

USACE R&D

FY23 ANNUAL REPORT



U.S. ARMY



US Army Corps
of Engineers



DR. DAVID W. PITTMAN

Since its founding, the U.S. Army Corps of Engineers (USACE) has served proudly as our nation's engineers. We have been the problem solvers who have worked the equations, faced the challenges head-on and delivered. We have stood on the front lines of our nation's wars and been on the leading edges of exploration to the West and to the stars. And behind each advancement, behind each accomplishment, has been a world-class tradition of research and development probing what is next and how we can do it better.

That tradition of innovation continued during FY23. This report serves as only a glimpse of the amazing work being done not only in USACE's world-class research facilities, but also in every district and division. At every level, in every branch, team and office, USACE is constantly innovating to better deliver our mission at a time when that mission has reached historic levels.

In this report, you will find an entire section dedicated to our nine USACE divisions, showcasing the amazing innovation being deployed to deliver our projects better, safer and faster than ever before. You will also see how the techniques and technologies being developed in our laboratories are being shared with our USACE teammates and with the public through our technology transfer and industry partners.

In a recent interview, Brig. Gen. William C. Hannan Jr., commander of USACE Transatlantic Division, said "leveraging the comprehensive capabilities of the U.S. Army Engineer Research and Development Center (ERDC) and the U.S. Army Corps of Engineers enterprise enables us to introduce innovation practices and technologies that sharpen our competitive edge."

I am so proud of that sentiment because it reflects our mission in its most basic form – sharpening the competitive edge of those on the front lines as we work together to solve the greatest challenges facing our nation and Warfighter.

As we support USACE's projects and programs, we do so proudly knowing no one can do what we can do. No one has the capabilities, the core competencies or the experience to do what we can do. Most importantly, no one can match our diverse and talented workforce.

FY23 was a fantastic year of developing and deploying innovations across USACE. We are proud of what we have accomplished, but we are not satisfied. We are emboldened.

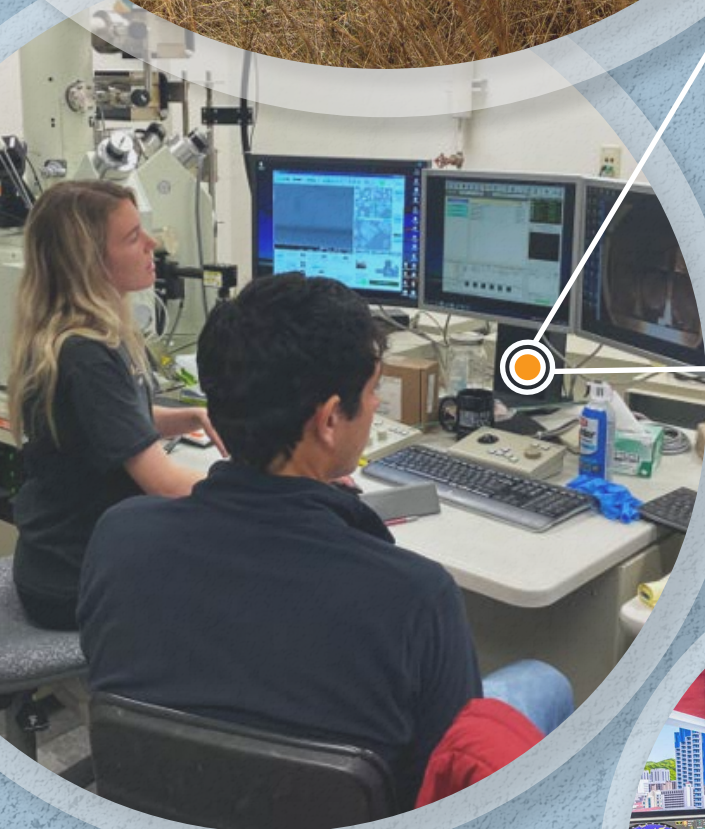
Wait and see what we do next.

ESSAYONS!

A stylized, handwritten signature of David W. Pittman in black ink.

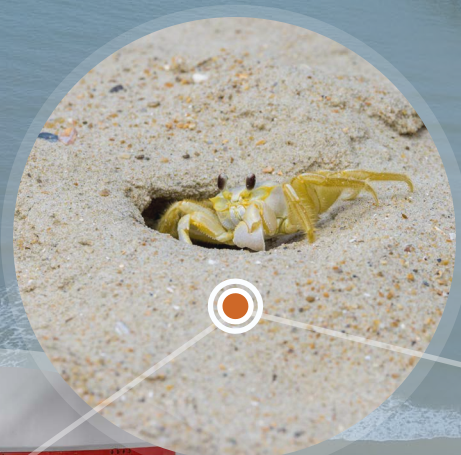
David W. Pittman, PE, PhD, SES
Director of R&D and Chief Scientist
U.S. Army Corps of Engineers

Director
**U.S. Army Engineer Research
and Development Center**



NAVIGATE

Deep Dive into the Power of ERDC	Page 6
Research Portfolio	Page 8
Sharing the ERDC Story	Page 14
Engagement with Academia	Page 16
Tech Transfer	Page 18
USACE Research and Development Strategy	Page 28
Civil Works Success Stories	Page 32
Installations & Operational Environments Success Stories	Page 56
Warfighter Support Success Stories	Page 72
Support for Others Success Stories	Page 94
Engineering With Nature®	Page 114
USACE Divisions: Innovations at Work	Page 118



US Army Corps
of Engineers®

Our mission is to deliver vital engineering solutions, in collaboration with our partners, to secure our nation, energize our economy, and reduce disaster risk.

POWER OF ERDC: DISCOVER, DEVELOP & DELIVER

From supporting operations on the International Space Station and farther into the solar system to tracking the locations and well-being of protected mussel species in rural river systems of Mississippi, ERDC's innovative research spans well beyond its seven research laboratories and facilities spread across nine states.

During FY23, ERDC's research portfolio and team reached levels not seen in its nearly 25 years. For the first time, ERDC's research portfolio surpassed \$2.4 billion, and its diverse team of engineers, scientists, technicians and support personnel exceeded 2,500 – a record team to support a record portfolio.

Finalized contracts and those aligned with small businesses increased significantly in FY23, and the number of people logging onto our digital platforms increased by more than 20 percent. The word is getting out. There's even more to the ERDC story.

The coming pages will further highlight the people, facilities and operations that have made ERDC successful, its research so critical and its future so bright.



Current and former ERDC team members celebrated the organization's 25th anniversary at a September ceremony.

A GROWING INVESTMENT IN

R&D

During FY23, the USACE research and development community continued to grow stronger, particularly at ERDC. Through new partnerships, agreements and contracts, R&D investment at ERDC surpassed \$2.4 billion, giving birth to more solutions for our nation's toughest engineering challenges. ERDC research is sorted into four categories: Civil Works (CW), Installations & Operational Environments (IOE), Warfighter Support (Wfs) and Support for Others (Sfo).

CONTRACTS
\$855.6
MILLION



2,106 NEW ACTIONS

\$182.5
MILLION



SMALL BUSINESS CONTRACTS
1,135 NEW ACTIONS

A RECORD

\$2.4
BILLION

ERDC'S FY23 PORTFOLIO
TOTAL OBLIGATION AUTHORITY IN FY23

41%

27%

14%

13%

4%

1%

MILITARY
REIMBURSABLE

MILITARY DIRECT

HPCMP
HIGH PERFORMANCE
COMPUTING
MODERNIZATION
PROGRAM

CIVIL
WORKS

OTHER
REIMBURSABLE

BASOPS
BASE
OPERATIONS
SUPPORT

22%
SOCIAL MEDIA
GROWTH



PUBLICATIONS



JOURNAL
ARTICLES 294

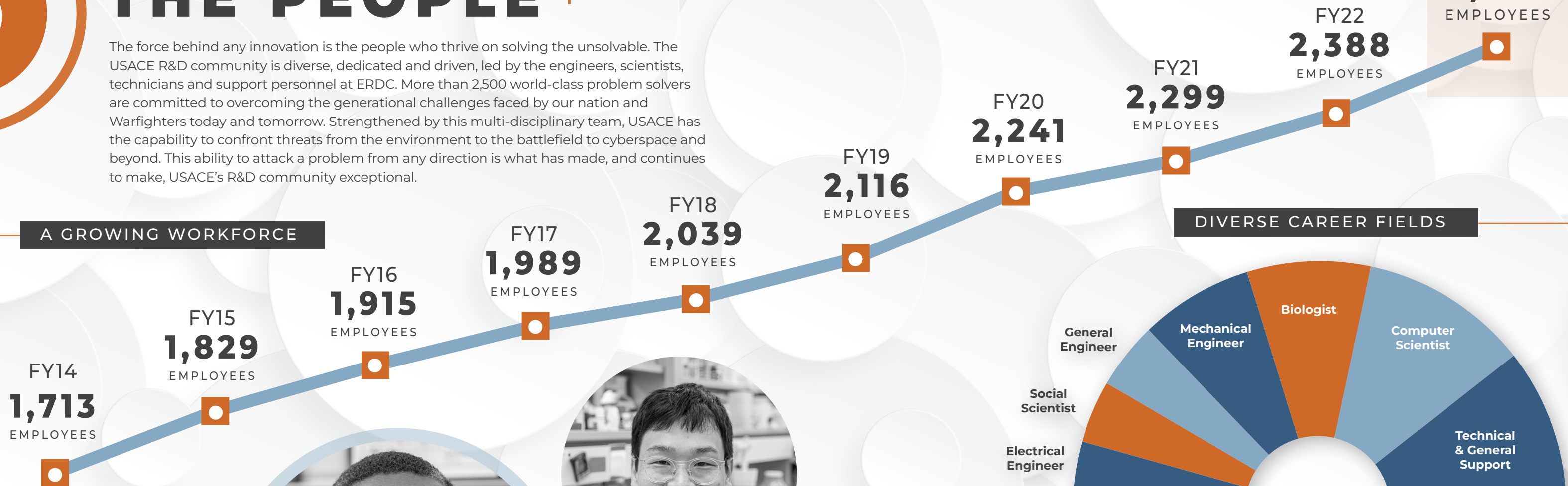
TECHNICAL
REPORTS 280

VISIT THE ERDC LIBRARY: WWW.ERDC.USACE.ARMY.MIL/LIBRARY/

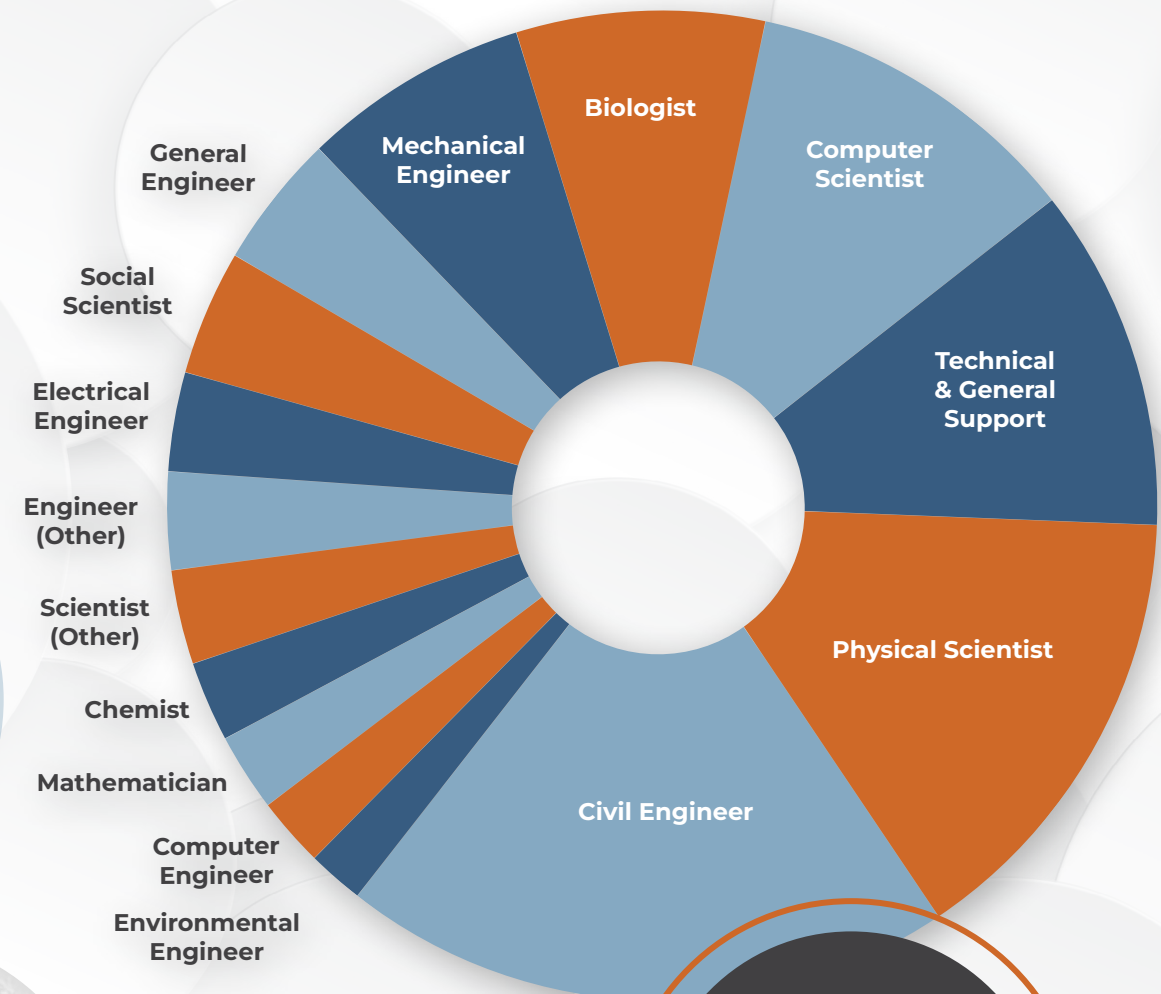
POWER OF ERDC: THE PEOPLE

The force behind any innovation is the people who thrive on solving the unsolvable. The USACE R&D community is diverse, dedicated and driven, led by the engineers, scientists, technicians and support personnel at ERDC. More than 2,500 world-class problem solvers are committed to overcoming the generational challenges faced by our nation and Warfighters today and tomorrow. Strengthened by this multi-disciplinary team, USACE has the capability to confront threats from the environment to the battlefield to cyberspace and beyond. This ability to attack a problem from any direction is what has made, and continues to make, USACE's R&D community exceptional.

A GROWING WORKFORCE



DIVERSE CAREER FIELDS



48%
FEMALE &
MINORITY

ERDC'S GOAL IS TO INCREASE BOTH
GENDER AND RACIAL DIVERSITY BY
AT LEAST 1% EACH YEAR

MULTIPLE LOCATIONS ONE TEAM

October 2023 marked the 25th anniversary of the orders that combined USACE's R&D laboratories into one organization – ERDC – that today features seven world-class laboratories with the unique ability to work individually and collaboratively on a wide spectrum of research projects. Those laboratories – located in Mississippi, Illinois, New Hampshire and Virginia, with headquarters in Vicksburg, Mississippi – are further supported by additional field sites where critical tests seek to enhance and validate research efforts. Combined, these laboratories and field sites form “One ERDC, One Team.”



Coastal and Hydraulics Laboratory (CHL)
Vicksburg, Mississippi



ERDC Headquarters
Vicksburg, Mississippi



Information Technology Laboratory (ITL)
Vicksburg, Mississippi



Geotechnical and Structures Laboratory (GSL)
Vicksburg, Mississippi



Environmental Laboratory (EL)
Vicksburg, Mississippi



Cold Regions Research and Engineering Laboratory (CRREL)
Hanover, New Hampshire



Geospatial Research Laboratory (GRL)
Alexandria, Virginia



Construction Engineering Research Laboratory (CERL)
Champaign, Illinois

ERDC FIELD OFFICES

Permafrost Tunnel Research Facility
Fox, Alaska

Alaska Research Office
Fairbanks, Alaska

Lewisville Aquatic Ecosystem Research Facility
Lewisville, Texas

Contingency Base Integration Technology Evaluation Center
Fort Leonard Wood, Missouri

Field Research Facility
Duck, North Carolina

Corbin Field Station
Woodford, Virginia

Extreme Exposure Station
Treat Island, Maine

ERDC International Research Office
London, England

SPREADING THE WORD

LEADERS CONNECT INNOVATIVE R&D TO REAL-WORLD CHALLENGES

Increasing the number of face-to-face strategic engagements and visits was a focus of ERDC leadership in FY23, part of an effort to better connect ongoing innovative research and the impact it can have and is having on real-world USACE projects and programs, elsewhere in the U.S. Army and Department of Defense (DOD), and beyond. During the fiscal year, the number of in-person engagements increased 24 percent, including key trips and critical meetings with district and division leaders and international partners in South America and Europe. The additional domestic engagement is key to meeting goals laid out by USACE leaderships to raise R&D as a program across the enterprise and further incorporate innovative thinking and planning into ongoing and future USACE projects.



In FY23,
in-person
engagements
increased
24%

Honorable Rachel Jacobson
*Assistant Secretary of the Army
for Installations, Energy, and
Environment*

Honorable Michael Connor
*Assistant Secretary of the Army
for Civil Works*

Mr. Paul Farnan
*Principal Deputy Assistant
Secretary of the Army for
Installations, Energy, and
Environment*

Mr. Willie Nelson
*Deputy Assistant Secretary
of the Army for Research and
Technology*

Dr. Michelle Zbylut
*Acting Deputy Assistant Secretary
of the Army for Research and
Technology*

Ms. Kristen Baldwin
*Deputy Assistant Secretary of the
Air Force for Science, Technology
and Engineering*

Lt. Gen. Omar J. Jones IV
*Commanding General,
Installation Management
Command (IMCOM)*

Maj. Gen. James E. Bonner
*Commanding General, Maneuver
Support Center of Excellence (MSCoE)
and CG, Fort Leonard Wood*

Dr. Eric L. Moore (SES)
*Deputy to the Commanding
General, DEVCOM U.S. Army Combat
Capabilities Development Command*

Mr. Joseph Welch (SES)
*Director, U.S. Army Command,
Control, Communications,
Computers, Cyber, Intelligence,
Surveillance and Reconnaissance
(C5ISR) Center*

Dr. George Ka'iliwai III
*Director of Requirements and
Resources, U.S. Indo-Pacific
Command*

Ms. Tracy V. Riker
*Executive Director, Navy
Expeditionary Combat Command*

Brig. Gen. Stephanie Ahern
*Director of Concepts, Futures and
Concepts Center, Army Futures
Command*

Honolulu, Hawaii

Chicago, Illinois

Champaign, Illinois

Fort Leonard Wood, Missouri

Washington, D.C.

Aberdeen Proving
Grounds, Maryland

Austin, Texas

San Antonio, Texas

Jacksonville, Florida

Miami, Florida

ALASKA

PUERTO RICO

BUILDING STRONG PARTNERSHIPS TODAY & BEYOND

The partnerships, agreements and engagements with academia support ongoing research efforts in several ways, among them building a pipeline of talented and passionate engineers, scientists and professionals seeking solutions to the challenges of today and tomorrow. USACE and ERDC are constantly seeking opportunities to build new academic relationships for strategic research that leverage unique capabilities and facilities, and where collaboration can deliver better answers faster and cheaper. In addition, ERDC R&D teams often seek ways to give back, engaging students through summer programs, guest lectures, thesis advising, teaching and more. These efforts, and others, are focused on making sure the critical and innovative work being conducted today not only continues but advances.

COOPERATIVE R&D AGREEMENTS
23 SIGNED IN FY23



110
CRADAS

95 EPAs
25 EDUCATIONAL
NEW PARTNERSHIP
AGREEMENTS

23 UNIVERSITY
ENGAGEMENTS

University of Arizona
Cambridge University
University of Illinois Urbana-Champaign
University of Hawaii
University of Puerto Rico at Mayaguez
University of Alaska-Fairbanks
University of Delaware
Johns Hopkins University
Louisiana State University
University of Southern Mississippi
Alcorn State University
Jackson State University
Prairie View A&M University

Rice University
Texas Southern University
Missouri University of
Science and Technology
Southern University
Mississippi Valley State University
University of Georgia
University of Mississippi
Mississippi State University
South Carolina State University
University of Southern California

ALCORN STATE UNIVERSITY



UNIVERSITY OF HAWAII

UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN



DELIVERING INNOVATION

At the core of ERDC’s research is its commitment to quickly transfer the technologies and techniques developed in its laboratories to customers, stakeholders and the American people.

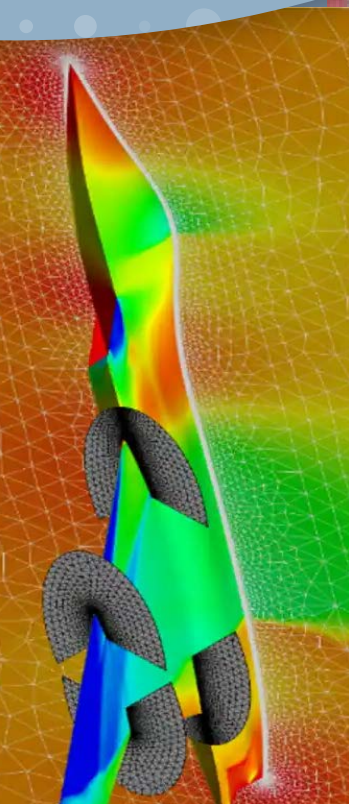
It’s the third leg of the organization’s motto – Discover, Develop and Deliver.

ERDC’s Office of Research and Technology Transfer (ORTT) oversees the transfer of R&D technologies and products to several groups, including the DOD and its agencies, other federal agencies, private companies, academic institutions, state and local governments and more.

ORTT also works to identify and facilitate opportunities to collaborate with others on research and to commercialize developed technologies, which is where ERDC’s vital partnership with ERDCWERX is so valuable.

As a neutral facilitator, ERDCWERX takes innovation to the marketplace through technology transition and transfer. It also provides a streamlined path to collaboration and contracting with ERDC.

In support of ORTT’s mission, ERDCWERX seeks to expand internal and external networks to include industry and academia, simplify the process for industry and academia to engage with ERDC, promote and leverage ERDC’s innovation strengths, and accelerate the progress of research, commercialization and other initiatives.



NAVIGATE

ERDC research named among top-100 R&D projectsPage 20

Tech transfer leader honored by DOD.....Page 20

Federal Laboratory Consortium honors ERDC-developed technologies.....Page 21

Military technologies set for commercialization.....Page 22

ERDC marks more than 20 international partnerships.....Page 23



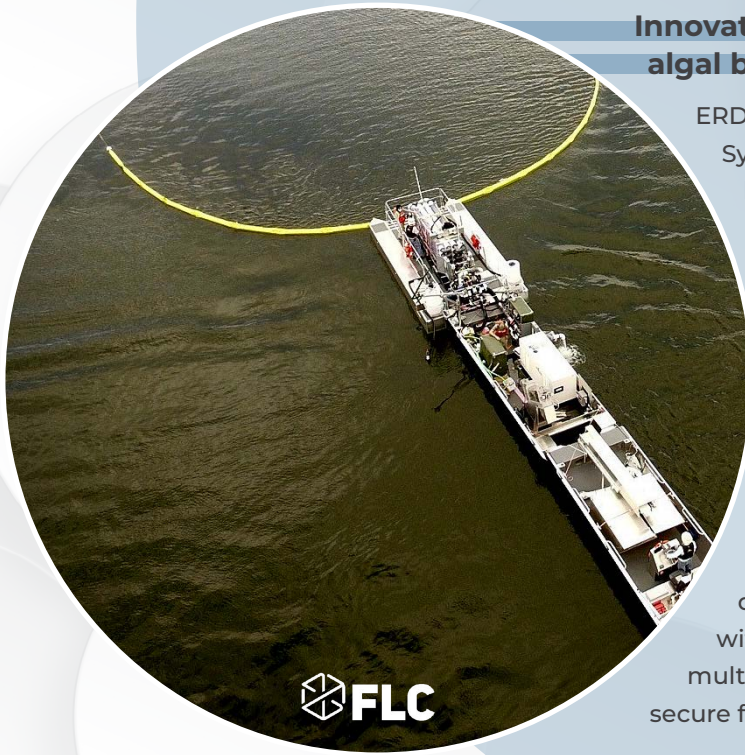
TECHNOLOGY TRANSFER • HIGHLIGHTS

A leader who has transformed ERDC's technology transfer program has been honored for her innovation-to-impact strategy and for driving economic growth among ERDC's private-sector partners. Antisa Webb; chief of the Technology, Knowledge and Outreach Division for the ERDC ORTT; was named the recipient of this year's George F. Linsteadt Award for Excellence in Technology Transfer. The award recognizes DOD professionals for "outstanding efforts in support and execution of initiatives to transfer technology developed in defense laboratories to partners in the public and private sectors." Webb is responsible for ERDC's technology transfer program and intellectual portfolio and serves as the lead for multiple technology advancement efforts. In nominating her for the award, ERDC leadership said Webb "led a transformation of technology transfer (T2) at ERDC" and developed a strategy "that generated substantial increases in invention disclosures, patents, spin-in agreements, licenses and royalties," and raised ERDC's T2 stature.



Innovative technology helps convert harmful algal blooms into valuable resources

ERDC developed the Harmful Algal Bloom Interception, Treatment and Transformation System (HABITATS) in collaboration with several partners. HABITATS collects and removes harmful algal blooms (HABs) using a fence-like skimmer, cleans and adds oxygen to the water, and converts the waste into products like biocrude oil and fertilizer. In 2023, ERDC's HABITATS team received the Federal Laboratory Consortium's (FLC) Impact Award. This award honors FLC member laboratories whose technology transfer efforts have made a tangible and lasting impact on the populace or marketplace, ranging from a local to global scale. HABs, which are overgrowths of algae in water, are a widespread environmental threat with an economic impact of more than \$2 billion per year. In a five-day test in 2020, HABITATS cleaned more than 200,000 gallons of water, yielding 700 gallons of algae paste that was converted into 20 quarts of biofuel. At full scale, a single module of HABITATS is expected to be able to treat two million gallons of contaminated water per day — meaning a contained body of water like a marina could be cleaned within a week. More extensive waterways could be treated in months using multiple modules. Turning the byproducts of the process into renewable, secure fuel will add to the technology's positive environmental impacts.



Top-100 R&D

An innovative technology developed by ERDC was recently recognized as a finalist in the 2023 R&D 100 Awards. The digital buoy system, developed through a collaborative effort between ERDC and the Army Geospatial Center, creates the capability to convert inland navigation buoys into "smart" buoys. This technology could ultimately allow tracking of buoys that wander off course and provide the foundation for an enhanced inland navigation communications network. ERDC's Tung "Alex" Ly, who developed the technology, was among other leaders in the R&D community recognized for their innovative ideas in science and technology. This competition is the only science and technology awards competition that recognizes new commercial products, technologies and materials currently available on the market for their technological significance. The digital buoy system was among entries from 15 countries and was the only finalist from a DOD laboratory.



Hands-on STEM Experience

Jackson State University (JSU) has partnered with ERDCWERX to create a Technology Commercialization Fellowship Program for recent graduates. Hosted by ERDCWERX at the Mississippi Center for Innovation and Technology in Vicksburg, Mississippi, and by JSU at its Technology Transfer Office, the program offers exposure to STEM-related innovation. In January 2023, ERDCWERX and JSU welcomed the first fellow, Shaun Walton, to participate in this immersive, hands-on learning experience. Walton, a civil engineering student at JSU, worked alongside ERDCWERX and ORTT to develop a comprehensive understanding of market research, business relationship development and patent commercialization.



During FY23, nearly \$430 million in contracts and agreements were awarded to industry and academia because of submissions through ERDCWERX. Most of these funds were awarded by ERDC directly to the contractors for Commercial Solutions Opening, Broad Other Transaction Authority Announcement, Tech Challenge and Broad Agency Announcement submissions.

FY23 TOTAL INCOME MORE THAN

\$3.2 million

Testing Services Agreements (TSAs) allow ERDC to test materials, equipment, models, computer software or other items for a collaborating partner. During FY23, ERDC executed 402 TSAs for a total income of more than \$3.2 million. These TSAs are executed primarily by the following ERDC facilities:

- **The Materials Testing Center**, part of ERDC's Geotechnical and Structures Laboratory, tests in the areas of geotechnical, concrete, materials, structural engineering, and airfields and pavements.
- **The Paint Technology Center**, located at ERDC's Construction Engineering Research Laboratory (CERL), tests the performance of paints and coatings.
- **The Triaxial Earthquake and Shock Simulator**, also at CERL, tests the ability of systems, facilities and equipment to survive realistic conditions of shock, vibration and earthquake ground motion.



Cutting-edge road, airfield repair technology honored



Induction Hot Mix Asphalt (iHMA), developed by ERDC and the Air Force Civil Engineer Center, offers an easy, one-step process with the convenience of cold mix asphalt and the toughness of hot mix asphalt, saving time and money. What sets iHMA apart is the use of induction — electromagnetic activation of metallic particles in the asphalt mix — to heat the asphalt, giving it the workability needed for durable repairs. For this capability, ERDC's iHMA team was named the recipient of the FLC Excellence in Technology Transfer Award. This award recognizes employees of FLC member laboratories and non-laboratory staff who have accomplished outstanding work in the process of transferring federally developed technology. iHMA is packaged in five-gallon containers, which are heated on demand at the repair site. Once the asphalt material is placed in an induction chamber, the system heats the mix to more than 300 degrees in less than five minutes — 90 percent faster than traditional heating methods. The technology will save billions of dollars on pothole repairs and keep airfields operational for the benefit of consumers and national security.

FROM THE LABS TO THE FRONT LINES



Scan for the ERDCWERX website



Scan for ERDC's Office of Technology Transfer

Commercialization of innovative technologies expands reach of ERDC's research

ERDC-developed technology endures military testing, set for commercialization

Developed by ERDC engineers in collaboration with Shavers-Whittle Construction (SWC), SUBMAT is a single-use, temporary roadway system created to support the off-loading of military vehicles during beach landings. Among SUBMAT's 2023 demonstrations was its expedient deployment to a large military exercise in the Philippines. During Balikatan 23, two SUBMATs were deployed in less than 12 hours to create a temporary "roadway" to facilitate off-loading of military equipment. During the 25 beach landings the SUBMATs supported, more than 160 pieces of U.S. Marine Corps equipment were off-loaded and then reloaded. A follow-on agreement has been awarded to allow production of prototypes for testing and demonstration purposes and sales to the U.S. government. SWC has since established Nearshore Logistics to continue R&D efforts while pursuing strategic commercialization. A cooperative research and development agreement and patent license agreement with Nearshore were successfully completed in 2023. Under the agreements, Nearshore will investigate future use of the technology in non-military applications, such as temporary boat ramps, piers, breakwaters, low water crossings and emergency access roadways.



System developed to protect our Warfighters has a bright and expanded future

The Modular Protective System Guard Tower (MPS-GT) — a lightweight, low-logistics, rapidly constructable tower developed by ERDC — provides expedient blast and ballistic protection for Warfighters operating in remote, austere combat environments. Patented in 2019, MPS-GT has been manufactured and deployed to multiple combat zones demonstrating this technology's ballistic protection and versatility. The tower's multi-layered armor panel system leveraged ERDC's existing Modular Protective Systems (MPS) technology that provides tailored protection based on threat levels. The MPS's inexpensive, lightweight, easily assembled and disassembled panels offer the latest advances in blast, ballistics and forced-entry resistance. The MPS-GT can provide both offensive logistical advantages and defensive protection capabilities in situations such as security, disaster relief, asset protection and more. Its armor panel system can be customized to provide the level of blast and ballistic protection necessary for its occupants in most any environment. Other uses include immediate protection for "soft target" public gathering events, observation points and other critical assets. After extensive field testing and real-world applications, the MPS-GT was licensed to Edwards Design & Fabrication and is being transitioned for further military and other non-DOD security applications.



INTERNATIONAL PARTNERSHIPS

ERDC has long celebrated its outreach and collaboration with foreign countries. In FY23, ERDC held 22 international agreements that focused primarily on military-to-military research. The projects included research on hardening structures, assessing bridging techniques and gaining a better understanding of military operations in extreme environments.



ERDC continually assesses the commercial potential of technologies developed in our research facilities and pursues patent, trademark or other intellectual protection for technologies deemed commercially viable. A new patent's term is 20 years from the date the patent's application was filed in the U.S. or, in special cases, from the date an earlier related application was filed. Developing patented technology is part of ERDC's mission, but the ability to quickly transfer that technology is critical.

FY23 PATENTS

Blast, Ballistic and Forced Entry Resistant Shelter

Inventors: Justin Roberts, John M. Hoemann, Craig R. Ackerman
Patent Number: 11,629,519

Survivability and Assault Multi-Tool Systems and Methods

Inventors: Gary E. Johnston
Patent Number: 11,662,181

Systems for Modeling Intelligent Sensor Selection and Placement

Inventors: David Keith Wilson
Patent Number: 11,675,684

Systems and Method for Testing Adhesion of Brittle Materials

Inventors: Emily Asenath-Smith, Garrett R. Hoch, Christopher J. Donnelly, Jordan M. Hodge
Patent Number: 11,719,619

Internally Partitioned Revetment Container for Rapid Attainment of Defense against Small Arms Fire

Inventors: John Paulson, Brennan S. Fridley, Gerrit Van Ommering, Joshua M. Peterson, Paul F. Mlakar
Patent Number: 11,733,006

Sand Boil Filter with Adjustable Hydraulic Head

Inventors: Axel M. Montavo-Bartolomei, Bryant A. Robbins
Patent Number: 11,745,122

Measuring Deflection to Determine a Dynamic Characteristic of a Cantilever

Inventors: Rebekah C. Wilson, Benjamin C. Masters
Patent Number: 11,754,437

Measuring Deflection to Determine a Characteristic of a Cantilever

Inventors: Rebekah C. Wilson, Benjamin C. Masters
Patent Number: 11,754,505

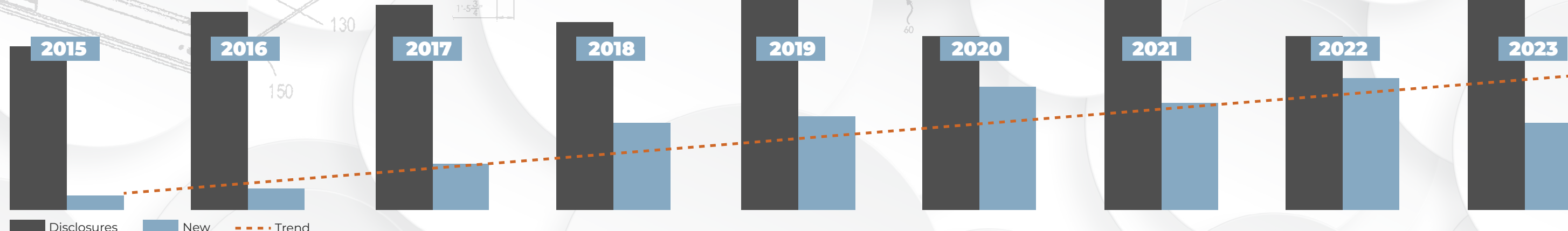
Frame and Stair Systems and Methods

Inventors: Omar Esquilin-Mangual, Catherine S. Stephens, Omar G. Flores, Andrew B. Edwards, Nicholas R. Boone
Patent Number: 11,761,213

97
ACTIVE
PATENTS

Sand Boil Filter

Blast, Ballistic and Forced Entry Resistant Shelter
This marks the sixth patent for ERDC's Hardened Alternative Trailer System technology



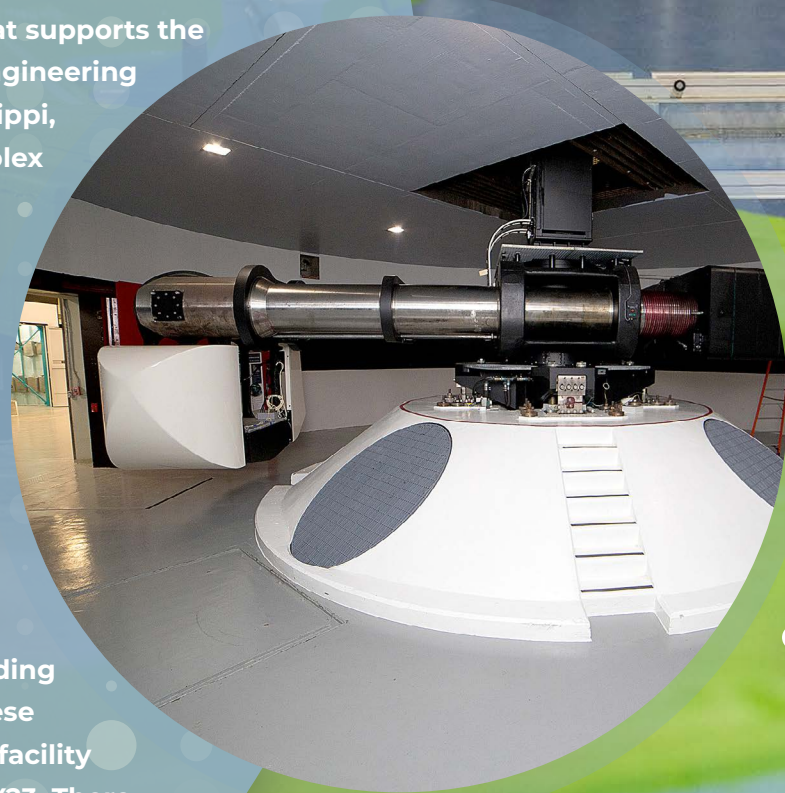
ONLY THE BEST

PREMIER FACILITIES SUPPORT **R&D** MISSION

Thanks to ongoing support and investment at many levels, ERDC's research and support facilities remain among the very best in the world. Totalling more than \$2 billion, these world-class facilities have been a focus of continued upgrades and expansion. During FY23, several ERDC locations received updates, with some unveiling new facilities all together. At ERDC's Field Research Facility in Duck, North Carolina, officials cut the ribbon on a new 4,000 square-foot annex building that supports the facility's expanding military engineering portfolio. In Vicksburg, Mississippi, the Centrifuge Research Complex received significant upgrades to its electrical and hydraulic systems, along with renovations to the control building. Vicksburg also celebrated the arrival of the Carpenter supercomputer, which can perform 9 quadrillion calculations per second and is fully equipped to enhance ERDC's ability to tackle the DOD's most demanding computational challenges. These are just three examples of the facility upgrades completed during FY23. There are several ongoing construction and upgrade projects in the pipeline, with a few of them having already completed the design process, and others close to breaking ground.



SHIP
SIMULATOR



CENTRIFUGE
RESEARCH
COMPLEX



BLAST LOAD
SIMULATOR



HYDRAULIC
PHYSICAL
MODELS



FIELD RESEARCH FACILITY
DUCK, NORTH CAROLINA

ALIGNMENT WITH USACE R&D STRATEGY

When released in November 2021, the USACE R&D Strategy laid out a framework that reshaped the focus and direction of its R&D community. ERDC's rich history and expertise well positions it as a leader for each of the strategy's 10 priorities. Since its founding in 1929, ERDC has leveraged its world-class facilities, capabilities and most importantly, its people to confront the most difficult engineering challenges of our time.

- CW CIVIL WORKS
- IOE INSTALLATIONS & OPERATIONAL ENVIRONMENTS
- WfS WARFIGHTER SUPPORT
- SfO SUPPORT FOR OTHERS



MITIGATE & ADAPT TO CLIMATE CHANGE
Climate change and extreme weather require unprecedented innovation. ERDC plays a key role in the national response, including assessing DOD and national vulnerabilities to climate-change effects; accelerating transition to renewable and zero-carbon energy; sequestering greenhouse gas emissions; and protecting warfighters and communities from severe weather impacts.



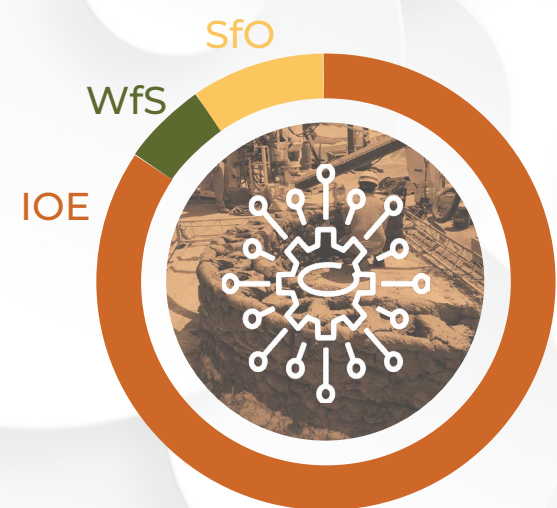
WIN FUTURE WARS
Future conflicts will occur at a longer range and greater speed than ever before. American Warfighters must be agile to rapidly respond to evolving threats from increasingly advanced adversaries. ERDC's foundation in geospatial research, military engineering, environmental characterization and advanced modeling and simulation will ensure our Armed Forces maintain overmatch and battlefield superiority.



MODERNIZE OUR NATION'S INFRASTRUCTURE
Much of our nation's civil and military infrastructure is beyond its original life expectancy. ERDC is developing new materials and practices, advanced maintenance and construction techniques, new structural designs, innovative data capture analysis, computer models, and other methods to ensure America's infrastructure is resilient, safe and affordable to support tomorrow's demands.

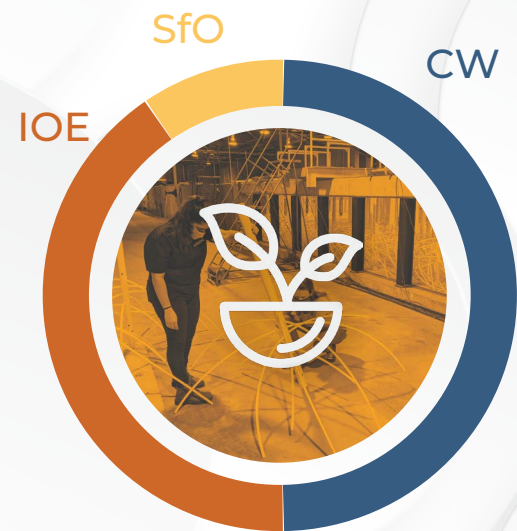


SUPPORT RESILIENT COMMUNITIES
Local and regional communities are facing growing hazards to commerce, human and ecosystem health, water supply, transportation, and other functions. ERDC provides open-access data and technologies to quantify present and future hazards and evaluate alternatives to support resilient communities while meeting national goals, such as environmental justice and social equity.



ENABLE SMART & RESILIENT INSTALLATIONS
Army installations must be more resilient in the face of constantly changing missions and threats. ERDC is developing advanced technologies and analytical capabilities and integrating smart features that will increase efficiency; enhance Soldier and family well-being; save money, water and energy; and make installations more resilient to hazards.





ENSURE ENVIRONMENTAL SUSTAINABILITY AND RESILIENCE

ERDC is developing design guidelines and techniques for executing projects that maximize environmental benefits. This includes innovative technologies and approaches that improve and sustain ecosystems while supporting the Warfighter and civil works missions.



SECURE RELIABLE INSTALLATION ENERGY

Military installations and missions must redesign their energy systems and move from carbon-intensive fuels while increasing resilience and grid independence. As extreme weather tests the strength of power-generation assets, ERDC is developing cyber-secure technologies that provide renewable and resilient energy for Army installations.



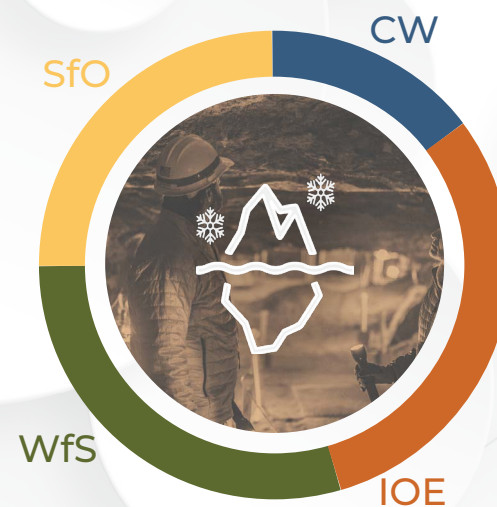
REVOLUTIONIZE AND ACCELERATE DECISION MAKING

Decision makers must use timely and reliable datasets to understand societal and environmental threats to operational capabilities faster and more accurately. ERDC is developing decision-support solutions powered by advances in big-data analysis, machine learning, artificial intelligence, computer simulations, autonomy and robotics.



IMPROVE CYBER AND PHYSICAL SECURITY

Attacks on our nation's critical infrastructure by our adversaries have become more frequent and severe, including sophisticated cyberattacks. Through innovations in risk detection, mitigation and reduction, ERDC is developing technologies that ensure critical infrastructure remains safe.



PROTECT AND DEFEND THE ARCTIC

As Arctic ice melts, competition for resources and influence in this strategically significant region increases. ERDC leads USACE, Army and DOD efforts to understand and adapt to changes in permafrost, snow, sea ice cover and ecosystems to promote mission resilience, military operations and polar region navigation.

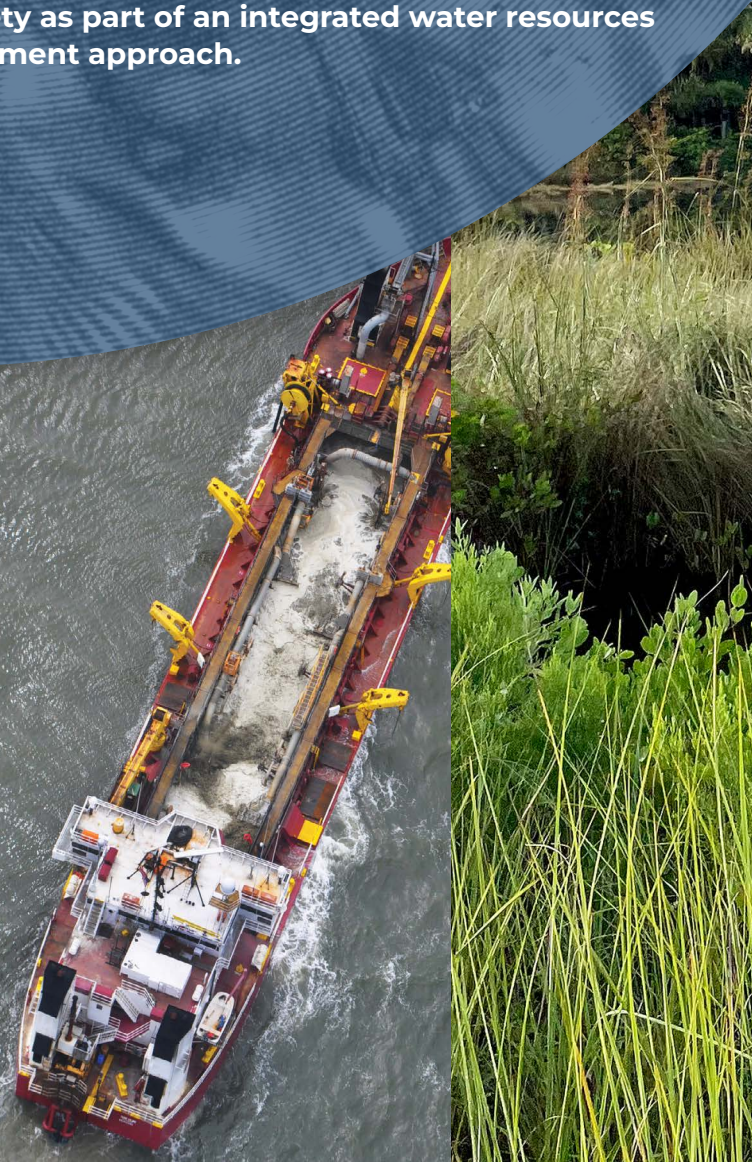


CIVILWORKS

Our nation’s engineering challenges are growing dramatically – from aging and often inadequate infrastructure, to rapidly changing demographics and urbanization, to mitigation of environmental contamination and climatic extremes.

USACE demands world-class research and development to best execute its Civil Works mission to support public and commercial navigation; restore, protect and manage aquatic ecosystems; and reduce flood risk.

Innovation must be particularly focused on reducing implementation times; improving resilience in the face of climate changes; and maximizing benefits to the economy, ecosystem quality, and public health and safety as part of an integrated water resources management approach.



NAVIGATE

- Fiber-Reinforced Polymers: Mitigating infrastructure corrosionPage 34
- DamBot™: Robotic platform provides initial inspectionPage 36
- Crowdsourced Bathymetry: A near-real-time waterway snapshotPage 38
- Mangrove Study: Examining how nature protects coastlinesPage 40
- Ecological Models: Multifaceted approach for environmental forecastingPage 42
- EWN Toolkit: Enabling broader NNBF application.....Page 44
- DOTS, WOTS & WRAP: Connecting practitioners with expertsPage 46
- Reservoir Flushing: Restoring valuable reservoir capacityPage 48
- DEMAND: Software helps reduce dredging delaysPage 50
- Post-Wildfire Modeling: Informing planners of potential flood risks.....Page 52
- Beneficial Use of Dredged Material: Increasing usage to 70 percent.....Page 54



BETTER THAN BEFORE

Fiber-reinforced polymers mitigate infrastructure corrosion

An innovative approach developed by ERDC to address fatigue cracks found in lock miter gates is now being used to mitigate corrosion's impact on these critical infrastructure components.

Fiber-reinforced polymers, cloth-like materials fortified with carbon fiber or basalt, have proven successful in extending the lives of miter gates by an estimated 20 years. Now, the same method is being applied to areas of extreme corrosion, helping recover the strength of steel I-beams on the miter gates experiencing as much as 30-percent corrosion.

In June 2023, engineers used these techniques to address corrosion on a tainter gate at Boggs Lock and Dam. All 11 of the facility's tainter gates have experienced corrosion, with some facing critical levels. Working with ERDC, the Vicksburg District used fiber-reinforced polymers to increase the strength of the bottom girder of some of the gates.

Due to FRP's light weight, durability and characteristics to resist both fatigue and corrosion, its use to repair steel structures has shown significant potential.



I-beams with up to 30% corrosion
have seen **RESTORED STRENGTH**
following repairs using FRP

SAFE & THOROUGH

Innovative robotic platform provides initial look at potentially dangerous structures



Dam inspection, which can be hazardous to USACE inspectors, can now be accomplished using robotic technology, reducing risk to personnel and preventing the loss of life.

USACE is responsible for operation of, maintenance on and inspection of more than 700 U.S. dams. The majority of these large projects have now exceeded their design lives, making the need for inspection critical to their continued use. One portion of an earthen dam that is hazardous to inspect is the outlet works. These subterranean conduits are subject to risks such as slips, trips and falls, but also low oxygen and other factors associated with confined spaces.

To aid USACE inspectors, ERDC developed the DamBot™, an amphibious robotic platform carrying sensors, such as cameras and lidar. It can enter the outlet works and perform a first look at the structure without exposing personnel to the risky environment. DamBot is also equipped with a 17-foot robotic arm to perform closer inspections of hard-to-reach structures. Also, the level and quality of the data collected by the DamBot provides previously unavailable, critical information on infrastructure health to inspectors.

This ERDC technology has been demonstrated at several USACE projects from California to Pennsylvania. The datasets collected can further structural health monitoring research, especially in change detection.

DamBot prevents INJURY, LOSS OF LIFE from dam inspection accidents

ALL TOGETHER NOW.

Crowdsourced bathymetry could provide near real-time snapshot of nation's waterways

While USACE performs routine surveys on the 25,000 miles of inland waterways it manages, these snapshots in time do not capture rapidly evolving changes. However, expanding this traditional survey capability is not cost sustainable.

To improve waterway safety, USACE researchers are working on a system that would use the depth finders and GPS of any volunteer vessel to create a near real-time picture of a channel and any obstructions that may exist. Data would be transmitted from existing waterway users and would then be analyzed and aggregated with data from with other vessels, making it easy to find emerging navigation hazards.

This crowdsourced bathymetry effort will help prioritize the actions of the USACE survey fleet and provide the ability to watch the waterways between scheduled surveys. It will also provide more immediate data after a hurricane or other natural disaster.

The critical next steps are determining the technology to transmit and collect the data (whether that is a private or public solution), finding ways to aggregate and analyze the data, and deciding how best to push out the information to those who need it, such as commercial operations and teams tasked with clearing any navigation threats.

Crowdsourced bathymetry can prioritize actions of USACE survey fleet and PROVIDE UPDATED DATA between surveys

NATURAL FLOOD BARRIER

Study examines how mangroves protect coastlines

As the risk of coastal flooding increases because of changing climates and stronger storms, communities need sustainable, resilient strategies to confront these risks. Mangrove forests have shown potential to provide significant protection from hurricanes and tsunamis, but more information is needed for them to be used in storm protection projects due to a lack of historic studies.

ERDC collaborated with the U.S. Naval Academy and Oregon State University to design a large-scale physical model representative of a North American red mangrove forest and construct it inside ERDC's largest wave flume. Extensive testing under various water levels and wave intensities produced a comprehensive dataset examining how mangroves contribute to flood protection and quantifying their effect on extreme waves and water levels.

Part of the USACE Engineering With Nature® (EWN) initiative, this project will enable more widespread and effective use of mangroves in coastal resilience projects.

The mangrove study will allow **MORE WIDESPREAD AND EFFECTIVE USE** of mangroves in coastal projects



PREDICTING THE UNPREDICTABLE

USACE develops multifaceted approach for environmental forecasting

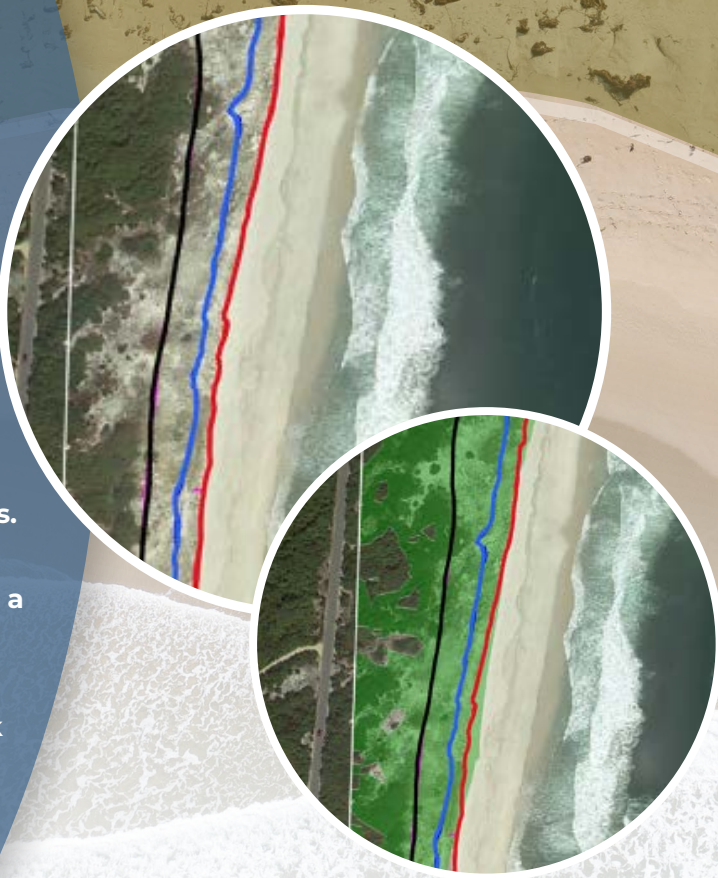
As the climate and environment continue to change and as the world becomes more complex and connected, there is a need for ecological models to show a more accurate representation of the system being studied.

To confront that challenge, ERDC's Integrated Ecological Modeling team has taken the innovative approach to predict environmental response by focusing on ecological modeling, forecasting how the environment will respond to different natural occurrences or large-scale USACE projects like ecosystem restoration, navigation and operations.

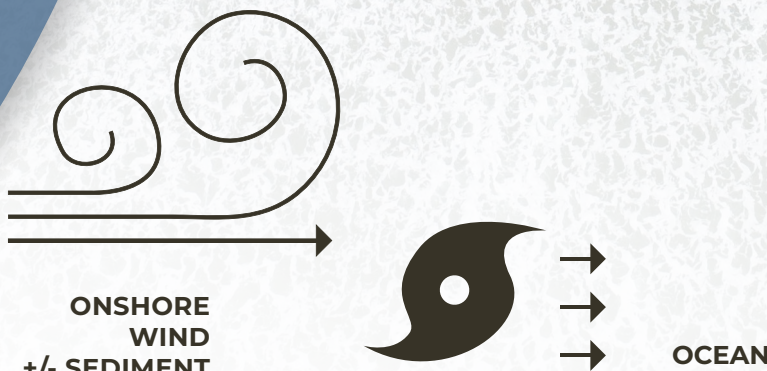
Researchers have now gone a step further by combining ecological models with engineering models.

Over the past several years, ERDC has conducted model development workshops for districts to provide a better understanding of the modeling process, giving districts the ability to develop functional models for their specific projects. These districts often come back to ERDC to develop or refine their models.

Having refined forecasting tools reduces the cost associated with long-term data collection and model development. These tools also provide a more accurate approach for predicting the dynamics of environmental systems.



Advanced ecological models
BETTER PREDICT
the dynamics of environmental systems



+/- VEG BIOMASS & MORPHOMETRICS

FOREDUNE

SECONDARY DUNE

BEACH

QUANTIFYING NATURAL INFRASTRUCTURE

Toolkit will enable natural & nature-based features



Scan for the EWN Toolkit



As Natural and Nature-Based Features (NNBF) become more prevalent in national infrastructure design, planners need better methods to predict and quantify the impact these EWN features may have if implemented. Current numerical modeling approaches require these features to be integrated manually, which is expensive and time consuming.

In response, ERDC developed the EWN Modeling Toolkit, a suite of tools that enables more timely and accurate modeling of EWN features. Subsequent efforts have expanded the capabilities so the toolkit can be applied to additional models commonly used by USACE engineers and the broader modeling community.

These tools will allow coastal modelers and engineers to better evaluate the efficacy of various designs and will provide crucial information to decision makers. This will ultimately lead to broader NNBF application and modernized infrastructure that is more resilient, sustainable and adaptable to climate change.

EWN Toolkit will lead to broader NNBF application and **MORE RESILIENT INFRASTRUCTURE**

Programs quickly connect practitioners with experts

In April 2023, the New Orleans District requested monitoring support during a dredge operation near Grand Isle, Louisiana, where concerns had been raised about the levels of sediment in the water and its potential impact on nearby oyster farms.

Leveraging capabilities of the Dredging Operations Technical Support Program (DOTS), an ERDC team deployed an autonomous underwater drone that captured information showing dredged sediment would not impact oyster operations.

DOTS provides access to information on technology – such as the autonomous underwater drone – related to operations and maintenance navigation and dredging missions. It supports rapid technical response for field offices, technology demonstrations, database management, training operations and more.

DOTS is just one of three programs that connects field practitioners with experts from ERDC's laboratories – providing support to ease the burden of program logistics.

The Wetlands Regulatory Assistance Program provides solutions to the science, engineering and technical challenges of the USACE Regulatory Program by developing tools to revolutionize and enhance regulatory decision making.

The Water Operations Technical Support program supports technology transfer efforts for environmental and water quality operational studies. It provides environmental and water management engineering technology to address water resource management challenges at USACE reservoir and waterway projects, and in river systems affected by project operations nationwide.

Programs leverage the
**WORLD-CLASS
EXPERTISE**
of USACE's research
laboratories



RUNNING OUT OF SPACE

USACE turns to innovative technique to restore valuable reservoir capacity



A unique sedimentation challenge occurs when a river enters a reservoir and most of its sediment becomes trapped along the bottom. As this sediment builds up over the years, the reservoir's water capacity decreases.

One place this is occurring is at Tuttle Creek Lake in Kansas. An important reservoir for flood control, navigation and recreation, Tuttle Creek has lost about 46 percent of its original storage capacity due to sedimentation.

In response, USACE researchers studied and recommended a pilot project using a technique that had never been used to flush sediment in a lake. A full-scale water injection dredge was designed to fluidize the sediment and flush it through the dam structure and downstream. The team will also be studying the environmental effects that releasing the sediment has on the downstream environment. Water injection dredging has the potential to be much less expensive than traditional dredging for moving large quantities of sediment in a reservoir. By collecting data, the group hopes to apply lessons learned to other USACE lakes and reservoirs.



Water injection dredging offers a **MUCH LESS EXPENSIVE** method for removing large quantities of sediment in a reservoir


REDUCING DREDGING DELAYS •

ERDC software modernizes, accelerates environmental evaluations

USACE dredges 200 million cubic yards each year, and federal law requires environmental evaluation of this tremendous amount of dredged material. Environmental compliance guidance is more than 30 years old and does not reflect the latest science, resulting in inconsistent analyses, disputes, avoidable testing costs and unnecessary project delays.

ERDC developed the Dredging Evaluation Management, Analysis and Networked Documentation (DEMAND), an electronic decision support tool that integrates the best available science and enables faster and more consistent environmental suitability evaluation for open water placement of dredged sediment. Multiple ERDC laboratories collaborated on the effort, guided by feedback from 13 districts in six divisions through webinars and workshops.

DEMAND will reduce dredging management delays through a clearer and more streamlined process for assessing sediment in the nation's ports and harbors. This tool will prevent decision bottlenecks that ultimately cost USACE money and potentially delay or limit more economic dredging options.



New DMMU

For cross comparability to historic data, use the same DMMU nomenclature and shape boundaries. Before naming the DMMU, consider historic DMMU nomenclature and boundaries. You may also enter information about the locality of the DMMU (e.g., Middle Turning Basin) or other information that does not change overtime (e.g., cut 3). If you are testing discrete sediment locations, simply enter that sediment as if it were a DMMU.

You must also enter a REFERENCE SEDIMENT (or disposal site) as one of the DMMUs/test materials. The reference/disposal site location will not be reviewed in the analysis.

New DMMU Name *

Reference Station

Estimated Volume (cu yd) *

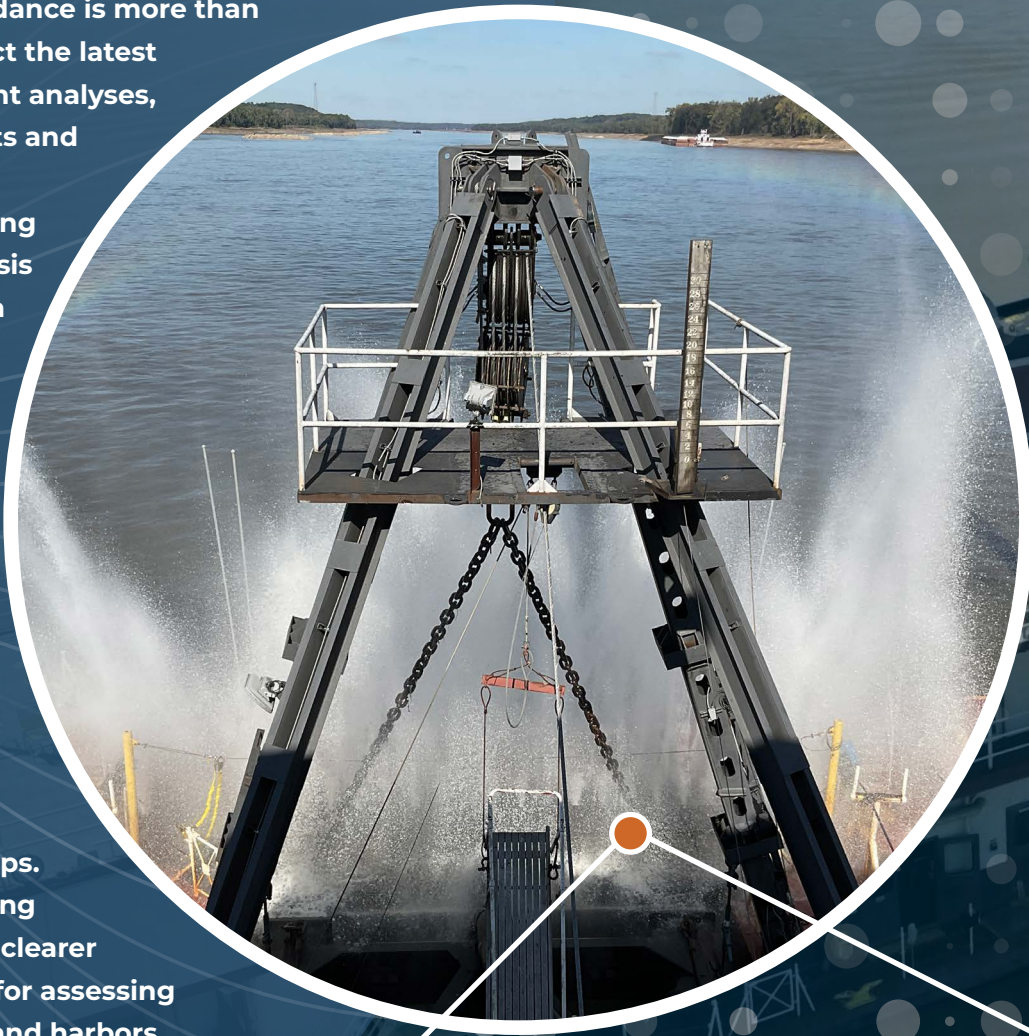
0

☒ Is Reference Sediment / Disposal Site?

Submit

When all DMMUs have been submitted, Click below to continue to CoPC Selection.

Add CoPCs



DEMAND will prevent decision bottlenecks that cost USACE
TIME & MONEY •

AFTER THE FIRE

New methodologies better inform planners of potential flood risks



In 2022, more than 65,000 fires burned more than 7.4 million acres in the United States alone. These wildfires reduced channel capacity and produced massive debris flows, consequently increasing the potential for floods, erosion and sedimentation. Current methods lacked the ability to predict these risks accurately and in a timely manner, leaving communities vulnerable to post-wildfire flooding.

USACE R&D is pursuing development of new methodologies, operational responses and numerical modeling techniques with higher accuracy and improved capability to quickly predict the areas at highest risk for deadly debris flows and flooding. These improved approaches provide local, state and federal planners and emergency responders the information needed to mitigate and manage these increased wildfire and flood risk threats.

The April 2022 Hermits Peak/Calf Canyon wildfire in New Mexico burned more than 341,000 acres. This wildfire significantly increased flood and debris flow risk to downstream communities. Improved technologies developed through R&D were rapidly deployed to provide near real-time emergency management tools for evacuations. This rapid support ultimately saved lives and provided accurate information to protect infrastructure and properties downstream.



New numerical modeling capabilities have **REDUCED RISK BY APPROXIMATELY 80%**

HEEDING THE CALL

Beneficial use challenge is being met with creativity, innovation and hard work

In January 2023, Lt. Gen. Scott Spellmon, 55th Chief of Engineers and USACE Commanding General, issued a challenge that has sparked innovation and research in discovering new and creative ways to use sediment pulled from USACE’s dredging operations.

In his “Beneficial Use of Dredged Material Command Philosophy Notice,” Spellmon called for USACE to beneficially use 70 percent of its dredged material by 2030 – a significant challenge given USACE traditionally used 30 to 40 percent in beneficial capacity.

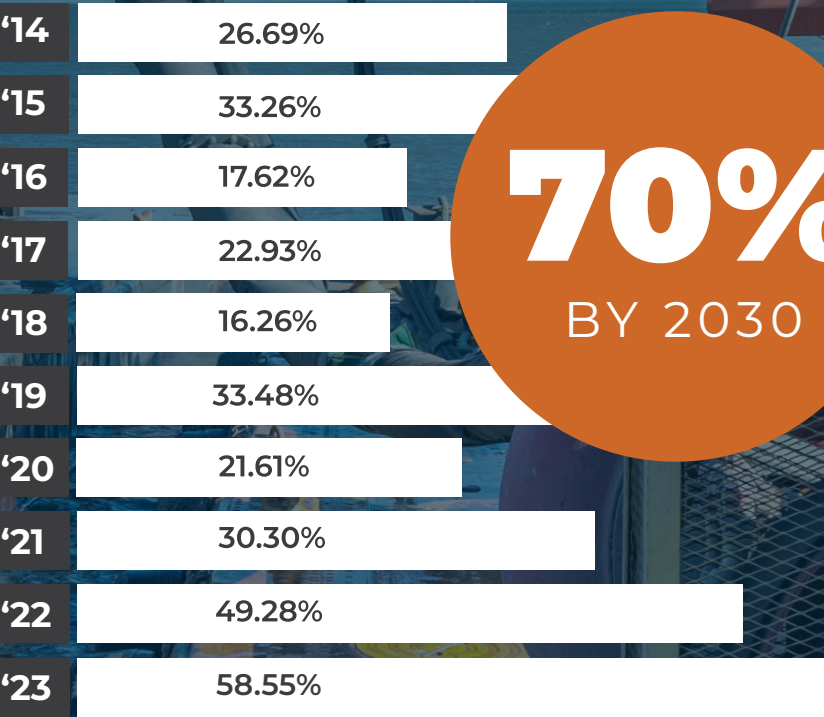
That challenge has sparked development in new techniques and technologies to test dredged material to see if it can be safely and beneficially used in projects. ERDC engineers have begun using dredged material as feed stock in 3D-printing components for future coastal resiliency projects and ecosystem restoration features.

These are just a few examples of creative thinking across USACE focused on using dredged material as a resource that can provide environmental, recreational, coastal storm risk reduction and economic benefits.



BENEFICIAL USE PLACEMENT

Below is a graph showing the percentage of dredged material that has been beneficially placed over the past 10 years. USACE is continuing to research and develop new techniques and technologies to increase its beneficial use to 70 percent by 2030.



Source: <https://rsm.usace.army.mil/budb>

USACE annually records roughly **200 MILLION CUBIC YARDS** of dredged material

INSTALLATIONS & OPERATIONAL ENVIRONMENTS

The Installations and Operational Environments portfolio is focused on improving the reliability, efficiency and effectiveness of military installations and protection against environmental threats where Warfighters operate.

This includes improvements in military construction technology, capacity and resource planning, and minimizing negative impacts of military infrastructure to the environment and communities. Through this work, USACE enables the execution of the Army Modernization, Installations and Climate strategies.

This effort accelerates technological innovation to meet current and future mission and project delivery demands, specifically in the areas of enabling smart and resilient installations and securing reliable installation energy.

NAVIGATE

- PFAS Research: Effort to mitigate ‘Forever Chemicals’Page 58
- Sustainable MILCON Construction: Developing materials, guidancePage 60
- Facility Investment Plan Wargame Analytics: Supporting installation decisionsPage 62
- Environmental Toolkit: Rapid contaminant screeningPage 64
- Flow Battery Prototype: Improving resilience, sustainabilityPage 66
- Installations of the Future: Digital twins kindle Tyndall rebuild innovationPage 68
- Environmental DNA: More efficient hunt for threatened speciesPage 70

MULTI-PRONGED ATTACK

ERDC leads groundbreaking research to mitigate 'Forever Chemicals'



Per- and polyfluoroalkyl substances (PFAS) are man-made chemicals and have been used since the 1940s in many household and industrial products because of their stain and water repellant properties. PFAS are present virtually everywhere in the world because of the large amounts that have been manufactured and used over the decades.

They are also found in certain firefighting foam, known as aqueous film forming foam, used to fight fires at airfields on military bases and commercial airports.

Through research programs funded by the DOD, ERDC is supporting the development of new technologies to improve the assessment and management of PFAS-impacted media, as well as the development of environmentally safe PFAS-free replacement materials.

ERDC's research has helped create new methodologies for measuring PFAS in food packaging materials and conducted environmental safety evaluations of candidate replacement firefighting foam.

In addition, ERDC's efforts have created a better understanding of the environmental risks of PFAS, developed technologies to safely remove these substances from contaminated surfaces and groundwater, and led efforts to evaluate commercial technologies for the destruction of PFAS-containing materials.

ERDC's R&D efforts have led to a **BETTER UNDERSTANDING** of the environmental risks of PFAS

CONSTRUCTING WITH CARE

ERDC developing materials, guidance for more sustainable military construction

Possessing the federal government’s largest inventory of buildings, the Army can greatly shrink its carbon emissions by integrating sustainable materials in future construction projects and developing standards to enable others to do the same.

Led by innovative ERDC research, USACE is helping drive this effort through cutting-edge work to develop new materials, analysis tools and design guidance specifications. ERDC is also leading tri-service coordination of four pilot projects that incorporate sustainable materials into military construction.

Those projects, including three that are outlined in the 2022 National Defense Authorization Act, take multiple approaches, such as modifying construction specifications, incorporating new types of concrete, and maximizing the use of mass timber – a strong and durable material that is more sustainable than steel or concrete.

ERDC is also partnering with the Composite Recycling Technology Center on another mass timber project to study whether thermally modifying readily available lumber creates a material that can be used for military housing.

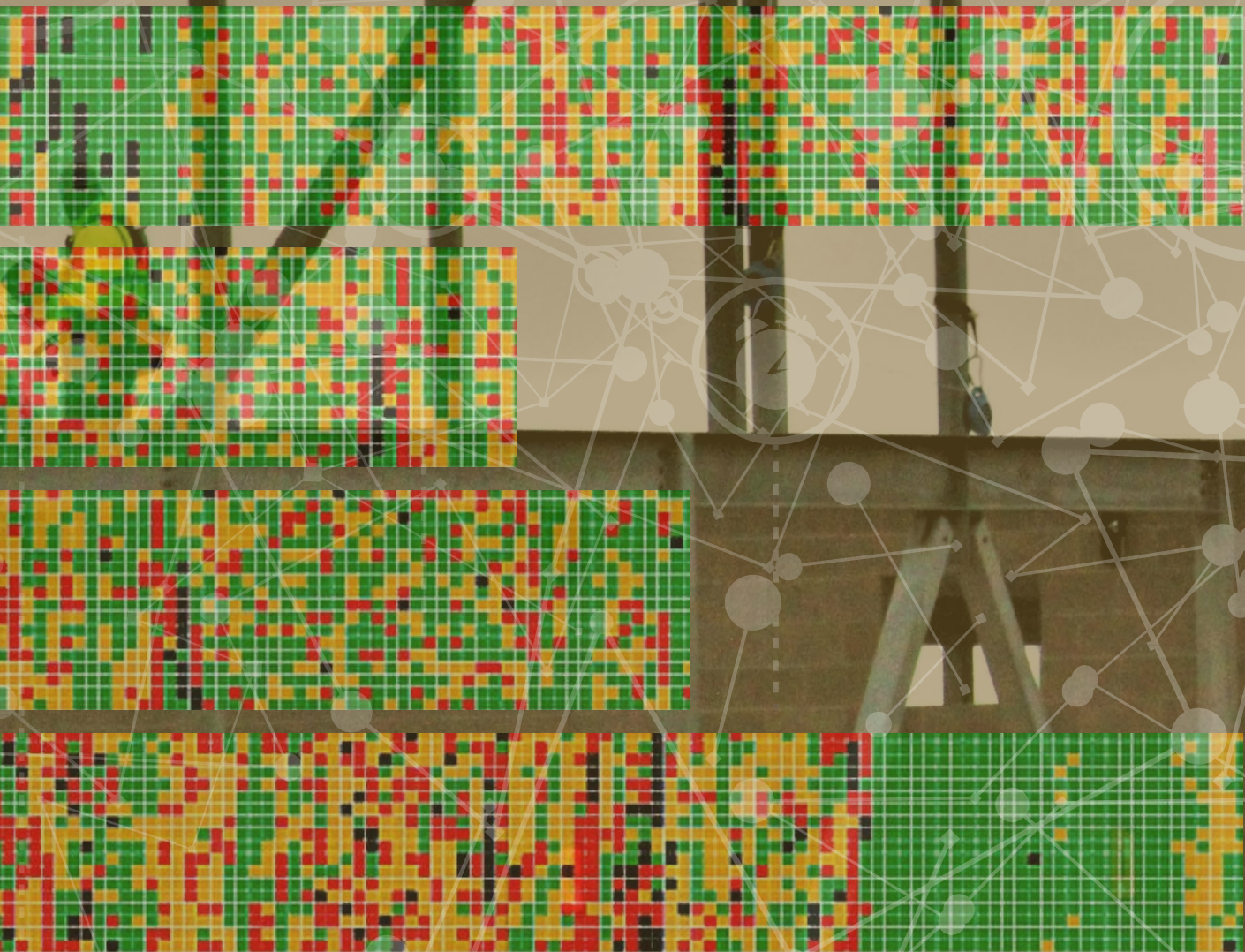
Through all of these projects, ERDC is supplying subject-matter expertise, supporting project delivery, testing how well these innovative materials meet the military’s elevated performance standards, and completing lifecycle analyses to determine broader applicability.



Sustainable designs seek to **REDUCE EMISSIONS** by at least 30% over conventional designs

GAMING INSTALLATIONS

Army decision support tool allows for planned courses of action



The Facility Investment Plan Wargame Analytics (FIPWA) is an Army decision support tool that joins data from the planned project list for restoration and modernization, military construction, real property, condition assessments, senior leader priorities and facility-type capacity. FIPWA enables senior commanders at the installation and command level to analyze Facility Investment Plan project priorities and forecast future impacts based on various courses of action.

Senior commanders from every active Army installation and major command used FIPWA to brief Army Materiel Command and the U.S. Army Installation Management Command senior leaders at wargame events. This allowed senior commanders to visually brief and defend their project priorities in a consistent framework. Because the integrated data model for FIPWA is built down to a facility component level, dashboards and information at that granular level were used as decision support points of reference during the wargame events.



**FIPWA informs Army leaders on
FACILITY INVESTMENT
PLANNING**

OUT OF HARM'S WAY

Toolkit enables rapid screening for contaminants

Facing multiple environmental threats from various hazards they encounter in theater, Warfighters, commanders and planners need the ability to rapidly assess the environmental quality of field locations and Army bases.

ERDC developed the Environmental Toolkit for Expeditionary Operations to provide real-time screening for environmental contaminants. These easily deployed, rapid screening tools can identify chemical contaminants in soil, air and water, improving situational awareness and reducing the time and effort needed to complete site assessments and associated environmental reporting.

The toolkit includes instruments that can screen for hazardous soil materials, asbestos, airborne chemicals, petroleum, harmful algal blooms, and water contaminants, among other hazards. It also includes an aerial survey drone that can provide preliminary screening inspections of facilities, roofs and warehouses.



Environmental Toolkit will help
ALERT WARFIGHTERS
to environmental hazards

POWER

WHEN YOU NEED IT

Flow battery prototype can improve resilience, sustainability



As the U.S. Army works to meet resilience and sustainability goals, USACE is teaming with private and government partners on a four-year pilot that will explore the first megawatt-scale long-duration energy storage system for the DOD.

ERDC is the leading technical evaluator and project manager of the effort that will determine the feasibility of a one-megawatt flow battery developed by Lockheed Martin. It is capable of storing 10 megawatt hours of energy and then powering critical parts of the installation when the local grid is unavailable or when renewable energy sources cannot provide sufficient power. The USACE Omaha District and USACE Huntsville Engineering and Support Center are also involved in the prototype evaluation, which is taking place at Fort Carson, Colorado.

The rechargeable system was procured through an innovative prototyping acquisition and will decrease carbon emissions and energy costs, while increasing resilience. Insights gained from this pilot project could support the deployment of future long-duration energy storage systems across the DOD.

The rechargeable system can store 10 MEGAWATT HOURS OF ENERGY

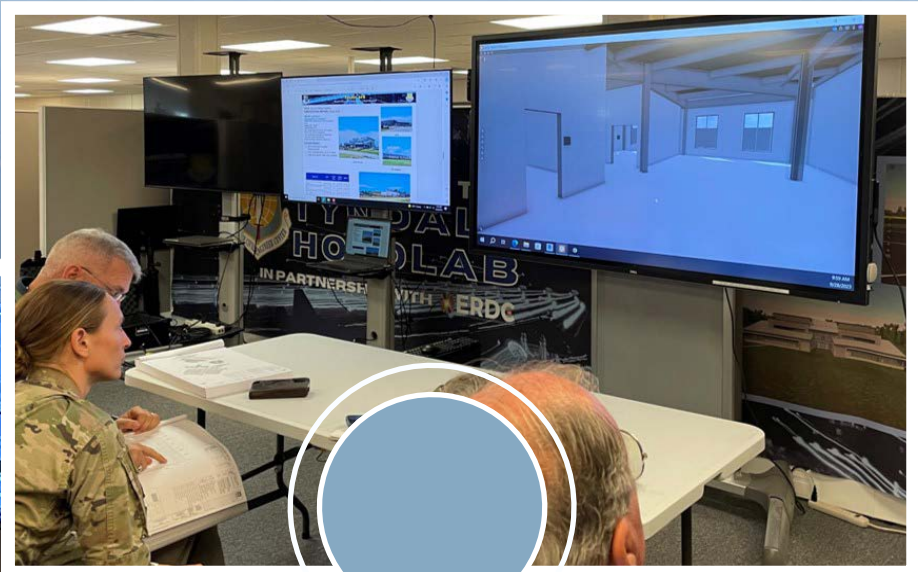
BUILDING BACK BETTER, SMARTER

Digital twins kindle innovation in Tyndall AFB rebuild

As the U.S. Air Force continues its ambitious rebuild of Tyndall Air Force Base following its 2018 destruction by Hurricane Michael, ERDC is playing an important role in those efforts, which also seek to transform the base into an innovative center of next-generation technologies.

In addition to providing science and technology expertise through on-site personnel, ERDC has also supplied a networking environment that allows cutting-edge software to be tested and used before enterprise transition. This includes extensive development of a digital twin, a virtual representation of the entire base that can provide advanced analytics and support numerous functions, including validating designs prior to construction, using sensors to proactively detect and respond to abnormalities, and simulating potential hazards.

Using these tools, a digital twin was used to review the proposed F-22 simulator building at Joint Base Langley-Eustis that would house F-22s being moved from Tyndall. This project was struggling to stay on schedule due to the complexity of the flight simulator equipment. However, the digital twin and virtual reality capabilities allowed participants to conduct a remote review of the proposal in only 25 percent of the time it normally takes and with greater certainty that the design was correct.



Digital twins enabled a remote review of a proposed facility in
A QUARTER OF THE TIME
and with greater certainty

IT'S THE LITTLE THINGS

Environmental DNA enables more efficient land sampling



The DOD maintains 30 million acres of military installations and training land. USACE oversees 12 million acres of public lands and water and oversees much of our nation's vital infrastructure components. And while the missions served by these lands and facilities differ, managers of both must be aware of how training and civil works projects may impact threatened or endangered species that may call those areas home. In fact, threatened and endangered species are the biggest environmental impact to military training operations. For this reason, installation managers need to better understand which species live in and travel through these training areas. To fill this important knowledge gap, ERDC got down to the basics. Using soil, water and even air samples in an area, researchers are now able to detect species DNA, giving installation managers and project coordinators an idea of what – if any – threatened or endangered species are in an area, and providing this information faster and cheaper than ever before. In addition to enabling faster and more detailed sampling efforts, the use of environmental DNA has also allowed teams to sample far more land.

eDNA can be between two to 70x
MORE COST EFFICIENT
than traditional sampling



WARFIGHTER SUPPORT



USACE applies its engineering and scientific expertise to support the Warfighter by improving all aspects of mission planning, preparation, execution and sustainment, including innovations to better protect our Soldiers.

The Warfighter Support portfolio helps advance Army modernization priorities, ensure battlefield dominance, and prepare U.S. Forces for multi-domain operations and other changes to the character of war. USACE is applying this research and development around the world. It is engaged in more than 130 countries on any given day, working for combatant commands, the U.S. Army, the DOD and other federal agencies that support the Warfighter.



NAVIGATE

- Airfield & Pier Damage Repair: Enabling global joint operationsPage 74
- SUBMAT: Improved shoreline, gap-crossing mobilityPage 76
- Sandhills Experiment: Making breaching saferPage 78
- Predictive Rotorcraft Maintenance: Increased efficiencyPage 80
- Modeling Snow Mechanics: Enhancing military mobilityPage 82
- Understanding the behavior of Ultra-High Performance ConcretePage 84
- Mobile Environmental Contaminant SensorsPage 86
- Autonomous Digital Design: Using AI to optimize materials.....Page 88
- Geospatial Engineer Toolkits: Enabling faster decisionsPage 90
- Operational Water: Increasing military’s water recycling capabilitiesPage 92

OVERCOMING OBSTACLES

USACE continues to offer solutions to repair damaged airfields, piers

Modern strategy demands the Joint Force be able to adeptly operate across all domains, requiring it to overcome obstacles that constrain freedom of maneuver. As the Army's Engineers, USACE R&D has a long history of solving Joint Force projection challenges dating to World War II. Recent solutions include technologies to rapidly repair damaged airfields in austere locations, overbridge damaged piers to support equipment throughput at port facilities, and allow armored vehicles to be unloaded from rail cars without the need for a permanent railyard.

In June 2023, a team from ERDC trained 145 Soldiers, Airmen, Sailors and Marines at the Joint Airfield Damage Repair Symposium at Fort Liberty, North Carolina. The event introduced new technologies for executing expedient airfield repair to support Army Multi-Domain Operations, Air Force Adaptive Basing, and Marine Corps Expeditionary Advanced Base Operation concepts. It also allowed ERDC researchers to identify future equipment and material needs, as well as joint doctrine updates required to enhance mission readiness.

ERDC is also a technical lead in an upcoming Under Secretary of Defense for Research and Engineering initiative designed to enable the rapid fielding of new prototype technologies to exercise assured logistics and power projection for combatant commanders.



"I WOULD BE REMISS IF WE DID NOT HIGHLIGHT THE INCREDIBLE TEAMWORK FROM ERDC ... WE GREATLY APPRECIATE THEIR STEADFAST SUPPORT AND LOOK FORWARD TO CONTINUED PARTNERSHIP!"

Col. Dan Herlihy, Commander 20th Engineer Brigade



New technologies enable the Joint Force to operate
ACROSS ALL DOMAINS

A BETTER LANDING

SUBMAT provides military forces improved mobility capabilities



Logistics operations in austere environments are hindered by the lack of force mobility across littoral zones, riverine shorelines and wet/dry gaps. These environments rapidly transition between wet and dry states, present steep slopes, and have weak soils that limit vehicle weight and number of passes.

Existing matting and site-stabilization systems cannot be readily adapted for submerged or partially submerged conditions along the shoreline.

To overcome this challenge, ERDC developed the submersible matting system (SUBMAT) to facilitate mobility across the shoreline and wet/dry gaps by combining current soil stability technology and mobility matting into a single product.

SUBMAT eliminates the size, deployment and buoyancy constraints that prevent existing land-based systems from being deployed directly in water at the shoreline.

During a large military exercise in the Philippines – Balikatan 2023 – SUBMAT was a force multiplier by saving hours, and most likely days, during the offloading process by avoiding the need to tow vehicles or reset the beach.

The U.S. Transportation Command has recommended SUBMAT be immediately added to the Table of Allowances for the Naval Beach Group and Army 7th Transportation Brigade Expeditionary to support future missions.

**ERDC-developed SUBMAT
ELIMINATES THE CONSTRAINTS
of existing matting, shoreline systems**

MAKING BREACHING SAFER

ERDC supports integration of robotic and autonomous technologies

As ground combat evolves, the DOD must integrate robotic and autonomous technologies to breach complex mine fields and obstacle belts more safely and effectively. To help meet this objective, the XVIII Airborne Corps and 20th Engineer Brigade organized and hosted the Sandhills Future Breaching Experiment at Fort Liberty.

ERDC played a leading role in this partnership event that demonstrated breaching capabilities and highlighted gaps for future experimentation. ERDC supplied and piloted multiple Unmanned Aircraft Systems, which helped characterize and locate complex obstacles during the experiment. An Expeditionary Modular Autonomous Vehicle provided by ERDC and equipped with a Mine Clearing Line Charge successfully fired two live rockets using remote firing systems provided by DEVCOM.

ERDC also delivered the Virtual Autonomous Navigation Environment – Remote Breaching Simulator (VANE-RBS), a digital simulation tool to help combat engineers gain experience in a synthetic training environment related to remote breaching operations. ERDC leveraged previous modeling and simulation work in support of the Next Generation Combat Vehicle to rapidly develop the customized VANE-RBS to support tactics, techniques and procedures development and supplement the limited time combat engineers had with physical breaching platforms.

Next steps include experimentation to inform the Army’s Human Machine Integration initiative regarding combat engineer capability needs.



Use of autonomous breaching technology
REDUCES THREATS TO SOLDIERS

SAVING LIVES AND

Army looks to data to predict and prevent aviation equipment failures

Predictive maintenance planning
**INCREASES EFFICIENCY
& REDUCES COSTS**

The Army currently employs one of the largest fleets of rotorcraft in the world, which includes the critical Black Hawk platform. Maintaining a fleet of this scale is costly and laborious. Traditional maintenance methods – which are inefficient – include either performing maintenance on a time-based schedule or when a failure occurs.

Predictive maintenance aims to overcome these challenges through a proactive, data-driven approach that leverages data to identify near real-time equipment failures before they occur, thus increasing the efficiency of maintenance activities, reducing costs and improving fleet readiness.

Since 2018, ERDC has leveraged its High-Performance Computing (HPC) resources and expertise to aid the Army in overcoming these challenges through the development of an HPC-resident data and analytic environment for aggregating, storing and preparing large-scale, heterogeneous data for analysis and artificial intelligence model development for predictive maintenance.

The environment incorporates a direct connection from Army operational data sources to ERDC HPC resources, giving the Army aviation community access to comprehensive data for developing predictive maintenance capabilities that streamline the maintenance process, saving time and saving lives.



PREDICTIVE THINKING

Innovative models enhance military's ability to maneuver in cold regions

For several months of the year, snow is the predominant surface and transportation substrate and paving material for areas located in mid-to-high latitudes. However, understanding how snow can support or impact maneuverability is often difficult.

To overcome these limitations and the problems faced by the U.S. Army and other services and allies operating in snow environments, ERDC developed a hybrid experimental and numerical modeling approach to better understand how microscale snow parameters impact the macroscale compressive strength of snow.

This work developed novel methods to quickly extract the microstructural properties of snow and use that information to characterize different geometric changes in a numerical model of the snow's microstructure.

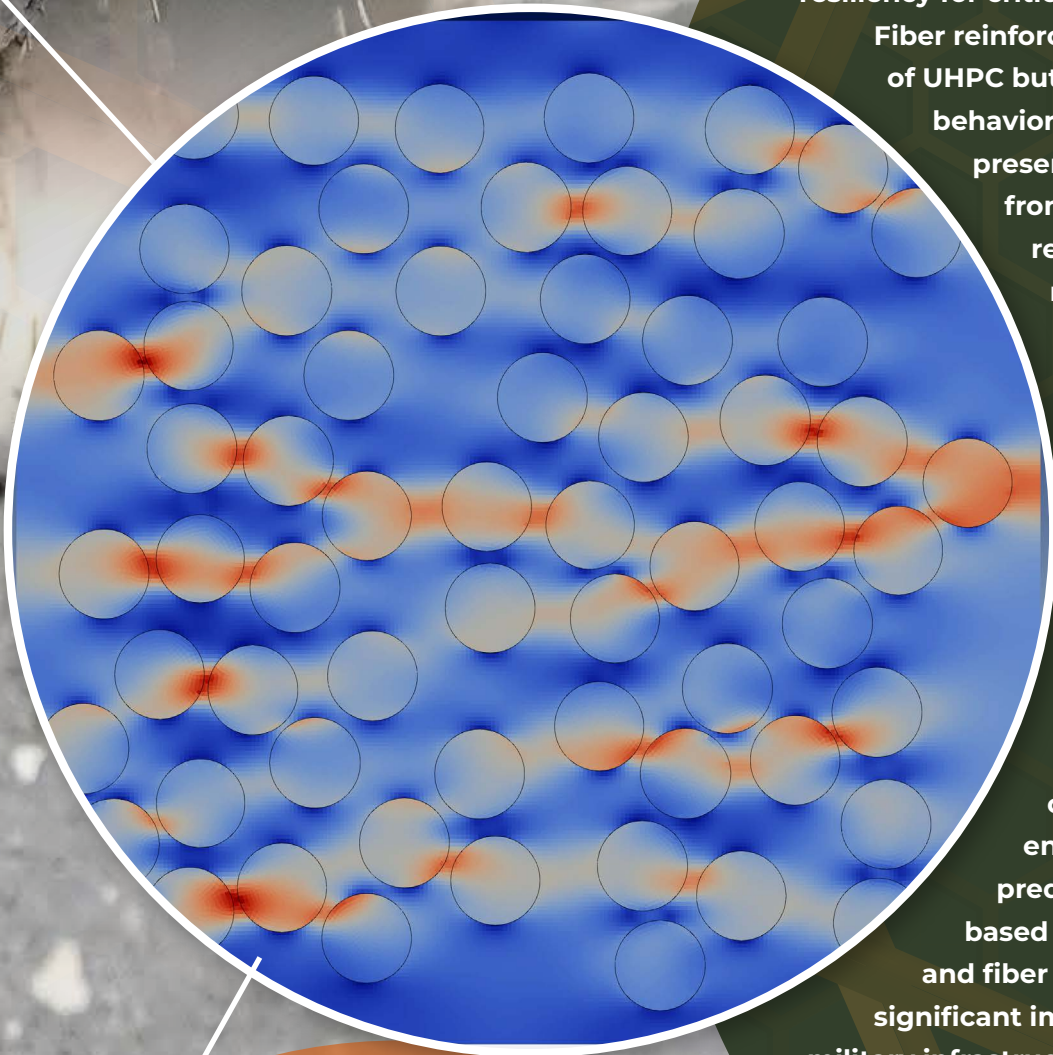
From understanding mobility issues in regions covered in snow to enabling improvements in snow construction and compaction techniques, ERDC's work is leading to enhanced predictive modeling of snow strength with a wide range of cold region applications.



Predictive models forecast the **STRENGTH OF SNOW** for mobility or use in construction

FORTIFYING THE FUTURE

Models being developed to project UHPC's performance in military infrastructure



The development of ultra-high-performance concrete (UHPC) is expected to play a key role for the Armed Services, as it seeks materials that offer increased reliability and resiliency for critical infrastructure projects. Fiber reinforcement is a key component of UHPC but understanding the behavior of UHPC with fiber blends presents challenges stemming from conflicting experimental results and the complexity of modeling fracture in a highly heterogeneous material.

ERDC basic research is advancing computational techniques, incorporating an embedded mesh approach, to precisely simulate the behavior of UHPC reinforced with fibers of various sizes.

This innovative approach enhances the understanding of UHPC fracture behavior, enabling more accurate predictions of UHPC properties based on the cementitious matrix and fiber characteristics. This has significant implications for designing military infrastructure components with improved strength and durability, advancing the field of concrete material technology.

Future computational models will **ENHANCE THE UNDERSTANDING** of UHPC fracture behavior

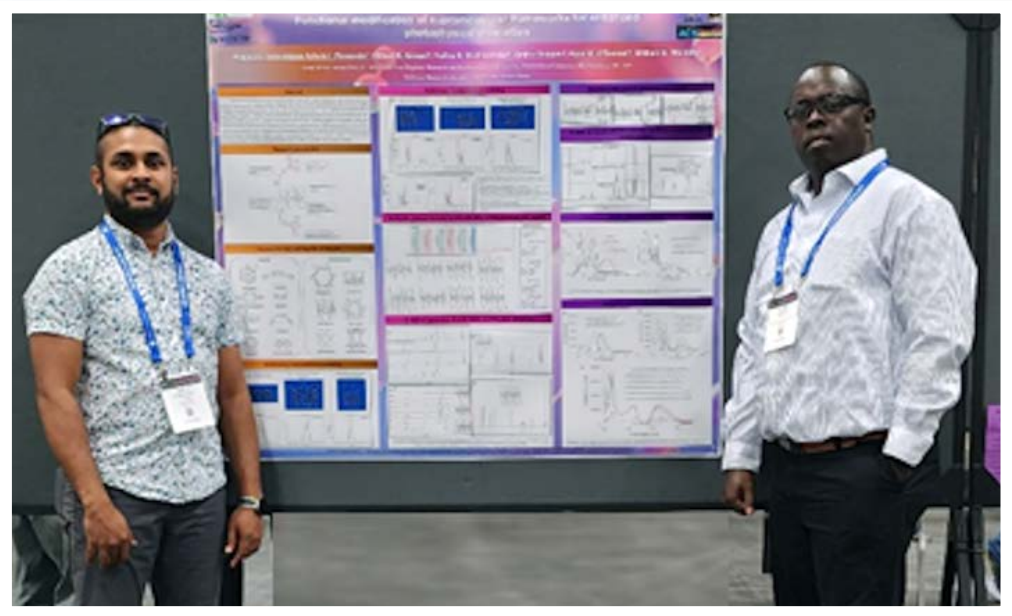
ADVANCING DETECTION CAPABILITIES

Research pioneers new method for sensing contaminants in the field

Soldiers need exceptional situational awareness of environmental contaminant threats they may face in the operational environment, and existing sensing methods have limitations.

During FY23, ERDC collaborated with the University of California San Diego to pioneer groundbreaking environmental sensing technologies. Their efforts led to the development of highly advanced environmental sensors capable of significantly improving the detection of two toxins – perchlorate and fluoride – in the field without requiring laboratory analysis. Through the creation of novel functional molecules, their research has revolutionized detection methods for perchlorate and fluoride, effectively addressing existing limitations and bolstering the Army’s capabilities.

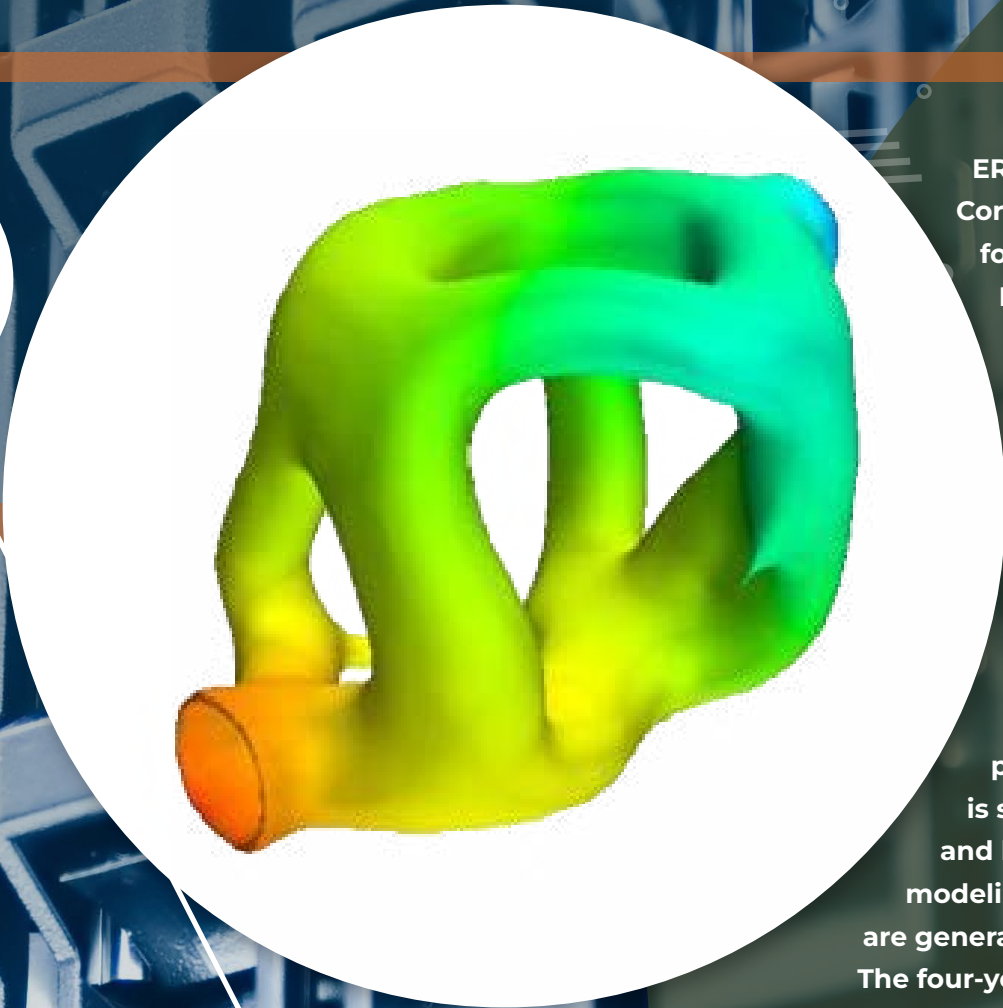
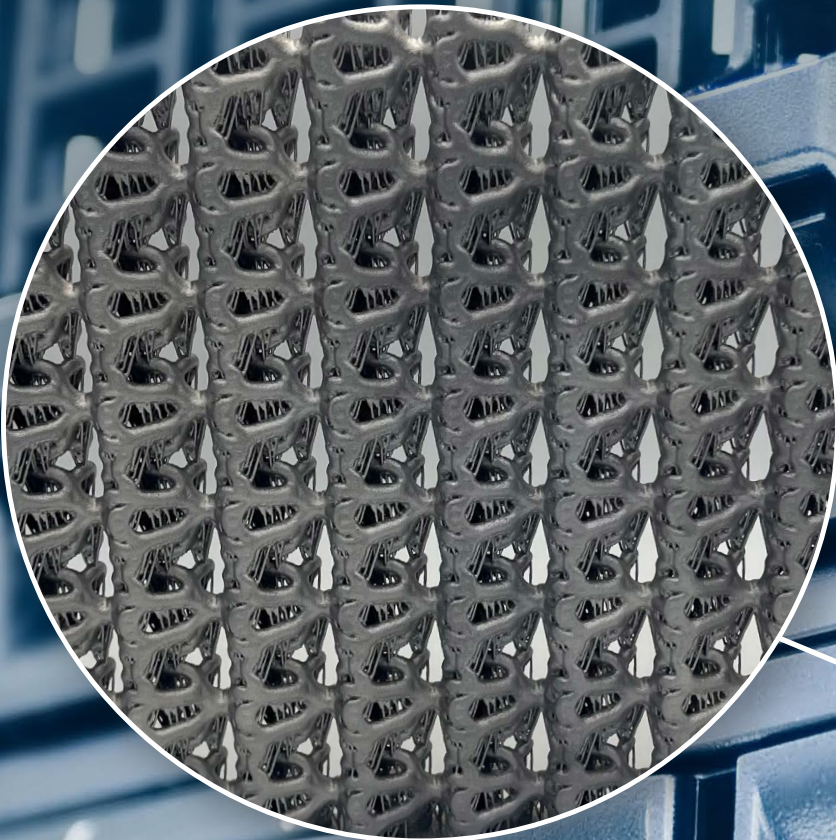
The team’s molecular sensing technologies lay a strong foundation for future improvements and advancements in various scientific fields and industries, such as environmental monitoring, agriculture and medicine. This cutting-edge research will improve public health, environmental monitoring and natural resource management and enhance the U.S. Army’s technical capabilities in challenging operational environments.



This effort will enhance the U.S. Army’s
**CAPABILITIES IN CHALLENGING
OPERATIONAL ENVIRONMENTS**

NEXT GENERATION MATERIALS

Effort uses AI to optimize digital design



ERDC is partnering with Eaton Corporation to design novel materials for the U.S. Army using Artificial Intelligence and high-fidelity simulations on ERDC's supercomputers.

The collaborative effort will result in better materials-by-design, digital engineering at component scale, and manufacturing process optimization for a variety of end-use applications that span mechanical and electromagnetic performance requirements. ERDC is supporting the technical work and helping scope and evaluate the modeling tools and prototypes that are generated.

The four-year effort encompasses AI-enabled computational design of components (digital engineering), optimizing how components are manufactured to minimize defects, materials-by-design, and combining each of these elements for a full materials-manufacturing-design optimization. The primary innovation is that the team is working to optimize materials against many requirements from strength to fatigue to thermal properties and more, rather than merely focusing on optimizing against a single requirement. This will result in designs that are much different than currently available design optimization tools with improved cost, lighter weight and better performance.

Effort will produce
NOVEL MATERIALS
optimized against many requirements



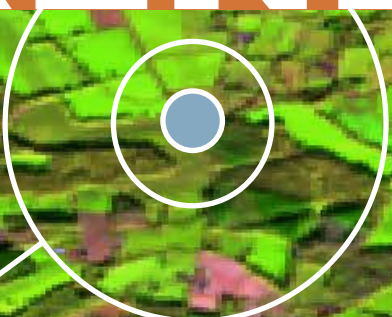
ENHANCED SITUATIONAL AWARENESS

Geospatial engineering tools enable faster decisions

Soldiers are often forced to rely on outdated geospatial data using manually intensive tools, which limit the speed with which situational understanding can be gained. Therefore, the Army needed an automated capability to transform data collected by tactical units – such as lidar, overhead imagery and full-motion video derived data – into temporally relevant three-dimensional terrain foundation and analysis products.

ERDC developed more than 30 geospatial tools that can rapidly process 2D and 3D imagery from a variety of sources to generate geospatial products that support faster decision making. Transitioned in September 2023 and compatible with the Next Generation Geospatial Workstation, the Enhanced Terrain Processing toolkit enables geospatial engineers to rapidly analyze temporally relevant terrain conditions, including land cover classification, tree location and crown estimates, terrain roughness, optimal mobility corridors and more.

Together, these tools will give the Warfighter superior situational understanding and knowledge of the operational environment, increasing mission effectiveness and improving Warfighter safety.



Tools will give the Warfighter
SUPERIOR KNOWLEDGE
of the operational environment

HAVE WATER, WILL TRAVEL

New Advanced Water Logistics System Supports Army Needs

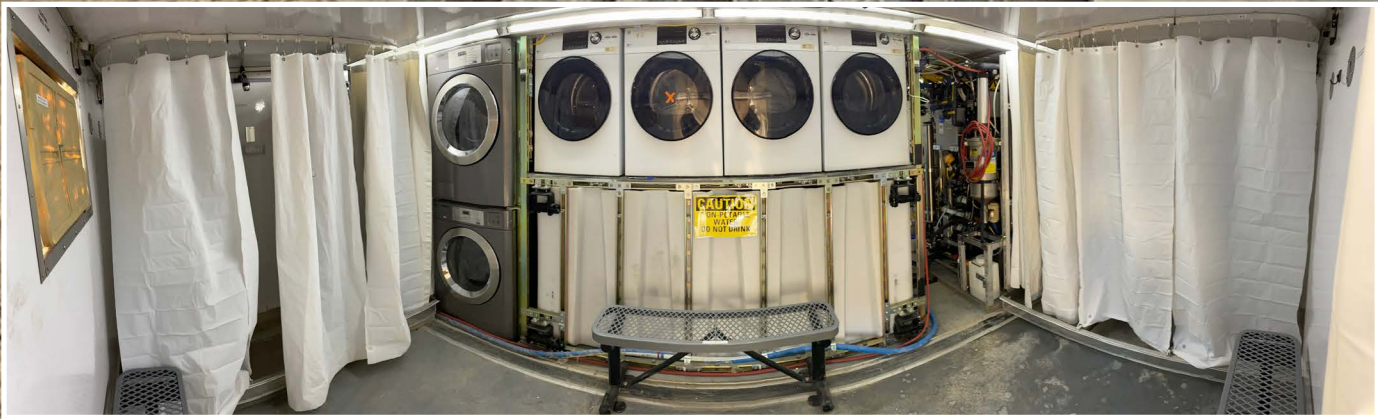


The Army has great capabilities to identify water sources in complex environments, and it also has capabilities for purifying that water and pushing it forward to sustain Soldiers. However, water remains one of the top resupply demand signatures on the battlefield.

To answer that need, ERDC and the Army Combat Capabilities Development Command Ground Vehicle Systems Center are developing the Advanced Low Logistics H2O system, or ALL-H2O, a wheeled system that is focused on hygiene support, demand reduction and increasing production at the point of need.

The ALL-H2O system provides shower and laundry support in a mobile platform. The onboard water recycling system reduces its resupply by 75 percent and produces clean water that exceeds reuse criteria. The showers, laundry and water recycling capability are on a popout hard-wall container located on the back of a Palletized Load System trailer and designed for quick setup and teardown. The front flatrack contains power generation and energy storage technology, water heaters and heat recovery systems, and peripheral equipment.

The ALL-H2O system was featured at Project Convergence in November 2022, and it underwent additional testing at Fort Leonard Wood, Missouri during the summer of 2023.

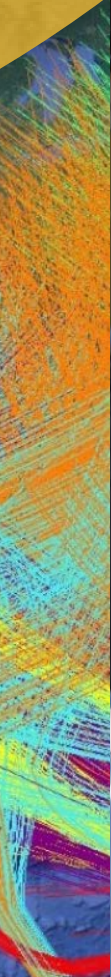


Water recycling capabilities
REDUCE RESUPPLY BY 75%

SUPPORT FOR OTHERS

As the nation’s premier public engineering and environmental sciences organization, USACE often supports other federal, state and local agencies, as well as private-sector and international partners. USACE’s Support for Others program largely focuses on five thrust areas: natural environment, infrastructure, security, contingency operations and energy.

USACE possesses unique engineering and scientific capabilities. These can be applied to diverse national challenges – from climate change to aging infrastructure to cybersecurity to soft-target protection – and the lessons learned from this research can often be leveraged to shape new USACE innovations.



NAVIGATE

RAPID & DETER: Security systems shine at NFL DraftPage 96

NATO Engagement: Providing expertise to critical alliesPage 98

Climate Assessment: Technology helps DOD, allies spot climate vulnerabilitiesPage 100

Innovation2Market: Businesses given chance to license ERDC technologyPage 102

Computer Alliance: ERDC helps Australia develop supercomputing programPage 104

More Durable Pavement: Using electron beam accelerators to strengthen roadsPage 106

Champlain Tower Investigation: Providing concrete forensicsPage 108

USA Luge: Researchers help Olympic team gain speedPage 110

Oil on Ice: Research supports rapid mitigationPage 112

PROS

HELPING THE

PROS

NFL Draft security bolstered by ERDC technology

When the National Football League sought to upgrade the security around the 2023 draft in Kansas City, Missouri, it did so with ERDC-developed technology.

In the months leading up to the draft, ERDC joined the Department of Homeland Security and local officials to provide a safe venue for the public and participants.

ERDC deployed the Ready Armor Protection for Instant Deployment (RAPID) barrier and the Deployable Expedient Traffic Entry Regulator (DETER).

RAPID is a collapsible protective security product used for critical asset protection and intrusion prevention that can be set up in less than 30 minutes.

DETER is an entry-control barrier that protects critical assets and soft targets from vehicular attacks. It was designed for quick deployment and is adaptable to various lane widths, road surfaces and environmental conditions.

Both systems are under consideration for use by the NFL and other agencies and organizations.



RAPID



DETER



RAPID is a barrier that
PROTECTS CRITICAL ASSETS
 and can be set up in less than 30 minutes

CROSSING THE POND

International alliance leans on USACE expertise



Collaborating with partners is a key part of the USACE mission, and the organization is deeply committed to supporting one of the United States's most important alliances.

ERDC has many touch points with the North Atlantic Treaty Organization (NATO) at all levels and across many areas, from strategic engagements with NATO

Headquarters to technical discussions with the NATO Military Engineering Centre of Excellence (MILENG COE).

ERDC is heavily involved in MILENG COE seminars, participating in bi-annual working groups, the annual Senior Joint Engineer Conference, Information Exchange seminars and specialty engagements. Topics range from force projection infrastructure like bridges and airfields to base support such as protective structures and operational power and energy.

ERDC team members sit on NATO teams of experts in such fields as military bridge assessment, contingency airfields, airfield damage repair and technical effects. They are also supporting NATO leaders on high visibility projects on gap crossing and countermobility.

Currently, ERDC is helping NATO Headquarters on its new Advancing Interoperability and Standardization funds to further develop a universal floating bridge adapter to allow multinational crossings of wide wet gaps.

**Collaborating with NATO
STRENGTHENS**
international alliances and research

CHANGE IN CLIMATE, CHANGE IN TACTICS

USACE tool helps DOD, allies pinpoint climate vulnerabilities

As changing climates and extreme weather patterns impact U.S. military lands, installations and mission plans, the DOD needed a tool to help it better understand and adapt to these climate hazards. In response, USACE R&D developed the DOD Climate Assessment Tool (DCAT), which assesses climate exposure to multiple hazards for DOD assets in this country and around the world. DCAT helps the DOD determine where to best apply resources to mitigate the climate vulnerability of its people, infrastructure and systems.

Responding to a request by Defense Secretary Lloyd Austin, a custom version of DCAT was developed for six U.S. allies. The Climate Assessment Tool (CAT) was released in April 2023, and specially tailored versions were shared with Australia, Germany, Italy, Japan, Korea and the United Kingdom to aid long-term planning and climate-informed decision making.

Sharing a customized version of DCAT with allies enhances their climate resilience, promotes security cooperation and interoperability, and strengthens U.S. national security.



Sharing CAT with allies promotes interoperability & STRENGTHENS NATIONAL SECURITY

IN IT TOGETHER

Businesses, investors explore ERDC technology transfer opportunities



As the U.S. military seeks to maintain its technological advantage, finding avenues to transfer technologies is vital to the DOD's mission of developing new technologies and promoting their commercialization.

Technology transfer efforts help ensure the nation's investment supporting innovative research is transferred from defense laboratories to the American people.

In May 2023, ERDC hosted the Innovation 2 Market (I2M) patent showcase in Vicksburg, Mississippi to allow businesses and investors to see what private-sector partnerships with ERDC have accomplished. The event was organized and hosted by ERDCWERX, ERDC's technology commercialization partner.

During the event, ERDC Geotechnical and Structures Laboratory Director Bart Durst and Andrew Edwards, Edwards Design and Fabrication, signed a contract allowing the company to manufacture and sell the Modular Guard Tower System patented by ERDC. In addition to that signing, attendees also gained insight into ERDC patents licensed to private companies.

The showcase featured ERDC technologies in electronics and sensors, environment and energy, and protective structures and systems, as well as ERDC's streamlined licensing options. The event also allowed attendees to network with ERDC's partners ERDCWERX and Techlink.



Technology transfer efforts
are key to our military's
TECHNOLOGICAL ADVANTAGE



Follow this link to learn more about commercialization opportunities with ERDC



A GLOBAL SUPERCOMPUTING ALLIANCE

ERDC’s supercomputing expertise supports
Australia in developing its own program

For nearly a decade, ERDC has supported the efforts by the Australia Department of Defence to develop and expand state-of-the-art high-performance computing capabilities.

Leveraging ERDC’s world-class experience and the support of the High-Performance Computing Modernization Program (HPCMP) – managed by ERDC – Australia’s capability will play a vital role in the design, development and analysis of modern weapon and national security systems.

Since 2016, ERDC and Australia have explored, formalized and continued to expand collaboration on defense supercomputing. From 2019 to 2023, with considerable assistance from HPCMP, Australia designed, contracted and built its first defense supercomputer.

In August 2022, with officials from ERDC and HPCMP in attendance, Australia debuted its first defense supercomputer named Taingiwilta, which means powerful in the language of the Kurna people.

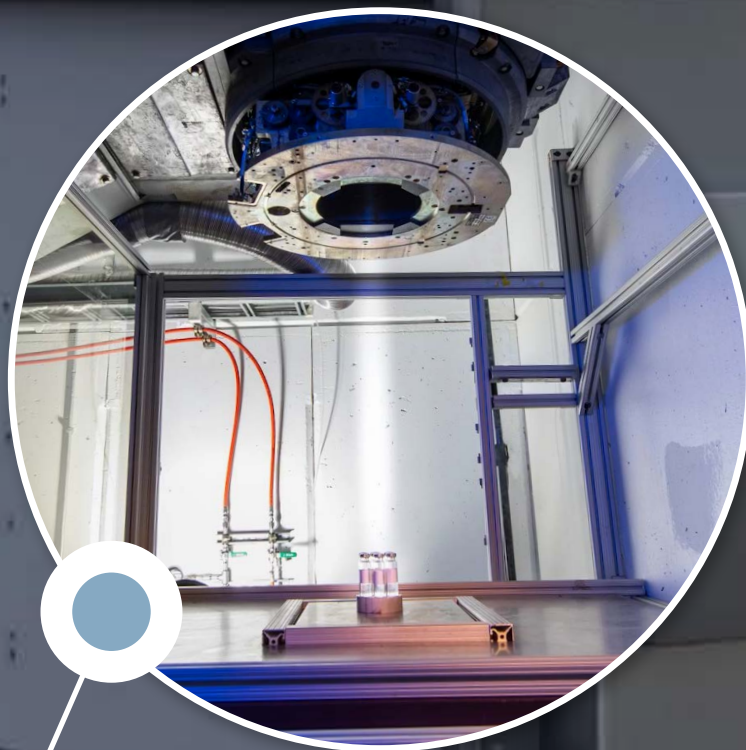
In recent years, this supercomputing collaboration has grown to include the UK’s Ministry of Defence (MOD). In February 2023, ERDC Director Dr. David Pittman and MOD’s Director of Strategic Programmes Dr. Shimon Fhima met to accelerate the formalization of their cooperation.



Australia’s supercomputing capability
will help **DESIGN & DEVELOP**
modern weapon and national safety
security systems

DURABILITY

Partnership applies innovative technology to strengthen road surfaces



Pavement infrastructure is a critical national asset that impacts military mobility, the transport of goods, and personal travel. However, current pavements require frequent maintenance, resulting in a high logistical burden and elevated carbon footprint. For the U.S. military, which demands strong surfaces that can support its heavy vehicles and aircraft, the high volume of repairs means large machinery and repair materials must regularly be moved to far-flung locations.

Responding to this need, a partnership between ERDC, the U.S. Department of Energy's Fermi National Accelerator Laboratory and the University of Illinois's Center for Transportation Research is using novel electron beam accelerator technology to create more durable pavements. The unique collaboration combines Fermilab's deep knowledge in particle acceleration science and technology with ERDC's extensive expertise in military pavement.

This effort will dramatically improve pavement strength, toughness and service time, potentially saving the DOD hundreds of millions of dollars, while also reducing the pavement industry's large carbon footprint.

Effort will reduce carbon footprint and could save the DOD **MILLIONS OF DOLLARS**

LOOKING FOR ANSWERS

USACE team supports Surfside condo investigation

The investigation into the June 2021 partial collapse of the 12-floor Champlain Towers South in Surfside, Florida, has had to overcome multiple challenges, from ensuring the stability of the remaining structure to locating building fragments that hold clues as to why the condominium collapsed and how to decrease the chances of a similar incident happening in the future.

USACE, and its R&D community, has played an important role in supporting that investigation, which is led by the National Institute of Standards and Technology (NIST). USACE executed 12 task orders with NIST, totaling more than \$2.1 million, with multiple USACE districts supporting the effort. ERDC's concrete forensics team provided research-level precision in sampling and unique column sawing equipment capabilities and has collected hundreds of evidence samples.

Thanks to their efforts, NIST was able to release a September 2023 update based on preliminary evaluations of the collected data.



USACE provided **RESEARCH-LEVEL PRECISION IN SAMPLING** and unique column sawing equipment

GOING FOR GOLD

Scientists help USA Olympic Luge Team in unlocking more speed



Photo source: USA Luge



ERDC is part of a group helping the USA Olympic Luge team go faster. For decades, the teams have been sliding more than 70 mph on ice, but there is room for improvement.

Recently, the luge team assembled an interdisciplinary group of athletes, scientists and engineers to develop new approaches to minimize ice friction and increase speed.

ERDC engineers and scientists were among those who participated in a workshop in Park City, Utah, and have been invited to serve as consultants for the team. During the workshop, the group brainstormed future research ideas and potential solutions to enhance sled design and performance.

ERDC is using the partnership to gain additional understanding of the high- and variable-speed ice friction phenomena and applying it to ongoing research to support the U.S. Army. Although mobility and traction applications often require good ice adhesion, skis and sleds are an important mobilization method that significantly benefits from decreased friction.

Olympic team research supports
BETTER MOBILITY
for the Army in Arctic environments

CLEANUP SPECIALISTS

USACE research supports rapid mitigation of Arctic oil spills

When it comes to oil spills, efficient cleanup methods play a vital role in mitigating damage. Striving to improve techniques to rapidly mitigate oil spills in sensitive Arctic environments supports USACE's mission of environmental stewardship, as well as the U.S. Army's efforts to execute its Arctic strategy.

To achieve this mission, ERDC researchers have been working in coordination with others – such as the Defense Advanced Research Projects Agency, Environmental Protection Agency, and National Oceanic and Atmospheric Administration, among others – for decades to develop novel systems for cleaning oil from ice-laden waters.

Unique ERDC facilities in New Hampshire are among only a few facilities in the federal government with the licenses, equipment and personnel to safely test in-situ burning, a technique often used to mitigate oil spills in ice-covered water. These facilities, plus ERDC's cold-weather expertise, allow technologies to be tested in controlled environments, giving researchers a better understanding of what will happen in real-world situations and helping them improve cleanup efficiency.



Research will enable techniques to
REDUCE OIL-SPILL DAMAGES

EFFICIENT & SUSTAINABLE

The establishment of Engineering With Nature® (EWN) revolutionized USACE, presenting a shift toward integrating natural elements into engineered solutions for maximum benefit, operational efficiency and sustainability.

While nature-based features had been sporadically practiced, EWN introduced a more systematic and focused framework. The formal launch of EWN in 2010, led by Dr. Todd Bridges, then-Army Senior Scientist for Environmental Science, marked a milestone where these concepts were synthesized into a cohesive structure.

Today, the program is a major partner with the DOD, and a surge of both Congressional and White House support has amplified the program and the importance of nature-based engineering solutions.

Now working with all ERDC laboratories and across USACE in proving ground districts and divisions, EWN has transitioned from a conceptual framework to a widespread movement. It informs policy, practice and research, driving the adoption of nature-based solutions for infrastructure development and contributing to a more resilient, sustainable and collaborative future.



Scan for the EWN website



Scan for the EWN podcast

NURTURING COASTAL HABITATS

New guidelines transform the management, use of dredged material

In an era where sustainable practices are at the forefront, ERDC and EWN unveiled guidelines for Thin Layer Placement (TLP), revolutionizing the management of dredged material. USACE annually dredges more than 200 million cubic yards of sediment for waterway maintenance, and these new guidelines address the organization's goal of increasing the beneficial use of dredged sediment to 70 percent by 2030.

The shift from traditional dredged material placement to TLP marks a strategic move toward ecological objectives, recognizing the critical role sediments play in countering sea-level rise and nurturing coastal habitats.

TLP involves purposefully depositing sediment in thin, one- to two-foot lifts to restore coastal wetlands and promote the natural recolonization of habitat and benthic species. The guidelines provide a comprehensive roadmap for practitioners, covering historical context, project characterization, goal setting, design considerations, construction insights, monitoring strategies, adaptive management and future research needs.

Developed through collaborative input of practitioners, the guide offers examples, considerations and case studies. It positions TLP as a transformative practice in the realm of sediment management, moving beyond the innovative application to standard practice.

Guidelines recognize critical role sediment plays in **COUNTERING SEA-LEVEL RISE**



INNOVATIONS AT WORK

From the smallest creeks and streams in the Northwest to the largest inland river system and navigation controls along the Mississippi River, innovation is driving USACE to deliver projects and programs within budget, better, faster and safer than ever before.

In the November 2023 edition of the USACE Power of R&D newsletter, Northwestern Division (NWD) Commander Brig. Gen. Geoff Van Epps said, “including innovation in all our efforts, from taking care of people to supporting partners and delivering programs, will be the key to our future success throughout NWD and the USACE enterprise.”

In collaboration with ERDC engineers and scientists, the EWN program, industry and academia, USACE has turned traditional planning, permitting, construction and infrastructure management on its head.

Examples of these new approaches include the adoption of NNBf in USACE projects to build more resilient coastlines; using new materials and techniques to extend the lives of critical infrastructure components; and incorporating the latest technologies to better manage and protect our nation’s critical water resources.

For USACE, innovation is critical to facing and conquering challenges that are becoming increasingly complex.

NAVIGATE

Great Lakes and Ohio River Division: Resilient coastlines with NNBf	Page 120
Mississippi Valley Division: Intricate river structure scans	Page 122
North Atlantic Division: Autonomous survey capabilities	Page 124
Northwestern Division: Models predict severe weather dam risks	Page 126
Pacific Ocean Division: Blending modern engineering with traditional knowledge	Page 128
South Atlantic Division: Using beach debris to strengthen dunes	Page 130
South Pacific Division: Reducing flood risk with natural features	Page 132
Southwestern Division: Software analyzes research data	Page 134
Transatlantic Division: Program encourages tomorrow’s engineers	Page 136

MAKING GREAT EVEN BETTER

Natural & Nature-Based Features key to
more resilient coastlines on the Great Lakes

Communities along the Great Lakes coastline are experiencing increased frequency in coastal flooding and erosion, causing property damage, putting lives at risk and disrupting local economies. And while NNBF can provide innovative ways to improve coastal resilience, current understanding of these measures is mostly limited to the ocean coast, resulting in a lack of confidence in applying them along the Great Lakes.

In response, researchers with EWN are developing a Great Lakes-specific playbook that includes NNBF and Multiple Lines of Defense (MLD) to improve future coastal resiliency.

The effort will assess and quantify the performance of existing NNBF and MLD projects along the Great Lakes, use EWN principles to develop new conceptual designs specific to the region that achieve greater resiliency, and estimate cost-benefit performance of innovative NNBF and MLD designs under a range of current conditions and future climate scenarios.

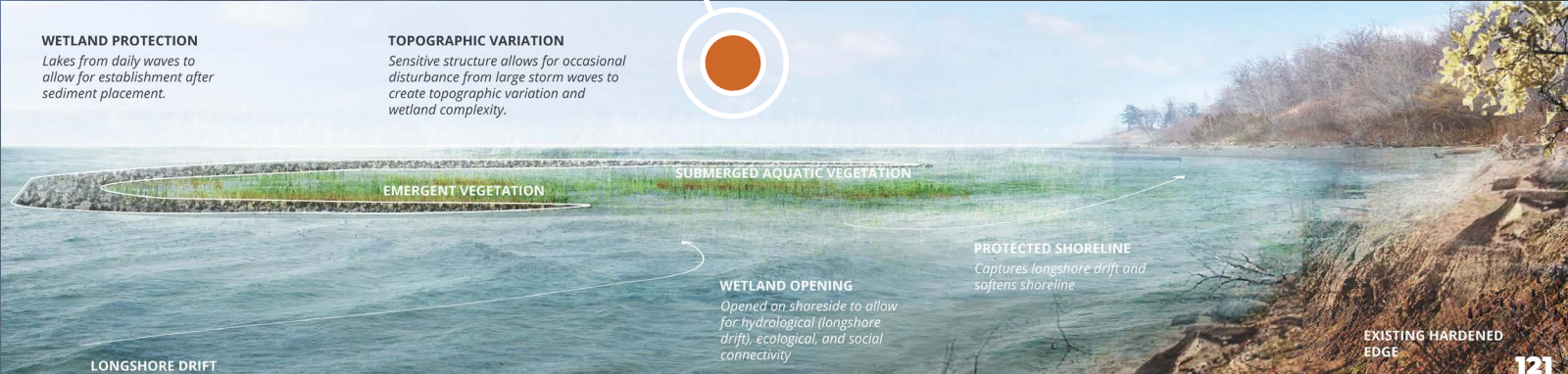
By informing the recently initiated Great Lakes Coastal Resiliency Study, this effort has the opportunity to directly apply this guidance in planning for coastal resiliency at a watershed scale.



OTHER INNOVATIONS

As part of an ongoing project in Fort Sheridan, Illinois, along more than two miles of Lake Michigan shoreline, the Chicago District and its partners restored 207 acres of ravines, riparian woodlands, bluffs, dunes and lacustrine habitat. The goal was to bring resilience and connectivity to coastal natural habitats and restore historical native plant communities. The habitat was restored by removing a dam, reestablishing native canopy cover and native plantings, promoting natural riverine sediment transport and more. Coastal bluff, beach and dune restoration included invasive plant species eradication and native plantings using local genetic ecotypes.

To improve conditions for employees and lock operations, innovative thinkers at the Nashville District developed a lock line hoist. This device eliminates the need for lock operators to navigate ladders to manually lift heavy and sometimes frozen lines more than two stories to the top of lock walls. Primarily focused on improving safety, this device reduces reliance on embedded ladders that are often intended for emergency use only. Designed and fabricated by Brad Marshall, Senior Lock and Dam Equipment Mechanic at Kentucky Lock, the device is now being considered for other facilities throughout the Nashville District.



MIGHTY IMAGES OF THE
MIGHTY
MISSISSIPPI

Historic water levels give researchers
unique opportunity to survey river structures

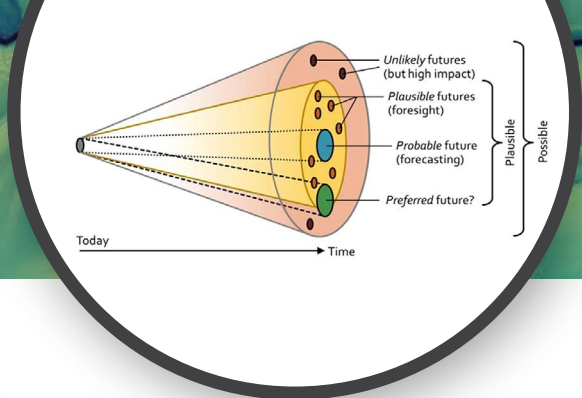
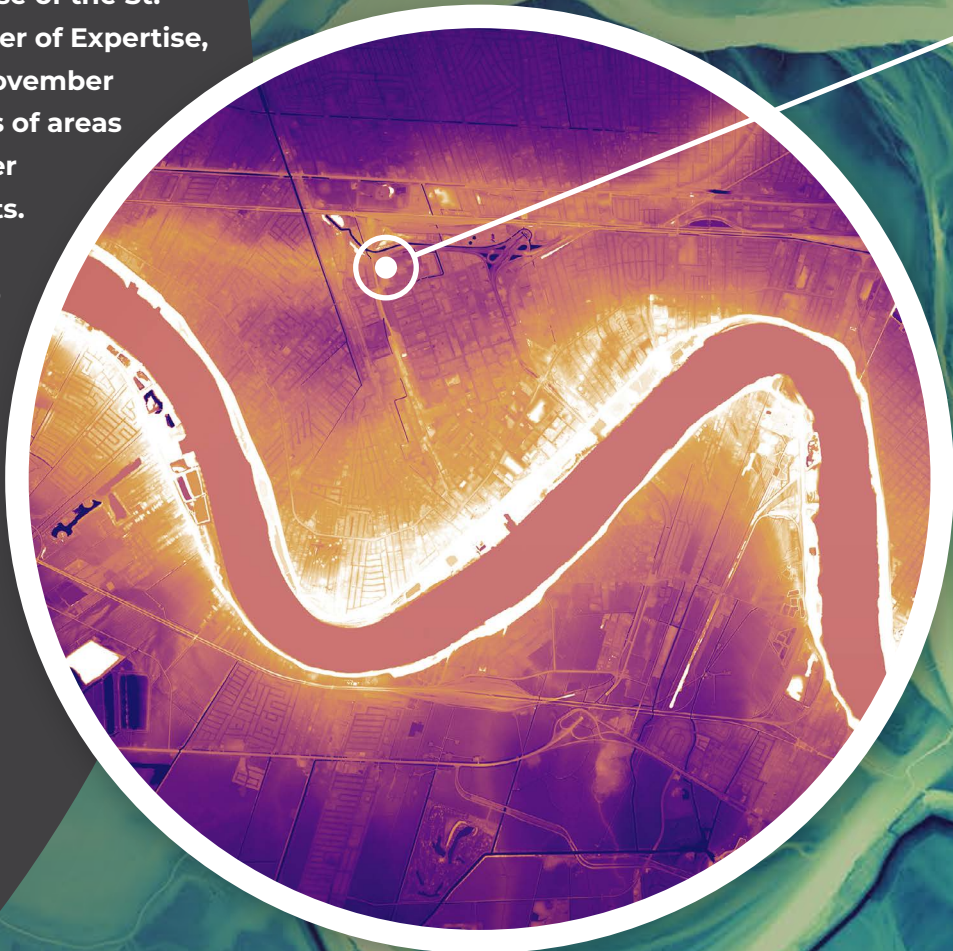
When Mother Nature gives you historically low river conditions, you take advantage of it. The Mississippi Valley Division (MVD), using the resources and expertise of the St. Louis District's Photogrammetric Mapping Center of Expertise, used the low levels of the Mississippi River in November 2022 to capture – in great detail – the conditions of areas along the Lower Mississippi River (LMR) and river training structures such as dikes and revetments.

The lidar survey of the more than 900 miles of the LMR was conducted from Cairo, Illinois to the Gulf of Mexico.

The aerial lidar survey provided critical data that will be used to update existing and future numerical models, inform geologic mapping of land near and around levees, and create a structural health assessment of the dikes and revetments.

Each dike system is unique. Following construction, these dikes are subjected to the natural forces of the river that can significantly alter original configurations. This makes determining the exact dimensions of the dikes difficult.

Quantifying this information will be beneficial to ongoing and future geomorphic assessments, modeling efforts and environmental studies.



The Future River Analysis and Management Evaluation (FRAME) model, developed by ERDC, is being used by MVD on the LMR to provide a better understanding of how various natural and river management factors have contributed to the observed morphological responses in the river over the past 100 years or more. Once calibrated, the model will provide insight into the impact individual factors; such as sediment supply changes, tributary dams, and levee construction and heightening; will have on the river system. This effort will result in an improved model and prove valuable to future geomorphic assessments and river management throughout the nation.

OTHER INNOVATIONS

Images produced by Dan Coe
Washington Geological Society
<https://www.usgs.gov/programs/national-geospatial-program/national-map>

FORCE MULTIPLIER

Autonomous uncrewed vessel supports critical survey mission

USACE's North Atlantic Division can expediently deploy a unique capability that can collect accurate hydrographic survey data of waters soon after the conclusion of a storm or other emergency event.

Surveyor Amy, an autonomous uncrewed vessel complete with a multi-beam survey system, can survey remote places difficult for traditional crewed survey vessels to reach and can work alongside crewed vessels as a force multiplier to cover vast project areas.

Applications for the Surveyor Amy system include coastal management and monitoring, dam safety and levee inspections, bridge inspections, post-storm damage assessments and 3D-modelling. The rapid deployment of the system during a crisis response period increases pre-storm and post-storm responsiveness for project assessments.

Surveyor Amy's lightweight reinforced rigid hull design is powered by twin, high-powered jet drive systems. It is also designed to self-right in a scenario where the vessel is flipped over by ocean conditions.

The accuracy of USACE hydrographic surveys is critical to the success of every design and construction activity. The capability afforded by Surveyor Amy allows for a faster, more accurate, safer and more affordable surveying option.

Here is a scan of an old steamboat wreck in New York's Hudson River.

OTHER INNOVATIONS

Due to the significant amount of data being collected daily at a remedial cleanup site, the Philadelphia District recognized the need for enhanced data collection. Traditional methods, such as paper forms and hand-drawn maps, were inefficient. These limitations hindered the progress of remediation efforts. USACE developed a digital, data-driven approach to revolutionize field data collection and transform the way data is managed and utilized. The product provided real-time data availability, increased efficiency, and quality and accelerated decision making.

The New England District is using an innovative covering to extend the life of paint systems protecting critical infrastructure components in the Northeast. Paint systems are a protective coating for bridges and other steel structures. These coatings, which can last an estimated 15-25 years, prevent and delay corrosion. By using a special, two-component epoxy primer and sealer and special techniques to apply the coating, officials expect these products to extend the paint life by another 10 years.

PREVENTING FUTURE FAILURE

Using atmospheric modeling to predict risks to dams from extreme rainfall events

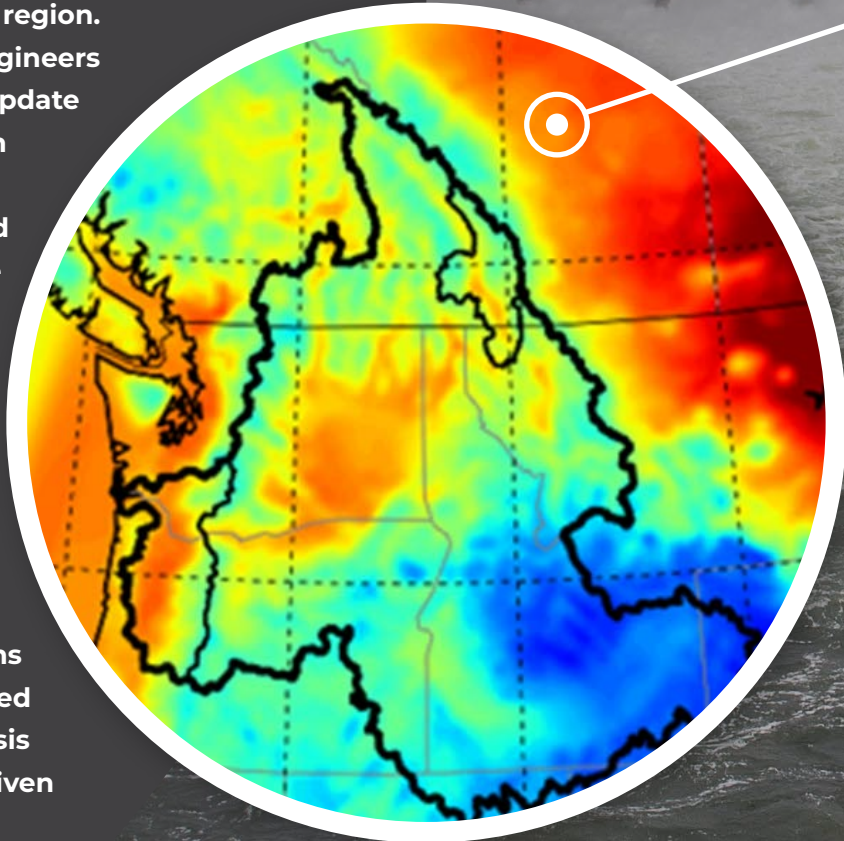
Characterization of extreme storms for a dam safety risk assessment can result in millions of dollars spent or saved on dam remediation.

USACE needs improved methods to reduce the uncertainty in inflow design flood estimates, especially estimating the impact of extreme storms in a given region.

Northwestern Division (NWD) engineers worked for more than five years to update the Probable Maximum Precipitation (PMP) metric, a key parameter in estimating Probable Maximum Flood (PMF). This update is of considerable importance for the design of hydraulic structures and for the risk assessment of their potential failure.

Unlike the traditional PMP estimation approach, this approach provides a sequence of extreme precipitation, as well as other atmospheric variables for large basins and long durations, which can be used to conduct a snowmelt-runoff analysis to estimate the PMF in snowmelt-driven regions.

This NWD project will help efforts to emphasize the use of atmospheric numerical models.



OTHER INNOVATIONS



NWD supported the beginning of large wood nourishment, part of an EWN pilot project to improve habitat in the Kootenai River below Libby Dam in northwestern Montana. The dam blocks the natural supply of large wood from the watershed upstream. This project seeks to beneficially reuse wood debris by placement in the river habitat, rather than the current management of large wood by contract burning and firewood. Large wood nourishment at Libby Dam is modeled after a similar project at Howard Hanson Dam, which has led to an increase in habitat on the Green River at a much lower cost than it would take to emplace it using traditional engineering and construction methods.



Working with the Pacific Northwest National Laboratory, NWD is collecting data to inform and improve the engineering and design of the downstream fish passage facility for the Howard Hanson Dam. Test treatments of sensor fish and live balloon-tagged fish were released at the upstream intake of the tunnel and recaptured downstream. Recaptured fish were evaluated for injury and survival, and sensor-fish data were downloaded for understanding hydraulic conditions in the tunnel. Results are pending completion of data analysis and will inform the dam's downstream Fish Passage Facility engineering design.

ANCESTRAL EXPERIENCE

Alaska project blends modern engineering
with traditional knowledge

Point Hope is a village in remote northwestern Alaska experiencing coastal erosion, flooding, thawing permafrost and sea-level rise. These factors affect the community ice cellars (sigluaqs) and sod houses, as well as the only road providing access to higher ground.

To address these impacts on cultural heritage, food security and safety, EWN and its partners, including the Point Hope community, are working to incorporate NNBf along the north shore of the Point Hope peninsula.

This project aims to integrate traditional ecological knowledge with modern engineering approaches to devise effective coastal resilience measures. Through community engagement, several priorities were identified, including preserving cultural sites, enhancing infrastructure reliability and ensuring safe maritime access.

Drawing on the community's ancestral knowledge, the project culminated in the development of preliminary designs for shoreline protection measures, including dune systems and enhanced sigluaqs.

Such partnerships that actively include traditional ecological knowledge enable EWN and its partners to optimize designs for enhanced resilience in cold regions.

Alaskan project seeks to
PRESERVE CULTURAL SITES
& ensure safe maritime access

WORKING WITH NATURE



Using natural material shows promise in building stronger dunes

USACE, the Mobile District, ERDC and research partners at the University of Southern Mississippi (USM) are trying to understand how dunes are naturally constructed and to build better, more resilient coastal dune networks.

One solution involves the use of wrack, the brown line of seaweed and other organic material that marks beach tide lines. Despite its unassuming nature, wrack may be essential in strengthening our nation's coastlines.

Unlike previous methods to construct man-made dunes, in which dunes are built to an elevation and then planted with vegetation, researchers along the Mississippi Gulf Coast are evaluating how a man-made dune responds when this wrack is incorporated into the dune incrementally, mimicking the natural growth cycle.

Continuing to assist the program under the EWN umbrella, USM's Gulf Coast Geospatial Center is providing high-quality surveys of the area, leveraging state-of-the-art survey-grade equipment and a team of experienced staff, faculty and students.



OTHER INNOVATIONS



Continued USACE investment, research and innovation is helping local and state stakeholders overcome the challenges of restoring cherished Everglades ecosystems. The South Florida Ecosystem Restoration Program's (SFERP) Comprehensive Everglades Restoration Program is the largest environmental restoration program in history. USACE has invested \$2.3 billion to date into the SFERP. USACE's support also includes leveraging the expertise of the EWN program and its understanding of using natural systems and processes. The Jacksonville District provided a tour of key locations in the Everglades area for ERDC and EWN leaders to give them a better understanding of the project's scope and restoration and resiliency goals.



ERDC and Savannah District engineers partnered to study vessel wakes near the north shore of Tybee Island, Georgia, to better understand which ships and operating conditions near the Port of Savannah are generating large wakes. Tybee Island is a popular vacation spot and tourist destination. However, commercial vessels transiting the Savannah entrance channel intermittently generate large wake events on the North Beach, creating a potential hazard for beachgoers. Using instrumentation data and U.S. Coast Guard vessel information, the team correlated each ship with the wake it generated. Further research is needed, but some mitigation suggestions were provided to Tybee Island and Coast Guard officials.

NATURAL

Incorporating natural features builds a better, more cost-effective flood risk plan

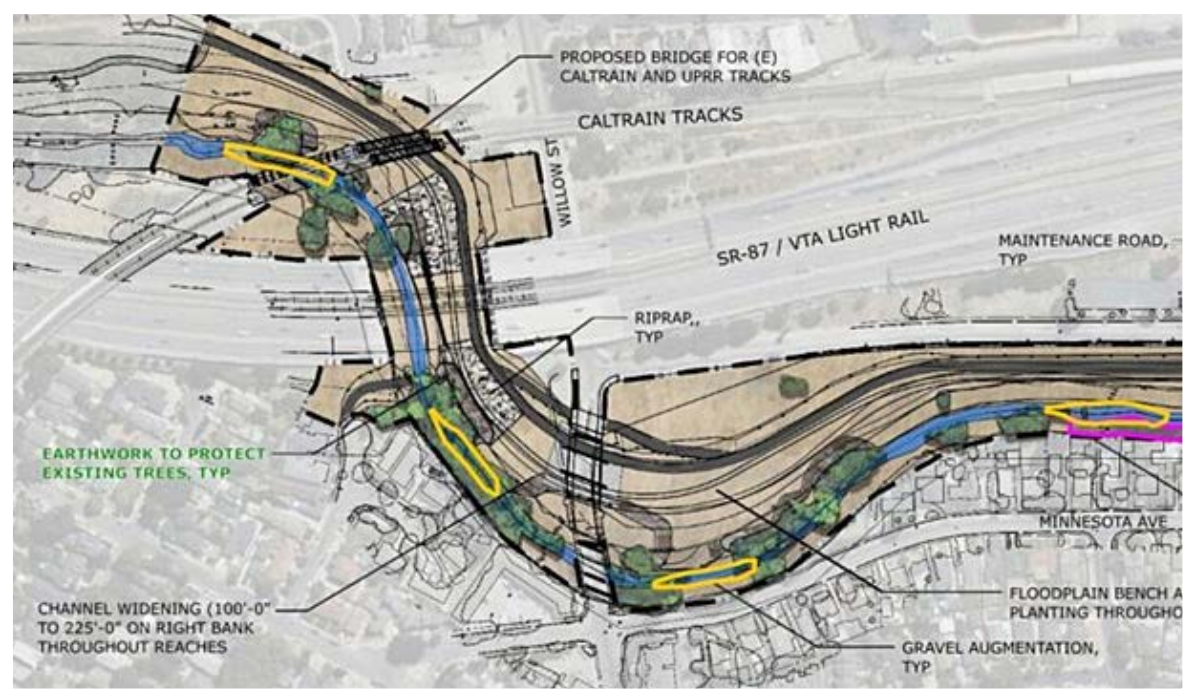
By revisiting an approved flood risk management plan from 2007 and incorporating lessons and designs from the EWN program, the South Pacific Division has laid out a new vision for a portion of the Guadalupe River that flows through the center of San Jose, California.

The Upper Guadalupe River Flood Risk Management Project, developed in coordination with the USACE National River Committee, includes converting nearby parking lots and pavement into riparian forests, reestablishing a previously urbanized floodplain, and effectively managing the risk of floodwaters breaking out of their constricted reaches.

The recommended plan is designed to be a self-sustaining, multi-stage channel that reduces maintenance requirements. It includes channel widening and floodplain benches that increase channel capacity, lower flood stages, and reduce pinch points.

The revised plan also is estimated to be half the cost of the previously authorized plan and yields an estimated \$12 million in net national economic development benefits.

It is projected the new design is comparably effective to the previously authorized plan at managing flood risk and provides higher environmental quality benefits through the creation of nearly 30 habitat units of riparian forest.



OTHER INNOVATIONS

Built on the success of Forecast-Informed Reservoir Operations (FIRO) to enable more efficient and resilient water management operations, SPD is looking to expand the initiative to more reservoirs and watershed operations. When first implemented at Lake Mendocino in the Russian River watershed, FIRO operations resulted in about 20 percent more storage in 2020 to improve water supply reliability in a drought year. FIRO is currently underway at Lake Sonoma, Prado Dam and Seven Oaks Dam, and Lake Oroville and New Bullards Bar Dam (Yuba-Feather watershed), all in California, and Howard Hanson Dam in Washington. The Yuba-Feather FIRO project started in 2019 with a targeted completion in 2024. This project develops a process to explore the potential for applying FIRO at New Bullards Bar Dam on the Yuba River and Oroville Dam on the Feather River, for the primary purpose of flood-risk reduction.

SOUND SCIENCE, SOUND DECISIONS

EchoClass accelerates process of
analyzing critical survey data

USACE manages millions of acres of forested habitats across numerous project areas. In 2023, surveys for protected bat species were conducted at various sites in the Little Rock District at Nimrod, Blue Mountain and Beaver lakes.

As bats forage and orient themselves in their environment, they produce echolocation calls that can be recorded using ultrasonic detectors and identified to species. In these types of surveys, several ultrasonic detectors are placed at sites of potential future management action.

Surveying for these listed species is a critical component in managing these areas and future projects. In the collection process, extensive amounts of data are compiled and must be analyzed.

To help accelerate the process, ERDC developed EchoClass to successfully filter out extraneous noise and data and correctly identify the protected bat species. This innovation allows decision makers to improve the accuracy of the data collected, reduce the analysis time and maximize the conservation of the protected bat species.



OTHER INNOVATIONS



To help in the development of autonomous survey capabilities and the collection of bathymetric data on important inland waterways, Southwestern Division (SWD) collaborated with ERDC to test the USACE Maritime Autonomous Survey System (UMASS). Surveys at Port Mansfield, Texas, in 2022 saw the UMASS vessel conduct a survey of approximately 200 miles of nearshore operations. Another survey mission was conducted on the Arkansas River at Lake Dardanelle near Clarksville, Arkansas. In its development and testing, UMASS has proven valuable in increasing the precision of survey data collected in the field.



SWD partnered with non-federal partners and ERDC to test the deployment of a biological control to combat the spread of an invasive tree species, Brazilian peppertree, in ongoing ecosystem restoration projects in the Rio Grande Valley. The project, part of the USACE Aquatic Plant Control Research Program, saw the release of Brazilian peppertree thrips – small insects – to curtail the invasive tree species' advance. The goal of this work is to utilize the biological control agent to manage Brazilian peppertree growth and spread, potentially reducing costs associated with tree removal and long-term population maintenance.

BUILDING THE NEXT ENGINEERS

Student program creates innovative design and great connections

To bolster USACE's standing in its local communities, improve relations with local high school districts and instill USACE design and building standards in tomorrow's engineers, the Middle East District (TAM) developed the High School Intern Program (HSIP) that was the recipient of a 2023 USACE Innovation of the Year Award.

HSIP provides eight students per year the opportunity to learn fundamentals of engineering and architecture through job shadowing, project design and active mentorship. The program takes place during the school semester for 16 weeks.

Students learn about USACE, TAM and what architects and engineers do in the field of construction design. Following job shadowing, students take part in a design project, which is later presented to the district commander, engineers and school officials. The HSIP is expected to increase from eight to 12 students per year beginning with the 2025-2026 school year.

"Through continuous education and outreach across our local education institutions, our commitment to providing STEM-related assistance to schools and youth has resulted in local high school students becoming some of the brightest STEM professionals in TAM," TAD Commander Brig. Gen. William Hannan Jr. said.

Students in Middle East District's High School Intern Program designed an intricate observatory.

OTHER INNOVATIONS

Transatlantic Division's (TAD) Expeditionary District (TAE) added the Facilitating Advanced Simulation Teaming (FAST) technology capability in FY23, giving engineers the ability to capture true scale 3D models – digital twins – of field conditions, infrastructure assets, buildings or other objects. The digital twins significantly reduce design time and increase future design accuracy. The models enable a fully interactive environment, which allows users to virtually explore designs and view the placement of key components. The technology was developed by ERDC and transferred to TAE.

USACE Cyber Security Professional of the Year
Hannah Theisen

USACE Innovator of the Year
Amy Rainer

USACE Researcher of the Year
Dr. Martin Page

USACE CAD/BIM Professional of the Year
Stephen Spangler

USACE Control System Professional of the Year
Robert Renz

USACE Information Management/Information Technology (IM/IT) Excellence in Customer Support
Byron Garton

USACE IM/IT Excellence in Organization Support Team
ERDC Map Based Mission Planning Team

USACE Resilience Role Model Award (Team)
Climate Action Team, which ERDC is a part

USACE Innovation of the Year
TAD and ERDC Facilitating Advance Simulation Teaming Team

USACE Sustainability Award
Engineering with Nature® program

USACE Manager of the Year
Lauren Dunkin

American Chemical Society Mississippi Section Chemist of the Year
Dr. Chris Griggs

US-UK S&T Lifetime Achievement Award
Pam Kinnebrew

BEYA 2023 Modern Technology Leader
Abdul Mohamed

FLC Impact Award
HABITATS Team (Dr. Martin Page and Marissa Campobasso)

FLC Excellence in Technology Transfer Award
Drs. John Rushing, Benjamin Cox and Sadie Casillas, and Web Floyd

Women of Color STEM Career Achievement in Government Award
Pat Sullivan

Women of Color STEM Technology Rising Stars
Brandy Diggs-McGee, Jessica Frierson, Catherine Thomas and Elizabeth Gao

Presidential Rank Award
Drs. David Pittman and Todd Bridges

2023 Inductees into the Waterways Experiment Station's Gallery of Distinguished Employees
Dr. Al Cofrancesco, Patti Duett and Dr. Bill Grogan

“OUR CHALLENGES ARE EVOLVING, AND WE MUST EVOLVE WITH THEM.

INNOVATION MUST BE INVOLVED IN EVERYTHING WE DO, AND IT BEGINS AS A CRITICAL INGREDIENT TO EVERY PLAN.”

Brig. Gen. John Lloyd
Commander, North Atlantic Division

“AS WE FACE SUCH UNPRECEDENTED STRESSES, USACE’S WORLD-CLASS RESEARCH AND DEVELOPMENT WILL BE **MORE IMPORTANT THAN EVER.**”

Brig. Gen. Daniel Hibner
Commander, South Atlantic Division

“... WE MUST LEAN INTO THE **EXPERTISE** OF THE WORLD-CLASS USACE RESEARCH AND DEVELOPMENT COMMUNITY AS THEY **DISCOVER, DEVELOP AND DELIVER** THE INNOVATIVE ANSWERS WE NEED.”

Brig. Gen. Antoinette Gant
Former Commander, South Pacific Division

“INCLUDING INNOVATION IN ALL OUR EFFORTS, FROM TAKING CARE OF PEOPLE TO SUPPORTING PARTNERS AND DELIVERING PROGRAMS, WILL BE KEY TO OUR **FUTURE SUCCESS** THROUGHOUT THE USACE ENTERPRISE.”

Brig. Gen. Geoff Van Epps
Commander, Northwestern Division

“INNOVATION WILL BE MORE IMPORTANT THAN EVER IN THE YEARS TO COME ... USACE MUST REMAIN COMMITTED TO WORLD-CLASS **RESEARCH AND DEVELOPMENT.**”

Maj. Gen. Diana Holland (retired)
Former Commander, Mississippi Valley Division

Jeremy Craner, a physical scientist with the Alaska District, captured this image of a defense position constructed on Fort Learnard near the mouth of Unalaska Bay during World War II.



U.S. ARMY
U.S. Army Corps
of Engineers

ERDC B-24-1