryogenic Collection of Complete Subsurface Samples for Molecular Biological Analysis (ER-1559), Oregon Health and Science University
- Impacts of Sampling and Handling Procedures on DNA- and RNA-based Microbial Characterization and Quantification (ER-1560), North Carolina State University
- Standardized Procedures for Use of Nucleic Acid-Based Tools (ER-1561), U.S. Navy, Naval Facilities Engineering Service Center
- BioReD: Biomarkers and Tools for Reductive Dechlorination Site Assessment, Monitoring, and Management (ER-1586), Georgia Institute of Technology
- Application of Microarrays and qPCR to Identify Phylogenetic and Functional Biomarkers Diagnostic of Microbial Communities That Biodegrade Chlorinated Solvents to Ethene (ER-1587), University of California at Berkeley
- Molecular Biomarkers for Detecting, Monitoring, and Quantifying Reductive Microbial Processes (ER-1588), Stanford University

FY 2008 New Start Projects

- New Cost Effective Method for Long Term Groundwater Monitoring Programs (ER-1601), Groundwater Services, Inc.
- Micro Ion Mobility Sensor (MIMS) For In-Situ Monitoring of Contaminated Groundwater (ER-1603), Oak Ridge National Laboratory

- Periodic Mesoporous Organosilicas (PMOs) as Preconcentration Elements for Improved Long-Term Monitoring of Key Contaminants in Groundwater (ER-1604), U.S. Navy, Naval Research Laboratory
- Novel Sensor for Real-Time Characterization and Monitoring of Chlorinated Hydrocarbons in Groundwater (ER-1605), Naval Facilities Engineering Service Center
- Computational and Experimental Investigation of Contaminant Plum Response to DNAPL Source Zone Architecture and Depletion in Porous and Fractured Media (ER-1610), University of Waterloo
- Practical Cost-Optimization of Characterization and Remediation Decisions at DNAPL Sites With Consideration of Prediction Uncertainty (ER-1611), University of Tennessee
- Metric Identification and Protocol Development for Characterizing DNAPL Source Zone Architecture and Associated Plume Response (ER-1612), Tufts University
- The Impact of DNAPL Source-Zone Architecture On Contaminant Mass Flux and Plume Evolution in Heterogeneous Porous Media (ER-1614), University of Arizona

FY 2009 Initiatives

In the FY2009 Solicitation, SERDP released three SONs concerning **Chlorinated Solvents**.

Reduced Uncertainty and Costs for Managing Large, Dilute Contaminant Groundwater Plumes – The objective of this Statement of Need (SON) is to solicit fundamental and applied research designed to improve our ability to manage large, dilute groundwater plumes of key contaminants of concern to the Department of Defense. Improved monitoring and characterization tools to assess natural attenuation processes should allow faster and less expensive assessments of the long-term risks posed by large contaminant plumes. These tools should reduce the uncertainty regarding the risks and environmental fate of contaminants in such plumes and reduce the costs for their long-term management. Improved technologies for more cost-effective remediation of these plumes could substantially reduce the life cycle costs for managing these plumes. Results of this research are expected to reduce the uncertainty and costs associated with managing these plumes and allow for more informed decision-making. The research should focus on 1) developing more cost-effective techniques to remediate large, dilute groundwater plumes, 2) improving the ability to evaluate, demonstrate, and measure relatively slow attenuation processes that may contribute to chlorinated solvent plume stabililization, and 3) developing a better understanding and improved methods to evaluate and measure processes responsible for sustaining chlorinated solvent plumes following reduction of the contaminant influx.

Improved Understanding of the Vapor Intrusion Pathway from Chlorinated Solvent-Contaminated Groundwater Plumes – The objective of this Statement of Need (SON) is to solicit fundamental and applied research that leads to better pathway assessment for vapor intrusion from chlorinated solvent-contaminated groundwater. Development of a greater understanding of the vapor intrusion pathway from chlorinated solvent-contaminated groundwater plumes will improve our ability to provide more accurate prediction, monitoring, and management methodologies. Greater understanding will ultimately lead to more cost-effective protection of human health. Specific objectives include 1) gaining a better understanding of natural spatial and temporal variations in vapor intrusion measurements and how to account for such variability in pathway assessment, 2) improving our ability to obtain accurate and cost-effective characterization of key site parameters that impact the vapor intrusion pathway, 3) improving our ability to predict vapor behavior under various physical, climatic, and/or geochemical conditions, and 4) improving our understanding of vapor attenuation mechanisms.

Improved Understanding of the Impact of Environmental Parameters and Sampling Methods on Measured Groundwater Contaminant Concentrations – The objective of this Statement of Need (SON) is to solicit fundamental and applied research that improves our understanding and ultimately allows for the prediction of which environmental parameters and sampling methods will provide accurate groundwater contaminant measurements for compliance sampling. Specifically, the SON seeks to gain a better understanding and predictive capability of how measured contaminant concentrations vary as a function of parameters such as hydrogeological conditions, geochemistry, well type, sampling method, contaminant type and concentration, or other key parameters. Reductions in the cost of LTM programs have the potential to greatly reduce the long-term liability for the DoD. Costs for LTM are increasing, and now represent a significant percentage of the total and future restoration costs. Research will focus on ultimately decreasing long-term monitoring (LTM) costs by improving our ability to utilize in-well field sensors, while maintaining an accurate representation of contaminant concentrations. The ability to reduce field mobilizations to collect compliance samples will have a substantial impact on long-term monitoring costs.

iii. Heavy Metals

Scope of Problem

Preventing the corrosion of metal components in military vehicles, aircraft, and weapon systems is a multibillion dollar challenge. Typically, corrosion is prevented by the application of sealants and coatings containing chromium as the primary corrosion inhibiting substance. Chromium, however, has been designated as hazardous and work is underway to reduce or eliminate chromium from sealants and coatings in compliance with either current or pending Occupational Safety and Health Administration (OSHA) requirements. Accordingly, DoD has committed to replace chromate-based sealants and metal finishing in current and next generation weapons systems. Strategic investments in chromate elimination research have been made, and these efforts have contributed significantly to our understanding of corrosion protection by chromates.

Figure II-10. Research is determining ecological screening values for heavy metal contamination in organisms.

Thousands of DoD sites (including those undergoing closure or realignment) require remediation of contaminated soil—a process that can be prohibitively expensive. Heavy metals are among the most common soil contaminants on these facilities, particularly cadmium, arsenic, chromium, and lead. SERDP has funded considerable research to identify environmentally acceptable levels and ecological screening levels of heavy metal contaminants in soil. Efforts also are underway to develop rapid, routine methods for measuring the bioavailability of heavy metals for plants and soil invertebrates.

Overview of Investment

Investments in heavy metals research span the Environmental Restoration and Weapons Systems and Platforms thrust areas. SERDP develops and promotes techniques and technologies that cost-effectively: (1) evaluate the presence and disposition of heavy metals; (2) detect, monitor, and remediate hazardous metals and metal compounds in soil and groundwater; and (3) develop new materials and processes that eliminate the need for these metals.

Evaluating the presence and disposition of metals in soil continues to be an expensive and time-consuming laboratory process. Metals may be complexed or otherwise bound to materials in the soil matrix, and some of these binding methods are strong enough to resist acidic and enzymatic breakdown (i.e. bioavailability) by plant and animal species. Because regulatory limits often are set based on the total metal in the soil, cleanup limits can be overly conservative.

The development of environmentally benign alternatives to heavy metals that provide the same functionality and result in no loss in military performance is imperative; however, until alternatives are developed for all applications, new technologies to recycle metal plating baths and control emissions and waste are needed. The following initiatives have been funded by SERDP to accomplish the Program's objectives in this area:

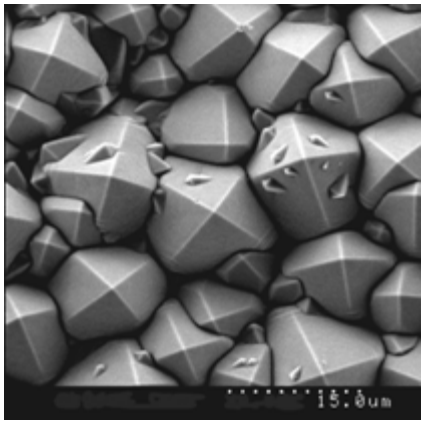

Figure II-11. Improving environmentally benign protective coatings by understanding the relationship between coating microstructure and its properties.

FY 2007 Completed Projects

- Soil Amendments to Reduce Bioavailability of Metals in Soils: Experimental Studies and Spectroscopic Verification (ER-1351), Purdue University
- Anaerobic Biostimulation for the In Situ Precipitation and Long-Term Sequestration of Metal Sulfides (ER-1373), GeoSyntec Consultants
- Environmental Fate and Exposure Assessment for Arsenic in Groundwater (ER-1374), California Institute of Technology
- Reduced Iron Sulfide Systems for Removal of Heavy Metal Ions from Groundwater (ER-1375), University of Michigan
- Chromium-Free Coating System for DoD Applications (WP-1341), University of Cincinnati
- Zeolite Coating System for Corrosion Control to Eliminate Hexavalent Chromium from DOD Applications (WP-1342), University of California, Riverside
- Investigation of Chemically Vapor Deposited Aluminum as a Replacement Coating for Cadmium (WP-1405), U.S. Air Force, Air Force Research Lab
- Electrolytic Plasma Processing for Sequential Cleaning and Coating Deposition for Cadmium Plating Replacement (WP-1406), U.S. Navy, Naval Research Laboratory
- Development of Chrome-Free Welding Consumables for Stainless Steels (WP-1415), Ohio State University

FY 2008 Ongoing Projects

- Anaerobic Biostimulation for the In Situ Precipitation and Long-Term Sequestration of Metal Sulfides (ER-1373), GeoSyntec Consultants
- Environmental Fate and Exposure Assessment for Arsenic in Groundwater (ER-1374), California Institute of Technology
- Reduced Iron Sulfide Systems for Removal of Heavy Metal Ions from Groundwater (ER-1375), University of Michigan

- Metal Ion Sensor with Catalytic DNA in a Nanofluidic Intelligent Processor (ER-1459), U.S. Army Corps of Engineers, Engineer Research and Development Center
- An Integrated Field and Laboratory Study of The Bioavailability of Metal Contaminants in Sediments (ER-1494), Stony Brook University, Marine Sciences Research Center
- Biological Processes Affecting Bioaccumulation, Transfer, and Toxicity of Metal Contaminants in Estuarine Sediments (ER-1503), Dartmouth College
- Investigation of Chemically Vapor Deposited Tantalum for Medium Caliber Gun Barrel Protection (WP-1425), New Jersey Institute of Technology
- Chromium Elimination in Medium Caliber Gun Barrels (WP-1426), U.S. Army, Benet Laboratories
- Non-Leaching, Benign Antifouling Multilayer Polymer Coatings for Marine Applications (WP-1454), Cornell University
- Corrosion Finishing/Coating Systems for DoD Metallic Substrates Based on Non-chromate Inhibitors and UV Curable, Zero Valent Materials (WP-1519), University of Missouri-Rolla
- UV Curable Non-Chrome Primer and Advanced Topcoat System (WP-1520), Foster-Miller, Inc.
- Non-Chromate/No-VOC Coating System for DOD Applications (WP-1521), U.S. Army, Army Research Laboratory

FY 2008 New Start Projects

- Directed Vapor Deposition of a Cadmium Replacement Coating for High Strength Fasteners (WP-1615), Luna Innovations, Inc.
- Ultra-high Efficiency / Low Hydrogen Embrittlement Nanostructured Zn-Based Electrodeposits as Environmentally Benign Cd-Replacement Coatings for High-Strength Fasteners (WP-1616), Integran Technologies
- Environmentally Friendly Anticorrosion Coatings for High Strength Fasteners (WP-1617), PPG Industries, Inc.
- Corrosion Protection Mechanisms of Rare-Earth Compounds Based on Cerium and Praseodymium (WP-1618), University of Missouri-Rolla
- Morphology and Mechanism of Benign Inhibitors (WP-1619), University of Cincinnati
- Scientific Understanding of Non-Chromated Corrosion Inhibitors Function (WP-1620), The Ohio State University
- Scientific Understanding of the Mechanisms of Non-Chromate Corrosion Inhibitors (WP-1621), Southwest Research Institute

FY 2009 Initiatives

In the FY2009 Solicitation, SERDP released two SONs concerning **Heavy Metals**.

Dynamic Accelerated Corrosion Test Protocol - The objective of this SON is to develop an accelerated corrosion testing protocol that would be acceptable across the Department of Defense (DoD). The need exists for an accelerated corrosion test methodology that more accurately reflects the operational environments of DoD end users. Military and commercial communities rely on accelerated tests to perform comparative evaluations of protective systems, especially in the development of new materials and the qualification of products to specifications. Current accelerated corrosion tests do not have a

dynamic stress component that is known to exist in the actual operating environments for many systems. In addition, test coupons are typically single metal alloy flat coupons, which are not representative of most systems that contain galvanic couples made from materials like composites, aluminum, titanium, and steel. With the advent of non-traditional inhibitor technologies, better testing protocols are needed to stress these new protective systems in an effort to understand how they perform compared to the standard systems that are currently in use. Improved accelerated tests will help shorten the development and implementation period for new materials by allowing scientists to more rapidly focus on promising alternatives and produce higher quality data that will lower the risk of putting new materials on test platforms. Compliant materials and processes would be brought to the user communities more quickly as the need for field testing would be far less, resulting in a greater confidence of successful implementation.

Environmentally Acceptable, Direct-To-Substrate Pretreatments for Multi-Material Systems - The objective of this SON is to develop easily applied and environmentally acceptable pretreatments for multi-material systems. Existing "wash primers", which usually contain hexavalent chromium, are applied in a thin layer using conventional painting equipment. These wash primers provide a slight acid etching of the surface as they contain phosphoric acid, and thus promote good adhesion of subsequently applied primers and topcoats. The hexavalent chromium in the wash primer performs two functions: 1) it serves as a corrosion inhibitor for eventual in-service exposures and 2) it helps promote even etching of metal substrates. The Department of Defense has a need for pretreatments that are environmentally acceptable, simple to apply, compatible with a broad range of existing military coatings, and require minimal infrastructure changes to apply. These pretreatments must contain no Hazardous Air Pollutants (HAPs) and be compliant with existing EPA regulations such as the Aerospace and Shipbuilding NESHAPs (National Emissions Standards for Hazardous Air Pollutants). The proposed research will benefit the DoD by providing cost effective and environmentally acceptable pretreatments for broad classes of DoD substrates and coating systems.

iv. Sediments Management

Scope of Problem

Aquatic sediments are often the ultimate receptors of contaminants in effluent from DoD activities. Sediment contamination problems are particularly difficult because of the tendency for contaminants to be retained within sediments for a long time. According to an estimate by the U.S. EPA, approximately 10% or 1.2 billion cubic yards of the sediment underlying the country's surface water is sufficiently contaminated with toxic pollutants to pose potential risks to fish and to humans and wildlife that eat fish. This represents the upper five centimeters of sediment, where many bottom-dwelling organisms live, and where the primary exchange processes between the sediment and overlying surface water occur. Adverse ecological effects in fish from contaminated sediments include fin rot, increased tumor frequency, and reproductive toxicity. In addition, contaminated sediments can pose a threat to human health when pollutants in sediments accumulate in edible, aquatic organisms.

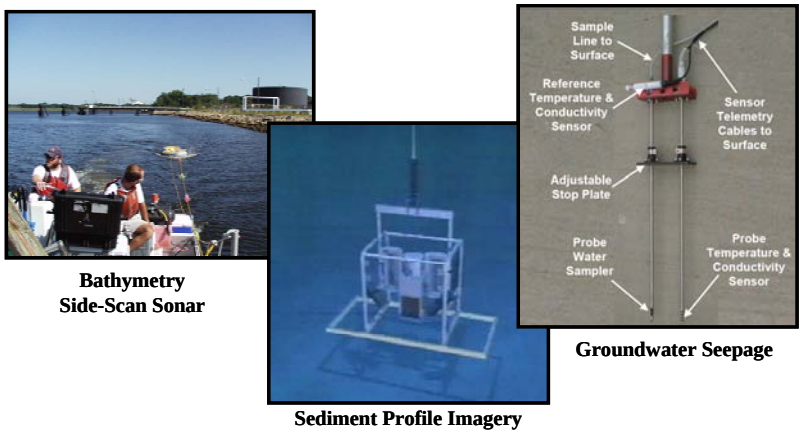

Figure II-12. Geophysical surveys for site selections for testing the effectiveness of geotextile materials on contaminated sediment.

Sediment contaminants include a wide variety of compounds, such as, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), various metals and metalloids, and military-unique compounds such as munitions constituents. The sediment contamination problem is exacerbated by the need to periodically dredge the old deposited sediments to maintain navigable depths in waterways. Nearly 300 million cubic yards of sediment are dredged from U.S. ports, harbors, and waterways each year. It is estimated that approximately 5% to 10% of these dredged materials are impacted with organic and inorganic contaminants. As estuarine and coastal sites, in particular, fall under increasing scrutiny, the number of DoD sites requiring action is likely to increase.

Overview of Investment

Contaminated aquatic sediments represent a particularly complex issue that is growing in significance. SERDP is currently investing in research and development efforts in the Environmental Restoration thrust area to (1) improve understanding of the basic science in sediment management, (2) develop effective tools to characterize and manage these sites to reduce risk to human health and the environment and (3) gain regulatory acceptance of new restoration technologies. The following projects have been funded by SERDP to accomplish the Program's objectives for Sediments Management:

FY 2007 Completed Projects

- Characterization of Contaminant Migration Potential Through In-Place Sediment Caps (ER-1370), Battelle Memorial Institute (Canceled in 2007)
- Integrating Uncertainty Analysis in the Risk Characterization of In-Place Remedial Strategies for Contaminated Sediments (ER-1371), University of Michigan (Project under review for additional work)
- Biotic and Abiotic Attenuation of Nitrogenous Energetic Compounds (NEC) in Coastal Waters and Sediments (ER-1431), U.S. Navy, Naval Research Laboratory
- Rational Selection of Tailored Amendment Mixtures and Composites for In Situ Remediation of Contaminated Sediments (ER-1491), University of Maryland, Baltimore County

FY 2008 Ongoing Projects

- Quantifying Enhanced Microbial Dehalogenation Impacting the Fate and Transport of Organohalide Mixtures in Contaminated Sediments (ER-1492), Rutgers University
- Reactive Capping Mat Development and Evaluation for Sequestering Contaminants in Sediments (ER-1493), U.S. Navy, Naval Facilities Engineering Service Center
- An Integrated Field and Laboratory Study of The Bioavailability of Metal Contaminants in Sediments (ER-1494), Stony Brook University, Marine Sciences Research Center
- Modeling and Decision Support Tools Based on the Effects of Sediment Geochemistry and Microbial Populations on Contaminant Reactions in Sediments (ER-1495), Carnegie Mellon University
- Using Passive Polyethylene Samplers to Evaluate Chemical Activities Controlling Fluxes and Bioaccumulation of Organic Contaminants in Bed Sediments (ER-1496), Massachusetts Institute of Technology
- Develop Accurate Methods for Characterizing and Quantifying Cohesive Sediment Erosion Under Combined Current-Wave Conditions (ER-1497), U.S. Army Corps of Engineers, Engineer and Research Development Center, Coastal and Hydraulics Laboratory

- Innovative In-Situ Remediation of Contaminated Sediments for Simultaneous Control of Contamination and Erosion (ER-1501), Savannah River National Laboratory
- Application of Tools to Measure PCB Microbial Dechlorination and Flux into Water During In-Situ Treatment of Sediments (ER-1502), University of Maryland, Chesapeake Biological Laboratory
- Biological Processes Affecting Bioaccumulation, Transfer, and Toxicity of Metal Contaminants in Estuarine Sediments (ER-1503), Dartmouth College
- Sediment Ecosystem Assessment Protocol (SEAP): An Accurate and Integrated Weight-of-Evidence Based System (ER-1550), Wright State University
- Bacterial and Benthic Community Response to Inorganic and Organic Sediment Amendments (ER-1551), U.S. Navy, Space and Naval Warfare Systems Center
- Measurement and Modeling of Ecosystem Risk and Recovery for In Situ Treatment of Contaminated Sediments (ER-1552), Stanford University

v. Air Emissions

Scope of Problem

The 1990 Clean Air Act Amendments (CAAA), the Resource Conservation and Recovery Act (RCRA), and state and local regulations restrict the emission of air pollutants such as volatile organic compounds (VOCs). The production of ozone depleting substances (ODS) also has been banned under national policy and international (Montreal) protocol. Further, federal and state environmental agencies have been authorized to regulate particulate matter (PM) and polycyclic aromatic hydrocarbons (PAH) emitted from local sources.

Figure II-13. SERDP efforts aim to understand and reduce engine emissions from air and land based weapon systems.

Military bases increasingly are being identified as point sources of these pollutants and are being held accountable for their emissions. DoD directives require significant reductions in hazardous air emissions and development of alternative materials and processes that meet environmental restrictions but that still allow DoD to continue operations in support of its national security mission. Air emissions are generated from many sources on military installations—from painting and stripping paint off military equipment to weapon system platforms such as ships, airplanes, and ground vehicles that were originally designed for system performance (but without concern for air emissions). The Services and SERDP are supporting research and development of technologies that will reduce or eliminate air emissions in readiness for the soon-to-be-released, 10-year Surface Coating National Emission Standards for Hazardous Air Pollutants (NESHAP).

Overview of Investment

SERDP develops and promotes technologies and/or materials that eliminate, reduce, or control environmentally damaging VOCs, hazardous air pollutants (HAPs), particulates, and ODSs from DoD platforms, weapons systems, and industrial processes. There is a need for technologies to rapidly detect and classify these compounds, and control of these releases is required. Environmentally benign alternatives include new materials to replace these compounds, new processes that eliminate use of these compounds, and new processes that reduce or eliminate the production of these compounds as a by-product. SERDP has funded the following initiatives to accomplish the Program's objectives:

FY 2007 Completed Projects

- Next Generation Fire Suppression Technology Program (NGP) (WP-1059), National Institute of Standards and Technology
- Temporal and Modal Characterization of DoD Source Air Toxic Emission Factors (WP-1247), U.S. Environmental Protection Agency, National Risk Management Research Laboratory
- Characterization of Off-Road Diesel Emissions of Criteria Pollutants (WP-1336), Desert Research Institute
- Developing EPA Approved Interim PM Test Method for JSF (WP-1538), U.S. Navy, Naval Air Systems Command

FY 2008 Ongoing Projects

- A Comprehensive Program for Measurement of Emissions From Military Aircraft (WP-1401), Oak Ridge National Laboratory
- Development of Emission Factors for Particulate Matter, Nitrogen Oxides, and Air Toxic Compounds from Military Aircraft (WP-1402), Battelle Memorial Institute
- Predictive Chemical and Statistical Modeling of Particulate Matter Formation in Turbulent Combustion with Application to Aircraft Engines (WP-1574), Stanford University
- Aromatic Radicals-Acetylene Particulate Matter Chemistry (WP-1575), University of Illinois at Chicago
- Effects of Soot Structure on Oxidation Kinetics (WP-1576), University of Utah
- Combustion Science to Reduce PM Emissions for Military Platforms (WP-1577), U.S. Air Force, Air Force Research Laboratory
- Predicting the Effects of Fuel Composition and Flame Structure on Soot Generation in Turbulent Non-Premixed Flames (WP-1578), Sandia National Labs

FY 2008 New Start Projects

- Quantifying Sulfate, Organics, and Lubrication Oil in Particles Emitted from Military Aircraft Engines (WP-1625), Aerodyne Research
- Measurement and Modeling of Volatile Particle Emissions from Military Aircraft (WP-1626), Carnegie Mellon University
- Development and Application of Novel Sampling Methodologies for Study of Volatile Particulate Matter in Military Aircraft Emissions (WP-1627), Oak Ridge National Laboratory
- Extreme Light Diagnostics for Measuring Total Particulate Emissions (WP-1628), Air Force Research Laboratory

FY 2009 Initiatives

In the FY2009 Solicitation, SERDP released one SON concerning **Air Emissions**.

Characterization of Emissions From Open Burn/Open Detonation – The objective of this Statement of Need (SON) is to seek applied research leading to improved quantification of all atmospheric emissions from the demilitarization of ordnance via open burn/open detonation (OB/OD). Previous OB/OD emissions studies have made use of testing procedures designed for continuous emission sources, leading to questionable estimates of these emissions. Proposals responding to this SON would develop real-time measurement methodologies that will accurately characterize the emissions from OB/OD operations, modeling and/or prediction capabilities to accurately predict emissions from OB/OD operations for a wide and representative variety of ordnance and munition items or, correction factors for existing OB/OD emissions data. This proposed effort will result in a Department of Defense (DoD) -wide approach to generating emissions factors that address regulatory concerns with data quality. Improved quantification of emissions will permit each demilitarization, testing, and training facility to generate toxic release inventories that will address regulatory concerns with currently available data.

vi. Energetic Materials

Scope of Problem

Military munitions containing energetic materials are an essential part of the defense arsenal. They include not only gun rounds, missile propellants, and explosives, but also pyrotechnic materials such as flares and smokes. Millions of pounds of energetic materials are made each year, producing significant quantities of hazardous wastes. These compounds are often found in the soil and groundwater at former and current ammunition manufacturing and load, assemble, and pack plants. The predomiant energetic chemicals of environmental concern include TNT and RDX, which were often used in combination, and HMX. In addition, the amino, reductive transformation products of TNT, such as 4-amino dinitrotoluene, are also toxic and have been detected in soil and groundwater.

Overview of Investment

Investments in the area of Energetic Materials span the Environmental Restoration and Weapons Systems and Platforms thrust areas. To reduce current liabilities, SERDP is working to (1) improve the fundamental understanding of the microbial processes that degrade these contaminants and (2) search for ways to improve on these natural processes to remediate munitions contaminants. To reduce future liabilities, SERDP is working to develop new propellants, pyrotechnics, and explosive materials that will reduce or eliminate the release of toxic materials to the environment, yet still meet mission performance requirements. The following initiatives have been funded by SERDP to accomplish the Program's objectives in the area of Energetic Materials:

Figure II-14. Residues from use of energetic materials contaminate soil and groundwater.

FY 2007 Completed Projects

- Engineering Transgenic Plants for the Sustained Containment and In Situ Treatment of Energetic Materials (ER-1318), University of Washington

- Enhancement of In Situ Bioremediation of Energetic Compounds by Coupled Abiotic/Biotic Processes (ER-1376), Pacific Northwest National Laboratory
- Biodegradation of Nitroaromatic Compounds by Stimulating Humic Substance- and Fe(III)-Reduction (ER-1377), GeoSyntec Consultants, Inc.
- Fate of Plant Tissue Associated RDX in Surface Soil (ER-1412), U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory
- Biotic and Abiotic Attenuation of Nitrogenous Energetic Compounds (NEC) in Coastal Waters and Sediments (ER-1431), U.S. Navy, Naval Research Laboratory
- Bioremediation Approaches for Treating Low Concentrations of N- Nitrosodimethylamine in Groundwater (ER-1456), Shaw Environmental, Inc.
- Development of Environmental Data for Navy, Air Force, and Marine Munitions (ER-1480), U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory
- Characterization and Fate of Gun and Rocket Propellant Residues on Testing and Training Ranges (ER-1481), U.S. Army Corps of Engineers, Engineer Research and Development Center
- Elimination of Redwater from TNT Manufacture (WP-1408), QinetiQ
- Catalytic Nitration of Toluene (Elimination of Red Water) (WP-1409), U.S. Army, Armament Research Development and Engineering Center

FY 2008 Ongoing Projects

- Groundwater Chemistry and Microbial Ecology Effects on Explosives Biodegradation (ER-1378), Shaw Environmental, Inc.
- Development of Toxicity Benchmarks and Bioaccumulation Data for N-Based Organic Explosives for Terrestrial Plants and Soil Invertebrates (ER-1416), National Research Council of Canada
- Development of Toxicity Data for Munition Compounds to Support Toxicity Reference Value Derivations for Wildlife (ER-1420), U.S. Army, Center for Health Promotion & Preventive Medicine
- Dissolution Rate, Weathering Mechanics and Friability of TNT, Comp B and Octol (ER-1482), U.S. Army Corps of Engineers
- Sustainable Range Management of RDX and TNT by Phytoremediation With Engineered Plants (ER-1498), University of York
- Phytoremediation for the Containment and Treatment of Energetic and Propellant Material Releases on Testing and Training Ranges (ER-1499), The University of Iowa
- Plant-Based Containment/Treatment of Energetic Material Releases for Application on Testing and Training Ranges (ER-1500), U.S. Army Corps of Engineers, Engineer Research and Development Center Environmental Laboratory
- Rhizosphere Bacterial Degradation of RDX, Understanding and Enhancement (ER-1504), University of Washington
- Characterization and Fate of Gun and Rocket Propellant Residues on Testing and Training Ranges (ER-1481), U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory
- Prokaryotic cDNA Substraction: A Method to Rapidly Identify Functional Gene Biomarkers (ER-1563), University of Texas at Austin

- Alternative for Perchlorates in Incendiary Mix and Pyrotechnic Formulations for Projectiles (WP-1424), QinetiQ
- Clean Electrochemical Synthesis of Alkylnitro Compounds (WP-1460), ATK Launch Systems
- Manufacture of TATB and TNT from Biosynthesized Phloroglucinols (WP-1582), Draths Corporation

FY 2008 New Start Projects

- A Portable Fiberoptic Surface Enhanced Raman Sensor for Real-Time Detection and Monitoring of Perchlorate and Energetics (ER-1602), Oak Ridge National Laboratory
- Periodic Mesoporous Organosilicas (PMOs) as Preconcentration Elements for Improved Long-Term Monitoring of Key Contaminants in Groundwater (ER-1604), U.S. Navy, Naval Research Laboratory
- New Approaches to Evaluate the Biological Degradation of RDX in Groundwater (ER-1607), Shaw Environmental Inc.
- The Molecular Microbiology of Nitroamine Degradation in Soils (ER-1608), University of Washington
- Identification of Microbial Gene Biomarkers for In-Situ RDX Biodegradation (ER-1609), Army Engineer Research and Development Center
- Metal and Oxide Additives as Agents for Munitions Self-Remediation (WP-1623), U.S. Army Engineer Research and Development Center
- Cyclic Dinitroureas as Self-Remediating Munition Charges (WP-1624), Naval Air Warfare Center – Weapons Division

FY 2009 Initiatives

In the FY2008 Solicitation, SERDP released one SON concerning **Energetic Materials**.

Reduced Uncertainty and Costs for Managing Large, Dilute Contaminant Groundwater Plumes – The objective of this Statement of Need (SON) is to solicit fundamental and applied research designed to improve our ability to manage large, dilute groundwater plumes of key contaminants of concern to the Department of Defense. Improved monitoring and characterization tools to assess natural attenuation processes should allow faster and less expensive assessments of the long-term risks posed by large contaminant plumes. These tools should reduce the uncertainty regarding the risks and environmental fate of contaminants in such plumes and reduce the costs for their long-term management. Improved technologies for more cost-effective remediation of these plumes could substantially reduce the life cycle costs for managing these plumes. Results of this research are expected to reduce the uncertainty and costs associated with managing these plumes and allow for more informed decision-making. The research should focus on 1) developing more cost-effective techniques to remediate large, dilute groundwater plumes, 2) improving the ability to evaluate, demonstrate, and measure relatively slow attenuation processes that may contribute to chlorinated solvent plume stabililization, and 3) developing a better understanding and improved methods to evaluate and measure processes responsible for sustaining chlorinated solvent plumes following reduction of the contaminant influx.

vii. Hazardous Materials/Solid Waste

Scope of Problem

The majority of DoD maintenance and repair activities for weapon system components involve the use of toxic or hazardous substances. Occasionally, these materials become waste products and make their way into the soil, sediments, air, or groundwater. From the deicing of aircraft and runways to removing coatings from substances, hazardous substances are a DoD-wide problem. In addition to hazardous wastes, DoD must contend with the problem of nonhazardous solid waste. This waste includes the packaging materials needed to sustain personnel both at home and deployed in the field. The areas of hazardous and nonhazardous solid waste are a large environmental problem that DoD must try to resolve.

Overview of Investment

SERDP develops and promotes techniques and technologies that cost-effectively eliminate, reduce, or control hazardous materials in soil, sediments, air, and groundwater. Eliminating hazardous materials from military platforms and weapons systems is the preferable solution, especially if there will be no net loss of military capability with the alternative material. In cases where environmentally benign alternatives have not been identified, control technologies, augmented with recycling and reuse methods as well as remedial technologies, need to be developed. SERDP has funded the following initiatives to accomplish the Program's objectives in Hazardous Materials/Solid Waste:

FY 2007 Completed Projects

- New Reactive Diluents for an Environmentally Efficient Approach to Composite Repair (WP-1596), U.S. Navy, Naval Air Systems Command, Research Sciences and Engineering Department
- Sequestering Lead in Paint by Utilizing Deconstructed Masonry Materials as Recycled Aggregate in Concrete (SI-1548), Iowa State University
- System Chemistry to Control Potential Environmental and Safety Hazards of Recycled Concrete Aggregate with Lead-Based Paint (SI-1549), U.S. Army Corps of Engineers, Construction Engineering Research Lab

FY 2008 Ongoing Projects

- PHA Bioplastic Packaging Materials (SI-1478), Metabolix
- Lightweight and Compostable Packaging for the Military (SI-1479), U.S. Army Natick Soldier Center
- Development of Environmentally Benign and Reduced Corrosion Runway Deicing Fluid (SI-1535), Battelle Memorial Institute
- Environmentally Benign Repair of Composites Using High Temperature Cyanate Ester Nanocomposites (WP-1580), Ames Laboratory

FY 2008 New Start Projects

- Rapidly Degradable Pyrotechnic System (WP-1622), Infoscitex Corporation

FY 2009 Initiatives

In the FY2008 Solicitation, SERDP released three SONs concerning **Hazardous Materials/Solid Waste**.

Advanced Methods for Removing Solids From Shipboard Waste Streams – The objective of this SON is to develop advanced concepts or techniques for separating and removing solids from shipboard liquid waste streams that use media-free or near permanent, reusable or extended life materials and methods that can enhance mission capability and environmental security through increased performance and reduced lifecycle cost. Navy ships utilize many commercially available technologies and systems to process liquid wastes that are, in great part, affected by solids suspended in the waste stream. These solids come in a wide range of material compositions, sizes, shapes, and densities, making removal and subsequent management difficult for many shipboard specific applications. If filtration is not sufficiently fine, solids are passed and accumulate inside the processing equipment and reduce performance due to packing and densification. If filtration is fine enough to remove the smallest particles, then the filters often have limited capacity and clog up rapidly. This is problematic, even with automated strainers and flushing filters, which frequently cycle due to the prevailing solids loading and the nature of their process control loops. Alternative methods or techniques are needed to provide or enhance critical wastewater processing capabilities aboard ships. These methods must be robust; operate at high efficiency and repeatability; have a relatively small footprint; are relatively light weight; can be automatically cleaned in place and are not labor intensive or complicated to operate, maintain or support; and will withstand harsh environmental conditions. The proposed research will benefit the DoD by providing a more efficient, cost effective and environmentally acceptable means to process and manage waste streams generated as an inevitable and essential part of shipboard systems. Cost savings will be realized through reduced operation and maintenance costs and enhanced mission readiness that may result in decreased reliance on contractor field support abroad.

Environmentally Benign Aircraft Deicing and Anti-Icing – The objective of this Statement of Need (SON) is to develop and test new environmentally benign chemical deicing and anti-icing formulations for use on military aircraft. Current deicing and anti-icing formulations have negative impacts on the aquatic environment due to their high biological oxygen demand (BOD) and the aquatic toxicity associated with additives for corrosion inhibition and other properties. New deicing and anti-icing formulations must meet or exceed the Federal Aviation Administration (FAA) mandated performance requirements and have a significantly lower BOD and reduced aquatic toxicity. Another important issue associated with the development of new deicers/anti-icers is compatibility with materials and coatings currently used on military aircraft. Proposals submitted in response to this SON should include appropriate testing to demonstrate the required deicing, anti-icing, environmental, and materials compatibility performance. Issues such as shelf life should also be addressed. The outcomes of this research will lead to a cost effective, environmentally benign deicing and ant-icing formulation. The work will allow military aircraft deicing functions to continue without the need for costly capture and treatment systems, while still meeting military requirements, potential future regulatory requirements, and protecting the environment.

Understanding The Science Behind How Methylene Chloride/ Phenolic Chemical Paint Strippers Remove Coatings – The objective of this SON is to gain a scientific understanding of how chemical paint strippers, especially those based on methylene chloride and phenol (MC/P), remove organic coatings. Paint strippers based on these chemicals quickly and easily remove primers and topcoats with virtually no damage to metallic substrates; they do not induce corrosion or hydrogen embrittlement when used on high-strength steels (HSS) and are relatively inexpensive. Alternatives to MC/P vary in chemistry and remove coatings using different mechanisms, which have not been fully characterized. They can cause corrosion of certain metals and some have been shown to induce hydrogen embrittlement of HSS. Specifically, proposals are requested that seek to develop a quantitative, mechanistic understanding of the basic functionalities of methylene chloride- and/or phenolic-based paint strippers. An understanding of how these materials function will make it much easier to identify novel materials for use in new chemical paint removers. Proposed solutions should yield concepts that will aid in the development of significantly less toxic chemical paint strippers that will meet/exceed the performance of strippers containing MC/P. The proposed research to be conducted under this SON is expected to lead to more efficient targeted

research that will result in the development of non-MC/P products. The elimination of MC/P will minimize the life-cycle burden of purchasing, handling, storing, using, and disposing of materials for paint removal. A final benefit is decreased turn-around-time. Current non-MC/P materials that do not harm the underlying substrates take up to 16 times longer to remove coatings versus the baseline. New materials will perform as quickly as the MC/P paint removers, reducing the turn-around-time for critical components. The health, safety, and environmental benefits will be maintained or even increased, greatly enhancing the quality of life for workers and lowering cost.

viii. Emerging Contaminants

Scope of Problem

DoD has defined emerging contaminants as chemicals or materials of interest that are characterized by a perceived or real threat to human health or environment and/or a lack of a published health standards or an evolving standard. A contaminant may also be "emerging" because of the discovery of a new source, a new pathway to humans, or a new detection method or technology. In the past, SERDP has funded research on contaminants such as perchlorate, affording DoD a position at the forefront of characterization and remediation when public awareness increased. SERDP continues today with the process of early identification of emerging contaminants with relevance to DoD needs.

Figure II-15. Current studies are investigating bioremediation approaches to treating low concentrations of N-nitrosodimethylamine (NDMA), a product of rocket fuel, in groundwater.

Overview of Investment

SERDP works closely with DoD's Materials of Emerging Regulatory Interest Team (MERIT) to identify new contaminants. SERDP's goal for the identified emerging contaminants is to acquire fundamental understanding of the mechanisms involved in contaminant destruction, either via chemical or microbial means, to develop adequate remedial technologies. Elucidation of the impact of co-contaminants on degradation processes is another important goal, along with the converse, namely improvement in understanding of the behavior of emerging contaminants under typical remedial technologies for co-contaminants. The goal is that these technologies developed under SERDP can then be transferred to enhance the remediation of these contaminants at DoD sites through further testing and evaluation under the other DoD programs such as ESTCP. The following projects have been funded by SERDP to accomplish the Program's objectives in the area of Emerging Contaminants:

FY 2007 Completed Projects

- Oxygenase-Catalyzed Biodegradation of Emerging Water Contaminants: 1,4-Dioxane and N-Nitrosodimethylamine (ER-1417), University of California at Berkeley
- Abiotic and Biotic Mechanisms Controlling In Situ Remediation of NDMA (ER-1421), Pacific Northwest National Laboratory
- Biodegradation of 1,4-Dioxane (ER-1422), Shaw Environmental and Infrastructure, Inc.

FY 2008 Ongoing Projects

- Bioremediation Approaches for Treating Low Concentrations of N- Nitrosodimethylamine in Groundwater (ER-1456), Shaw Environmental, Inc.
- Prospects for Remediation of 1,2,3-Trichloropropane by Natural and Engineered Abiotic Degradation Reactions (ER-1457), Oregon Health and Science University

ix. Energy

Scope of Problem

DoD occupies over 620,000 buildings and structures worth $600 billion that are located on more than 400 installations in the United States. DoD spends over $2.5 billion per year on facility energy consumption. DoD is the largest single energy consumer in the Nation representing 78% of the federal sector, and a significant (and sometimes the largest) energy user in many local metropolitan areas. Additionally, deployed forces have special energy needs requiring innovative technology solutions. It is the DoD policy to increase energy conservation, reduce energy demand, and increase the use of renewable energy to improve energy flexibility to not only save financial resources and reduce emissions but also enhance personnel capabilities in the field.

Overview of Investment

Decreased dependence on fossil fuels and increased energy security are major goals within DoD. Both of these goals suggest that the DoD considers diversifying its current sources of energy by exploring both efficient, energy producing and energy conserving technologies. To achieve these, DoD needs to explore all alternatives, including expanding the use of renewable energy systems such as wind, solar, geothermal, biomass, and biofuels, and other advanced non-polluting distributed energy resources (DERs) technologies (for example, fuel cells and microturbines). Investments in Energy research are addressed in the Sustainable Infrastructure focus area. SERDP seeks to develop technologies that can be applied to ranges, installations, and deployed forces. The following initiatives have been funded by SERDP to accomplish the Program's objectives in the area of Energy.

FY 2008 New Start Projects

- Modeling and Simulation of a DG-Integrated Intelligent Microgrid (SI-1650), Virginia Tech
- Efficient Thermoelectric Power Conversion of Waste Heat for Deployed Forces (SI-1651), RTI International
- Advanced Soldier Thermoelectric Power System for Power Generation from Battlefield Heat Sources (SI-1652), Pacific Northwest National Lab

D. SERDP Projects of the Year

Each year, SERDP recognizes major R&D accomplishments with its Project of the Year awards. The awards are presented at the annual Partners in Environmental Technology Technical Symposium & Workshop hosted by SERDP and its sister program, ESTCP. More than 900 environmental professionals from government agencies, academia, and the private sector participated in the conference, which was held December 4-6, 2007, in Washington, D.C.

SERDP Project of the Year for Environmental Restoration

Identification and Characterization of Natural Sources of Perchlorate – Dr. Gregory Harvey, U.S. Air Force, Aeronautical Systems Center Engineering Directorate, Wright-Patterson Air Force Base, Ohio

Perchlorate is an emerging contaminant of concern throughout the nation, with 44 states identified as having water sources that have tested positive for perchlorate. For some time, it has been assumed that because perchlorate is a primary component of fuel for rockets and missiles, most perchlorate in the environment must come primarily from military sources. Scientists have been aware that perchlorate also occurs naturally in the environment, but the sources and extent of its occurrence have not been well documented. This groundbreaking research, conducted by Dr. Harvey in collaboration with colleagues at Texas Tech University and the U.S. Geological Survey, for the first time provides a conceptual picture with supporting data of naturally occurring perchlorate, mechanisms of its production, and how it accumulates and moves in the environment. The results, which include data from dozens of sites in the United States and around the world, show that the amount of perchlorate produced naturally in the atmosphere and that accumulates in soils in semi-arid and arid environments is much more widespread than previously believed. These findings provide scientists, regulators, the military, and other stakeholders with a better understanding of where perchlorate comes from-knowledge that is essential to effectively manage this environmental risk.

SERDP Project of the Year for Munitions Management

Improving Detection and Discrimination of UXO in Magnetic Environments – Dr. Yaoguo Li, Colorado School of Mines, Department of Geophysics, Golden, Colorado;

The military trains with live munitions to maintain readiness at all times; however, not all munitions detonate during training. Cleaning up military sites suspected of containing munitions that have been armed and fired yet remain unexploded is one of the most pressing environmental problems facing DoD. It is particularly difficult to distinguish unexploded ordnance (UXO) from magnetic rocks and soils, especially in complex geological settings found throughout the United States. Building on prior SERDP Exploratory Development (SEED) research, Dr. Li developed a processing technique that screens out this geologic clutter and that is based on a fundamental understanding of the origin of magnetic soils and their effects on electromagnetic and magnetic data. This work will improve the efficiency and reliability of UXO detection and discrimination in magnetic environments and significantly reduce costly excavations of large numbers of non-UXO.

SERDP Project of the Year for Sustainable Infrastructure

Riparian Ecosystem Management: Impacts, Restoration and Enhancement Strategies – Dr. Patrick Mulholland, Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, Tennessee

On many military ranges, training involves operating large vehicles such as tanks on terrain near riparian ecosystems. Such training, over time, often results in vegetation loss and severe erosion from upland areas, which results in sediment buildup in these streams and which eventually can affect water quality downstream and negatively impact associated riparian and stream ecosystems. Dr. Mulholland's project demonstrates the effectiveness of using low-cost restoration strategies, including physical stabilization and revegetation as well as the addition of woody debris at strategic points, to improve water quality and stream biodiversity. This research provides an improved understanding of the impacts of upland and riparian disturbances, enabling land managers to make informed decisions about training intensity and leverage these practical, cost-saving methods that control sedimentation and improve the overall health of streams.

SERDP Project of the Year for Weapons Systems and Platforms

Development of Chrome-Free Welding Consumables for Stainless Steels – Dr. Gerald Frankel, The Ohio State University, Department of Materials Science and Engineering, Columbus, Ohio;

DoD personnel perform a significant amount of welding for the manufacture and repair of stainless steel parts and structures in thousands of ships and tanks. In many cases, this welding must be conducted in confined spaces. Welding fumes generated using conventional stainless steel welding rods, or consumables, are particularly harmful because they contain hexavalent chromium, a known carcinogen. The ability to control and capture these fumes is difficult, and the common method of protecting workers by putting them in cumbersome protective gear is impractical in these cramped settings. Building on prior SEED research, Dr. Frankel and his team developed a chromium-free welding consumable that provides the same strength and corrosion properties as conventional welds and that protects the workforce that repairs ships and tanks while minimizing the need for costly monitoring and mitigation measures.

E. FY 2007 Workshops

Over the past 10 years, SERDP has sponsored a number of workshops that have proven to be an invaluable forum for identifying DoD's high-priority environmental needs. With participation by a variety of renowned experts providing diverse viewpoints from the military services, Federal government, academia, and industry, each topical workshop (1) examines the current state of the science and engineering, (2) identifies gaps in knowledge and technology, and (3) prioritizes those gaps against DoD needs to determine where investments in RDT&E could have the greatest impact on DoD's ability to address its environmental requirements. Workshop results are incorporated into the Program's strategic plan and used when developing solicitations for proposals and seeking innovative solutions to DoD's high-priority environmental needs. Results of the FY 2007 workshops highlighted below already are impacting current and future investment decisions.

Southeast Region TER-S Workshop, February 27 - March 1, 2007, Cocoa Beach, Florida

DoD has a vested interest in sustaining its testing and training capabilities throughout the United States, and particularly in the Southeast where it owns or manages a wide of array of unique and sometimes rare habitats. Installations within this region span coastal, longleaf pine, Fall Line sandhills, bottomland hardwoods, floodplains, upland systems, and inland aquatic and wetland environments, providing essential habitats for more than 200 TER-S. Further, they are situated in areas with significant concentrations of urban, agricultural, and industrial use, which have severely impacted historic amounts and conditions of the aquatic and terrestrial ecosystems on which TER-S depend.

Figure II-16. Longleaf pine habitat.

The specific objectives for the Southeast regional workshop were to (1) assess TER-S management needs within a regional context, with an emphasis on system-level and cross boundary approaches; (2) assess these approaches for their potential to keep common species

common while recovering or enhancing TER-S populations; (3) examine the current state of the science and practice within DoD for such holistic approaches; (4) identify potential partners and existing partnership structures whose focus is, at least in part, meeting TER-S conservation objectives; (5) identify the gaps in knowledge, technology, management, and partnerships that, if addressed, could improve implementation of system-level and cross boundary approaches; and (6) prioritize investment opportunities to address gaps.

Four white papers covering emerging issues in forest health, aquatic priorities, connectivity in fragmented landscapes, and natural disturbance events prepared in advance of the workshop as well as a field tour of Cape Canaveral highlighting its award-winning natural resource management program set the stage for discussions. Participants identified several topics of particular importance for TER-S management in the Southeast, including gaining a better understanding of fire, restoration, and ecological system linkages, as well as how related management activities impact species, habitats, and the military's training mission.

Southeast Regional Planning & Sustainability Workshop, April 25-27, 2007, Atlanta, Georgia

In April 2007, SERDP co-hosted the Southeast Regional Planning and Sustainability Workshop in Atlanta, Georgia. The workshop built upon DoD's increasing interest in working with outside partners to help ensure the sustainability of DoD lands and resources and encourage sustainable land use planning in communities and regions near military bases. The workshop's development was overseen by a diverse Steering Committee, several members of which also played active roles in the workshop and in compiling the workshop report. Key stakeholders with an interest in the future growth and development of the Southeast took part in this three-day discussion. Stakeholders represented many interests groups from the public, private and non-profit sectors that are active in military base operations; land use planning; community development; conservation of farmlands, forests and natural areas; and real estate investment. Representatives from academia in the fields of agriculture, city and regional planning, forestry, and wildlife ecology also participated.

Figure II-17. Factors affecting encroachment and sustainability, and the transformation of DoD forces.

Goals of the workshop were 1) to identify the high-priority issues of shared concern between the military, academia, and other key stakeholders related to sustaining military training lands, regional planning, and compatible land use in the Southeast and 2) to explore collaborative approaches – particularly ones that engage the academic and research community – that can build on existing efforts and help address these high-priority issues.

The workshop was designed to build upon DoD's Sustainable Ranges Initiative, including conservation buffer efforts, increased outreach with partners and surrounding communities, the Southeast Regional Partnership for Planning & Sustainability (SERPPAS), and other related activities. In order to identify shared issues of concern among the military and stakeholders as well as potential collaborative approaches to meet those concerns, the workshop was divided into five Breakout Groups – Military, Forests, Agriculture, Land Corridors, and Built Environment. The workshop report which can be found on the SERDP website (www.serdp.org), integrates the main recommendations from these Breakout Groups, and divides those recommendations into areas of policy, research, and outreach. It calls for increased DoD collaborative efforts with researchers and other stakeholders to meet the sustainability

challenges of the Southeast, and identifies a number of promising areas offering opportunity for future progress.

DoD Metal Finishing Workshop - Chromate Alternatives for Metal Treatment and Sealing, May 2007, Ogden, Utah

DoD spends $10-20 billion/year on corrosion control for weapons systems and platforms. To reduce these costs, the performance of corrosion control systems needs to improve, but at the same time environmental and health pressures are forcing a move away from the existing corrosion control technologies that use cadmium (Cd) and chromium (Cr6+). The new OSHA PEL for Cr6+ and growing restrictions on the use of chromates around the world are driving manufacturers and maintainers to find non-toxic alternatives. The most cost-effective approach is to use commercial off the shelf (COTS) products wherever possible, while working with suppliers to modify products that do not adequately meet DoD's needs. In May 2007, SERDP hosted the **DoD Metal Finishing Workshop - Chromate Alternatives for Metal Treatment and Sealing** in Ogden, Utah. This technical workshop brought together individuals from DoD and industry to identify specific DoD needs, commercial solutions, and engineering data for replacing chromate processes used for metal finishing in the overhaul and new weapons systems in vehicles, aircraft and, vessels. A plenary session that provided DoD and industry overviews was followed by breakout sessions grouped by distinct corrosion control applications. The meeting was held near Hill AFB (Ogden Air Logistics Center), and attendees toured the plating and finishing shops at Hill to provide commercial suppliers with a better understanding of how DoD uses chromates. This meeting resulted in the release a SERDP statement of need in the FY09 solicitation. A summary report of the workshop findings is available in the SERDP and ESTCP Online Library at http://docs.serdp-estcp.org.

Workshop on Technology Needs for the Characterization, Management, and Remediation of Military Munitions in Underwater Environments, July 31-August 1, 2007, San Diego, California

Many active and former military installations have ranges and training areas that include adjacent water environments such as ponds, lakes, rivers, estuaries, and coastal ocean areas. Modern geophysical surveying techniques can effectively be used to characterize sites potentially contaminated with munitions on dry land. However, the environment in underwater sites both restricts access to and may significantly impact the performance of established and emerging characterization technologies. Environmental concerns and safety considerations often restrict the use of common munitions recovery and demolition technologies underwater.

Figure II-18. UXO in underwater environments presents numerous technical challenges.

SERDP and the Environmental Security Technology Certification Program (ESTCP) convened a workshop on July 31-August 1, 2007, in San Diego California, to define the future research needs in this area. The primary goal of the workshop was to allow government managers and investigators to explore ongoing work in related fields that may be applicable to underwater munitions sites, as well as to identify gaps in understanding that must be addressed by future research. The goals of the workshop were to establish guidance for DoD's future investments by

identifying: 1) gaps in capabilities that could be addressed through integration and demonstration of systems based on existing technologies, and 2) gaps in understanding that must be addressed by basic and applied research in phenomenology, sensor development, signal processing and supporting technologies.

The research and demonstration areas developed from the stated issues were prioritized into critical and high-priority needs. These needs identified by the expert panel will guide the SERDP strategic plan for investments in this area and resulted in two FY2009 SERDP SONs entitled *Improvements in the Detection and Remediation of Underwater Military Munitions* and *Phenomenology of Military Munitions in Underwater Environments* that were described earlier in this section. A summary report of the workshop findings is available in the SERDP and ESTCP Online Library at http://docs.serdp-estcp.org.

SERDP and ESTCP Technical Exchange Meeting on DoD Operational Range Assessment and Management Approaches, August 7-8, 2007, Annapolis, Maryland

The sustainability of DoD's operational ranges is crucial to maintaining the readiness of the military forces and developing and testing improved weapon systems. DoD policy states that the design and use of operational ranges and the munitions used on them must minimize potential harmful environmental impacts. Concern over the release of munitions constituents (MC) on ranges and their potential to migrate to off-range areas is increasing, however, and endangers the long-term sustainability of ranges. Assessment programs now are being implemented across the Services although mitigation and management approaches largely are in the developmental stage. There is a need for sound science and effective tools to assess and manage operational ranges in a manner that reduces risk to human health and the environment.

With participation by 75 of the Services' range managers and contractors conducting or designing range assessments as well as DoD-funded investigators, the objectives of this meeting were to (1) inform representatives from the range management and assessment communities of applicable technologies developed by SERDP, ESTCP, and the Army Environmental Quality Technology Program and (2) identify technology needs of the range management and assessment community that could be addressed through additional research and development efforts supported by SERDP and ESTCP.

Overviews of the Service's operational range assessment programs, lessons learned from the Military Munitions Response Program, and the state of the science in assessment and management approaches were followed by two breakout sessions on technical issues associated with current range assessment practices and technology needs in the areas of characterization; risk, modeling, and assessment; and mitigation and management. Poster sessions provided additional details on components of the range assessment programs, highlighting specific case studies, and on ongoing research and demonstrations. The entire group participated in the final discussion and selection of the critical and high priority research and demonstration needs. A final report documenting results is now available in the SERDP and ESTCP Online Library at http://docs.serdp-estcp.org/ using W-09 as the Search Phrase. SERDP has released two FY 2008 SONs as a result of this workshop—one on identification of MC source zone locations and strength and a second on MC fate and transport.

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III. MANAGEMENT ACTIONS

A. Council Actions

Multiagency management and oversight of SERDP continues to be one of the clear strengths of the Program. Active participation by the members of the SERDP Council, their designated representatives on the EWG, and the STCs precludes duplication of effort, ensures quality Program content, and facilitates information transfer. This tripartite arrangement, composed of executive, programmatic, and technical individuals who represent the three primary participating organizations, yields a depth and breadth of knowledge and experience at several levels of management and technical expertise that lend significant credibility to the Program.

Multiagency participation is a clear strength of the Program.

On September 28, 2006, the SERDP Council approved the FY 2007 Program Plan and the FY 2008 Investment Plan. For FY 2007, SERDP was appropriated $64.049 M, which included funding for one congressional interest project.

The Council met one year later on September 28, 2007, to approve the FY 2008 Program. The President's Budget Request for SERDP for FY 2008 was $68.874 M, representing an increase of $5.19M from the FY 2007 appropriation. The congressional appropriation for FY 2008 increased SERDP's budget to $69.674 M, which included one congressional interest project. The Council approved the FY 2008 Core program as presented. The Council further granted the Executive Director the authority to execute any congressional interest projects to ensure that they are appropriately focused on defense issues. The Council also reviewed and approved the FY 2009 investment guidance.

B. Executive Director and Program Office

The SERDP Executive Director, Technical Director, and Program Office staff continued to ensure that the Program focuses on the mission needs of the DoD via refining and implementing an investment strategy that successfully satisfies these mission needs. In FY 2007, the Executive Director and Program Office staff continued the Program's emphasis on (1) research to support the sustainability of range operations and the reduction of current and future liabilities; (2) solicitation and selection of proposals from the broadest possible pool of world class researchers; and (3) promotion of technology transfer to ensure the rapid transition of innovative technologies to the DoD user community.

i. Continued Emphasis on UXO and Range Sustainability and New Initiatives in Energy and Climate Change

SERDP continued to implement its investment strategy that frames research topic areas in terms of DoD priorities. The strategy is based on the premise that the Department's environmental issues fall into two major areas. The first area is **Sustainability of Ranges and Range Operations**, which includes maritime sustainability, TER-S, active clearance of UXO, toxic air emissions and dust, urban growth and encroachment, and noise. The second area of the SERDP investment strategy is **Reduction of Current and Future Liability,** which addresses (1) contamination from past practices and includes research on munitions response, chlorinated solvents, heavy metals, contaminated sediments, and emerging contaminants such as perchlorate and (2) material substitution and new processes to control life-cycle costs, which includes elimination of hazardous materials to reduce the cost of operation, repair, and demilitarization as well as achieving compliance through Pollution Prevention. The continuing SERDP investment in UXO detection and discrimination as well as the emphasis on range sustainability research

over the past several years reflects SERDP's focus on priority investment opportunities. According to a Defense Science Board (DSB) estimate, the cost to cleanup UXO is estimated to be more than $50 billion. SERDP's belief is that the development of advanced technology can reduce this cost by nearly 70%. Therefore in FY 2007, SERDP continued to invest heavily in innovative UXO detection and discrimination technologies with an emerging interest in the underwater UXO. Furthermore, the UXO Program Plan undergoes a thorough peer review every year to ensure that it properly characterizes the broad problem, establishes clear and logical goals, and identifies specific, relevant, near-term technical objectives.

SERDP also continued to fund research in DoD's Senior Readiness Oversight Council (SROC) key environmental areas impacting the sustainability of training and testing ranges, including: munitions constituents (MC), TER-S, maritime sustainability, air quality, noise, and urban encroachment. Investments in these areas spanned the Environmental Restoration, Sustainable Installations, and Weapons Systems and Platforms Focus Areas of SERDP. SERDP funded research to provide range managers with techniques to assess the potential for soil or groundwater contamination, to remediate such contamination, and to reduce or eliminate future contamination.

In FY2007, SERDP also began to address issues related to energy and climate change and their impacts on DoD. Executive Order 13423 requires the all Federal Agencies to improve energy efficiency and reduce greenhouse gas emissions through the reduction of energy intensity and to increase the use of renewable energy sources. Both of these goals suggest that the DoD considers diversifying its current sources of energy by exploring efficient, energy producing and energy conserving technologies. SERDP seeks to develop technologies that can be applied to ranges, installations, and deployed forces. As a result, in FY2007 SERDP issued an SON on Scalable Power Grids that Facilitate the Use of Renewable Energy Technologies and an SON on Innovative Technologies for Electricity Production from Waste Heat for Deployed Forces. Successful proposals submitted in response to these SONS are being funded in FY2008.

Climate change in general and sea level rise in particular have potential ramifications for National Security. Draft legislation for the FY 2008 Defense Authorization Bill includes a section entitled: *Department of Defense Consideration of Effect of Climate Change on Department Facilities, Capabilities and Missions.* This legislation directs the Defense Department to provide guidance to military planners to assess the risks of potential climate change and to include an assessment in the next Quadrennial Defense Review of the Armed Forces capabilities to respond to the consequences of climate change. In response to these developments, SERDP in FY2008 issued a request for proposals to fund research beginning in FY2009 to perform assessments of the impact of sea level rise on military infrastructure.

ii. Proposal Solicitation

SERDP takes pride in the fact that funds for new start projects are available to industry, academic, and federal researchers alike, and the SERDP Council continues to be pleased with SERDP's ability to reach out to this broader pool of researchers through a Broad Agency Announcement (BAA). SERDP again extended two solicitations—a "Core" solicitation that has traditionally been used to develop the annual program and a SEED solicitation. The SEED Program is designed to provide initial funding for high-risk, high-payoff proof-of-concept projects. Funding is limited to a maximum of $100,000 for up to one year. Successful efforts may compete for additional funds in the following years.

iii. Technology Transfer

Since 1991, SERDP has funded more than 700 individual projects. Several avenues are taken to ensure that the successful efforts of the research teams are transitioned to either higher development programs, such as ESTCP, or implemented directly into field use.

Technology transfer and transition continued to be a primary area of focus during annual project reviews by both the SERDP SAB and the STCs. All Principal Investigators (PI) are tasked to prepare Annual Technical Reports that serve as a fundamental baseline of technical progress. At the end of each project, a Final Technical Report is required. These reports are maintained in an online library maintained by SERDP and ESTCP. Additionally, they are entered into the Defense Technical Information Center (DTIC) in both a hard copy and electronic version. DTIC provides all researchers with copies of these reports upon request.

SERDP has posted Fact Sheets on its web site for every SERDP funded project, past and present. These Fact Sheets include summaries of the technical accomplishments and potential benefits of each project. The SERDP web site also provides links to web sites maintained by SERDP researchers that give additional information about technologies developed under SERDP.

Each year, SERDP, in cooperation with ESTCP, hosts the *Partners in Environmental Technology Technical Symposium & Workshop*. This event has, for the past ten years, attracted hundreds of researchers, technology developers and users, and regulators to meet in a collegial and informative setting. In December 2007, the annual Symposium once again succeeded in providing an excellent technology transfer and networking forum for researchers, scientists, and engineers from both the federal laboratory system and the nonfederal sector alike. The Symposium focused on "Meeting DoD's Environmental Challenges" in recognition of the fact that, while significant advances have been made in addressing environmental issues, additional challenges continue. This event brought more than 900 technology developers and implementers together, as well representatives from the policy, programmatic, regulatory, academic, and industrial sectors. The annual SERDP Project-of-the-Year Awards were given to the best projects in each of the four Focus Areas for FY 2007. These awards have successfully attracted the attention of the scientific and engineering community around the globe and have measurably helped either to transition this technology into higher development programs or to implement its use in field applications. This conference, which has received numerous accolades, will continue to be enhanced to serve as a significant technical, educational, and technology transfer event.

C. Actions of the SERDP Scientific Advisory Board

In accordance with Section 2904, Title 10, U.S.C., the SERDP SAB is required to meet a minimum of four times during the fiscal year. In FY 2007, the SAB met four times. Consistent with the statute, the Board made recommendations to the SERDP Council through the Executive Director regarding the projects reviewed. They also assisted and advised the Council in identifying environmental opportunities and provided advice on other environmental issues within the scope of SERDP.

Figure III-1 provides a list of dates and locations of all SAB meetings held during FY 2007. In accordance with the Federal Advisory Committee Act, all meetings were open to the public and detailed records of events are maintained. Further, all records, reports, working papers, and agendas were made available to the public for review. In FY 2007, no requests were made to review this information.

SAB Meeting Number	Date	Location	Projects Briefed		
			New Start	Continuing	Total
1	October 17-19, 2006	Arlington, VA	19	0	19
2	March 13-14, 2007	Arlington, VA	5	1	6
3	June 13-14, 2007	Albany, NY (Watervliet Arsenal/Benet Labs)	1	4	5
4	September 11-13, 2007	Arlington, VA	19	0	19

Figure III-1. Summary of FY 2007 SAB Meetings.

The Board continued its proactive strategic role in identifying and defining environmental research gaps and associated technology development opportunities. The Board continued to support strongly the concept of focused technical workshops to provide an assessment of the state of the science and identify and prioritize specific research needs in areas of interest to SERDP. Several Board members actively participated in these workshops.

During their review and evaluation of proposals, the SAB conscientiously scrutinized each effort to understand and enhance the research partnerships that were proposed. Considered to be a major strength of the Program, cooperative research efforts have demonstrated a higher quality of effort by ensuring that each facet of the project is afforded a second look and chance to ensure that it is conducted with the highest standards. Where appropriate, the SAB suggested improvements or additions to the research team —from inclusion of a Co-PI having specific disciplinary credentials that would enhance the research effort to offering suggestions of organizations that might shed additional light and enhance the metrics and procedures proposed in the effort. The SAB also strongly encouraged inclusion of graduate students in research teams to promote training and foster development of technical expertise in cutting-edge technologies.

The Board continued its key focus on assisting SERDP to ensure that SERDP-supported projects meet the highest standard of technical and scientific quality. The SAB addressed this issue from three avenues.

- First, the SAB firmly supports SERDP's procedure to have each and every proposal reviewed by at least three Peer Reviewers who are experts in the discipline most closely related to the proposal's technical approach.
- Second, the members encouraged close coordination between projects that address related problems.
- Third, the Board fully supported the midyear In-Progress Review of each project by the STCs.

The SAB continued to emphasize technology transfer potential as an important criterion for evaluating proposals. Technology transfer is one of the SERDP Keys to Success, and the Board members continued their keen interest in the role of the military Services and eventual users of the technologies being developed. Complete technical reporting, including publications in the peer-reviewed literature as well as SERDP-required interim and final technical reports, was a metric used to determine project technical achievement and management acumen.

The SAB continued its participation in the planning and execution of the annual *Partners in Environmental Technology Technical Symposium & Workshop* sponsored by SERDP. During strategy discussions at SAB meetings, the members offered comments on the overall theme of the Symposium and suggestions for technical session topics and plenary and session speakers. The active involvement of the SAB has been a significant contributing factor to the overall success of each Symposium.

In the past the SAB has suggested areas of opportunity for SERDP investment. Often, these areas prove to become the focus of a national or worldwide research effort. An example of research that commenced at the suggestion of the Board is the remediation of groundwater contaminated with perchlorate. Due to their proactive thinking, SERDP was able to get a head start on understanding this phenomenon and initiating research to resolve associated issues.

Consistent with past practice, the Executive Director solicited the advice of the membership regarding his proposed allocation of funds among the four Focus Areas for FY 2008. The Board was fully supportive of the proposed profile and general trends of investment within each of the four Focus Areas. A summary of all projects reviewed by the SAB and the results of their deliberations may be found in Figure III-2.

At the September 2007 SERDP Council meeting, Dr. Ellen Mihaich, Chair of the SAB, advised the Council of how the SAB ensures that quality research is focused on high-priority DoD needs and that technology transfer is fostered to the users in the field. Dr. Mihaich was supportive of the Program stating that, during her tenure, the Program has continued to make progress and that the Board members, who represent a diverse group of highly respected experts, truly believe in the program. She opined that SERDP research on state-of-the-art technologies is well published and is recognized worldwide. She noted that she was impressed with the variety of technologies and the breadth of the research executed by the Program.

D. Plans for FY 2008

i. FY2008 Program

In FY 2008, SERDP will aggressively respond to the increasing challenges of environmental issues impacting training and testing activities as well as the remediation of lands contaminated with UXO. Specifically, in response to the President's FY 2008 budget request and subsequent congressional changes, SERDP in FY2007 issued SONs in each of the four Focus Areas to address the following issues:

Environmental Restoration

- Improved Methods and Practices for Long-Term Monitoring of Contaminated Groundwater
- Improved Understanding of the Biological Degradation of Nitroamines in the Environment
- Improved Understanding and Prediction of Plume Response to DNAPL Source Zone Architecture and Depletion

Munitions Management

- Advanced Discrimination of Military Munitions Exploiting Data from the ESTCP Discrimination
- Pilot Study
- Improvements in the Detection and Disposal of Underwater Military Munitions
- Improved Technologies for Wide Area Assessment of Potential Munitions Response Sites
- Advanced Technologies for Detection, Discrimination and Remediation of Military Munitions
- SEED: Advanced Technologies for Detection, Discrimination and Remediation of Military Munitions

Sustainable Infrastructure

- Managing and Restoring the Dry Forest Ecological System in the Pacific Islands
- Impacts of Military Activities and Invasive Species on Pacific Island Freshwater and Near-Shore Marine Ecosystems
- Characterization of Air Emissions from Prescribed Burning
- Scalable Power Grids that Facilitate the Use of Renewable Energy Technologies

Project Number	Recommendation				FY07 Meeting Date				New Starts	Continuing Projects
	Fund		Not Fund		1	2	3	4		
	FY07	FY08	FY07	FY08	Oct-06	Mar-07	Jun-07	Sep-07		
WP-1574	$ 276				Oct-06				●	
WP-1575	$ 122				Oct-06				●	
WP-1576	$ 146				Oct-06				●	
WP-1578	$ 516				Oct-06				●	
WP-1577	$ 597				Oct-06				●	
WP-1583	$ 564				Oct-06				●	
WP-1584	$ 490				Oct-06				●	
MM-1570	$ 200				Oct-06				●	
MM-1572	$ 345				Oct-06				●	
MM-1573	$ 301				Oct-06				●	
MM-1595	$ 200				Oct-06				●	
MM-1564	$ 120				Oct-06				●	
MM-1566	$ 474				Oct-06				●	
MM-1568	$ 308				Oct-06				●	
SI-1541	$ 188				Oct-06				●	
SI-1545	$ 442				Oct-06				●	
SI-1547	$ 592				Oct-06				●	
ER-1588	$ 426				Oct-06				●	
ER-1561	$ 308				Oct-06				●	
ER-1551	$ 223					Mar-07			●	
ER-1433	$ 250					Mar-07			●	
ER-1453	$ 349					Mar-07			●	
MM-1598	$ 576					Mar-07				
SI-1546	$ 253					Mar-07			●	
SI-1462	$ 167					Mar-07				●
ER-1492		$ 499					Jun-07			●
ER-1599[1]	$ 1,300						Jun-07		●	
SI-1388[2]							Jun-07			●
SI-1543	$ 264						Jun-07			●
SI-1413	$ 2,449						Jun-07			●
MM-1634		$ 301						Sep-07	●	
MM-1635		$ 396						Sep-07	●	
MM-1637		$ 242						Sep-07	●	
MM-1638		$ 225						Sep-07	●	
MM-1629		$ 233						Sep-07	●	
MM-1634		$ 363						Sep-07	●	
WP-1618		$ 310						Sep-07	●	
WP-1620		$ 643						Sep-07	●	
WP-1621		$ 249						Sep-07	●	
ER-1601				$ 208				Sep-07	●	
ER-1602		$ 339						Sep-07	●	
ER-1603		$ 290						Sep-07	●	
ER-1605		$ 424						Sep-07	●	
ER-1611		$ 455						Sep-07	●	
ER-1614		$ 241						Sep-07	●	
ER-1612		$ 290						Sep-07	●	
ER-1494		$ 448						Sep-07		●
ER-1503		$ 460						Sep-07		●
TOTALS	**$12,446**	**$6,409**		**$208**						

[1] Congressional Earmark.
[2] Project update to Board; no vote on funding required.

Figure III-2. Summary of Proposals Reviewed by SAB in FY 2007 by Focus Area (Funding in Thousands)

- Innovative Technologies for Electricity Production from Waste Heat for Deployed Forces
- SEED: Innovative Approaches for Non-Destructive Sensing and Analysis of the Integrity of Historic Buildings and Structures

Weapons and Systems Platforms

- Environmentally Benign, High-Strength Fasteners for Weapons Systems
- Scientific Understanding of Non-Chromated Corrosion Inhibitors Function
- Environmentally Benign Pyrotechnics Assemblies
- Self-Remediating Munitions
- Understanding Volatile Particle Emissions from Military Aircraft

In developing the FY 2008 program, 20 SONs were prepared, with two issued specifically for the SEED program. All SONs were made available to the private sector via a BAA. The Core solicitation resulted in 199 preproposals submitted by nonfederal participants. Of the 181 full proposals that were received from both federal and nonfederal participants in response to the Core Solicitation, 47 were selected for funding. In the SEED solicitation, of the 54 proposals that were received, eight were selected for funding. Figures III-3 and III-4 depict the distribution of Core and SEED proposals selected during the FY 2008 program development process.

CORE PROPOSALS					
Thrust Area	Number of Proposals Selected	Source			Approximate Value (in millions)
		Federal	Academia	Private	
Environmental Restoration	14	5	7	2	4.882
Munitions Management	12	2	2	8	3.280
Sustainable Infrastructure	9	3	5	1	3.873
Weapons Systems and Platforms	14	4	4	6	4.131
Total	49	14	18	17	16.166

Figure III-3. FY 2008 Core New Start Proposal Distribution by Focus Area.

SEED PROPOSALS					
Focus Area	Number of Proposals Selected	Source			Approximate Value (in millions)
		Federal	Academia	Private	
Environmental Restoration	0	0	0	0	0
Sustainable Infrastructure	3	2	1	0	.299
Weapons Systems and Platforms	0	0	0	0	0
Munitions Management	5	2	2	1	.469
Total	8	4	3	1	.768

Figure III-4. FY 2008 SEED New Start Proposal Distribution by Focus Area.

ii. FY 2008 Workshops

Throughout FY 2008, SERDP will continue to conduct workshops, special studies, and gap analyses to identify future opportunities for research and potential opportunities for integration/collaboration to address unmet high-priority research needs. Among the topics that will be addressed in FY 2008 are:

- Southwest Region Threatened, Endangered and At-Risk Species, Tucson, AZ
- Surface Finishing and Repair Issues for Sustaining New Military Aircraft; Tempe, Arizona
- Research Needs for Assessment and Management of Non-Point Air Emissions from DoD Activities; Research Triangle Park, NC
- Research and Development Needs for Understanding and Assessing the Bioavailability of Contaminants in Upland Soils and Sediments; Annapolis, MD
- Research and Development Needs for Understanding and Assessing the Bioavailability of Contaminant in Upland Soils and Sediments; Annapolis, Maryland
- SERDP-ESTCP/National Association of Ordnance Contractors (NAOC) Technology Transfer Workshop; location to be determined

The results of these workshops will ensure that the SERDP investment strategy will continue to evolve and maintain its focus on high-priority DoD environmental technology research needs.

iii. FY2009 Solicitation

In early FY 2008, SERDP issued 20 SONs in the four Focus Areas for projects to be funded in FY 2009 (see Section II for descriptions of each of the FY 2009 SONs):

Environmental Restoration

- Reduced Uncertainty and Costs for Managing Large, Dilute Contaminant Groundwater Plumes
- Improved Identification of Munitions Constituent Source Zone Locations and Strength
- Improved Understanding of the Vapor Intrusion Pathway from Chlorinated Solvent-Contaminated Groundwater Plumes
- Improved Understanding of the Fate and Transport of Munitions Constituents on Operational Ranges
- Improved Understanding of the Impact of Environmental Parameters and Sampling Methods on Measured Groundwater Contaminant Concentrations

Munitions Management

- Improvements in the Detection and Remediation of Underwater Military Munitions
- Phenomenology of Military Munitions in Underwater Environments
- Advanced Technologies for Detection, Discrimination, and Remediation of Military Munitions
- SEED Advanced Technologies for Detection, Discrimination, and Remediation of Military Munitions

Sustainable Infrastructure

- Development of Science-Based Recovery Objectives for Ecological Systems in the Southeastern United States
- Managing and Restoring Southeast Coastal Ecosystems Under the Threat of Climate Change
- Accelerated Pine Forest Mortality in the Southeastern United States

- Understanding Impacts of Military Activities on Archaeological Resources
- Assessment of the Impact of Sea Level Rise on Military Infrastructure

Weapons Systems and Platforms

- Advanced Methods for Removing Solids from Shipboard Waste Streams
- Characterization of Emissions from Open Burn/Open Detonation
- Dynamic Accelerated Corrosion Test Protocol
- Environmentally Acceptable, Direct-To-Substrate Pretreatments for Multi-Material Systems
- Environmentally Benign Aircraft Deicing and Anti-Icing
- Understanding the Science Behind How Methylene Chloride / Phenolic Chemical Paint Strippers Remove Coatings