

RECORD VERSION

STATEMENT BY

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RESEARCH AND DEVELOPMENT CENTER (ERDC)**

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Chairman Ernst, Senator Heinrich, and distinguished members of the Subcommittee, thank you for the opportunity to discuss the U.S. Army Engineer Research and Development Center's (ERDC) role and mission as a major Department of Defense (DOD) Science and Technology (S&T) laboratory. I greatly appreciate the support this committee has shown to S&T, and the opportunities this support has provided ERDC over the years to enhance its ability to carry out its mission.

ERDC is the science and technology arm of the U.S. Army Corps of Engineers (USACE), conducting research and development (R&D) in the areas of Military Engineering, Geospatial Research and Engineering, Environmental Quality and Installations, and Civil Works. Army's S&T investments develop technology options to ensure the Army is ready today and remains robust tomorrow. ERDC, and other Army laboratories, create new understandings that translate research into militarily-useful technologies through innovative solutions to satisfy capability gaps across the entire force.

ERDC's seven laboratories are located in four states: the Construction Engineering Research Laboratory in Champaign, Illinois; the Cold Regions Research and Engineering Laboratory in Hanover, New Hampshire; the Geospatial Research Laboratory in Alexandria, Virginia; and the Coastal and Hydraulics, Geotechnical and Structures, Environmental, and Information Technology Laboratories in Vicksburg, Mississippi. In addition to its laboratories, ERDC has field sites conducting specialized research: a 1,800-foot coastal research pier in Duck, North Carolina; an Aquatic Ecosystem Research Facility in Lewisville, Texas; the Permafrost Research Tunnel in Fairbanks, Alaska; and its International Research Office in London, which exists to promote cooperation with the international research community as a means to advance science and engineering knowledge and technical capabilities in areas relevant to the U.S. Army, DOD and our international military partners. ERDC has a workforce of more than 2,300 engineers, scientists and support personnel within its seven laboratories and field sites.

In Fiscal Year 2016, ERDC executed \$425 million in research, development, test, and evaluation (RDT&E), highlighted by work in support of the nine Army S&T Objectives (STO) programs, the Army's top S&T efforts warranting Army senior leadership oversight. ERDC also executed just over \$70 million in Civil Works direct funding on

R&D to address navigation, flood control and risk management, and ecosystem management and restoration. This body of R&D promotes safe and resilient communities and infrastructure; helps facilitate commercial navigation in an environmentally sustainable fashion; restores degraded aquatic ecosystems and prevents future environmental losses; and implements effective, reliable and adaptive life-cycle performance management of infrastructure. In addition to these major programs, ERDC executed more than \$500 million in reimbursable programs for every Service within DOD and other federal agencies, such as the State Department, the Defense Threat Reduction Agency, the Department of Interior, the U.S. Bureau of Reclamation, the Department of Homeland Security, the National Geospatial-Intelligence Agency, and the National Science Foundation.

ERDC builds its program (\$1 billion in FY16) by its stakeholder base (i.e., Military Engineering, Geospatial Research and Engineering, Environmental Quality/Installations, and Civil Works). This approach forces ERDC to view problems from stakeholder perspectives, rather than from a technical interest perspective, and necessitates that it solve problems that span technical areas by employing multi-disciplinary teams. As part of its annual program development process, ERDC meets with a wide variety of stakeholders to better understand their problems. At any given time, ERDC has as many as 50 employees embedded in stakeholder organizations to ensure complete understanding of stakeholder requirements and to effectively transfer technology to these stakeholders.

To meet stakeholder objectives, ERDC creates tailored scopes of work and develops solutions to fit their business processes and decision making. It transitions its technology to the Warfighter, to Civil Works, to the acquisition community, and to other government agencies, academia, and industry. It also provides the Warfighter and deployed civilian personnel around the globe with 24/7 access to subject matter experts through the USACE Reachback Operations Center. ERDC responds to thousands of reachback requests each year from around the world. In addition, ERDC provides subject matter experts through deployment to both Contingency and Humanitarian Assistance/Disaster Relief (HA/DR) operations. Since 2003, ERDC has deployed 335 team members, some with multiple deployments, to support Contingency Operations; and more than 435 team members to support HA/DR operations both CONUS and OCONUS.

Today, I would like to discuss three components resident in everything ERDC does as it carries out its diverse mission – People, Programs and Facilities. These three components are essential, not only to ERDC's success, but also to the success of each and every Defense laboratory.

Cutting-edge solutions to challenges of national importance, a satisfied stakeholder base that returns time and again for the services ERDC provides, and world-class facilities in which to conduct that research -- none of these can be successful without our people. They are ERDC's most critical resource and the resource I am most passionate about.

Innovation requires a talented workforce, and I am proud to have represented, as ERDC's past Director, the more than 2,300 engineers, scientists and support personnel of the ERDC. These men and women are committed to solving national security challenges and developing technology solutions to ensure the readiness of our Warfighters and the installations that support them, as well as their responsibility to enhance and protect our nation's water resources and the economic security they provide. These team members are agile, stakeholder-focused, passionate about their work, leaders in their technical fields, and committed to the delivery of exceptional products and services.

ERDC partners with academia, industry and the other Services to provide solutions to military and national security challenges, but it is its in-house capability to assemble multi-disciplinary teams across its seven laboratories, in concert with key external partners, of which we are most proud. It brings the best minds to the challenge, and provides its stakeholders with the technology, products and services they need to fit their requirements and meet mission goals.

If we are to continue providing reliable and sustainable S&T solutions to our Nation and Allies, it is vital that we hire and retain the best and brightest engineers and scientists our country has to offer.

ERDC has embarked on a human capital initiative to hire 800 engineers and scientists during FY16-20 in order to maintain and enhance in-house capacity to meet its mission. In its first year, ERDC exceeded its annual goal by hiring more than 160 new researchers. ERDC was able to meet this important goal in large part because of its Direct Hiring Authorities, which save time, effort and costs, and allow the organization to more effectively hire the best and brightest minds available.

These authorities are possible only because ERDC is one of 18 Science and Technology Reinvention Laboratories (STRs) with Laboratory Personnel Management Demonstration (Lab Demo) Projects authorized by the National Defense Authorization Act (NDAA) for FY1995, PL 103-337, Section 342. Thank you for your support of Lab Demo.

ERDC's Lab Demo Program was implemented in 1998. Its program includes Performance Management (Pay for Performance); Position Classification (Pay Banding); Hiring flexibilities (Distinguished Scholastic Appointments); Employee Development flexibilities (Degree Training, Sabbaticals), and Reduction in Force flexibilities to assure the best employees are retained.

Over the years, Congress has recognized and addressed the unique human resources needs of the STRLs by including additional authorities and provisions in several NDAs. These include:

- Exclusion of the STRLs from the National Security Personnel System;
- Direct Hire for Advanced and Bachelor's Degrees, STEM Technicians, and Senior Science and Technical Managers (SSTM) (and expansion of these authorities);
- Direct Hire for Students (authorized in December 2014, but not yet delegated);
- Ability to adopt a flexibility available in another STRL;
- Non-competitive conversion of students to permanent employees;
- Utilization of Retired Annuitants; and
- Retirement incentives payment.

The foregoing provisions address the uniqueness of STRLs like ERDC, first and foremost, by placing the responsibility for Human Resources and the accompanying authorities at the Laboratory Director level.

ERDC's list of success stories is endless, but a few stand out. In an age where we are competing with the salaries and benefits offered by private industry, the Lab Demo Program has increased ERDC's ability to compete for the best and brightest students. Pay for Performance has allowed ERDC to achieve a higher retention rate for high performers, with an increase in turnover for low performers. ERDC has achieved increases in minority and female engineers and scientists, as well as an increase in PhDs. It has successfully utilized Voluntary Emeritus positions, whose experience and technical skills enhance ERDC's reputation and expand knowledge of its programs at universities and organizations around the country.

Implementation and increased authorization for SSTM positions within ERDC (23 positions in FY16) allows ERDC to recognize positions responsible for directing many of its highly visible and technical programs. These SSTM positions are especially valuable to recognize the performance of higher-level duties when Senior Executive Service (SES) and Senior Scientists (ST) spaces are less appropriate.

While these authorities have greatly enhanced ERDC's ability to hire and retain world-class scientists and engineers, it still faces challenges. When Congress includes new

hiring authorities granted to Laboratory Directors in the annual NDAA's, ERDC is currently required to implement them by publication of a Federal Register Notice. For example, in NDAA 2015, Congress delegated Laboratory Directors direct hire authorities for students. The NDAA was signed in December 2014. These authorities have not been delegated, nor has a Federal Register Notice been published authorizing their use. As a result, the STRLs are continuing the untimely process of advertising student positions through USA Jobs and losing valuable students to the private sector. Additionally, NDAA 2016 authorized the noncompetitive conversion of students to permanent appointments, increased authorizations for direct-hire appoints and authorities regarding the utilization of reemployed annuitants and the payment of retirement incentives. These authorities have not yet been delegated.

I want to thank Congress for its continued support to the STRLs by including language in the 2017 NDAA that will greatly benefit the STRLs.

DOD's challenges in recruiting and maintaining a high-quality workforce also include competition for these individuals, a limited supply of top-quality STEM students and careerists, and the ability to make job offers in a timely manner. ERDC's ability to offer competitive salaries and benefits, coupled with other provisions in the Direct Hiring Authorities, allows ERDC to compete in this hiring pool. Additionally, ERDC uses every student program available to increase its pool of future recruits. During this past year alone, ERDC employed more than 230 student interns from 65 colleges and universities. With authority to directly hire students, that number would increase.

Because ERDC has great people, it is able to execute meaningful and impactful programs. DOD Service Labs play a key role in National Security, and ERDC has a long history of providing innovative solutions to keep our Warfighters and Civilians safe at home and abroad. On September 11, 2001, the plane that was flown into the Pentagon struck a section that had just been retrofitted with ERDC-developed blast protection technology. This protection kept the section from collapsing long enough to get personnel to safety, significantly reducing the death toll at the Pentagon.

ERDC has since developed and deployed several pioneering force- and terrorist-threat protection technologies. More than \$1 billion in protection technology has been installed in theater to protect base camp structures from rocket and mortar attacks. Research into weapons effects on structures and affordable mitigation techniques informed the composite and construction industry without revealing theater vulnerabilities. ERDC, working with industry partners, identified solutions that were technically feasible and readily available for immediate fielding. ERDC's Overhead Cover Protection system development was fast-tracked, in part, by \$250 million in supplemental funding from Congress. This multi-layer protection system was designed and constructed over existing critical facilities at U.S. base camps in Iraq – living quarters, dining halls and

other high-occupancy facilities – to protect the force from insurgent rocket and mortar attacks by preventing them from penetrating overhead cover barriers and hitting facilities. This technology reduced a high casualty rate pre-emplacement down to zero. The State Department later invested in this technology to protect its critical facilities and personnel around the world. The very building we are sitting in today is safer because of ERDC protection technologies in collaboration with the Architect of the Capitol.

Another technology breakthrough is ERDC's Deployable Force Protection (DFP) program. Products include the advanced, lightweight Modular Protection System (MPS), based on an innovative, patented material of high-strength, flexible concrete with ballistic performance – comparable to ceramic armor – at a fraction of the cost and weight. Four trained Soldiers can assemble an 8-by 12-foot MPS module in 15 minutes without equipment or special tools. The Army's Rapid Equipping Force (REF) quickly introduced the MPS into Iraq and Afghanistan, and in 2010, a modified version was developed for the Navy. DFP now includes MPS Mortar Pits, Guard Towers and other quickly-deployable protection systems that are easily constructed and reusable, keeping our Warfighters safe. Prototype protective structures developed in the DFP program were recently needed to protect critical assets in numerous deployed locations. The lab's inventory of prototype structures was rapidly made available to satisfy urgent theater needs, while the Army REF procured additional quantities from vendors holding licenses for the government-patented technology. Anticipating future orders, researchers are working with the Defense Logistics Agency Warstopper Program and Rock Island Arsenal's Joint Manufacturing and Technology Center to prepare both government and industry manufacturing groups to meet future surge requirements.

ERDC-developed technologies to deny, deter and defeat IEDs are being used in Afghanistan, where insurgents employ IEDs powerful enough to throw 14-ton MRAP vehicles into the air. In a five-month period at the beginning of this emerging threat, more than 100 Soldiers had suffered crushed or damaged spinal columns from being thrown around in MRAPs. One ERDC advance, called HARD IMPACT, defends U.S. and Coalition forces against IEDs placed in thousands of road culverts throughout the country by retrofitting existing culverts with protection designs and incorporating those designs into new roadway systems. ERDC was approached by the U.S. Intelligence community to develop forensics capabilities after blast events. Two programs, CALDERA and FERRET, developed procedures, tools and training to effectively collect, measure and document post-blast forensic signatures of underbelly IED attacks. These technologies and products have been transitioned to Intel analysts and Warfighters.

In the interval between 2006 and 2014, in support of numerous U.S. Central Command (CENTCOM) Joint Urgent Operation Needs Statements, ERDC engineers and research

teams led whole-of-government and industry teams in developing more than six major quick reaction capability (QRC) programs that were formerly recognized by the Joint Improvised Explosive Device Defeat Organization (JIEDDO) and CENTCOM as effective counter-IED (C-IED) systems. The total ERDC QRC resource execution in this period exceeded \$2 billion. Airborne systems included Saturn Arch, Desert Owl, Copperhead and Radiant Falcon, all of which were transitioned to Army Aviation by the close of 2014. At present, Saturn Arch and Copperhead continue to provide CENTCOM with unique C-IED operational capabilities. On the ground, ERDC led the successful development and deployment of the Sand Dog C-IED system, which was deployed on Talon robots for both Explosive Ordnance Disposal and Engineer Route Clearance teams.

Tunnel Detection technologies developed by ERDC have been applied along the Mexico border, in Iraq, and along the Egypt/Gaza border. ERDC is the technology lead for the U.S. Government's Interagency Tunnel Deterrence Committee – 11 law enforcement and intelligence agencies – which has been involved in hundreds of tunnel detection efforts along the border of Mexico since 9/11. ERDC developed and has remotely operated detection systems in Iraqi prisons; at the request of the State Department and DOD, ERDC installed a tunnel detection system along the Egypt/Gaza border and trained Egyptian military engineers to operate the system. ERDC has worked with additional Allies to provide tunnel detection technologies and training to help ensure regional stability.

ERDC is collaborating with the U.S. Air Force, Army, Marine Corps and others to identify significant challenges for planners, analysts and operators that impede the ability to accomplish operations in an Anti-Access/Area Denial (A2/AD) environment and the capabilities needed to address the challenges. ERDC's role in force projection in A2/AD environments is focused on developing and demonstrating technologies for planning and conducting entry operations with non-existent, damaged or destroyed infrastructure. ERDC technologies include rapid airfield repair kits for early-entry airborne engineer units; terrain surfacing kits for Unmanned Aircraft Systems (UAS) landing strips, helicopter landing zones, and logistics over-the-shore operations; remote monitoring of critical infrastructure using infrasound; battlefield sensors for operational engineer reconnaissance, assessment and planning; and decision support tools to capture Subject Matter Expert (SME) processes for remote infrastructure assessment. Coastal modeling technology developed in ERDC's Civil Works mission area is also being applied to the A2/AD environment, a great example of dual-use technology that crosses mission area lines. Also, as part of the Long Range Research and Development Planning Program-Ground Combat (LRRDPP-GC), ERDC and its fellow S&T laboratories are currently working to help shape policy for the Third Offset

Strategy. This strategy's goal is to identify high-payoff, enabling technology investments to provide U.S. forces with a decisive advantage in land-associated operations in the 2030 timeframe.

ERDC's Map Based Planning Services (MBPS) program provides DOD with a unique, web-based capability for military planners to collaboratively develop strategic plans. MBPS employs the concept of a digital plan with automated tools to reduce the burden of manual work, the risk of human errors, and the resources expended on updates and corrections. With military planners deployed across the U.S. and all over the world, substantial time and cost savings also result from reduced travel to various planning team meetings. By increasing efficiency in the planning process, MBPS allows planners to provide senior decision makers with more options within months rather than years, and thereby meet the challenges of a rapidly evolving world.

National- and theater-level assets provide a synoptic view of the operational environment; there is a growing need and a growing number of requests for ERDC's Tactical Mapping (T-UAS) program on demand – high-resolution tactical mapping capabilities at the lowest levels to support mission planning and enhanced situational awareness. The T-UAS program uses a variety of UAS full-motion video and electro-optical image data to rapidly produce 2D and 3D geospatial products and provide enhanced local situational awareness to users at the lower echelons of the Armed Forces. This technology builds on previous ERDC R&D to fill in gaps for mast-mounted Light Detection and Ranging (LIDAR) efforts and has gone from a concept and capabilities demonstration in late 2015 to funding by REF to field mapping platforms and FMV kits for Warfighters in Iraq in June 2016 with the first map products created in July.

Future readiness includes not only providing our Soldiers with the equipment and technology advances they need to win the fight, but also delivering environmentally sustainable solutions for energy, water, and waste (EW2) on installations at home and abroad. ERDC R&D also supports installation training needs while protecting the environment.

ERDC has developed a holistic approach for EW2 environmental sustainability at military installations around the world and in contingency environments. The ERDC-developed Net Zero Planner (NZZ) is a web-based tool for installation-wide EW2 planning. The tool is designed to perform complex engineering calculations with relative simplicity and provide an engineering-based solution for planning EW2 investments at installations. NZZ has been demonstrated at multiple DOD installations and is currently being used by the USACE Fort Worth District to develop sustainability component plans as part of the master planning process. ERDC is working closely with Headquarters,

USACE to develop a transition plan for NZP and incorporate it into the planning process across the Corps.

ERDC is the Army leader in Operational Energy R&D and is developing scalable solutions for small, semi-permanent contingency bases (300 to 1,999 personnel). Operational energy R&D focuses on the primary areas of planning and analysis; resilient distribution; metering and monitoring; demand reduction; and supply efficiency. These focus areas are inter-related and are designed to address all stages of the base camp lifecycle. Planning tools such as the Virtual Forward Operating Base assist in base camp planning and operation to reduce supply and logistics burdens on camp operators. ERDC's Deployable Metering and Monitoring System gives operators knowledge of where their resources are being used.

ERDC, together with the National Aeronautics and Space Administration (NASA) Marshall Space Flight Center and Kennedy Space Center, and Caterpillar, Inc., is developing an additive 3D printing technology capable of printing custom-designed expeditionary structures on demand, in the field, using concrete sourced from locally available materials. The three-year Automated Construction of Expeditionary Structures (ACES) program brings together expertise from within ERDC, NASA, Caterpillar, and Contour Crafting Corporation to conduct highly-focused research designed to prototype an automated construction system that can fabricate a 500 ft² structure in less than 24 hours. In late 2016, when the Secretary of the Army asked for examples of Army innovation, the Honorable Katherine Hammack, then-Assistant Secretary of the Army for Installations, Energy and Environment, briefed him on the ACES program. Presented with more than 35 examples of Army innovation, the Secretary chose ACES as one of three to present to the Secretary of Defense to show the most promising innovation activities going on in the Army.

ERDC R&D is also providing integrated maneuver land sustainment technologies to support installation training land management through the use of vehicle-based impact models; application of training exercise impact assessment and monitoring technologies; range design guidance; impact mitigation and resolution technologies; and installation encroachment assessment software. One success story is ERDC's work to assess training lands at Fort Hood, Texas, the largest active duty armored post in the U.S. Every acre counts, to both the Army and to two endangered species of birds that call the installation home. In 1993, 36 percent of Fort Hood training land was under seasonal training restrictions for habitat protection. ERDC worked with Fort Hood biologists for years to assess habitats, sources of negative impacts, and potential stress from military training on both species. This collaboration has proven that military impacts on the species are nominal and that current management strategies have positive impacts on both endangered birds. By 2000, the percentage of restricted

training lands had dropped to 24 percent; by 2010, it was 4.6 percent; and by 2015, it was 0 percent. The U.S. Fish and Wildlife Service rendered a Biological Opinion in 2015 that allows the Army to manage all training lands at Fort Hood without seasonal restriction, but within agreed-upon impacts to the bird species.

In the area of information technology, ERDC manages and executes the DOD High Performance Computing Modernization Program (HPCMP), a comprehensive, highly-integrated, high-performance computing *ecosystem* that includes supercomputers and related expertise, a nationwide DOD research network, and system and application software to the Services and Defense agencies. The HPCMP is characterized by three core elements: DOD Supercomputing Resource Centers, information-assured networking (the Defense Research and Engineering Network and associated cybersecurity posture), and software applications expertise that addresses the unique computational requirements of the DOD. These three elements form a complete *ecosystem* that supports the DOD research, development, test, and evaluation (RDT&E) and acquisition engineering communities.

The HPCMP supports approximately 2,000 active users from Army, Navy, Air Force, Marine Corps, and other DOD agencies within the Science and Technology (S&T), acquisition engineering and Test and Evaluation (T&E) communities. HPCMP users address challenges such as the discovery of new materials to address unique DOD requirements, numerical modeling of hypersonic flight, modeling and prediction of weather to support DOD, analysis of space systems, and evaluation of options for future DOD systems, including the design of next generation aircraft carriers, submarines, air vehicles and ground vehicles.

DOD Supercomputing Resource Centers (DSRCs) provide advanced computational resources and specialized expertise to enable DOD to take advantage of supercomputing. DSRCs are located in:

- AFRL DSRC at Wright Patterson Air Force Base in Dayton, Ohio;
- Air Force Maui High Performance Computing Center (MHPCC) DSRC at the Air Force Optical & Supercomputing Observatory site in Kihei, Hawaii;
- Army Research Laboratory (ARL) DSRC in Aberdeen, Maryland;
- Army ERDC DSRC in Vicksburg, Mississippi; and
- Navy DSRC at the Naval Meteorology & Oceanography Command, Stennis Space Center, Mississippi.

The Defense Research and Engineering Network (DREN) provides a robust cybersecurity posture for the HPCMP. DREN provides a very high bandwidth, low latency, low jitter network specially designed to serve the needs of the science/engineering and test/evaluation communities. The DREN supports

Unclassified, Secret, and above Secret communications and delivers service to 53 of the DOD's 62 laboratories and 20 of the DOD's 22 major range and test centers. In the S&T environment, the DREN is a critical enabling technology for the collaborative science and engineering workflow; in the T&E environment, the DREN is a unique resource enabling a diverse range of critical activities that cannot be provided by traditional networks. For example, the DREN supported 26 T&E events in FY16, including:

- F-35 Joint Strike Fighter (JSF) Record and Playback Event 3
- Small Diameter Bombs (SDB) II Live Fly Testing (On Going)
- TRITON Flight Testing (On Going)
- Aegis Integrated Air and Missile Defense (IAMD) Base Line (B/L) 9C1D BLD 18.1.2
- Joint Distributed Infrared Countermeasures (IRCM) Ground-test System (JDIGS)

The HPCMP is also charged with the creation, improvement and optimization of software applications that use the network and supercomputers efficiently to develop effective solutions to the DOD's challenges. This includes training for engineers and scientists on effective use of HPCMP resources; R&D to pull emerging technologies from industry and academic centers into routine use by HPC users; and efforts to increase effectiveness of existing applications to new DOD challenges or develop new DOD-unique applications.

The largest strategic software investment for DOD resides in the Computational Research and Engineering Acquisition Tools and Environments (CREATE) initiative, which provides government-owned high-fidelity, multi-physics software for ships, air vehicles, radio frequency, and ground vehicles essential to supporting the acquisition engineering community. While HPCMP-developed software applications are service/mission specific, they are designed to provide cross-service/OSD agency capabilities. As such, these investments provide the Department with significant synergies in terms of software sustainability and applicability within the services. One example of leveraging HPC resources to address high-impact DOD challenges is the ERDC-led Engineered Resilient Systems (ERS) program. DOD is leveraging years of S&T investment to transform acquisition processes through ERS. By enabling more detailed engineering analyses, ERS significantly increases the number of materiel alternatives examined early in the acquisition process, in equal or less time than traditional methods. The program and its associated DOD Community of Interest are developing concepts, techniques and tools that significantly sharpen requirements prior to major acquisition milestones and support prototyping and experimentation.

In addition to its world-class research to support the Warfighter, ERDC is also the world leader in Water Resources Infrastructure and Management, Navigation, Operations and Maintenance, and Environmental Resources R&D in support of the USACE Civil Works mission. This R&D is critical to national security by enabling a vital lifeblood link to our nation's commerce and economy, and supports the movement of supplies and materiel vital to our national defense. The Civil Works capabilities ERDC develops and provides not only support national security interests within our borders, but also enable this Nation to support water resources maintenance, repair and rehabilitation operations in war zones, like Mosul Dam in Iraq, and Kajaki and Dahla Dams in Afghanistan. ERDC Civil Works expertise, combined with its military technology and environmental security R&D, is truly unique. ERDC's ability to leverage these otherwise disparate capabilities within the bounds of one organization creates powerful dual-use opportunities. ERDC's Critical Infrastructure Protection Program is a perfect example of how it leverages its military expertise to protect Civil Works infrastructure. Technologies developed to protect personnel and facilities in contingency environments have been transitioned to protect critical infrastructure in the U.S., from buildings in our capitol and major cities, to locks and dams and other navigation infrastructure; and from bridges like the Golden Gate, to other transportation infrastructure such as subway and railway systems.

Finally, I welcome the opportunity to discuss the importance of facilities, infrastructure and the 219 Program to the overall DOD S&T posture.

The ERDC employs a world-class team and conducts world-class research, but it has a need to modernize and recapitalize its experimental facilities to ensure it can continue to support the Warfighter and the Nation in a world-class manner. While ERDC has some new and state-of-the-art facilities, the average age of ERDC facilities is 41 years, and its recapitalization rate extends into the next century. Technology advances are moving at a rapid pace and U.S. adversaries are taking full advantage of these advancements. Research facilities must be built to be adaptable and resilient or they will become outdated and obsolete. Just as importantly, the Nation must ensure our research facilities have sufficient sustainment dollars in order to minimize the amount of research dollars we must divert to support operations and maintenance. Finally, our research facilities must be of a quality to aid in recruitment and retention of the best and brightest research staff in the world.

In FY14 and FY15, ERDC was successful in obtaining funding for two Unspecified Minor Military Construction (UMMC) projects using the Laboratory Revitalization Program authority provided by this Committee. With that funding, ERDC constructed a new \$2.5 million Fragmentation Research Facility and will soon begin construction of a \$3.8 million facility to construct large concrete targets to support blast, penetration and fragmentation research. For FY17, ERDC submitted a list of requirements for

consideration in the UMMC program, its number one priority being a Transformer Yard (\$1.9 million) at its Cold Regions Research and Engineering Laboratory in New Hampshire that will improve efficiency, safety and operations. ERDC also included a project to expand its capacity to improve Projectile Penetration Research (\$3.8 million) at its Vicksburg, Mississippi, campus to meet current and future requirements. Both projects were selected for funding in FY17. The expanded authority for labs provided in the Laboratory Revitalization Program, particularly the \$4 million UMMC threshold, has been extremely valuable to the ERDC. It was rewarding to see that the FY17 NDAA signed into law in December 2016 extended the program to FY25 and increased the threshold to \$6 million. ERDC hopes to take advantage of the new threshold right away, and is optimistic that, over the next few years, Congress will see fit to make this program permanent, allowing Laboratory Directors to plan and execute infrastructure improvements well into the future.

While ERDC has had some success with minor construction, it has yet to break into the Major Military Construction future years' defense plan. ERDC has not had a project funded with MILCON in recent memory, nor does it have one in the current POM. In light of significant reduction in funds available for military construction and the requirement for Army leadership to support Soldier readiness initiatives, ERDC has deferred asking for support in MILCON for the past few years. ERDC leadership has begun identifying requirements where MILCON would be an appropriate funding source in order to try again in future. With limited funds available and considering Army needs, it is understood that there will be many more projects deferred than will be programmed for funding. This reality is likely to remain the situation for years to come, making the Laboratory Revitalization and 219 authorities even more critical to ensuring laboratory directors can respond quickly and adapt to emerging threats.

ERDC's 219 Authority gives it a mechanism to provide funds for innovative research, technology transfer, workforce development, and to improve facilities and infrastructure. ERDC has had great success in using this authority over the years and greatly appreciates the Committee's willingness to extend the authority each time it was close to expiration, to expand the authority, and to provide clarification of the Congress' intent in order to improve the program's effectiveness. I always appreciated that your staff took the time to meet with me here in Washington, D.C. and travel to ERDC facilities and see firsthand how we were implementing this program. The cooperation across the Committee staff and with their colleagues in the House has resulted in a great program, and I am pleased to see that the FY17 National Defense Authorization Act made this authority permanent and increased the amount that can be collected from 3 to 4 percent.

The 219 Program has allowed Directors to allocate funds toward research efforts to address needs and requirements that arise faster than the normal budget planning cycle. This was recently highlighted by an ERDC investment to develop an Advanced Blast Load Simulator prototype. This research led to a working 4-ft by 4-ft prototype and a comprehensive and affordable plan to build the capacity to conduct controlled blast experiments on target surface areas of 12-ft by 12-ft. Previous attempts to build this scale were technically challenging and cost-prohibitive. Conducting blast experiments of this size in a controlled laboratory environment will allow ERDC to perform multiple experiments in a shorter period of time at significantly reduced cost and with improved accuracy. Full-scale field tests are expensive, time-consuming, and require valuable range time. While field tests will always be necessary, the simulator will ensure those tests are optimal and shorten the time required to provide solutions to save Soldiers' lives. This would not be possible without Section 219 authority.

In FY15 and FY16, the 219 Program allowed me, as then-Director of ERDC, to spend approximately \$5 million a year to upgrade facilities infrastructure at the four main ERDC sites and at our research facilities in Alaska. Improvements include airfield and pavement testing areas; backup generators and chemistry labs for projects that ensure ERDC was able to properly maintain housing of animals and live organisms for experimentation; and to upgrade and maintain dominance in extreme cold environments. Each of these projects is relatively small compared to some of the multi-million dollar military construction projects you may see, but they have a huge impact on the quality of research and capability of ERDC engineers and scientists. I appreciate the flexibility this mechanism provides. Unfortunately, the labs have not yet been able to take advantage of the authority you provided in the FY14 NDAA that allows directors to accrue funds over multiple fiscal years to support larger infrastructure needs. Laboratories continue to work toward a way to implement processes that will allow them to do this in an accountable, auditable and sustainable fashion. Your staff are aware of this and are committed to working with the laboratories to address these challenges.

In conclusion, Army Chief of Staff General Mark Milley has stated that "we will do what it takes to build an agile, adaptive Army of the future. We will listen and learn ... from the Army itself, from other Services, from our interagency partners, but also from the private sector ... we will change and adapt." I always took pride in the relationships ERDC built within the Army, with its Service partners and other federal agencies, and with academia and industry. These were "my" stakeholders, as were Congress and the American public. It is for you I worked, and I did not take lightly the trust that was placed in me to solve problems critical to our Nation's security and the well-being of our Armed Forces and citizens.

The engineers and scientists, support personnel, and leadership of the U.S. Army Engineer Research and Development Center take extreme pride in what they do. On behalf of its new leadership, I invite you all to visit at any time to see this firsthand as you talk to the ERDC team. ERDC team members come to work every day, knowing that what they do makes a difference – they are saving lives; helping safeguard our citizens at home and around the world; and protecting and enhancing the environment around us.

Thank you for your time.

Madam Chairman, this concludes my statement. I would be happy to answer any questions you or other Members may have.