**US Army Corps
of Engineers®**
Engineer Research and
Development Center

Calendar Year 2014

Center for the Advancement of Sustainability Innovations

Work Plan

Contents

INTRODUCTION	1
ANTICIPATING EMERGING ISSUES	6
SUSTAINABILITY APPROACHES, EDUCATION AND KNOWLEDGE MANAGEMENT	9
SUSTAINABLE REGIONAL PLANNING	11
SUSTAINABLE ENERGY SOLUTIONS	15
SUSTAINABLE WATER & WASTE RESOURCES	19
SUSTAINABLE NATURAL INFRASTRUCTURE	26
CLIMATE CHANGE	28
GREEN REMEDIATION AND REUSE	30
SUSTAINABLE FORWARD MILITARY OPERATIONS	33
SUSTAINABLE FACILITIES AND INFRASTRUCTURE	37
ACRONYMS AND ABBREVIATIONS	49
REPORT DOCUMENTATION PAGE (SF 298)	53

Introduction

The Center for the Advancement of Sustainability Innovations (CASI) was established by the US Army Engineer Research and Development Center (ERDC) as a new capability in 2006, hosted at the Construction Engineering Research Laboratory (CERL) in Champaign, IL. CASI's mission is to focus ERDC expertise, technologies and partnerships towards helping the US Army Corps of Engineers (USACE), the Army, and the Department of Defense (DoD) achieve more sustainable missions, facilities, and operations. CASI provides the military with capabilities that enhance national security through more effective use of limited resources and improved coordination and partnerships with host communities and stakeholders in the US and across the globe.

In all efforts, CASI teams strive to measure sustainability innovations against the Triple Bottom Line of mission, environment, and community. In addition, CASI focuses on cost savings, innovation, collaborative solutions, and continuous learning, all of which directly link sustainability to Army Business Transformation and the Army Campaign Plan.

This 2014 Work Plan is the seventh published for CASI. Previous Work Plans were published in 2008-13. These publications are referenced below, with links provided to the documents (all of which are located on the CASI website under the "Library" section).

Fiscal Year 2007 Annual Report, Center for the Advancement of Sustainability Innovations, William Goran, ERDC/CERL Technical Note (TN-08-02), May 2008, (CASI Work Plan for 2008),

<http://acwc.sdp.sirsi.net/client/search/asset/1002025>

CASI Work Plan Fiscal Year 2009, William Goran, Annette Stumpf, and Michelle Hanson, ERDC/CERL Special Report 08-21, November 2008,

https://eko.usace.army.mil/secure/4BA5065B-E946-50E1-20324297E3099A62/Work_PlanFINALMay1509_%282%29.pdf

Center for Advancement of Sustainability Innovations: 2010 Work Plan, William Goran, et al., ERDC/CERL TN-10-1, April 2010, at either:

https://eko.usace.army.mil/secure/4B7DD77A-C376-36A8-A84FEC6F7A1DC3BE/FY_2010_CASI_Work_Plan.pdf

<https://eko.usace.army.mil/centers/casi/library/?syspage=Documents&id=263155>

Center for Advancement of Sustainability Innovations: 2011 Work Plan, William Goran, et al., ERDC/CERL TN-11-11, January 2011,

<https://eko.usace.army.mil/centers/casi/library/?syspage=Documents&id=263037>

CASI Work Plan Calendar Year 2012, William D. Goran, Michelle Hanson, Elon Zeigler, and Annette Stumpf, ERDC/CERL TN-12-1, January 2012,

<https://eko.usace.army.mil/secure/4BDCC685-B81D-1CD1-3D958CFDE2DB11C5/2012WorkPlan-13-Jan-FINAL-smallfile.pdf>

CASI Work Plan Calendar Year 2013, William D. Goran, Michelle Hanson, Elon Zeigler, and Annette Stumpf, ERDC/CERL TN-13-1, February 2013,

<http://acwc.sdp.sirsi.net/client/search/asset/1025640>

https://eko.usace.army.mil/secure/4BEEA029-CCBA-E2E0-0960748272F8F7EF/ERDC-CERL_TN-13-1.pdf

The purpose of these Work Plans is to:

- Provide a framework to capture the diverse activities being conducted as part of CASI
- Help various sponsors, partners and stakeholders understand the scope of activities and expertise offered through CASI
- Identify areas where activities can be leveraged for those with similar interests or ongoing investments
- Suggest potential projects that have been conceived but not yet resourced by potential partners and sponsors
- Enhance dialog and teaming across the different technical focus areas for CASI
- Document CASI activities.

Technology Focus Areas

One of the key values of CASI is to provide “systems level” expertise to address complex sustainability issues. Installations and communities engage across a wide range of economic, environmental, social, and mission issues that interact in multiple temporal and spatial dimensions. Most of the issues addressed in this Work Plan cross over multiple technology focus areas. The focus areas are simply useful “bins” for planning suites of projects and joining groups of experts. These technology focus areas also indicate the explicit topical areas where CASI has selected teams of experts from within and beyond ERDC. As the sustainability challenges of the US military change, these technology focus areas will also change. Currently, the 10 CASI technology focus areas are:

- Anticipating Emerging Issues
- Sustainability Approaches, Education and Knowledge Management
- Sustainable Regional Planning
- Sustainable Energy Solutions
- Sustainable Water & Waste Resources
- Sustainable Natural Infrastructure
- Climate Change
- Green Remediation and Reuse
- Sustainable Forward Military Operations
- Sustainable Facilities and Infrastructure.

Coordination and Outreach

Website

The CASI website is supported by the Engineering Knowledge Online (EKO) portal:
<https://eko.usace.army.mil/centers/casi/>

The website includes a calendar of events, information on each of the 10 technology focus areas, a library with all available CASI documents and publications, and links to other related sites. Several CASI technology focus areas manage additional web resources supplementing the information on CASI’s website, with links from the CASI website.

Marketing Materials

The CASI brochure and poster are available for download on the CASI website. A CASI display supports marketing activities at conferences, job fairs, and other venues.

Electronic Copies

Electronic copies of the Work Plan are available at:
<https://eko.usace.army.mil/centers/casi/library/>

Partnerships

CASI strives to bring the best team to any specific challenge and this often involves the creation of unique partnerships for each project. CASI has formal and informal partnership arrangements with many academic, industry, and government organizations. In many of the descriptions of ongoing projects, these partner organizations are highlighted. Some partnership activities are also described in the “highlights” section to follow.

Projects in This Work Plan

The Work Plan is an important tool for CASI to share information and create dialog across multiple stakeholders and organizations. While CASI projects are usually funded by an individual sponsor, in most cases these projects are also of interest to other sponsors. The work plan allows for all sponsors to learn about and follow the progress of any project of interest, and where appropriate, to acquire access to the project outcomes. In addition, a project sponsored by one organization may help create the dialog necessary to initiate a related or follow-on effort tailored to another organization.

This work plan discusses three project categories: Completed, Ongoing, and Proposed. While each project is identified within a specific technology focus area, many of these projects are relevant across multiple technology focus areas.

Completed projects were finished either late in 2012 or during calendar year 2013. The immediate outcomes could be a service (e.g., a new web capability), a forum (e.g., the Interagency Climate Change Impacts and Adaptations forum sessions in 2013), a demonstration of a capability, and/or a publication or presentation. However, for many CASI initiatives, the long-term outcomes are improved understanding of system relationships and tradeoffs, and/or the identification of new pathways to achieve more efficient and sustainable military operations.

Ongoing projects are those efforts currently in progress, with some phase of the work underway. Ongoing projects may already exhibit outcomes (e.g., services, forums, or reports), while activity in these projects continues.

Proposed projects are ideas, not yet funded by any sponsor, but many are actively being discussed with a sponsor. There is no certainty that the proposed projects in the CASI Work Plan will be funded; some proposed projects described in the 2013 Work Plan have become ongoing projects in the 2014 plan, some proposed 2013 projects have been dropped, and others are still seeking sponsors.

2013 Highlights

Sustainability Innovations Speaker Series

In 2010, the University of Illinois at Urbana-Champaign (UIUC) Sustainability Office, currently led by UIUC Vice-Chancellor for Outreach, Dr. Pradeep Khana, and CASI established a new speaker series. Approximately once each academic semester, an invited speaker visits Champaign-Urbana to give presentations at selected UIUC venues and at the Champaign facilities of ERDC. This speaker series started in spring 2011 with Dr. James Harris of Cranfield University speaking on the ecosystem services at Salisbury Plain, the United Kingdom Ministry of Defence’s primary military training area near Stonehenge. In November 2011, Dr. Chris Pyke, Vice-President for Research, US Green Building Council, spoke on Accelerating Green Building Market Transformation with Information Technology. In spring of 2012, Majora Carter from New York City gave presentations entitled “Hometown Security,” in which she described community transformations in New York City and elsewhere. For the 2012-13 academic year, Dr. Michael Webber, University of Texas, presented on sustainable systems engineering in April 2013.

Army Climate Change Vulnerabilities Assessment

A CASI team from three ERDC laboratories is helping the Army develop a framework to assess climate change vulnerabilities across Army lands, facilities, and operations. This effort is being guided by a newly formed Army Climate Change Work Group chaired by Assistant Secretary of the Army for Installations, Energy & Environment (ASA[IE&E]). It involves the analysis of relevant policy, guidance, and training, as well as a high-level assessment analysis. In 2012, this project developed an Army High-Level Climate Change Vulnerability Assessment, and a framework roadmap for five important Army processes (master planning, integrated natural resources management planning, strategic and sustainability planning, range complex master planning, and critical infrastructure assessments) that will incorporate changing climatic conditions into future plan versions. In 2013, this adaptation planning framework was piloted at two Army installations, Fort Huachuca and Fort Stewart. Reports for the 2012 and 2013 efforts are currently under review by ASA(IE&E). In 2014, work will focus on expanding planning frameworks to include emergency response plans and potable water system plans, screening of Army installation coastal vulnerabilities, Data and Technology Support Requirements for Climate Change Vulnerability and Adaptation Planning Processes, and draft Army policy and regulatory guidance for climate change adaptation planning.

Net Zero Partnerships

The Army Installations research program has invested in a toolbox of analysis and modeling capabilities for Net Zero Installation analysis. Several preliminary applications of these capabilities is already underway at sites including Fort Carson, CO, West Point, NY, and Fort Leonard Wood, MO. Planning charrettes at these and other bases have been aimed at helping base staff to sort through complex net zero decisions.

CASI Webinars

In 2013, CASI partnered with the Corps of Engineers Environmental Community of Practice (ECoP) to present webinars on the following Public Works Technical Bulletin (PWTB) topics:

- *Water Efficient Installations* (PWTB 200-1-105), January 30
- *Reducing the Army's Construction and Demolition Waste* (PWTBs 200-1-23, 200-1-120), February 27
- *Strategies for Implementing Sustainable Stormwater Management in Historic Districts* (PWTB 200-1-118), March 13
- *GPS-Based Underwater Video Mapping for Aquatic Threatened and Endangered Species Habitat* (PWTB 200-1-114), April 03
- *Low Impact Development for Sustainable Installations: Stormwater Design and Planning Guidance for Development within Training Areas* (PWTB 200-1-62), May 16
- *PCBs in Caulk and Paint* (PWTB 200-1-126), June 12
- *Rainwater Harvesting for Army Installations* (PWTB 200-1-75), July 24
- *Innovative Uses of Recycled Tank Tracks for Erosion Control* (PWTB 200-01-16), August 14
- *Biodegradation for Treatment of POL-Contaminated Soil* (PWTB 200-01-111), October 30
- *Opportunities for Reducing Construction and Demolition Waste from Residential Communities Initiative (RCI) Programs* (PWTB 200-1-48), November 21
- *Implementing a Water Conservation Program on Army Installations* (PWTB 200-01-104), December 12.

CASI Leadership

William D. Goran
CASI Director
217-373-6735

william.d.goran@usace.army.mil

Annette Stumpf
Knowledge Sharing
217-373-4492

annette.l.stumpf@usace.army.mil

Michelle Hanson
Associate Director
217-373-3389

michelle.j.hanson@usace.army.mil

Elon Zeigler
Communications Manager
217-373-7256

elon.p.zeigler@usace.army.mil

Anticipating Emerging Issues

Leads: William Goran, Michael Case, and Natalie Myers, CERL.

Description: The purpose of this focus area is to engage stakeholders through forums, white papers, publications, and other means regarding emerging sustainability issues; to interpret how these emerging issues might affect military and national security activities and operations; and to initiate a dialog about potential courses of action to respond to these issues.

Publications

Considerations in Identifying Army Lands Suitable for Forest Products and Agricultural Outleasing, Natalie Myers, Thomas Smith, and Patrick Guertin, PWTB 200-1-125, June 2013.

Published as a USACE PWTB, this effort quantified the benefits and costs of expanding forest and agriculture reimbursable lands. AR 200-1 requires installation/command staff to “routinely examine Army land to determine what areas, if any, are available for agricultural outleasing and/or sale of forest products.” This language encourages installations to expand the use of forestry and agricultural reimbursable programs to maximize environmental and economic benefits, without compromising the mission. Using multicriteria evaluation, this bulletin provides an integrated overview of how to identify lands potentially suitable for outleasing, while also considering military activity and ecologic variables.

Logging operations at Fort McCoy, WI, help maintain trails adequate for use by heavy mechanized vehicles, reduce or prevent erosion, and reduce/remove obstacles.

CASI White Papers

CASI white papers represent one of the key contributions of the center. This ERDC-CERL funded series addresses at least one topic per year. These white papers are posted on the CASI website and usually become part of an associated briefing that is presented in multiple forums. For example, copies of the tradeoffs with renewable energy projects report, completed in 2010, were distributed to military attendees to the GovEnergy conference in 2010, and the report recommendations have been briefed in over a dozen different venues. The 2011 white paper, *Net Zero Water for Army Installations, Considerations for Policy and Technology* (July 2011), has been used in ASA(IE&E) workshops relating to Net-Zero Water (NZW). In 2012, two topics were addressed. The first entitled “Contingency Bases and the Problem of Sociocultural Context.” This white paper, published in July 2012, examined the interactions and impacts of contingency bases (CBs) on their host communities and regions, and considered pathways for sustainable approaches that help to build local capacity and to enhance security.

The second, entitled "USACE Systemic Sustainability Communications," focused on the diverse and rapidly evolving virtual technologies. The 2013 topic was "Considering System Impacts of Biofuel Production," which addressed biofuel production on Army lands and the risks and tradeoffs associated with this alternate land use. The results were briefed to ODASA(IE&E) (August 2013) and the USACE ECoP (October 2013). In June 2013, USACE Institute for Water Resources sponsored a further investigation of the topic specific to USACE facilities. The 2014 topic will address "Resource Recovery and Energy Recovery from Wastewater Treatment Facilities."

Ongoing Projects

Draft "Technology Futures: IMCOM Futures, Water Conservation for Army Installations: An Evaluation of Technologies for Improving Water Security," Elisabeth M. Jenicek, et al.

Draft "Multiple Stressor Concept," William Goran, Andrew Bruzewicz, Steven Hearne, Swartha Veeravalli, and William Meyer.

This paper explores how multiple stressors can be integrated into ongoing disaster preparedness training and preparedness collaborations with our partner nations. With changing climates, there is an increased likelihood of natural disasters (storms, droughts, coastal inundations, heat waves) occurring more frequently and co-occurring with other stressors (earthquakes, corruption, illicit trafficking, migration, terrorist activities, etc.). The relatively low cost, small footprint approach involves using scenario analysis capabilities within and supplemental to existing Defense programs (Defense Environmental International Cooperation [DEIC] and Civil Military Emergency Preparedness [CMEP]). These programs (and others) already reach many dozens of partner nations each year, but they do not necessarily make the linkage with other stressors or with climate vulnerabilities.

Resource Recovery and Energy Recovery from Wastewater Treatment Facilities, 2014 CASI White Paper, Richard Scholze and Victor Medina.

Proposed Projects

Biomaterials Harvesting for Fuel

Many military bases are using (or considering the use of) biomaterials for fuel, and need to understand thresholds of tolerance for biofuel production from military landscapes and neighboring communities. While many opportunities exist to obtain fuel from biomaterials, these materials also play a critical role in ecosystem health — maintaining soil nutrients, water infiltration capacity, and important biotic communities. Installations that elect to use biomaterials for fuel should have a strong, scientifically based framework to understand harvesting capacities and degradation thresholds.

Proposed to: USACE Civil Works

POC: Natalie Myers, CERL

2013 CASI White Paper

Rare Earth Metals Harvesting

An emerging critical Defense concern is the military's growing dependence on Rare Earth Metals (REMs) that come from diverse and often unstable locations around the globe. REMs are essential for a diverse and expanding array of high-technology components/applications in the US industrial economy, including myriad Defense needs. Today nearly all (93%) of the REM used in the United States are either directly imported from China or in products from countries that rely on raw materials from China. Unfortunately, there are no fully satisfactory substitutes for REM functionality, and China has restricted REM exports in the past. In 2010, the China Ministry of Commerce restricted overall global shipment of REMs by 72%. Possible supply shortages and export restriction by China have provided a new momentum for companies across the globe to consider recovery and recycling processes. Accordingly, the 2012 Defense Authorization Act requires the DoD to inventory its sources and reserves of REMs-containing materiel, potentially valued at hundreds of millions of dollars. One way for the DoD to secure potentially critical REM supplies, without affecting its mid- and long-term missions, in a conflict or artificially generated shortage environment is to harvest REMs from existing waste streams.

Proposed to: TBD

POC: Natalie Myers, CERL

Forest Expenditure Standards

The Automatic Reimbursable Authority (ARA) for forest management at Army installations is unique among Army funding sources because proceeds created by the installation forestry operations may be used for operation and maintenance, minor construction, purchase of forestry equipment, and other obligations directly related to the reimbursable forestry program. These funding decisions are likely based on complex factors, such as DoD forestry policies, regulations, and guidelines, environmental factors, threatened and endangered species management requirements, and forestry best management practices. Because these factors require specific knowledge about forestry regulations, forest ecology, and specific site conditions, funding decisions are often made by the installation forester. For this reason, the proposed study will focus on the installation foresters to evaluate and implement forest management expenditure standards for appropriate funding sources.

Proposed to: ACSIM

POC: Natalie Myers, CERL

Sustainability Approaches, Education and Knowledge Management

Leads: Michelle Hanson, Chris Rewerts, and David Krooks, CERL.

Description: This focus area concentrates on improvements in sustainability metrics and reporting, advancements in sustainability education and learning resources, and management and sharing of sustainability approaches and knowledge.

Publications

Resource Efficiency in the US Army Corps of Engineers: Examination of Strategies To Reduce Energy Use and Greenhouse Gas Emissions, Paul Loechl, Michael Kemme, Payal Shah, and William Goran, ERDC/CERL Technical Report TR-12-17, October 2012, [http://acwc.sdp.sirsi.net/client/search/asset:asset?t:ac=\\$N/1011787](http://acwc.sdp.sirsi.net/client/search/asset:asset?t:ac=$N/1011787)

Energy and Greenhouse Gas Emission Reduction Opportunities for Civil Works Projects Unique to the US Army Corps of Engineers, Michael Kemme and David Underwood, ERDC/CERL TR-12-19, October 2012, <http://acwc.sdp.sirsi.net/client/search/asset/1013103>

Army Fugitive Refrigerant Gas Emissions Tracking, K. James Hay and Michael Kemme, ERDC/CERL LR-12-7, November 2012.

Greenhouse Gas Estimations from Army Commuting, K. James Hay and Michael Kemme, ERDC/CERL LR-12-6, November 2012.

Developing Baselines for Prescribed Burning Smoke Management Plans and Best Management Practices, Michael Kemme, December 2012.

Ongoing Projects

Fort Leonard Wood Sustainability Initiative

Calendar year 2014 represents the fifth year of partnering with Fort Leonard Wood to develop, evaluate, and accelerate the integration of sustainability into installation facilities, operations, and activities. As part of its strategic sustainability vision, Fort Leonard Wood seeks to meet Army Net Zero objectives. Fort Leonard Wood and CERL identified FY 2013 requirements to implement net zero actions regarding water, waste, and energy and other integrated sustainability actions. The purpose of the current CASI project is to provide Fort Leonard Wood with engineering and cost analyses, guidance, specifications, and cost-benefit information to resource and implement these sustainability actions.

One specific effort underway in FY14 is an investigation of the logistics and economics of using an in-vessel aerobic composting system for composting food, landscape, and other high carbon waste materials at Fort Leonard Wood. A second effort is an analysis for integration of

small-scale cogeneration plants and for application of magnetic bearing chiller compressors at Fort Leonard Wood. A third undertaking is the development of a roadmap for removing WWII-era buildings at Fort Leonard Wood in an economical and sustainable fashion, while providing a tool to enable the installation to approach its Net Zero Waste objectives.

A product of the FY13 effort, a draft CERL Technical Report, *FY13 Net Zero Energy, Water and Waste Portfolio for Fort Leonard Wood, MO*, is undergoing editing by a team of CERL researchers. See also the [Sustainable Facilities and Infrastructure](#) section of this report.

Sponsor: Fort Leonard Wood

POCs: Susan Bevelheimer and Annette Stumpf, CERL

Landfill Air Emissions Inventory

Under EO 13514, Federal agencies must report a comprehensive inventory of absolute Greenhouse Gas (GHG) emissions annually. Municipal solid waste landfills are one of the GHG emission source types that must be included in GHG inventories. The GHG Mandatory Reporting Rule will also require these facilities to determine the GHG emissions for on-site landfills. The objectives of this project are to develop data describing open and closed solid waste landfills, to calculate GHG emissions, and to document a process to facilitate annual reporting. This work will be delivered to the sponsor early in CY 2014, having been updated with FY12 and FY13 data.

Sponsor: ACSIM

POC: Stephen Cosper, CERL

Sustainable Regional Planning

Leads: James Westervelt and Elisabeth Jenicek, CERL

Description: The continued ability of a military installation to support current and future missions relies on the availability of regional built and natural resources. This focus area supports planning and stakeholder coordination at a regional or “shared resource” scale. Regions are defined as shared resources in a watershed, ecosystem, military operating area, air shed, transportation network, and economic impact area. Capabilities developed in this technology focus area are designed to enhance collaboration, improve stakeholder engagement and understanding, simulate potential future scenarios, and integrate diverse data into environments to enhance coordinated planning and decision-making.

Publications

Land Use Scenarios: Environmental Consequences of Development. This book captures results of the “Alternative Futures at the Range Complex Level: Southwest United States” projected managed by Dr. David Mouat at the Desert Research Institute and funded through the Office of the Secretary of Defense (OSD) Sustainable Ranges Program. Alan W. Shearer, David A. Mouat, Scott D. Bassett, Michael W. Binford, Craig W. Johnson, Justin A. Saarinen, Alan W. Gertler, and Julide Koracin.

Methodology for a First-Order Assessment of the Potential for Pollutant Loading from Military Installations in the Chesapeake Basin, ERDC LR-13-1. Alexis L. Coplin, Terry M. Sobecki, and David M. Soballe, June 2013.

Indigenous Plantings to Prevent Erosion on Army Lands with the Chesapeake Bay, ERDC LR-13-2. Pamela Bailey, Sarah Miller, Scott Bourne, and Timothee Cary, July 2013.

The Impact of Invasive Species on Department of Defense Installations in the Chesapeake Bay Watershed, ERDC/EL LR-13-1. Judy F. Shearer, Nathan E. Harms, and Mark Graves, July 2013.

Corrective Actions for Marina Erosion and General Pollutant Runoff, ERDC/EL LR-13-2. Sarah J. Miller, J. Craig Fischenich, Michael G. Channel, Robert W. McComas, and Karl Kerr, July 2013.

Recommendations for Army Lands Management Contribution to Oyster Restoration in Chesapeake Bay, ERDC/EL LR-13-4. Todd M. Swannack, Molly K. Reif, Scott Bourne, Andrew F. Casper, and David M. Schulte, July 2013.

Submersed Aquatic Vegetation (SAV) Restoration for Army Installations on Chesapeake Bay: Identification of Suitable Sites and Restoration Methodology, ERDC/EL LR-13-5. Chetta S. Owens, R. Michael Smart, Todd Beser, Gary O. Dick, and Lynde Dodd, August 2013.

Next Generation Urban Encroachment Model Final Report, Unpublished final report on Small Business Innovative Research (SBIR) Contract Number #W9132T-08C0042. Jeff Terstriep, LEAMgroup, Inc., September 2013.

Products

White Sands Missile Range Maneuver Area Comparison Tool

As the installation increases its support of maneuver activities, the natural resource office wants to ensure optimal short and long-term activity support. The tool analyzes a wealth of installation geographic information system (GIS) maps and imagery to help select the best areas for each activity event.

Sponsor: White Sands Missile Range

POC: Natalie Myers, CERL

Fort Riley Urban Encroachment Impact Analysis

A technology developed jointly by the ERDC and UIUC is being used in the Fort Riley, KS, eco-region to model encroachment and other issues. The Land-use Evolution and impact Assessment Model (LEAM) originated with funding from the Small Business Innovation Research Program, became more robust with National Science Foundation and DoD grants, and grew into a spin-off business, LEAM Group.

LEAM mathematically simulates how population, employment, social issues, and land use are likely to change both across the region and into the future. LEAM also predicts various impacts resulting from these changes. The model supports master planning and other decisions about ecosystem management.

Fort Riley is serving as a test bed for the ERDC-CERL and LEAM Group to engage a large regional stakeholder group, called the Flint Hills Regional Council. This council, established with a grant from the Office of Economic Adjustment, represents 19 counties surrounding the fort. Modeling is supported through LEAM Desktop, a tool that is embedded in a web-based collaborative environment called the LEAM Planning Portal.

The project presents a unique opportunity to demonstrate LEAM's capabilities in that the community is experiencing both decline and growth with the fort in Junction City and Kansas State University in nearby Manhattan. Through the Desktop, council members can model, for example, impacts of an event such as Base Realignment and Closure bringing 10,000 new troops and their families to Fort Riley. Would new transportation routes and schools be needed? What type of business development could be encouraged?

LEAM allows the stakeholders to model various goals for their region. Among those being considered are maintaining the rural culture through measures such as preventing urban sprawl; creating ride share opportunities to reduce transportation costs; increasing vocational education and entrepreneurship; re-energizing existing downtowns, including historic building preservation; and agricultural awareness to conserve grasslands.

Sponsor: Fort Riley, Army Small Business Innovation Research (SBIR) Program

POC: Jeff Terstriep, 217-841-5935, jefft@leamgroup.com

Projects

Recognizing Regional Stability in the Growth Patterns of Megacities

The Megacity Reconnaissance, Surveillance, and Intelligence (M-RSI) Project is exploring novel community- and city-level remote sensing techniques that allow more accurate sociocultural analyses of areas that affect and are affected by rapid urbanization. M-RSI will also explore new methods to understand the changes in population composition in rapidly urbanizing areas. These methods will improve sociocultural analysis at the community- and city-level using remotely sensed information.

Sponsor: The Joint Staff

POC: Charles Ehlschlaeger, CERL

Army Chesapeake Bay Protection and Restoration

ACSIM prepares the Annual Army Chesapeake Bay Action plan to provide the framework for the Army to maintain its course in supporting the protection and restoration of the Chesapeake Bay and over time, to track progress towards achieving the goals, objectives, and targets of the Army Chesapeake Bay Strategy. Several projects were funded to provide inventory and baseline information for Army stakeholders in the Chesapeake Bay area to facilitate compliance with the Army Strategy. The projects included:

- Developing a nutrient and sediment management plan template to include best management practices and guidance for establishing baseline conditions
- Identifying and developing corrective actions for marina erosion and general pollutant runoff
- Identifying, inventorying, and classifying Army shoreline along the Chesapeake Bay and major tributaries
- Identifying historical and potential submerged aquatic vegetation
- Assessing the impact of invasive species on the Chesapeake Bay watershed
- Using indigenous plants to prevent erosion in the Chesapeake Bay watershed
- Identifying installations with suitable habitat for oyster restoration.

Sponsor: ACSIM

POC: Patrick Deliman, EL

SIRRA: CONUS-Wide Regional Sustainability Analysis

The Sustainable Installations Regional Resource Assessment (SIRRA) web-based analysis tool provides a simplified national assessment of sustainability across 10 issues: (1) air quality, (2) air space, (3) energy, (4) urban development, (5) threatened and endangered species, (6) location, (7) water, (8) economy, (9) quality of life, and (10) infrastructure. The SIRRA methodology rates the regions surrounding 308 military installations in terms of vulnerability due to 48 individual sustainability indicators. The SIRRA tool uses existing science- and measurement-based national data sources. The data is then mapped into GIS coverages for individual indicators coded as red, amber, or green. The database is available at:

<http://datacenter.leadgroup.com/sirra/>

SIRRA maps visually communicate to the public, officials, and installation managers those areas in need of further study and attention to the management of local resources.

Proposed Projects

Adapting to Changes in the Hydrologic Cycle under Non-Stationary Climate Conditions

As climate change causes hydraulic variability to be non-stationary, this research aims to develop a better understanding of the responses to changes in the timing and intensity of snowmelt and subsequent runoff events; and develop adaptive frameworks for application of these methods to enable informed adaptation in critical DoD facilities. In particular, the focus is on: (1) characterizing the spatial and temporal distribution of climate-induced changes in the intensity and variability of heavy precipitation and runoff; and (2) developing and evaluating next generation hydrologic intensity duration-frequency theory and methods that are valid for non-stationary conditions.

Proposed to: SERDP

POC: Dr. Anne Koster

Forecasting Urban Growth around Installations: Supporting Regional Impacts on Military Installations

The objective of this proposal is to create a modeling tool with a web-based interface that will allow regional planners to:

- graphically identify an area of interest around any Continental United States (CONUS) installation or range complex
- review and modify forecast population projections
- add/subtract Soldiers and families
- run an urban growth forecast based on these inputs
- review and share results in the form of maps, movies, text, graphs, and charts.

Proposed to: IMCOM

POC: James Westervelt, CERL

Sustainable Energy Solutions

Lead: Franklin Holcomb, CERL

Description: From a military capability systems support perspective, power and energy are critical to sustainability. They are a consideration in many facets of military operations. The purpose of this technology focus area is to identify the sustainability needs associated with integration of power and energy into military missions.

Publications

Energy and Water Conservation Assessments: A Field Guide. David M. Underwood, ERDC/CERL Special Report SR-12-13, September 2012.

USACE Support to Contingency Base Energy Management: Lessons Learned, John Vavrin, et al., Technical Report ERDC/CERL TR-13-8, August 2013.

Ongoing Projects

Net Zero Installations Technical Support

The Army's vision is to appropriately manage natural resources with a goal of Net Zero Installations. Today the Army faces significant threats to energy and water supply requirements both at home and abroad. Addressing energy security and sustainability is operationally necessary, financially prudent, and mission essential. The goal is to manage installations not only based on Net Zero Energy (NZE), but of Net Zero Water and Net Zero Waste as well. CERL personnel are providing technical assistance to the Net Zero Pilot Installations to help them achieve their goals of NZE, Net Zero Water, Net Zero Waste, individually and in combination.

Sponsor: Deputy Assistance Secretary of the Army for Energy and Sustainability (DASA[E&S])

POCs: Alexander Zhivov (Energy), Elisabeth Jenicek (Water), and Stephen Cosper (Waste), CERL

Technical Management for JCTD SPIDERS

CERL researchers are providing technical management of the FY11-13 Joint Capability Technology Demonstration (JCTD) Smart Power Infrastructure Demonstration for Energy Reliability and Security (SPIDERS) Program. The 3-year JCTD SPIDERS program will deploy microgrid technology to Joint Base Pearl-Hickam, HI, Fort Carson, CO, and Camp Smith, HI. The deployed microgrids will ensure critical missions have a reliable and secure electric power supply. The project will address the advanced controls needed for utility-connected and islanded modes of operation, cyber security risk mitigation, and transition of microgrid technology to standards.

Sponsors: Multiple – Joint OSD, Services

POCs: Harold Sanborn, Melanie Johnson, and Tarek Abdallah, CERL

Building-Scale Direct Current (DC) Power System with Renewable Energy Integration

A research team will install and demonstrate a DC power system with solar panel integration for a single control room at Fort Huachuca, AZ. Research will address the economic feasibility of DC power systems at Army installations. It will also monitor energy efficiency, energy security, and power quality improvements associated with the DC power system. Based on the findings in the project analysis, recommendations will be made for new construction and retrofitting of Army buildings with DC power systems. These systems can be implemented in any building with substantial DC loads, which makes the project results broadly applicable to Army installations.

Sponsor: ACSIM ITTP

POC: Melanie Johnson, CERL

Integration of Energy/Sustainable Practices into Standard Designs

Broad targets of this research aim to help the Army become NZE ready. The technical objective is to investigate building features and construction methods and materials to optimize the selected standard designs with regard to energy reduction and sustainability and, at a minimum, to ensure that the selected standard designs meet all applicable energy reduction and sustainable design policies (e.g., Leadership in Energy and Environmental Design (LEED) Silver, Energy Policy Act [EPA] 2005, EISA07, EO 13423 and EO 13514).

Sponsor: USACE

POC: Alexander Zhivov, CERL

Systems Approach to Improved Facility Energy Performance

This project will integrate three synergistic building technologies into an enhanced barracks system design. An innovative dedicated outdoor air system that incorporates energy recovery from the building's exhaust air stream will be combined with improved building envelope air and moisture barriers to ensure that humidity levels within the building are adequately controlled. A radiant cooling/heating system will be included to maintain temperatures within the occupant rooms. Successful integration of these technologies is expected to result in improved building energy efficiency, reduced risk of mold and mildew, and reduced maintenance requirements without sacrificing occupant comfort.

Sponsor: DoD Environmental Security Technology Certification Program (ESTCP)

POC: James Miller, CERL

Exhaust Hood and Makeup Air Optimization

Exhaust hoods and makeup air units are often poorly designed and controlled. It is common for them to operate at constant flow rates for long periods of time, sometimes up to 24 hours per day. This large energy waste (up to 80% of energy used can be saved) results in uncomfortable working conditions in buildings such as dining facilities. Four buildings will be selected and retrofitted for optimization of exhaust hoods and associated makeup air flow rates. This work will be accomplished primarily through installation of temperature and opacity sensors connected to controllers and variable speed motor drives.

Sponsor: ESTCP

POC: David Underwood, CERL

When applied to exhaust hoods, variable flow systems can yield significant energy savings.

Converting Constant Volume, Multizone (MZ) Air Handling Systems to Energy-Efficient Variable Air Volume Multizone Systems

This project will demonstrate a low cost technique to convert a constant volume MZ air handling unit (AHU) to an energy-efficient variable air volume MZ AHU. This technique converts the MZ system into a variable volume MZ system by focusing almost entirely on instrumentation and controls rather than the demolition and installation of ductwork and terminal units, and is thus accomplished for a lower first cost, with less system down time and with less disturbance of building occupants. This includes upgrading the system controls via programming changes or controller replacement and the installation of new and replacement actuators and sensors needed to support the conversion and to monitor and control the system. Demonstration systems are being installed at Fort Bragg, NC, Fort Campbell, KY, and at ERDC-CERL, Champaign, IL.

Sponsor: ESTCP

POC: David Schwenk, CERL

Field Validation of Microencapsulated Phase Change Material Slurry as Heat Transfer Fluid

This project will demonstrate microencapsulated phase change material heat transfer formulations in a ground sourced heat pump system located at Fort Hood, TX. The proposed heat transfer fluid could reduce or save pumping energy by as much as 50%. Also, implementation and use of the fluid should provide a 5-year payback, depending on the level of use of the proposed product.

Sponsor: ESTCP

POC: Sean Morefield, CERL

Energy-Efficient Phase Change Materials (PCMs) Insulation

This project will demonstrate and implement blown-in insulation, which incorporates PCMs, to enhance the effective "R-value" of insulation, thus reducing energy transfer through walls while maintaining comfortable temperatures for building occupants. The cost savings due to the use of these insulating materials will be quantified and life-cycle costs will be compared to the current costs. Updates will be developed for applicable Unified Facilities Guide Specifications for use of the PCM-insulation to transfer the technology to other suitable locations.

Sponsor: ESTCP

POC: CERL

Advanced, Energy-Efficient Shelter Systems (AEESS) for Contingency Basing and Other Applications

AEESS is a joint Army/Air Force program to address energy inefficiencies associated with shelter systems, particularly tents. It will develop and demonstrate technologies for a new generation of energy-efficient shelters.

Sponsor: Office of the Assistant Secretary of Defense (ASD), Operational Energy Capabilities Improvement Fund (OECIF)

POC: Ashok Kumar, CERL

Indigenous Materials for Military Facility Construction

Standard military facility construction materials are expensive to transport and can be inappropriate for the regional climate. Since up to 50% of a base camp's power demand comes from building heating and cooling, identifying building methods and materials that improve energy efficiency can greatly reduce overall power demand. Locally available or indigenous construction materials can fill this need, and can reduce the logistical footprint of the base, thereby reducing the risk to convoy personnel who transport these materials. The use of indigenous materials can offer long-term cost benefits, and can foster an increase in regional economic, social, and environmental autonomy. This study develops adaptable criteria for an austere military design based on locally available or indigenous construction materials and techniques suited to the environment and climate conditions.

Sponsor: HQUACE

POC: Garth Anderson, CERL

ROOFER Energy Performance Assessment and Course of Action (COA) Analyses

The objective of this proposed project is to demonstrate COA analysis methods and techniques that employ the ROOFER Sustainment Management System (SMS) and its information database to enable facility managers to evaluate energy-saving options as part of developing roof repair and replacement projects. Full implementations of an enhanced version of ROOFER will be performed at selected DoD installations to demonstrate the utility and benefits of integrating these options into their roof asset management program.

Sponsor: ESTCP

POC: David Bailey, CERL

High Efficiency Dehumidification System

Many DoD facilities are located in humid areas that are prone to mold growth problems resulting from the installed heating, ventilating, and air-conditioning (HVAC) designs that are incapable of maintaining proper humidity control. The objective of this proposed project is to demonstrate a HVAC system based on a High Efficiency Dehumidification System (HEDS)/Cooling Recovery Coil (CRC) design. The HEDS system can reduce peak energy consumption by up to 33%, while reducing humidity and mold problems.

Sponsor: ESTCP

POC: Dahtzen Chu, CERL

Sustainable Water & Waste Resources

Leads: Elisabeth Jenicek, Laura Curvey, Richard Scholze, Stephen Cosper, Giselle Rodriguez, and Annette Stumpf, CERL; Kathleen White, IWR; and Dr. Victor Medina, EL.

Description: This focus area relates to the access to, and sustainable use of water resources, and to the management of Army relevant waste materials. Activities include evaluating water resources status (quantities and qualities); and developing conservation approaches and technologies, water reuse technologies and approaches, and other capabilities to improve and enhance the availability and quality of water as a sustainable resource. Activities also include developing new technologies for managing Army relevant waste materials and providing technical assistance to individual installations and the ASA(IE&E) Net Zero program.

Publications

"Case Studies of Scenario Analysis for Adaptive Management of Natural Resource and Infrastructure Systems," Hamilton, Thekdi, Jenicek, Harmon, Goodsite, Case, Karvetski, and Lambert, *Special Issue of Environment, Systems, and Decisions on Scenario Analysis*, February 2013.

Scenario analysis is essential in sustainable management of water resources and other infrastructure systems. In a context of systems engineering, scenario analysis can provide an integrated and timely understanding of emergent conditions and can help to avoid regret and belated action. This paper addresses scenario analysis for several resource and infrastructure systems, including: (1) water resources (2) land use corridors, (3) energy infrastructure, and (4) coastal climate change adaptation. Scenario analysis and systems analytics must be integrated with social science expertise in a decision support context to facilitate a participatory approach. Scenario analysis helps illuminate relative merits of alternative strategies for long-term sustainability of natural resource and infrastructure systems.

"Composting Toilets Demonstrated at Camp Atterbury," Elisabeth Jenicek, *Public Works Digest*, May/June 2013.

This article describes the ACSIM ITTP sponsored demonstration program at Camp Atterbury, IN. Composting toilets proved cost effective when compared to operations and maintenance costs of existing portable toilets.

Considerations for Net Zero Water Installations, Elisabeth Jenicek, et al. Technical Report. ERDC/CERL TR-13-18, September 2013.

This report documents the first year of effort under the RDT&E project "Integrated Installation Energy, Water, and Waste Modeling." Previous modeling efforts were reviewed as a means to selecting/developing the models to be used to support modeling for energy, water, and waste. The scale of models reviewed includes installation/city scale, regional scale, and watershed scale. Additional reviews were conducted to document the range of water conservation/efficiency measures that could be used to achieve Net Zero. Several of the selected models were applied to the Fort Carson region, using a set of identified measures and associated assumptions, to demonstrate and document their effectiveness for this project.

Hydrologic Analysis of Fort Leonard Wood, MO. Michael Follum, Darla McVann, Elisabeth Jenicek, and Michael Case. Draft Technical Report. Expected publication, April 2014.

This report analyzed the hydrologic ability of Fort Leonard Wood in south-central Missouri to sustainably meet its water requirements with natural sources within the boundaries of the installation.

Laboratory Study for Evaluating Performance of Unit Processes to Treat the Electrodialysis Reversal (EDR) Reject Stream for the Proposed Fort Irwin Water Treatment Plant. V.F. Medina, S.A. Waisner, J.L. Johnson, R. Wade, J. Mattei-Sosa. Technical Report. ERDC/EL TR-12-30. December 2012.

<http://acwc.sdp.sirsi.net/client/search/asset/1013680>

A new water treatment system is planned for Fort Irwin in Barstow, CA to address existing regulatory requirements and to account for anticipated expansion at the installation. Fort Irwin has indicated a water recovery requirement of 99%. Achieving this level will require a treatment system for the EDR reject stream that will recover 92% of the influent water. CH2M HILL has proposed a system consisting of partial lime softening, filtration, and reverse osmosis (RO), which would increase water recovery to an estimated 98%. To reach 99%, a Mechanical Vapor Recompression (MVR) evaporative-distillation (MVR evaporator) unit has also been proposed. The purpose of the current study was to use laboratory testing to evaluate the effectiveness of partial lime softening, RO, and electrocoagulation (EC).

Tests were as follows:

- Partial lime softening was evaluated at dosages of 500-2000 mg/L of hydrated lime $[\text{Ca}(\text{OH})_2]$.
- Partial lime softening (1500 mg/L dose) was combined with magnesium chloride (MgCl_2) to improve performance.
- Electrocoagulation (EC) was tested as an alternative to partial lime softening.
- RO testing was carried out using a General Electric (GE) polyamide AD membrane, a membrane designed for desalination of seawater.

The study indicates that partial lime softening with MgCl_2 as an additive will be effective for pretreating water entering the RO unit. RO treatment was effective at meeting treatment and recovery goals, although fouling should be monitored. Evaporative distillation was not tested in this study, and analysis indicates that the costs per gallon are relatively high. However, it may be worth the cost due to the severe water management issues faced by Fort Irwin.

Care must be taken to optimize the other processes so that the application of the evaporative-distillation unit can be minimized, saving costs.

New water treatment system planned for Fort Irwin, CA

Events

West Coast Conference on Soils, Sediments, Water & Energy. March 2013, San Diego, CA. "Treatment of EDR Reject Water Using Lime Softening and Reverse Osmosis," Heather Knotec Smith and Victor Medina.

ERDC Stability Operations Webinar Series. April 2013. "Application of Environmental Technologies to Address Needs Identified in Contingency Operations." Victor Medina.

Ongoing Projects

Assessment of Composting for Organic Solid Waste at Fort Polk, Louisiana, V.F. Medina, M. Wynter, S. Cospers, G. Rodriguez, D. Gebhart, S. Hunter, and P. Kemme. Draft Technical Report.

A study was conducted to evaluate composting as a way to increase waste diversion at Fort Polk, LA. Wastes were evaluated from a range of activities, and it was found that a number of materials currently landfilled are suitable for composting, including vegetation, food wastes, pulverized paper (which is not suitable for recycling), consumer contaminated paper (not suitable for recycling), damaged wood pallets, and sludge from the wastewater treatment plants. Waste records from Fort Polk suggest that a composting operation producing at least 2200 tons per year (from a food waste/vegetation strategy) is feasible. This would represent considerable solid waste diversion, consistent with meeting Net Zero Waste Goals. Between the Integrated Training Area Management (ITAM), the Directorate for Family, Moral, Welfare, and Recreation (DFMWR) (golf course, athletic and drill fields) and smaller users, there are enough users to consume all the compost that could be generated from an on-site operation. A suitable area for on-site composting is available. There are also other alternatives to on-site composting, including current management, other means of waste diversion (including direct soil application of certain waste materials and anaerobic digestion of food wastes), and developing partnerships with composting facilities offsite. Although this project focuses on Fort Polk, the assessment could be broadly applicable to other Army installations. In addition, the issues found at the Joint Training and Readiness Center (JTRC) might have applicability to contingency environments and deployed operations.

Assessment of Anaerobic Digestion for Contingency Base Waste, V.F. Medina, S.A. Waisner, S. Cospers, G. Rodriguez, D. Gilbert, R. Tucker, I. MacAllister, R. Scholze, J. Burken, and J. Wang. Draft Technical Report.

A study was conducted to evaluate anaerobic digestion as a way to treat organic waste from CBs and to generate energy from the process through biogas. The project focused on laboratory studies to evaluate the treatment of applicable wastes and determine gas production. The study found that food waste, which is very effectively treated, generates relatively large volumes of gas. Methane concentrations in the gas range from 60 to 70%. Studies with latrine wastes also had high gas production, and inhibition by toilet chemicals was minimal. A pilot study was conducted at the CBITEC at Fort Leonard Wood. Calculations suggest that the generated gas

Composted materials increase waste diversion at Fort Polk, LA.

could offset energy use by 15 to 30%, depending on the size of the CB, and fuel cost savings (fully burdened and incorporating estimates for force protection) were estimated to be as high as \$500,000 per month. Some issues were identified regarding reaction instabilities that could cause the reactors to fail. Some suggestions were identified to address these issues, particularly using a mix of wastes along with food, which should improve stability and increase the utility of the process to address waste problems in a CB setting.

Recyclable Materials Online Marketing System for Qualified Recycling Programs (QRPs)

This project, which began in FY13 and continues through FY14, is assessing the performance of Recycle Match, an online recyclables marketing system, at Fort Hood, TX and Fort Campbell, KY for maximizing profits on the QRP. Recycle Match's online platform was installed and is now operating at both installations. CERL will evaluate net cost over previous business processes and net material marketing capability and will provide recommendations for further rollout or for any modifications that would facilitate Army use.

Sponsor: Michael Andres, IMCOM

POC: Giselle Rodriguez, CERL

Test Anaerobic Digestion Unit

Integrated Water Planning Through Building Level Cascade of Water Use

This project, in its second year, is demonstrating the retrofit of existing facilities with technologies that reduce potable water consumption through conservation and building graywater reuse. Conservation measures apply to sinks, showers, and toilets. The demonstration will retrofit technologies at an Army Fitness Center at Fort Irwin, CA. The retrofit work is being contracted through the Huntsville Center of USACE and execution is planned for FY14. Data collection will continue for 1 year after the retrofit.

Sponsor: James Galvin, ESTCP

POC: Elisabeth Jenicek (PM), CERL

Fort Leonard Wood Integrated EW2 Portfolio

This project, in its second year, is demonstrating the Modeling for Net Zero Energy, Water, and Waste RDT&E capability, the Net Zero Planner tool. Efforts during the first year included a water site assessment that collected data and surveyed buildings. The result of the assessment was a set of recommendations for reducing water use and initial models to calculate installation water use based on disaggregation of end-uses. The second year's efforts will increase the accuracy of the models and develop projects that will lead to reductions in water use.

Sponsor: Fort Leonard Wood, MO, PAIO

POC: Annette Stumpf (PM), Susan Bevelheimer, and Elisabeth Jenicek (NZW lead), CERL

Water Conservation for Training Areas

This project demonstrated and validated water conservation strategies at a training area at Camp Atterbury, IN. Technologies that encourage water conservation in training include automated bulk water dispensing facilities, composting toilets, and efficient fixtures. Water consumption was monitored both prior to and after the retrofits to document savings. While technology retrofits were installed, trainers conducted a water awareness education program. Data collection continued through January 2013. The results of this demonstration will be used to inform water efficiency programs at other Army training bases.

Sponsor: ACSIM ITTP

POC: Elisabeth Jenicek (PM), CERL

Demonstration of a Modular Wetland Treatment System for Parking Lot and Motor Pool Runoff

This project is evaluating off-the-shelf “modular wetland” technologies for stormwater runoff treatment under military unique conditions.

Sponsor: ACSIM ITTP

POC: Heidi Howard, CERL

Greenwall Demonstration for Energy Conservation

This project demonstrated and validated “off-the-shelf” greenwall technology at Fort Hood.

Sponsor: ACSIM ITTP

POC: Heidi Howard, CERL

Water Sustainability Studies at Four NZW Installations

This project applied the methodology developed in the Army Installation Water Sustainability Assessment to four additional NZW Installations: Aberdeen Proving Grounds, MD; Fort Buchanan, PR; Camp Rilea, OR; and Tobyhanna Army Depot, PA. The study projected and evaluated the sustainability of water supply and demand over a 30-year time period. In addition, this project developed draft metrics for new water requirements that focus on water use per capita and leak detection. Publication of the technical report documenting this work is imminent.

Sponsor: ASA(IE&E)

POC: Elisabeth Jenicek (PM), CERL

Water Planning Project Tracking Tool

This project will provide a reference database by which both resident units and operators can capture the efficiency standards and conservation measures already in place. Additionally, it will maintain an accurate demand profile of Army installations as they progress towards NZW.

Sponsor: ASA(IE&E)

POC: Marc Kodak, ASA(IE&E)

Methane Recovery Evaluation of Army Wastewater Treatment Plants (WWTPs)

This project will assess methane recovery potential at Army Wastewater Treatment Plants to quantify their methane gas generation rates, evaluate those rates against current methane gas recovery technologies, and complete a preliminary analysis to identify WWTPs with the potential and cost to install and operate a recovery system vs. existing local utility rates.

Sponsor: Wanda Johnsen, ASA(IE&E)

POC: Richard Scholze, CERL

A large portion of land use in the North Coast Basin area of Oregon is urban development and woody wetlands such as these on Fort Rilea, OR.

Rotary Gasification of Solid Wastes for Base Camps

This project will develop a deployable waste to energy system that will provide mixed waste disposal and a gaseous fuel to power a standard diesel generator.

Sponsor: Strategic Environmental Research and Development Program (SERDP)

POC: Stephen Cospers, CERL

Fort Polk Compost Plan

This project will develop a plan to process all organic wastes generated at Fort Polk into a valuable soil amendment to be applied to training lands.

Sponsor: Fort Polk Directorate of Public Works (DPW)

POC: Dr. Victor Medina, EL

Net Zero Compost Technologies

This project will review compost technologies that would be applicable to the eight Net Zero Waste installations. It will study material compatibility, throughput, cost, equipment, and labor requirements for each approach.

Sponsor: Ms. Wanda Johnsen, ASA(IE&E)

POC: Stephen Cospers, CERL

Anaerobic Digestion for Base Camp Organic Wastes

This project will perform laboratory and pilot scale testing of co-digestion of food and latrine wastes to determine the feasibility and methane output of the process.

Sponsor: Leonard Wood Institute

POC: Dr. Victor Medina, EL

Water Sustainability Studies at Eight US Army Materiel Command (AMC) Installations

This project will apply the methodology developed in the Army Installation Water Sustainability Assessment to eight Army Materiel Command Installations: Anniston Army Depot (AD), AL; Blue Grass, KY; Corpus Christi AD, TX; Iowa Army Ammunition Plant (AAP), IA; Lake City AAP, MO; Radford AAP, VA; Red River AD, TX; and Sierra AD, CA. The study will project and evaluate the sustainability of water supply and demand over a 30-year time period.

Sponsor: ASA(IE&E)

POC: Elisabeth Jenicek (PM), CERL

Testing of the KRIA Ionizing Reactor.

This project will test and evaluate a novel reactor that electro-chemically generates ionized oxygen (superoxide), focusing on diesel range hydrocarbons, polychlorinated biphenyls, nutrients, and algae.

Sponsor: Premier Materials, LLC (CRADA)

POC: Victor F. Medina, EL

KRIA Ionizing Reactor

Proposed Projects

Satellite Reclamation of Wastewater

This project will demonstrate the use of wastewater scalped from a sewer system and treated with a membrane bioreactor for use as irrigation water or aquifer recharge.

Proposed to: ITTP

POC: Richard Scholze, CERL

Demonstration of RecycleMatch

This project will demonstrate the use of an online marketplace to efficiently market recyclables at three Net Zero Waste installations.

Proposed to: IMCOM

POC: Giselle Rodriguez, CERL

Sustainable Natural Infrastructure

Leads: Alan Anderson, CERL

Description: The purpose of this focus area is to engage stakeholders through forums, white papers, publications, and other means about DoD-related concerns with natural resources in terms of managing DoD assets and natural resources to support sustainability of training and testing missions on military lands, as they relate to international and national security and stability.

Ongoing Projects

Draft "Alternative Term Subsidy Program for Private Land Development," Timothy J. Hayden.

This project evaluates the economic efficacy and viability of developing policies and mechanisms for term easements. ACSIM is the sponsor for this effort and partners are CERL and the University of Illinois.

Draft "INRMP Guidance for Incorporating Advanced Management Capabilities and Dynamic Changes in Future Mission, Climate and Land," Timothy J. Hayden.

This report identifies developing requirements and areas of emphasis, with a further emphasis on those elements that may have the most direct bearing on INRMPs. It provides information and direction on how these new and developing requirements and considerations might be incorporated into INRMP planning and implementation processes. In the context of national renewable energy initiatives and developing climate change adaptation approaches, this report addresses the relevance of recent national, DoD, and Army policy guidance and directives for INRMP review and implementation. It provides recommendations for ACSIM(ISE) policy guidance for INRMP revision to address evolving natural resources management policies and regulatory requirements and evaluates processes for incorporating best practices and capabilities in INRMPs to meet land management challenges in the face of dynamic and uncertain future conditions.

Draft "Streamlining the Installation/USFWS Consultation Process and Evaluation of Army Terms and Conditions," Timothy J. Hayden.

This report evaluates Army consultation processes through case studies to provide recommendations for enhancing the efficiency of Army ESA consultations, and provides recommendations for negotiating and evaluating Army Biological Opinion Terms and Conditions (BO T&Cs).

Alternative Management Strategies for Threatened and Endangered Species (TES) on Military Lands

More than 240 candidate species on DoD installations are eligible for Federal listing under the ESA, and more than 700 petitioned species will undergo US Fish and Wildlife Service (USFWS) review by 2018. DoD will require management options beyond the current primarily single species management

approaches to address the potential management cost and compliance burdens caused by this possible wave of newly listed species. This project will identify and provide recommendations for alternative approaches to TES management on military lands to would mitigate future management and compliance costs for future listed species.

Proposed to: ACSIM

POC: Jinelle Sperry

Climate Change

Leads: William Goran, ERDC-CERL, with input and review from Kevin Knuuti (ERDC-CRREL), Kelly Burks-Copes (ERDC-EL), Andrew Bruzewicz, Kathleen White, and Jeff Arnold, IWR; and I. Sam Higuchi, National Aeronautics and Space Administration (NASA).

Description: This focus area relates to the impacts of climate change on public resources and to the manner by which managers adapt to these impacts. This aspect of CASI is broadly “interagency” focused, as these impacts and adaptations are relevant to all public resource managers, not just US military activities and missions. However, the 2008 Defense Authorization bill included language that requires DoD to identify the impacts of climate change on military facilities, ecosystems, and missions. In addition, the 2010 Quadrennial Defense Review and the 2011 Defense Science Board Report on Climate Change and National Security further commit DoD to assessing the impacts of climate change on assets and operations. The *Department of Defense FY 2012 Climate Change Adaptation Roadmap* provides a framework and action plan to integrate climate change considerations into existing planning processes and to partner with Federal agencies and allies on the challenges of climate change.

Events

Interagency Forum on Climate Change Impacts and Adaptations

This Forum meets periodically in the Washington, DC, area, and participants also join in by telephone and website. The Forum has been meeting since November 2007 and has grown steadily. Forum activities are scheduled for half-day sessions every 6 to 8 weeks. A work group website is maintained on FedCenter.gov, accessible through URL: <http://www.fedcenter.gov/programs/greenhouse/ccforum/>. Persons interested in attending this Forum, seeking information on upcoming or past forums, or requesting access to the Forum briefings should contact ccforum@fedcenter.gov. This Interagency Forum has support from FedCenter through the US Environmental Protection Agency (USEPA). In 2013, sessions were held in January, March, April, June, September, October, and December. A similar number of sessions are planned for 2014.

Ongoing Projects

Army Climate Change Adaptation Planning Framework and High-level Vulnerability Assessment

A CASI team from three ERDC laboratories is helping the Army develop a framework to assess climate change vulnerabilities across Army lands, facilities, and operations. This effort is being guided by a newly formed Army Climate Change Work Group chaired by ASA(IE&E). It involves the analysis of relevant policy, guidance, and training, as well as a high-level assessment analysis. In 2012, this project developed an Army High-Level Climate Change Vulnerability Assessment, and a framework roadmap for five important Army processes (master planning, integrated natural resources management planning, strategic and sustainability planning, range complex master planning, and critical infrastructure assessments) that will incorporate changing climatic conditions into future plan versions. In 2013, this adaptation planning framework was piloted at two Army installations, Fort Huachuca and Fort Stewart. Reports for the 2012 and 2013 efforts are currently under review by ASA(IE&E). In 2014, work will focus on expanding planning frameworks to include emergency response plans and potable water system plans, screening of Army installation coastal vulnerabilities, Data and Technology Support Requirements for Climate Change Vulnerability and Adaptation Planning Processes, and draft Army policy and regulatory guidance for climate change adaptation planning.

Sponsor: ASA(IE&E)

POC: CERL

Global Change Sustainability

A CASI team is providing support to the IWR program relating to climate change adaptation for water resources management. Current efforts focus on data development and analyses to assess implications of IWR adaptation planning for water sustainability and resource management for facilities and operations across civil works business lines. Continuing efforts will focus on civil works adaptation pilot locations. A major objective of this support is to help USACE “bridge the stovepipes” across Military and Civil Works programs. In 2013, three projects were completed including Wildlife Corridor Analysis for Civil Works Applications, SIRRA Biofuel Indicators for CorpsMap Applications, and Relevance of Civil Works (CW) Drought Contingency Plans for Army Installations. Reports for these three efforts are currently under review by IWR.

Sponsor: IWR, oversight by Dr. Kathleen White.

POCs: CERL

Proposed Projects

High-level Vulnerability Assessment for OCONUS Army Installations

This project will conduct a high-level analysis of Outside Continental United States (OCONUS) Army installation vulnerabilities to climate change. This assessment would be modeled after the Army High-Level Climate Change Vulnerability Assessment submitted to ASA(IE&E) in 2013. This study would help inform an analysis of how and where current OCONUS locations might be vulnerable to new stressors; and how, where, and when global changes might be altering analog climatic, ecological, and social conditions for US OCONUS installations.

Proposed to: TBD

POC: CERL

Green Remediation and Reuse

Lead: Carol Lee Dona, EM-CX.

Description: The purpose of this focus area is to increase awareness and activity across USACE and the Army for incorporating sustainable practices into their environmental remediation and reuse activities.

Publications

Quantifying Life-Cycle Environmental Footprints of Soil and Groundwater Remedies

This joint Navy/Air Force/USACE SERDP/ESTCP project validated the two publicly available DoD GSR tools, *SiteWise*, developed jointly by the Navy, Army, USACE, and Battelle, and the US Air Force Sustainable Remediation Tool (SRT). The tools were validated on six military sites (three Air Force [SRT application], two Navy, and one Army [*SiteWise* application]). The DoD tools, which are spreadsheet-based and use literature referenced values to convert remedy information into GSR metric information, were validated by comparing their results with those from a full Life-Cycle Analysis (LCA) process as defined by International Standards Organization Standards 14040 and 14044. The LCA was performed with SimaPro, a commercially available LCA software package. The tool application to the six validation sites found that the DoD tools have distinct advantages over SimaPro with respect to availability, cost, ease of use, and ability to share files for collaboration, peer review, and documentation. The project also found that the DoD tools provide reasonable footprints for sustainability metrics and provide results for the types of decisions the tools are intended to support. Various improvements in terms of calculation of footprints and ease of use or formatting were made to the DoD tools based on the project results.

<http://www.serdp.org/Program-Areas/Environmental-Restoration/Contaminated-Groundwater/Monitoring/ER-201127>

Sponsor: ESTCP

POC: Carol Dona, EM-CX

Presentations

The following presentations were presented at the Battelle Jacksonville, FL Conference, June 2013:

"Incorporation of Green and Sustainable Remediation Considerations into Army Environmental Remediation."

"Constraints on Implementation of Green and Sustainable Remediation Recommendations from Follow Up on an Army Remedial System Evaluation."

"Multiple Tools Developed from Army GSR Pilot Projects for Evaluating and Comparing GSR Considerations in Remedial Decision-Making."

"Application of Sustainable Remediation for Sustainable Redevelopment: A Collaborative, Multistakeholder Approach – DoD and Army," part of a multistakeholder panel discussion.

Ongoing Projects

Development of Questionnaires for Upward Reporting of GSR Activities.

Draft data fields for Army GSR reporting have been developed, updated, and uploaded to the new Army Headquarters Army Environmental System (HQAES) database scheduled to go online in spring 2014. A similar set of questions have been developed for use in the USACE Formerly Used Defense Site (FUDS) environmental remediation program and is currently under review by USACE HQ for potential use for upward reporting by USACE District FUDS program managers.

Sponsor: Army and USACE FUDS

POC: Carol Dona, EM-CX

Top-counterclockwise:
(1) Phytoremediation of arsenic at Spring Valley FUDS site, Washington DC;
(2) wind turbine powered groundwater recirculation well at the Former Nebraska Ordnance Plant Superfund Site, Mead, NE;
(3) passive samplers, used across many Corps sites

Development of a GSR Best Management Practice List for Use by USACE District Environmental Remediation Project Teams

A draft set of GSR Best Management Practices (BMPs) as revised from the BMP list developed in the 2012 Army GSR Study is currently under review by USACE HQ for use in the field by USACE District environmental remediation teams.

<http://cdm16021.contentdm.oclc.org/cdm/ref/collection/p266001coll1/id/2298>

GSR Contract Language Pilot

GSR contract language as developed in the 2012 Army GSR Study has been included in the contracting for a remedial investigation/feasibility study project in the Louisville District USACE. The effectiveness of the contract language will be assessed through the project performance, with the contract language updated with any revisions.

<http://cdm16021.contentdm.oclc.org/cdm/ref/collection/p266001coll1/id/2298>

Scheduled Training

"Green and Sustainable Remediation in the Formerly Use Defense Site (FUDS) Program," 4-hour web-based training, March 2014.

Proposed Projects

Increase Green Remediation and Optimization Inclusion in USEPA Projects Executed by the USACE

The USACE Districts execute a significant amount of environmental remediation work for the USEPA regions. USEPA HQ has indicated its intent to increase the amount of GSR and optimization that is included in this remediation. The EM-CX and USEPA would co-develop and teach a pilot training at one USACE District to achieve this purpose. Lessons learned from the pilot training would be incorporated into a training module that could be used by all the USEPA regions.

Proposed to: USEPA HQ

POC: Carol Dona, EM-CX

Case Study to Develop a Process to Incorporate Green Remediation into the Remediation Project Decision-Making on USEPA Projects Executed by USACE

Inclusion of green remediation has been proposed on a USEPA Superfund Project in the Feasibility Study planning stage. The EM-CX would collaborate with the USACE District helping execute the project to both incorporate green remediation and develop a process to systematically incorporate green remediation into the remediation decision-making process.

Proposed to: USEPA HQ

POC: Carol Dona, EM-CX

Development of Federal Partner, Agency-Wide GSR BMPs

This project would include bundling of various Federal agency and guidance agency GSR BMPs, as well as development of a working template that can be used to sort and summarize BMPs on a project-specific basis.

Proposed to: USEPA HQ and USACE HQ

POC: Carol Dona, EM-CX

GSR Update for the Federal Remediation Technology Roundtable "FRTR Presents"

This project would be a 2-hr presentation through the USEPA CLU-IN web site where the following topics would be presented:

- Federal agency-wide GSR evaluation tools
- Federal agency-wide GSR metrics, and
- Federal agency-wide GSR BMPs.

Proposed to: USEPA HQ and USACE HQ

POC: Carol Dona, EM-CX

Sustainable Forward Military Operations

Lead: Kurt Kinnevan, CERL.

Description: This focus area relates to full spectrum contingency operations, from disaster response and humanitarian assistance through stability operations and conflict or post-conflict reconstruction. This aspect of CASI directly supports:

- new designs for CBs and updating the Army Facilities Components System – Theater Construction Management System being led by USACE
- support to OSD, Department of the Army (DA), and Services with regards to planning, design, operations, management, construction, policy and Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities (DOTMLPF) of CBs
- effort to develop a programmatic approach to contingency basing being led at Army and Joint levels, and coordinated internationally through the North Atlantic Treaty Organization (NATO) and others
- Army Campaign Plan Directive 2-8, Institutionalizing Contingency Bases, being led by ASA(IE&E).

- ➔ Improved Deployability
- ➔ Reduced Resource Requirements/Better Systems Management
- ➔ Modular/Scalable
- ➔ Reusable/Durable/Reliable
- ➔ Enhanced Survivability

Ongoing Projects

Note: While the CASI work on CBs was initiated with a series of studies, starting in 2007, at the beginning of FY11 (October 2010), the ERDC began research efforts with Army research and development funds to address key knowledge gaps identified by a Army Training and Doctrine (TRADOC) analysis of CBs. The various CASI studies helped contribute to this TRADOC analysis and to the subsequent research efforts. By 2013, this research work is progressing in several dimensions – a foundational project to develop a virtual simulation environment for contingency base, a large scale testing and demonstration facility at Fort Leonard Wood, and numerous efforts to develop and test specific technology solutions for energy, water, waste, and operations of CBs. These efforts are managed within the ERDC Environmental Quality/EQI business areas, with linkages to Military Engineering and other ERDC business areas. These research efforts, funded by various research programs, are not reported in detail in this work plan. The CASI Work Plan only identifies the projects funded directly by sponsor organizations that task CASI to perform specific studies or analysis.

Analysis of Policy and Guidance Regarding Sustainability and Environmental Considerations in Overseas Contingency Operations in the Joint, Interagency, Intergovernmental, and Multinational (JIIM) Environment (Draft Report)

This report analyzed the links between national strategies and policies with the implementation requirements necessary to achieve sustainable contingency operations. It performed a

review of existing strategies and policies and found that none of the documents is directed at implementing or developing sustainability as a driving factor in contingency operations. Therefore, this study evolved to identify the existing regulatory, policy, doctrinal, conceptual, or guidance documents related to sustainability or environmental considerations that could be linked, directly or indirectly, to contingency operations.

Sponsor: Stephen Hearne, ASA(IE&E)

POC: Dr. David Krooks, CERL

Analysis of Policy and DOTMLPF as It Pertains to Sustainability and Environmental Considerations during Overseas Contingency Operations

This effort involved a detailed analysis of US policy, Army and Joint Doctrine, pertinent international agreements with the European Union and NATO, and DOTMLPF aspects as they pertain to supporting or mandating sustainability during contingency operations.

Sponsor: US Army Engineer School Directorate of Environmental Integration

POC: Kurt Kinnevan, CERL

Virtual Forward Operating Base Planning Tool

This effort is designed to convert and update the older *GeoBEST* application to an application that can be used to perform contingency base planning and design, and to link it with a resource use algorithm to provide a dynamic resource and waste inventory.

Sponsor: Program Manager Force Sustainment Systems

POC: Dr. Ahmet Soylemezoglu, CERL

NATO Net Zero Base Camp

CERL provides the US Delegation team leader to a NATO effort to explore the economic and military benefits of reducing the resource requirements and waste footprint of military base camps in an operational environment. This project will increase the knowledge base and communications among nations, encouraging the innovative integration of technologies that will contribute to the ultimate goal of a sustainable ("zero footprint") military compound in a rational and holistic way.

Sponsor: OSD, Installations and Environment

POC: Kurt Kinnevan and Dr. Ahmet Soylemezoglu, CERL

Sustainability Criteria for CBs

ASA(IE&E) is funding a study for CERL to conduct research, to evaluate the value and relevance of sustainability criteria for contingency basing design and operations, and to provide the results of this research and evaluation in a summary report. This evaluation will consider multiple criteria types, their applicability, and limits in terms of forward basing and forward operations, and the potential value of these criteria from the perspective of mission support, operational efficiencies in base operations, Soldier and civilian effectiveness, and host nation interactions. The process will result in a list of criteria considered most relevant and valuable for expeditionary sites of different types and durations. These criteria are not intended to be prescriptive, but to provide helpful considerations and references for contingency basing planners.

Sponsor: Stephen Hearne, ASA(IE&E)

POCs: Garth Anderson and Annette Stumpf, CERL

Contingency Basing Integration Technology Evaluation Center (CBITEC)

Army G4 Logistics Innovation Agency provided funding to USACE (CERL and Kansas City District) to design, construct and operate a full scale contingency base at Fort Leonard Wood to conduct a demonstration, assessment, and evaluation of contingency basing capabilities and technologies (power, environmental, sustainable construction, and force protection) that support Army requirements and future acquisition decisions. This facility will also provide a training venue to military units and Engineer School students to learn sustainable base operations. CERL supports the Maneuver Support Center of Excellence by preparing a

CBITEC master plan and a technology evaluation plan, and by providing a project manager, to be located at Fort Leonard Wood, for the long-term operation of the facility.

Sponsor: Army G4 Logistics Innovation Agency

POC: Garth Anderson, CERL

Prototype Development of Detailed Component Analysis Model (DCAM)

This project funds the development of the DCAM into a flexible/standalone user tool. This work consists of designing/developing the framework that can first convert the currently available modeling capabilities (Force Provider based) into a standalone version. Then the required user interface components/modeling algorithms will be developed to allow for generation of variable Operational Tempo (OPTEMPO) sensitivity analyses based on various new/existing technologies.

Sponsor: Program Manager Force Sustainment Systems

POCs: Dr. Ahmet Soylemezoglu and Dr. Nathan Putnam, CERL

Proposed Projects

UK Collaborative Effort on CBs

CERL met with representatives of the UK MOD to discuss potential collaboration on technology assessment of contingency basing needs. The discussion also suggested expanding the talks with both Canadian and Australian military efforts.

Proposed to: OSD, Installations and Environment

POC: Kurt Kinnevan, CERL

Contingency Base Design and Construction Metrics for Transition from Initial to Temporary to Enduring Standards

This proposed Army Study Program will determine the metrics that drive the tipping points to transition from one construction standard to another during contingency operations.

Proposed to: Army Study Program

POCs: Garth Anderson, CERL

Universal Contingency Base Construction Standards

This proposed Army Study Program effort will develop a consistent set of construction standards across all Combatant Commands (COCOMs) that will take into account potential environments, OPTEMPOs, missions, and quality of life standards.

Proposed to: Army Study Program

POCs: Garth Anderson, CERL

Contingency Base Sustainability Metrics Based on Mission Type and OPTEMPO

This proposed Army Study Program effort will quantify the level of sustainability of a contingency base with respect to the OPTEMPO and type of mission being supported.

Proposed to: Army Study Program

POCs: Garth Anderson and CPT Tom Decker, CERL

Strategic and Tactical Operational Resource Model (STORM)

ERDC-CERL, in collaboration with the Program Manager Expeditionary Energy and Infrastructure and the Product Directorate for Contingency Base Infrastructure, is proposing to develop a modeling and simulation capability that assesses resource requirements and bridges the gap stemming from informational dynamics across the strategic and tactical levels. It will provide a methodology for accounting and tracking resource requirements that reflect the interdependencies associated with mission dynamics, base camp designs, unit occupancy, distribution systems and approaches, on-site storage, consumption variances, operational durations, and acceptable risk parameters for the operations.

Proposed to: DoD OEPP

POCs: Kurt Kinnevan and Dr. Ahmet Soylemezoglu, CERL

Identifying the Characteristics of the “Commodities” That are Part of the Sustainment Requirements for CBs.

There are general categories of “things” that get moved in theater. Determining how they move with respect to their environment, with one another, and within the distribution network is a challenge. This effort will focus on identifying these characteristics and confirming their interrelationships to be able to define the mechanics of transporting “resources” from entry point to final destination. The

categories of resources to be addressed include: (1) People (Soldiers, civilians, and contractors [US and allies], and host nation and third country nationals); (2) Consumable Resources and Waste, Infrastructure material and materiel; and (3) service functions (laundry, meals, mail, medical, morale, welfare, and recreation [MWR,] etc.).

Proposed to: Army Study Program

POCs: Kurt Kinnevan and Dr. Ahmet Soylemezoglu, CERL

Sustainable Facilities and Infrastructure

Leads: Annette Stumpf and Richard Schneider, CERL.

Description: The purpose of this focus area is to help USACE, the Army, and DoD work towards achieving Net Zero Installations by focusing on sustainable planning, design, construction, renovation, and installation development goals. CERL provided technical expertise and policy analysis/support for the Army's Sustainable Design and Development (SDD) since the initial SDD research began in 1999. CERL Sustainable Facilities and Infrastructure leads have worked closely with ACSIM, IMCOM, USACE, and installations to inspire change and help them adopt new life-cycle cost-effective technologies, design and construction practices, and sustainable planning strategies to work towards Net Zero Energy, Water, and Waste goals. The focus area leaders are ERDC experts working closely with the USACE Regional Technical Centers of Expertise for Energy, Sustainable Design, and Life-Cycle Cost Analysis to transform the USACE enterprise business process so all projects meet Army High Performance Sustainable Building requirements. Team leads also provide technical support and collaboration with the US Green Building Council (USGBC) and other organizations involved in SDD. Finally, we develop and share essential technical information to an Army-wide network of SDD change agents.

Publications and Products

High Performance Sustainable Building (HPSB) Score Sheet

This score sheet will help Tri-Service team's survey existing buildings to determine whether existing buildings comply with Unified Facilities Criteria (UFC) 1-200-02, *High Performance Sustainable Building Requirements*. The score sheet was developed and coordinated with Tri-Service sustainable design POCs and will be tested in FY14 at two installations during the BUILDER assessment

Sponsor: ACSIM

POCs: Richard Schneider, Annette Stumpf, and Julie Webster, CERL

Resilient Home Program

CERL has published two reports to conclude their participation with the Department of Homeland Security's Resilient Home Program (RHP). The RHP was a collaborative research program among CERL, Department of Energy Savannah River National Laboratory, Clemson University, and North Carolina State University. The objective of this research was to develop methods of reinforcing residential structures against natural disasters, (i.e., improving resilience), thus enabling residents to reoccupy their homes sooner, reduce repair requirements, and resume normal lives. High wind, flood, and wildfire perils were addressed. CERL's major contributions consisted of participating in a gap analysis to identify requirements for further research and education, identifying resilient construction methods and technologies, developing an educational program for a Gulf Coast regional resilient home conference, contributing technical and engineering knowledge to the Resilience Scoring Utility, and developing benefit-cost analyses for resilient residential construction, both new and retrofit. These activities are documented as ERDC/CERL TR-12-20, *ERDC-CERL Participation in the Resilient Home Program 2009-2012* and ERDC/CERL TR-13-10, *Costs and Benefits of Resilient Construction*.

Sponsor: US Department of Energy Southeast Regional Resilience Institute

POC: Thomas Napier, CERL

Rapid Energy Modeling Workflow Demonstration Project Final Report

The DoD has a critical need to evaluate energy consumption of existing facilities. To address this need, the Rapid Energy Modeling methodology was deployed. The workflow captures information on operations and geometry of a building, generates a 3D building model, and then simulates energy use patterns and reports on energy conservation measures. Rapid Energy Modeling was applied to a sample of 23 DoD buildings. The simulated and actual building energy data was analyzed by energy type (electricity and natural gas) and energy use intensity (EUI).

ESTCP Project Number: 201259 Final Report will soon be available through URL:

<http://www.serdp.org/Program-Areas/Energy-and-Water/Energy/Conservation-and-Efficiency/EW-201259>

Fact Sheet: <http://www.serdp.org/Program-Areas/Energy-and-Water/Energy/Conservation-and-Efficiency/EW-201259>

POCs: John Sullivan, Autodesk, Inc., and Annette Stumpf, CERL

Sustainability Criteria for Contingency Bases, Draft ERDC/CERL Technical Report

Recent US contingency operations have demonstrated the vulnerability of contingency base logistical supply lines. The large materiel, energy, and water footprint of US facilities must be resupplied via risky ground convoys, expensive airlift, or airdrop. This problem is exacerbated by the large variety in approaches to planning and design of these bases and their varying levels of efficiency in operations, making them difficult to sustain. Military base planners have few practical guidelines or references to use to help improve the logistical sustainability of the bases and the quality of life of the warfighter. The planning, design, and construction industries in the United States have developed various criteria to help improve the sustainability of facilities and infrastructure. Programs such as LEED®) and the Sustainable Sites Initiative provide guidelines and certification standards to achieve accepted levels of sustainability. While specific criteria are useful in commercial construction and neighborhood planning, many are not directly applicable to military contingency operations.

The purpose of this study is to examine the various design and construction sustainability programs and determine what concepts, principles, guidelines and specific measures have relevance to military contingency infrastructure for temporary and semi-permanent construction. This report will describe criteria that have appropriate military application that engineers, planners, and base operators can consider for use during the establishment of CBs. Application of as many of these criteria as is practical could substantially decrease the logistical footprint of the base by reducing construction materials, increasing the energy efficiency of structures, and reducing water demand.

POCs: H. Garth Anderson and Annette Stumpf, CERL

FY13 NetZero Energy Water Waste Portfolio at Fort Leonard Wood, MO, Draft ERDC/CERL Technical Report

This report describes development of an integrated portfolio of cost-effective and appropriate strategies, approaches, and technologies to help Fort Leonard Wood implement its strategic vision. ERDC-CERL performed assessments to baseline energy, water, and waste at Fort Leonard Wood. Energy, water, and waste systems are highly interrelated, and therefore must be evaluated concurrently and optimized in a single integrated effort. The information provided should help decision makers at Fort Leonard Wood compare and evaluate feasible options to identify the best long-term profile that will keep the installation's resource use costs low and that will provide secure energy with a decreased impact on natural resources.

POCs: Annette Stumpf and Susan Bevelheimer, CERL

Demonstration of Energy-Saving Outdoor Lighting Technologies: Presidio of Monterey, CA, and Fort Eustis, VA, ERDC/CERL CR-12-25

Energy-saving outdoor lighting technologies were demonstrated at two Army installations: the Presidio of Monterey, CA (POM), and Fort Eustis, VA. The existing light fixtures, high-pressure sodium at POM and metal halide (MH) at Fort Eustis, were replaced with light emitting diode (LED) and magnetic induction fixtures (MIFs). Energy consumption data was calculated and metered. The cost of installation was recorded, and the cost of operation was calculated. Simple payback calculations and life-cycle cost analyses (LCCA) were performed. Comparisons were made between the existing and retrofitted lighting systems. Recommendations then were made regarding the economic feasibility of these retrofits. Operating energy savings were significant at both locations. However, the initial cost of installing these types of lighting systems diminished the life-cycle cost savings. The relatively high cost of electricity at POM makes it worthwhile to invest in these retrofits because the simple and net present value (NPV) payback times are reasonable. By contrast, the low cost of electricity at Fort Eustis discourages a retrofit investment in these technologies at the current time.

Authors: Patrick L. Edwards, Thomas R. Napier, and Sarah B. Nemeth

URL: <http://acwc.sdp.sirsi.net/client/search/asset/1033262>

POCs: Patrick Edwards and Thomas Napier, CERL

Opportunities to Increase Construction and Demolition Diversion, Thomas R. Napier, USACE Public Works Technical Bulletin, PWTB 200-1-120, October 2012.

Economic and environmental burdens associated with landfill disposal of construction and demolition (C&D) materials are well documented, as are various agency directives aimed at the reduction of C&D waste. The Army's plan to achieve 25 net zero Army installations by 2030 should leave no doubt as to the mandate for C&D waste reduction. Since implementing C&D waste diversion policies, the Army's green building practices, along with the construction industry's practices in general, have progressed significantly. According to Solid Waste Annual Reporting (SWAR) data, Army-wide C&D diversion rates have exceeded the minimum mandated at the time. However, this level of performance is not consistent throughout all installations or Army facility programs. Opportunities to improve diversion rates exist because the most successful practices to divert C&D materials are not being applied as broadly as they could be. This PWTB documents experiences gathered from USACE and installation DPW projects that involve demolition and new construction. The PWTB also includes input from DPW personnel at installations that represent the largest amount of Military Construction (MILCON), and feedback received from HQUSACE, USACE District, IMCOM, and Office of the Assistant Chief of Staff for Installation Management (OACSIM) personnel involved with construction, demolition, and waste management activities. The resulting lessons learned are described and accompanied by recommended practices to improve C&D waste diversion performance.

Events

USACE-Wide Sustainability & Energy Webinars

CERL developed and presented webinars for IMCOM and USACE on HPSBs, PWTBs, COBie, BUILDER, buildSMART, Sustainability Criteria for Contingency Bases, and RCI deconstruction during FY13, including:

- Autodesk Rapid Energy Modeling Training Webinar, September 2013, POC: Annette Stumpf
- White House Subcommittee on Building Technology Research & Development Briefing, 10 July 2013, by Annette Stumpf
- *GreenBuild 13*, 20-22 November 2013, Philadelphia, PA
- Ongoing
 - Fort Leonard Wood quarterly Installation Strategic Sustainability Planning meetings with the six goal teams, and additional meetings to provide technical expertise to Fort Leonard Wood customers, Meetings held January 28-February 1, 2013; April 22 – 26, 2013; July 22-26, 2013; and December 2-6, 2013, POC: Annette Stumpf or Susan Bevelheimer
 - Water Audit conducted at Fort Leonard Wood, 24-27 June 2013
 - Operations and Maintenance (O&M) Division Investment Strategy Development Meeting, 14-16 January 2014
- Planned
 - Fort Leonard Wood Quarterly Installation Strategic Sustainability Planning Meetings: 10-14 March 2014; 16-20 June 2014; and 8-12 September 2014
 - High Performance Sustainable Building Engineering Regulation development meeting at HQUSACE, 29-30 January 2014
 - Society of American Military Engineers (SAME) Meeting on Building Material Recovery & Reuse at Fort Leonard Wood MO, 19 March 2014, POC: Thomas Napier or Annette Stumpf, ERDC-CERL
 - GreenBuild 14, 22-24 November 2014, New Orleans, LA
 - White House Sub Committee briefing, Fort Leonard Wood Integrated Strategic and Sustainability Planning (ISSP) briefing, Enterprise Approach to Design and Construction (EADC), Washington, DC, 29-30 January
 - Fort Leonard Wood Infrastructure Workshop
 - Fort Leonard Wood Quarterly Sessions
 - Rapid Energy Modeling Webinars.

C&D Waste Reduction Webinars

CERL developed and presented three webinars for HQUSACE related to reducing C&D waste from USACE new construction, renovation, and demolition projects. These webinars are directed primarily towards USACE personnel at Districts and Resident Offices, among others. Topics have included reducing waste construction and demolition projects, Net Zero Waste and role of C&D Waste reduction, and reducing C&D waste from RCI developments.

Sponsor: HQUSACE

POC: Thomas Napier, CERL

Ongoing Projects

Rapid Energy Modeling Workflow Demonstration Project

This ESTCP project was completed during FY13, but the report is being finalized by Autodesk, Inc. in collaboration with CERL. Autodesk tested a package of software tools, web services, and consulting expertise to assess and prioritize the energy reduction potential in new and existing DoD buildings. The proposed method quickly captures existing building geometry, systems, and materials to generate a data-rich 3D Building Information Model (BIM). These BIM models were used to predict building energy and water use, energy and water reduction opportunities, and to verify and monitor the modeled structure's perfor-

mance. The goal is to demonstrate a cost-effective, repeatable, accurate, and highly scalable method that serves DoD's immediate needs and that generates lessons to improve the method for broader adoption across other government agencies in the longer term. The ESTCP team worked to identify 32 DoD buildings with at least 1 year of metering data in a variety of climates for this project. Each building was visited and modeled. The team will then compare the results with actual metering data to validate the process. A final report will be published and made available at:

<http://www.serdp.org/Program-Areas/Energy-and-Water/Energy/Conservation-and-Efficiency/EW-201259>

Sponsor: ESTCP

POCs: John Sullivan, Autodesk, Inc., and Annette Stumpf, CERL

ACSIM SDD Activity General Support

ACSIM provides funds to CERL for general support of its SDD activities. CERL facilitates the exchange of information among the Army, Air Force, and Navy concerning SDD policies and activities; acts as the liaison between the Army and USGBC representing Army interests in USGBC practices and products development; serves as the Army's single POC for membership in the USGBC, coordinating Army individual membership in the USGBC and providing guidance on all aspects of Army USGBC membership; provides LEED requirement interpretation, and scoring as well as general design and planning guidance on issues associated with sustainable design; provides Army Project Development Teams (PDTs) guidance on USGBC LEED Certification Minimum Program Requirements (MPRs), and on which LEED rating system is best for a given project; and compiles data and case files on Army/Corps LEED Certification for Army HPSB compliance.

Sponsor: Vincent Kam, ACSIM

POCs: Richard Schneider and Annette Stumpf, CERL

LEED Platinum Community Emergency Services Station at Fort Bragg, NC

HPSB Reporting

Funds are provided by ACSIM for CERL to determine the points of intersection between the BUILDER SMS, the requirements of the Guiding Principles for High Performance and Sustainable Buildings (GP), and the Installation Status Report; and to determine how the systems may best feed into the Headquarters Information System (HQIIS) for proper reporting of Federal mandates by the Army. This effort will determine the Army's implementation of GP for new, existing, and leased buildings. This is required for the Army to be on track to meet the 15% goal by 2015 by reporting that at least X% of buildings greater than 5000 gross sq ft meet GP as reported in the Federal Real Property Profile. (In this requirement, "X%" is defined as 7% for 2011, 9% for 2012, 11% for 2013, 13% for 2014, 15% for 2015, and 15% constant through 2020 with a goal of 100% of the qualified buildings meeting the criteria.)

The product of this effort is documentation stating where information necessary for EO 13423 compliance is currently collected in Army systems. Where data is not currently collected, suggestions for the proper integration point with current Army systems will be addressed — with the goal of HQIIS being the final portal and conduit for the Army's compliance submission. A HPSB Score Sheet for Sustainable Existing Buildings was developed to verify compliance with UFC 1-200-02, *High Performance Sustainable Buildings Requirements* and coordinated with the Tri-Service SDD experts. The HPSB Score Sheet, which was added to the BUILDER SMS, will be used during surveys of two Army Installations during FY14. Additional work is being done to determine a formal method of adding the sus-

tainability code to 1354s when buildings are transferred from USACE to IMCOM installations so the code can be entered into the Real Property database for upward reporting.

Sponsor: Vincent Kam, ACSIM DAIM-ODF

POCs: Richard Schneider and Annette Stumpf, CERL

USGBC Implementation Advisory Committee

ACSIM provided funds for CERL to represent the Army as a member of USGBC's Implementation Advisory Committee. This subcommittee of the LEED Steering Committee (LSC) is charged with assessing and recommending solutions to the LSC for review and approval. Its purpose is to advise USGBC staff on the scope, content, and rigor of technical resources and tools supporting LEED programs with the goal of maintaining LEED's integrity while also providing an effective, predictable, and satisfying LEED customer engagement. Implementation Advisory Committee members were recruited to represent Army interests in maintaining the LEED standards.

Sponsor: Vincent Kam, ACSIM

POC: Richard Schneider, CERL

An Enterprise Approach to Design and Construction of HPSB

In 2012, the USACE initiated the Regional Technical Centers of Expertise for Energy, Sustainability, and Life-Cycle Cost Analysis (RECX). These regional technical centers are uniquely managed through a lateral strategy that allows for customer-driven priorities with regional leadership. Each Regional Technical Center is accountable to USACE as the technical expert for two or more areas. They are managed directly through their Major Support Commands (MSC), which collectively form a management board led by USACE Headquarters Engineering and Construction Branch. The Engineering Research and Development Center and the Huntsville Center act in an advisory capacity.

As the technical requirements advanced and MSCs shared business processes, it quickly became evident that the level of service provided to the customer was not uniform across divisions. This presents an opportunity to raise the expectations and technical competencies of all divisions thus catalyzing the Corps as an agency to lead the Army towards universal High Performance Sustainable Buildings. The RECX determined that the most effective advancement of HPSBs into the US Army Corps business process is the holistic revitalization of the planning, design, construction, and operations process. In first quarter FY13, the RECX initiated the Enterprise Approach to the Design and Construction of HPSB with the aforementioned intention.

A Project Management Plan (PMP) established and formalized the process by which the Regional Technical Centers of Expertise and the RECX Management Board will develop the Corps' EADC of High Performance Sustainable Buildings. The project will build consistency and raise the level of quality for Corps projects evenly across all Districts within USACE.

The intention of this project is to develop a standard process for a life-cycle cost-effective, high performance, sustainable building of quality design and construction to perform and function as expected, verified, and tested before the Corps leaves the project site and completes financial closeout.

Sponsor: HQUSACE, George Lea

Project Leads: Lyndsey Pruitt and Kelli Polzin

Participants: Regional Technical Centers of Expertise for Energy, Sustainability, and Life-Cycle Cost Analysis (RECX) composed of USACE District personnel and ERDC subject matter experts.

POCs: Annette Stumpf and Richard Schneider, CERL

Sustainable Design & Development Policy Support

CERL is working on related projects that were funded by ASA(IE&E) and ACSIM. These projects involve developing guidance for implementing the new SDD Policy Update issued on 16 December 2013. An integrated management plan was developed to ensure that all the new policy considerations were addressed. These CERL research projects are being coordinated with the HQUSACE effort called "Enterprise Approach to Design and Construction (EADC)" led by George Lea (HQUSACE Military Programs Branch Chief, Engineering and Construction [E&C] Community of Practice), and Lyndsey Pruitt (HQUSACE USACE HQ Proponent for Sustainability and Energy). The EADC project team is comprised of experts from the USACE Regional Centers of Energy, Sustainable Design and Life-Cycle Cost Analysis (RECX), and ERDC.

The primary technical objective of the CERL research is to: (1) provide technical support for the ASA(IE&E) SDD Policy Update, and (2) identify, evaluate, and update existing SDD guidance as necessary to integrate the new SDD policy into practice. For new construction, we felt the best way to accomplish that objective was to ensure that policy and guidance being developed by USACE met ASA(IE&E)'s requirements. A master spreadsheet was built to map SDD policy considerations to qualified RECX team members who are writing six Engineering Construction Bulletins (ECBs) and two Engineer Regulations (ERs). These documents will ensure USACE project teams deliver HPSB meeting the current SDD policy requirements.

Project team members are being funded to identify and evaluate current Army implementation guidance and to identify guidance gaps or deficiencies as a basis for determination of the effort scope. We are looking to the RECX subject matter experts to make that determination and to address such questions as: What is the current 'state of the practice'? What policy and guidance exists? How adequate is it? Who is to use the information, how and when? Is it in the right format? Does it address both new construction, and operations, maintenance and repair? If not, what are the knowledge gaps that need to be filled? We asked for a RECX recommendation on what, if anything, is needed and the amount of effort that will be required to fill any gaps. Requirements were discussed, prioritized, and scopes agreed to at the HPSB Engineer Regulation meeting in Washington, 29-30 January 2014 at HQUSACE.

The USACE EADC effort is currently focused on new construction, but the ASA(IE&E) SDD policy covers everything on an installation, including O&M, renovations, and other activities. To meet this gap, CERL has been working with HQ IMCOM, Fort Leonard Wood, and other installations to understand how their business processes and practices need to be modified. CERL has been working closely with the Fort Leonard Wood DPW for the past 5 years, and we have had several meetings to discuss how the new SDD policy would affect their DPW practices. We plan to leverage those lessons learned through webinars or guidance to help other installations adjust to the new SDD policy.

Sponsor: Ms. Wanda Johnsen (Office of the Assistant Secretary of the Army for Installations, Energy, and Environment (ASA[IE&E] and proponent of the SDD policy) and Mr. Vincent Kam (DAIM-ODF).

POCs: Annette Stumpf and Richard Schneider, CERL

Model-Driven Energy Intelligence

This ESTCP proposal was submitted by Honeywell International, Inc. in collaboration with CERL. The goal is to leverage BIM to enable more effective coordination of unintegrated management systems. The team will demonstrate the potential for DoD to maximize energy-saving initiatives by expanding model-driven, integrated decision-making across DoD real estate holdings, regardless of age. This will help DoD meet energy reduction requirements and will simultaneously reduce the burden involved in the analysis and reporting required to track and measure these savings and to establish the required metrics. This demonstration

will show that BIM is an effective tool to optimize multiple energy management initiatives and human resources responsible for accomplishing energy management goals.

Sponsor: ESTCP

POCs: Liana Kiff, Honeywell International Inc., and Beth Brucker and Thomas Napier, CERL

C&D Waste Management & Reporting Guidance

The objective of this work is to: (1) update the current Army C&D waste diversion goals and reporting process for USACE contracted and installation-level projects to implement the new Sustainable Design and Development (SDD) Policy update and to provide consistency with DoD reporting requirements, and (2) update the building design guidance to implement the SDD policy's requirements for collection/temporary storage of recyclables and reusable items within new buildings and major renovations.

Sponsor: Ms. Wanda Johnson, ODASA Energy & Sustainability

POC: Thomas Napier, CERL

Fort Leonard Wood Deconstruction

A significant number of WWII-era buildings remain on Fort Leonard Wood property. Most are of wood frame construction and have been occupied and well maintained over the years. However, many occupy sites planned for future facilities, are functionally obsolete, or are uneconomical to continue to operate. They will be scheduled for demolition within the near future. Typical demolition practices will include mechanical wrecking and landfill disposal. Some materials may be recycled. However, the wood materials have an economic value that is wasted by mechanical demolition. CERL is supporting the Fort Leonard Wood DPW in their efforts to remove these buildings in a manner by which the primary construction materials, wood, are recovered and reused as construction materials or repurposed to other value-added products. Specifically, CERL has performed a feasibility assessment for deconstructing WWII-era wood buildings and concluded the wood material is marketable, buildings can be deconstructed in an economical and efficient manner, and wood recovery services and markets exist within Missouri as well as neighboring states. CERL is also providing technical input to the development of project requirements and specifications, and conducting market outreach to attract qualified and capable services to these projects.

Sponsor: Fort Leonard Wood

POC: Thomas Napier, CERL

Hazardous Materials in Buildings:

Some Materials that at one time were considered to be high performing and improved building performance have since been discovered to be hazardous, toxic, or otherwise problematic to safety and health. These materials, which remain in many Army buildings, are encountered during remodeling and demolition activities. They jeopardize the health of occupants as well as tradespersons handling them. CERL is developing a hazardous building materials training curriculum that will be directed at DPW personnel in both classroom and online formats. This training will address activities in which hazardous materials can be encountered (i.e., operations, remodeling, and demolition), general requirements for handling hazardous materials, contracting requirements for removing and disposing of hazardous materials, and specific guidance for asbestos, lead based paint, PCB's, mold, pesticide-contaminated materials, and preservative treated lumber. The curriculum will include examples, quizzes, tests, and input from Army experts in hazardous and toxic material.

Sponsor: ACSIM

POC: Thomas Napier, CERL

CERL Researcher Leads Deconstruction and Building Materials Reuse Association

Thomas Napier, a CERL Research Architect and Principal Investigator, is currently the president of the Building Materials Reuse Association. The Building Materials Reuse Association (BMRA) is a non-profit educational organization whose mission is to advance the recovery, reuse, and recycling of building materials in a way that reduces the consumption of new

resources, reduces landfill waste, creates a value-added market and increases cost-effectiveness, expands job opportunities and workforce development skills, and promotes the sustainability of communities and the environment through resource preservation. Mr. Napier encountered the BMRA through his research in building deconstruction and materials reuse. His association with the BMRA has contributed significantly to his expertise in the subject matter and workings of that industry. This knowledge has been applied frequently to deconstruction and material reuse research and support to the Army with deconstruction projects.

Sponsor: N/A. No government funding is applied to Mr. Napier's involvement with BMRA

POC: Thomas Napier, CERL

Update C&D Waste Reduction: Technical Guidance and Technology Transfer

CERL is involved with reducing waste from the Army's construction, demolition, and renovation programs. CERL personnel have participated with deconstruction projects at Army installations, performed cost and schedule analysis, analyzed the effects of residual lead on recovered wood and concrete materials, developed guidance documents contributing to Army and USACE policy, and conducted various technology transfer events. Guidance developed by CERL can be found at the Whole Building Design Guide (WBDG) website in the form of USACE PWTBs and at a WBDG resource page on C&D waste reduction.

Sponsor: Malcolm McLeod, HQUSACE

POCs: Thomas Napier and Stephen Cosper, CERL

Proposed Projects

Using the Building/Human Interface to Reduce Energy Consumption

The US Army has been directed to reduce energy consumption in its operations and facilities. Unfortunately, the DoD and the USACE are not meeting their goals, having scored "RED" in two GHG reduction categories and in the reduction of energy intensity category in the Office of Management and Budget (OMB) Scorecard on Sustainability/Energy for the past 4 years (i.e., 2010-2013). Both the Army and the private building industry now recognize that actual energy consumption is very often greater than predicted by energy models, with energy savings failing to materialize. It appears the potentially greatest variable in the discrepancy between predicted and actual energy use lies with the building's occupants and how they interact with their built environment. Personnel can diminish energy systems' efficiency by such actions as keeping windows open or blocking air diffusers; adding plug loads such as space heaters; attempting to override preset controls; or ignoring energy-saving practices such as leaving lights on when leaving a room.

Occupant Engagement is an emerging field of study within the building industry. In their October 2012 Army Energy Awareness Month paper: *Conservation, Efficiency, Sustainability, Technology Advancements and Behavioral Change (Emphasis Added) Are the Pathways to Creating an Energy- and Water-Secure Army*, the Sergeant Major of the Army, the US Army Chief of Staff, and the Secretary of the Army have emphasized the importance of energy conservation to mission effectiveness and individuals' role in building energy performance. A white paper is proposed under the CASI program to identify shortcomings in the current building/occupant interface; how Army occupants contribute to inefficient use of energy. These include development of design parameters; construction and commissioning; building management; building managers' systems controls; occupant activities and behaviors; and other factors. Emerging practices will be evaluated for applicability to Army facility management practices.

Proposed to: TBD

POC: Thomas Napier, CERL

Performance Testing of Extremely Energy-Efficient Blast Resistant Windows

The primary objective is to provide the Army with blast test data for extremely energy-efficient windows (triple- or quad-paned) interpreted to correspond with Unified Facilities Code 4-010-01 levels of protection. Resulting data can be used in the future to revise blast resistant window design software to accommodate multiple air spaces. If any of the tested windows rate at very low, low, medium, or high levels of protection, an important secondary objective is to provide the Army with reliable window choices (including market availability and cost) satisfying the performance criteria for both extreme energy efficiency and blast resistance.

Proposed to: ACSIM ITTP, TBD

POC: Julie Webster, CERL

Cost-Benefit of High Performance and Sustainable Buildings

New buildings are designed for high performance and sustainability (HPS). Research is proposed to develop a process by which the Army can identify the costs of HPS features in new buildings, identify the longer-term performance in environmentally related areas, and calculate the overall cost-versus-benefit of HPS buildings. Major new construction programs are winding down and the Army will be devoting considerable resources to upgrade existing buildings. Assessing the “value of green” in existing building upgrades will also be included in this strategy and methods.

Proposed to: ASA(IE&E)

POC: Thomas Napier, CERL

Guiding Principles for Sustainable Existing Buildings: Establishing Facility Operational Performance Goals for Energy, Water, Material Use and Recycling, and Indoor Environmental Quality

EO 13514 directs each Federal agency to implement high performance sustainable Federal building design practices in new and existing facility programs. Within these GPs are requirements to: (1) assess existing conditions and operational procedures of buildings and major building systems and identify areas for improvement; (2) establish operational performance goals for energy, water, material use and recycling, and indoor environmental quality; and (3) ensure incorporation of these goals throughout the remaining life-cycle of the building. A systematic method to assess existing buildings and develop performance goals is needed as the first step in conforming to these GPs.

Proposed to: TBD

POC: Thomas Napier, CERL

Best Practices for Recycling Asphalt Shingles (RAS)

Waste asphalt shingles offer a major potential for recovery and recycling. Bitumen can be recovered from new shingle scrap and tear-off shingles from reroofing and demolition. Beneficial uses include hot mix asphalt, cold asphalt patch and waste-to-energy conversion. Until recently, asphalt shingle recycling has not been widespread throughout the United States. Today the infrastructure has expanded and methods have become more efficient, making shingle recycling much more practical than in the past. With the dramatic increase in petroleum prices, the economic feasibility has further improved. More C&D recycling businesses accept shingles, more bitumen manufacturers will take RAS, and more jurisdictions are including RAS in their paving specifications. Challenges still remain, such as complying with occupational and environmental regulations. The Army needs guidance to capitalize on this resource, especially in establishing realistic recycling criteria, composing workable contract requirements, developing opportunities with local recyclers and pavement authorities, and supporting contractors through the various construction and maintenance programs.

Proposed to: TBD

POC: Thomas Napier, CERL

Balancing Daylighting and Energy Conservation for DoD Schools (Fort Knox Case Study)

With 70% of its facilities considered to be in poor condition, the DoD Education Activity is embarking on a \$3.7 billion renovation and construction initiative to replace its aging schools with 21st century learning environments. The activity is capitalizing on the opportunity to not only redefine its own schools, but to provide a model for how schools will be built in the future. This is a rare opportunity to address sustainable design issues, evaluate the performance of implemented strategies, and have a positive impact on the children of Service men and women worldwide. The study will have an immediate impact on the construction and renovation of 134 schools over the next 5 years. An integrated design charrette process and building information modeling is proposed at Fort Knox, KY, to identify a range of daylighting strategies while providing balanced quality natural light conducive to learning.

Proposed to: TBD

POCs: Annette Stumpf and Richard Schneider, CERL

Daylighting Comparison of Two Headquarters Buildings

Recommended illumination levels have been reduced in American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) and LEED energy standards. In addition, EAct 2005 requires a 30-40% reduction in energy consumption below ASHRAE's goal for new facilities. This project will determine how effective the daylighting strategies are in providing adequate daylight and in reducing electrical lighting loads by: providing evidence-based design direction for USACE designs; measuring the amount of artificial light savings by introducing natural light; and evaluating the cost savings for future life-cycle cost analysis.

Proposed to: TBD

POCs: Annette Stumpf and Richard Schneider, CERL

Hybrid Solar Roofing Systems

Solar energy systems have been available for several decades in both photovoltaic (PV) and thermal versions. Neither method of converting sunlight to usable energy has been cost effective until recently. However, a Lawrence Berkley Laboratory study determined the cost of PV installations has declined greatly in the past 10 years. Thermal and PV solar systems have traditionally been treated as separate technologies, either one or the other being chosen for a particular application. This under-uses the potential for solar energy by failing to capitalize on the thermal potential when using PV systems, or the electrical generation potential when using thermal systems alone. A combination or "hybrid" system makes greater efficiency of the heat collected by PV systems but not used to generate electricity. Tests have shown that hybrid PV/thermal systems can generate four times the energy from the same surface for a 25% increase in cost. Army installations have not yet approached the full potential of using fully renewable, essentially "free" energy that creates minimal environmental impacts. A demonstration is proposed to integrate both thermal and PV solar collection systems with a roofing system. By doing so, the weather barrier of the roof is not compromised by installation of an independent solar collection component, and the PV array contributes to the weather-resistant properties of the roofing materials. The PV array generates electricity for the building's power supply. If surplus energy is generated, it can be returned to the grid. The thermal medium can be either air or fluid. However, an air medium is recommended for this proposal because of greatly reduced maintenance requirements.

Proposed to: TBD

POC: Thomas Napier, CERL

Preserving Embodied Energy and Economic Benefits of Historic Buildings

Historic properties are often perceived as energy and maintenance burdens. Economic analyses applied to these buildings are based on the lowest direct operating cost. The inherent environmental value of the building's embodied energy (the energy, measured in fossil fuels, consumed to make any product, bring it to market, put it to use, and then to dispose of it at the end of its useful life) is not included in these decision processes. The Advisory Council on Historic Preservation advises that replacing historic properties with new "green" buildings may actually create an energy deficit that will take much longer to recover than is commonly perceived. Another study concludes that new, "green" buildings could take up to 76 years to offset the embodied energy wasted by demolition. A process model is proposed to guide DoD installation planners and facility management personnel in assessing the economic and environmental values of historic and potentially eligible buildings.

Proposed to: TBD

POCs: Thomas Napier and Susan Enscoe, CERL

Acronyms and Abbreviations

AAP	Army Ammunition Plant
ACSIM	Assistant Chief of Staff for Installation Management
AD	Army Depot
AEESS	Advanced, Energy-Efficient Shelter Systems
AHU	Air Handling Unit
AMC	US Army Materiel Command
AR	Army Regulation
ARA	Automatic Reimbursable Authority
ASA(IE&E)	Assistant Secretary of the Army for Installations, Energy and Environment
ASD	Assistant Secretary of Defense
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
BIM	Building Information Model
BMP	Best Management Practice
BMRA	Building Materials Reuse Association
BO	Biological Opinion
C&D	Construction and Demolition
CASI	Center for the Advancement of Sustainability Innovations
CB	Contingency Base
CBITEC	Contingency Basing Integration Technology Evaluation Center
CERL	Construction Engineering Research Laboratory
CMEP	Civil Military Emergency Preparedness
COA	Course of Action
COCOM	Combatant Command
CONUS	Continental United States
CPT	Captain
CR	Contract Report
CRADA	Cooperative Research and Development Agreement
CRC	Cooling Recovery Coil
CRREL	Cold Regions Research and Engineering Laboratory
CW	Civil Works
CY	Calendar Year
DA	Department of the Army
DASA(E&S)	Deputy Assistant Secretary of the Army for Energy and Sustainability
DC	Direct Current
DCAM	Detailed Component Analysis Model
DEIC	Defense Environmental International Cooperation
DFMWR	Directorate for Family, Moral, Welfare, and Recreation
DoD	US Department of Defense
DOTMLPF	Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities
DPW	Directorate of Public Works
E&C	Engineering and Construction
EADC	Enterprise Approach to Design and Construction

EC	Electrocoagulation
ECB	Engineering and Construction Bulletin
ECoP	Environmental Community of Practice
EDR	Electrodialysis Reversal
EKO	Engineering Knowledge Online™
EL	Environmental Laboratory
EM-CX	USACE Environmental and Munitions Center of Expertise
EO	Executive Order
EPAct	Energy Policy Act
EQI	Environmental Quality and Installations
ERDC	Engineer Research and Development Center
ERDC-CERL	Engineer Research and Development Center, Construction Engineering Research Laboratory
ERDC-CRREL	Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory
ERDC-EL	Engineer Research and Development Center, Environmental Laboratory
ESA	US Endangered Species Act
ESTCP	Environmental Security Technology Certification Program
EUI	Energy Use Intensity
FRTR	Federal Remediation Technology Roundtable
FUDS	Formerly Used Defense Sites
FY	Fiscal Year
GE	General Electric
GHG	Greenhouse Gas
GIS	Geographic Information System
GP	Guiding Principles for High Performance and Sustainable Buildings
GPS	Global Positioning System
GSR	Green and Sustainable Remediation
HEDS	High Efficiency Dehumidification System
HPS	High Performance and Sustainability
HPSB	High Performance Sustainable Building
HQ	Headquarters
HQAES	Headquarters Army Environmental System
HQIIS	Headquarters Information System
HQSACE	Headquarters, US Army Corps of Engineers
HVAC	Heating, Ventilating, and Air-Conditioning
IMCOM	Installation Management Command
INRMP	Integrated Natural Resources Management Plans
ISSP	Integrated Strategic and Sustainability Planning
ITAM	Integrated Training Area Management
ITTP	Installation Technology Transition Program
IWR	Institute for Water Resources
JCTD	Joint Capability Technology Demonstration
JIIM	Joint, Interagency, Intergovernmental, and Multinational
JTRC	Joint Training and Readiness Center
LCA	Life-Cycle Analysis
LCCA	Life-Cycle Cost Analysis
LEAM	Land-use Evolution and impact Assessment Model
LED	Light Emitting Diode

LEED	Leadership in Energy and Environmental Design
LLC	Limited Liability Company
LR	Letter Report
LSC	LEED Steering Committee
MH	Metal Halide
MIF	Magnetic Induction Fixture
MILCON	Military Construction
MOD	UK Ministry of Defence
MPR	Minimum Program Requirement
M-RSI	Megacity Reconnaissance, Surveillance, and Intelligence
MSC	Major Subordinate Command
MVR	Mechanical Vapor Recompression
MWR	Morale, Welfare, and Recreation
MZ	Multizone
N/A	Not Applicable
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NPV	Net Present Value
NZE	Net Zero Energy
NZI	Net Zero Installation
NZW	Net-Zero Water
O&M	Operations and Maintenance
OACSIM	Office of the Assistant Chief of Staff for Installation Management
OCONUS	Outside Continental United States
ODASA	Office of the Deputy Assistant Secretary of the Army
ODASA(IE&E)	Office of the Deputy Assistant Secretary of the Army for Installations, Energy & Environment
OECIF	Operational Energy Capabilities Improvement Fund
OEPP	Operational Energy Plans and Programs
OMB	Office of Management and Budget
OPTEMPO	Operational Tempo
OSD	Office of the Secretary of Defense
PAIO	Plans, Analysis, and Integration Office
PCB	Polychlorinated Biphenyl (PCB)
PCM	Phase Change Materials
PDT	Project Development Team
PM	Project Manager
PMP	Project Management Plan
POC	Point of Contact
POL	Petroleum, Oil, and Lubricants
POM	Presidio of Monterey, CA
PV	Photovoltaic
PWTB	Public Works Technical Bulletin
QRP	Qualified Recycling Program
RAS	Recycled Asphalt Shingles
RCI	Residential Communities Initiative
RDT&E	Research, Development, Test and Evaluation
RECX	Regional Technical Centers of Expertise for Energy, Sustainability, and Life-Cycle Cost Analysis

REM	Rare Earth Metal
RHP	Resilient Homes Program
RO	Reverse Osmosis
SAME	Society of American Military Engineers
SAV	Submerged Aquatic Vegetation
SBIR	Small Business Innovative Research
SDD	Sustainable Design and Development
SERDP	Strategic Environmental Research and Development Program
SIRRA	Sustainable Installations Regional Resource Assessment
SMS	Sustainment Management System
SPIDERS	Smart Power Infrastructure Demonstration for Energy Reliability and Security
SR	Special Report
SRT	(US Air Force) Sustainable Remediation Tool
STORM	Strategic and Tactical Operational Resource Model
SWAR	Solid Waste Annual Reporting
T&Cs	Terms and Conditions
TBD	To Be Determined
TES	Threatened and Endangered Species
TN	Technical Note
TR	Technical Report
TRADOC	US Army Training and Doctrine Command
UFC	Unified Facilities Criteria
UIUC	University of Illinois at Urbana-Champaign
UK	United Kingdom
URL	Universal Resource Locator
US	United States
USACE	US Army Corps of Engineers
USEPA	US Environmental Protection Agency
USFWS	US Fish and Wildlife Service
USGBC	US Green Building Council
WBDG	Whole Building Design Guide
WWII	World War II
WWTP	Wastewater Treatment Plant

REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.					
1. REPORT DATE (DD-MM-YYYY) 27-03-2014		2. REPORT TYPE Final		3. DATES COVERED (From - To)	
4. TITLE AND SUBTITLE CASI Work Plan: Calendar Year 2014				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT	
6. AUTHOR(S) William D. Goran, Annette Stumpf, Michelle Hanson, and Elon Zeigler				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) US Army Engineer Research and Development Center (ERDC) Construction Engineering Research Laboratory (CERL) PO Box 9005, Champaign, IL 61826-9005				8. PERFORMING ORGANIZATION REPORT NUMBER ERDC/CERL TN-14-1	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) US Army Engineer Research and Development Center (ERDC) Construction Engineering Research Laboratory (CERL) PO Box 9005, Champaign, IL 61826-9005				10. SPONSOR/MONITOR'S ACRONYM(S) CEERD-CN	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT The Center for the Advancement of Sustainability Innovations (CASI) was established by the US Army Engineer Research and Development Center (ERDC) as a new capability in 2006 to be hosted at the Construction Engineering Research Laboratory (CERL) in Champaign, IL. CASI was established with the goal of focusing the value of ERDC expertise, technologies and partnerships toward helping the US Army Corps of Engineers (USACE), the Army, and the Department of Defense (DoD) achieve more sustainable facilities and operations. CASI provides the military with capabilities that enhance national security through more effective use of limited resources and improved coordination and partnerships with host communities and stakeholders in the United States and around the globe. In all efforts, CASI teams strive to measure sustainability innovations against the Triple Bottom Line Plus, as stated in the 2004 Army Strategy for the Environment: (1) benefit to the organizational missions, (2) benefit to the communities that help support and are impacted by preparations for and the conduct of the missions, (3) benefit to the environment and (4) benefit to the economy. This 2014 work plan is the seventh plan published for CASI.					
15. SUBJECT TERMS CASI, Center for the Advancement of Sustainability Innovations, Army, environment, sustainability					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT SAR	18. NUMBER OF PAGES 56	19a. NAME OF RESPONSIBLE PERSON
a. REPORT Unclassified	b. ABSTRACT Unclassified	c. THIS PAGE Unclassified			19b. TELEPHONE NUMBER (include area code)