



**US Army Corps  
of Engineers®**



## BROAD AGENCY ANNOUNCEMENT

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U.S. ARMY ENGINEER RESEARCH  
AND DEVELOPMENT CENTER  
(ERDC)

**TABLE OF CONTENTS**

INTRODUCTION..... 3

PART I BACKGROUND & RESEARCH INTERESTS ..... 7

Conference & Symposia Grants ..... 10

Coastal & Hydraulics Laboratory ..... 11

Geotechnical & Structures Laboratory..... 23

Environmental Laboratory ..... 35

Information Technology Laboratory ..... 62

Construction Engineering Research Laboratory ..... 66

Cold Regions Research & Engineering Laboratory..... 81

Geospatial Research Laboratory ..... 92

Reachback Operations Center ..... 95

PART II PRE-PROPOSAL & PROPOSAL EVALUATION ..... 96

PART III PRE-PROPOSAL & PROPOSAL PREPARATION ..... 98

Section 1 – Introduction ..... 98

Section 2 - General Information ..... 100

Section 3 - Type of Contract ..... 103

Section 4 - Contents of Pre-Proposal ..... 104

Section 5 - Contents of Full Proposal ..... 105

Section 6 - Subcontracting Plan..... 107

ATTACHMENTS..... 108

Attachment A – Clauses for Fixed Price Contracts

Attachment B – Clauses for Cost-Reimbursable Contracts

Attachment C – Additional Representations and Certifications

## POINTS OF CONTACT

For contractual questions concerning proposals to **EL, GRL, GSL, ITL, and UROC** contact the following: [ERDC-BAA@usace.army.mil](mailto:ERDC-BAA@usace.army.mil) -or- Andrea Knowles at 703-428-6519.

For contractual questions concerning proposals to **CERL** contact: Andrea Thomas at 217-373-6746 or [CERL-CT-Quotes@usace.army.mil](mailto:CERL-CT-Quotes@usace.army.mil).

For contractual questions concerning proposals to **CHL** contact: Christine Wilson at 217-552-5258 or [CHL-BAA@usace.army.mil](mailto:CHL-BAA@usace.army.mil)

For contractual questions concerning proposals to **CRREL** contact: Melodie Fisher at 601-634-4687 or [CRREL-BAA@usace.army.mil](mailto:CRREL-BAA@usace.army.mil).

For technical questions, contact the technical personnel listed at the end each topic area. Proposals shall not be submitted to technical personnel.

## PREPARATION INSTRUCTIONS AND ADDRESSES SHOWN IN PART III.

For more information about ERDC visit our website at: <http://www.erdcd.usace.army.mil/>

## INTRODUCTION

The U.S. Army Engineer Research and Development Center (ERDC) includes the Coastal and Hydraulics Lab (CHL), the Geotechnical and Structures Lab (GSL), the Reachback Operations Center (UROC), the Environmental Lab (EL) and the Information Technology Lab (ITL) in Vicksburg, Mississippi, the Cold Regions Research and Engineering Lab (CRREL) in Hanover, New Hampshire, the Construction Engineering Research Lab (CERL) in Champaign, Illinois, and the Geospatial Research Laboratory (GRL) in Alexandria, Virginia. The ERDC is responsible for conducting research in the broad fields of hydraulics, dredging, coastal engineering, instrumentation, oceanography, remote sensing, geotechnical engineering, earthquake engineering, soil effects, vehicle mobility, self-contained munitions, military engineering, geophysics, pavements, protective structures, aquatic plants, water quality, dredged material, treatment of hazardous waste, wetlands, physical/mechanical/chemical properties of snow and other frozen precipitation, infrastructure and environmental issues for installations, computer science, telecommunications management, energy, facilities maintenance, materials and structures, engineering processes, environmental processes, land and heritage conservation, and ecological processes. This research is conducted by Government personnel and by contract with educational institutions, non-profit organizations and private industries.

“The provisions of the Competition in Contracting Act of 1984 (P.L. 98-369) as implemented in the Federal Acquisition Regulation (**FAR 35.016**) provide for the issuance of a Broad Agency Announcement (BAA) as a means of soliciting proposals for basic and applied research and that part of development not related to the development of a specific system or hardware procurement. To be eligible for consideration and possible contract award, the technology or methodology shall be either basic research, applied research, advanced technology development not for a specific system/hardware, or demonstration and validation. BAAs may be used by agencies to fulfill their requirements for scientific study and

experimentation directed toward advancing the state-of-the-art or increasing knowledge or understanding rather than focusing on a specific system or hardware solution. The BAA shall only be used when meaningful proposals with varying technical/scientific approaches can be reasonably anticipated. "Basic Research" is defined as research directed toward increasing knowledge in science with the primary aim being a fuller knowledge or understanding of the subject under study, rather than any practical application of that knowledge. "Applied Research" is the effort that normally follows basic research, but may not be severable from the related basic research; attempts to determine and exploit the potential of scientific discoveries or improvements in technology, materials, processes, methods, devices, or techniques; and attempts to advance the state-of-the-art. This announcement must be general in nature, identify the areas of research interest, include criteria for selecting proposals, and solicit the participation of all offerors capable of satisfying the Government's needs. The proposals submitted under this BAA will be subject to peer or scientific review. Proposals that are selected for award are considered to be the result of full and open competition and in full compliance with the provisions of PL 98-369, the Competition in Contracting Act of 1984. Resulting agreements may be in the form of purchase orders, contracts, grants, or cooperative agreements depending upon the specifics of the effort, such as extent of Government involvement, actual scope of work, and cost.

This guide constitutes the BAA of this Command and conforms to regulatory requirements of the Federal Acquisition Regulation. This guide provides prospective offerors information on the preparation of proposals for basic or applied research. Directions as to form and procedures are included. This guide is also posted on [www.Grants.gov](http://www.Grants.gov).

Proposals from U. S. Government facilities and organizations will not be considered under this program announcement.

**PERSONS SUBMITTING PROPOSALS ARE CAUTIONED THAT ONLY A CONTRACTING OFFICER MAY OBLIGATE THE GOVERNMENT TO ANY AGREEMENT INVOLVING EXPENDITURE OF GOVERNMENT FUNDS.**

This BAA supersedes all previous editions and shall remain in effect until superseded.

Proposals are encouraged from Historically Black Colleges and Universities or Minority Institutions (HBCUs/MIs) for students to provide research support to any of the research and development areas listed in this BAA. HBCU/MIs interested in submitting a proposal must address the specific areas of research under which they are submitting. They must also clearly state within their proposal their capability to perform the contract and include a positive statement of their eligibility as an HBCU or MI. These contracts will be written in accordance with the Contract Student Regulation as regards pay, GPA requirements, place of performance and every other requirement or statement within the regulation.

ERDC also encourages small business concerns, women owned small businesses, small disadvantaged business concerns, small businesses located in HUBZones, businesses participating in the Small Business Administration 8(a) program, and service disabled veteran-owned small businesses to submit research proposals for consideration.

The Offeror, by submission of an offer or execution of a contract in response to this solicitation, certifies that the Offeror is not debarred, suspended, declared ineligible for award of public contracts, or proposed for debarment pursuant to FAR 9.406-2. If the Offeror cannot so certify, or if the status of the Offeror changes prior to award, the Offeror must provide detailed information as to its current status.

Proposals submitted under the BAA should clearly identify within the proposal any research that is expected to be fundamental in nature as defined in National Security Defense Directive 189. Fundamental research means basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are restricted for proprietary or national security reasons.

**Please see page 35 for white paper/pre-proposal submittal information. (e.g., Strategic Environmental Research and Development Program (SERDP), Environmental Security Technology Certification Program (ESTCP), DoD Basic 6.1 Research Program, RESTORE Act, etc.)**

Federally Funded Research and Development Centers (FFRDCs) and Government entities (Government/National laboratories, military educational institutions, etc.) are subject to applicable direct competition limitations and cannot propose to this BAA in any capacity unless they meet the following conditions. FFRDCs must clearly demonstrate that the work is not otherwise available from the private sector AND they also provide a letter on letterhead from their sponsoring organization citing the specific authority establishing their eligibility to propose to government solicitations and compete with industry, and compliance with the associated FFRDC sponsor agreement and terms and conditions. This information is required for FFRDCs proposing to be prime or subcontractors. Government entities must clearly demonstrate that the work is not otherwise available from the private sector and provide written documentation citing the specific statutory authority (as well as, where relevant, contractual authority) establishing their ability to propose to Government solicitations. At the present time, DARPA does not consider 15 U.S.C. 3710a to be sufficient legal authority to show eligibility.

While 10 U.S.C. 2539b may be the appropriate statutory starting point for some entities, specific supporting regulatory guidance, together with evidence of agency approval, will still be required to fully establish eligibility. DARPA will consider eligibility submissions on a case-by-case basis; however, the burden to prove eligibility for all team members rests solely with the Proposer.

Located in London, England, the International Research Office (IRO) (<http://www.erd.usace.army.mil/Media/FactSheets/FactSheetArticleView/tabid/9254/Article/476750/international-research-office.aspx>) of the US Army Engineer Research and Development Center (ERDC) (<http://www.erd.usace.army.mil/Home.aspx>) promotes cooperation with the international research community as a means to advance science and engineering knowledge and technical capabilities in areas relevant to ERDC research interests. Research Grants that address topics in this BAA; Visiting Scientist Travel Grants to

ERDC laboratories; and Conference/Workshop Grants are available in this context. Please address questions for IRO concerning the submission of proposals to: (Tel: +44-1895-62-6522 Email: [usarmy.usace.ercd-iro@mail.mil](mailto:usarmy.usace.ercd-iro@mail.mil)).

## PART I

### BACKGROUND AND RESEARCH INTERESTS OF THE RESEARCH LABORATORIES

The **COASTAL AND HYDRAULICS LABORATORY (CHL)** has nationally - and internationally - recognized engineering and scientific expertise related to inland waterways and the estuarine and coastal zones. CHL has foremost capabilities in prototype data collection, experimental research and numerical modeling and simulation of processes involving water levels, current, winds, waves and tides, and their interaction with sediments and structures.

Specific and unique expertise exists in the engineering, hydrodynamics, sediment transport, dredging and dredged material disposal, physical processes associated with environmental analyses, groundwater modeling, military hydrology, harbor engineering, and riverbank and shore protection. CHL has the Tri-Service Reliance mission for Logistics-Over-the Shore (LOTS) for Sustainment Engineering. The Shore Protection Manual, which is internationally recognized as the most authoritative source of engineering design and guidance for the coastal engineering profession, was originally developed by the Coastal Engineering Research Center (CERC), and is being replaced by the CHL with an updated and greatly expanded Coastal Engineering Manual.

The **GEOTECHNICAL and STRUCTURES LABORATORY (GSL)** performs research, development and testing in many areas such as: soil mechanics, foundation design, slope stability, seepage analysis, pavements (both expedient and permanent), rock mechanics, engineering geology and geophysics, earthquake engineering, vehicle mobility and trafficability, structural dynamics, explosion and weapon effects, survivability, earth dynamics, construction materials, impact of high-velocity projectiles, development of methods for installation of fixed installation camouflage, concealment and deception, and design and analysis of structures to resist static and dynamic loading. The Geotechnical and Structures Laboratory is equipped to perform any type of laboratory testing, including centrifuge applications, needed to assist in the types of research described herein.

The **ENVIRONMENTAL LABORATORY (EL)** conducts Military and Civil Works R&D for the Corps of Engineers, other Department of Defense elements, and other Government agencies in the general areas of Environmental Restoration (Clean-up) and Environmental Conservation. Areas of research include: (a) environmental sensing development, (b) hazardous waste site characterization and treatment, (c) sediment geochemistry and biological effects, (d) water quality modeling, and unexploded ordnance (UXO).

Environmental Conservation deals with sustaining natural resources entrusted to DoD for continued use through improving and developing tools and technologies of fundamental and applied process level research, use of modeling and statistics for forecasting; all which

conserve, protect, and enhance natural and cultural resources and foster stewardship. Areas of research include: (a) environmental database development; (b) environmental impact prediction, assessment, and management; (c) environmental criteria for stream channel alteration; (d) natural resource management, and animal movement behavior response to environmental (aquatic, terrestrial, aerial, social) patterns; (e) aquatic nuisance species management; (f) threatened and endangered species protection and management; (g) ecology, restoration, and management of plant communities in aquatic ecosystems; (h) water quality; (i) outdoor recreation; (j) cultural resources; and (k) ecosystem simulation.

The **INFORMATION TECHNOLOGY LABORATORY (ITL)** conducts research, development, and studies and provides technical assistance and operational support in information technology (IT) and closely related fields, with particular emphasis on the areas of computer-aided interdisciplinary engineering, computer-aided design and drafting, building information modeling, computer-aided facilities management, computer science, high performance computing, advanced computer security, general-purpose computing, and sensor and instrumentation systems. These activities are conducted to support and enable execution of missions of USACE, the Army, and DoD.

The U.S. Army **CONSTRUCTION ENGINEERING RESEARCH LABORATORY (CERL)** offers research and development (R&D) support, as well as technical assistance, to a variety of customers throughout the Department of the Army (DA) and other Government agencies. CERL is the lead Army facility for conducting R&D on infrastructure and environmental issues for installations. CERL's research is directed toward increasing the Army's ability to more efficiently construct, operate, and maintain its installations and ensure environmental quality and safety at a reduced life-cycle cost. To accomplish the mission, CERL has two Divisions: Facilities and Installations. Researchers in these Divisions are matrixed across the ERDC organization in multi-disciplinary teams that bring the best expertise to bear on solving problems for the Department of Defense.

The mission of the **COLD REGIONS RESEARCH AND ENGINEERING LABORATORY (CRREL)** is to solve interdisciplinary, strategically important problems of USACE, Army, DoD, and the Nation by advancing and applying science and engineering to complex environments, materials, and processes in all seasons and climates, with unique core competencies related to Earth's cold regions. As a national resource for cold regions science and engineering, CRREL promotes understanding to support mission success through development and delivery of transformative technical solutions that meet operational challenges. Key technical areas of research and development include signature physics, terrestrial and cryospheric sciences, biogeochemical processes, environmental fate and transport geochemistry, force projection and sustainment, cold regions infrastructure, water resources/geospatial applications and hydrology and hydraulics.

The **GEOSPATIAL RESEARCH LABORATORY's (GRL)** mission is to enable battlefield dominance by pioneering geospatial solutions for the Warfighter. This mission is accomplished through research, development, operations and systems support, and the application of expertise in the geospatial, topographic and related sciences. Throughout its history, GRL has developed and exploited geospatial-related technologies critical to



meeting the Nation's military. GRL has applied its expertise to the needs of homeland defense and the global war on terrorism. These technologies and their related research, operations and systems development activities, essential to the Army in accomplishing its global mission, include the following:

- Timely acquisition, fusing, analysis, display, and dissemination of remotely sensed, multi-sourced information depicting imagery, features, elevation, and other information essential to accurately describe the land warrior battle space.
- The development of geographic information software that enables reliable, efficient, and secure information management, interoperability and accessibility for various user communities operating globally, each with different needs.
- The development of globally fielded applications and systems for acquiring, accessing, fusing, and delivering terrain and feature information to the soldier.
- The development of accurate on-the-fly global positioning systems for use with inertial guidance as essential positioning engines for acquiring near real time, dynamic, high-accuracy, remotely sensed 3-d terrain and feature information.
- The development of increasingly compact, more efficient, and more comprehensive applications and systems aimed at providing low echelon combat units with information in near-real-time, enabling rapid response to developing situations in any battle space.
- The development of new and innovative techniques to understand and visualize terrain and battle space information in all dimensions, and to accommodate reasoning within analytical results.
- The development of accurate and efficient survey and mapping systems for use by both military and civil communities.
- Capabilities in acquisition, testing and fielding of topographic systems; advanced and engineering development of imagery systems; and research and development in the areas of imagery and intelligence data exploitation.
- Operational capabilities in geospatial information and imagery requirements development; terrain, hydrologic, and environmental analysis; and information services.

The **USACE REACHBACK OPERATIONS CENTER (UROC)** is an engineering analysis reach back (i.e., telepresence) capability to support personnel in the execution of their mission across the full operational spectrum. Research in this area includes the development and/or integration of models (empirical, analytical, numerical, etc.) and hardware to improve subject matter expert (SME) response time, provide highly accurate engineer analysis to deployed personnel, and improve the capability of personnel in the field to collect engineering data.

## CONFERENCE AND SYMPOSIA GRANTS

### I. Introduction

The ERDC supports conferences and symposia in special areas of science that bring experts together to discuss recent research or educational findings or to expose other researchers or advanced graduate students to new research and educational techniques. The ERDC encourages the convening, in the United States, of major international conferences, symposia, and assemblies of international alliances.

### II. Eligibility

Notwithstanding the above, the Department of Defense (DOD) has imposed certain restrictions on the ERDC's co-sponsorship of scientific and technical conferences and symposia. Specifically, DOD instruction 5410.20 prohibits co-sponsorship of conferences and symposia with commercial concerns, i.e., ERDC cannot co-sponsor conferences or symposia with a for-profit company. Scientific, technical, or professional organizations which qualify for tax exemption under the provision of 26 U.S.C. Sec. 501 (c) (3) may receive conference and symposia grants.

### III. Conference Support

Conference support proposals should be submitted a minimum of six (6) months prior to the date of the conference.

### IV. Technical Proposal Preparation

The technical portion of a proposal for support of a conference or symposium should include:

- a. A one page or less summary indicating the objectives of the project.
- b. The topics to be covered.
- c. The location and probable date(s) and why the conference is considered appropriate at the time specified.
- d. An explanation of how the conference will relate to the research interests of the ERDC and how it will contribute to the enhancement and improvement of scientific, engineering, and/or educational activities as outlined in the BAA.
- e. The name of chairperson(s)/principal investigator(s) and his/her biographical information.
- f. A list of proposed participants and the methods of announcement or invitation.
- g. A summary of how the results of the meeting will be disseminated.

### **Cost Proposal Preparation**

The cost portion of the proposal should show:

- a. Total project conference costs by major cost elements.
- b. Anticipated sources of conference income amount from each.
- c. Anticipated use of funds requested.

V. Participant Support

Funds provided cannot be used for payment to any federal government employee for support, subsistence, or services in connection with the proposed conference or symposium.

## COASTAL AND HYDRAULICS LABORATORY (CHL)

### I. Introduction

Research is performed in the areas of hydraulic structures such as locks, dams, outlet works, control gates, stilling basins, spillways, channels, fish handling systems, and pumping stations, flood control channels, navigation channels, riverine and estuarine hydrodynamics and transport processes, groundwater, hydrology; dredging-related equipment, and on coastal problems related to shoreline protection, beach erosion, navigation, sedimentation, Regional Sediment Management, inlet stabilization, and construction, operation and maintenance of coastal structures (breakwater, jetties, groins, seawalls, etc.). Major areas of interest include coastal hydrodynamics (wind waves, tides, currents, wind related water levels); coastal sedimentation (longshore transport, inlet sedimentation); coastal geology and geomorphology; design and stability of coastal structures; erosion and storm reduction potential of natural and nature-based features; system optimization methods and performance metrics for coastal operations; coastal resiliency; and interaction of structures and coastal processes. Other activities include descriptions of coastal processes; theoretical studies; watershed and regional sediment and water systems studies; numerical and physical model techniques; data collection and analysis techniques; development of laboratory and prototype instrumentation and equipment. The following sections contain information on these research areas and specific research thrusts.

### II. Research Areas

#### A. Physical Processes in Estuaries (CHL-1)

1. The research program in estuarine physical processes deals with the hydrodynamic and transport characteristics of water bodies located between the sea and the upland limit of tidal effects. Research is directed toward knowledge that will improve field measurements and predictions of these processes. Specific areas of required research include the following physical processes in estuaries and other tidal waters.

2. Specific areas of required research include the following physical processes in estuaries and other tidal waters.

- a. The propagation of tides.
- b. Transport of salinity, mixing processes, stratified flows.
- c. Transport, erosion, and deposition of sediments, including settling velocity, aggregation of sediment, consolidation of sediment.
- d. Behavior and characteristics of sediment beds, including movement, consolidation, armoring, bonding, physical chemical characteristics, density, erodibility.
- e. Flow between aquifers and surface waters.

3. Specific areas of required research include the following activities with respect to the physical processes listed.

- a. The effect of human activities, including dredging construction, vessel traffic, flow diversion, training, structures, and protective structures.
- b. Measurements of parameters that are indicative or descriptive of the processes listed in paragraph 2 by in-situ and remote methods in the lab and field.
- c. Prediction of processes listed in paragraph 2 by analytical methods, physical models, numerical models, and other techniques.
- d. Conceptual and mathematical descriptions of the processes listed in paragraph two.
- e. Development of materials, equipment, and methods that potentially lead to applied research that would make human activities listed safer, more economical, or more effective.
- f. Development of methods, techniques, and procedures that enable the treatment of an estuary as a system.

(Contact: Dr. Julie Rosati, (202) 761-1850, Email: [Julie.D.Rosati@usace.army.mil](mailto:Julie.D.Rosati@usace.army.mil))

## **B. Inland Hydraulic Structures (CHL-2)**

1. The research program in hydraulic structures is related to the hydraulic performance of locks, dams, outlet works, control gates, stilling basins, spillways, channels, bank protection, riprap stability, pumping plants and other hydraulic structures, and with physical and/or numerical model studies to predict and analyze the physical water quality aspects of water resources projects.
2. Specific areas of required research include the following:
  - a. Conduct physical and numerical hydraulic model investigations of a wide variety of hydraulic structures to verify proposed designs and develop more effective and economical designs.
  - b. Analyze model and prototype data and inspection of field installations to develop design criteria for hydraulic structures.
  - c. Develop methods of correlating theoretical and experimental information with design methods used by the Corps of Engineers to improve existing procedures and provide material for inclusion in appropriate manuals.
  - d. Develop physical and/or numerical models to predict and analyze the water quality aspects of water resources projects and design appropriate hydraulic structures to control water as well as water quantity while satisfying the desired objectives.

e. Conduct research and/or develop numerical codes to advance techniques for analyzing physical aspects of water quality in lakes and rivers through a better understanding of the hydrodynamics in density-stratified environments and for improving water quality within and downstream of density-stratified reservoirs and to investigate the ability of existing and proposed water resources projects to satisfy established water quality standards.

f. Conduct basic studies for development of hydraulic design and operation guidance for hydraulic structures used in inland waterways for navigation and flood control purposes, including wave forces/loads on gates (tainter, miter, etc).

g. Conduct/analyze tests, both model and prototype, of the performance of hydraulic appurtenances to flood control and navigation dams such as spillways, outlet works, energy dissipaters, and approach and exit channels, to develop design guidance that will provide structures of maximum efficiency and reliability with minimum maintenance.

h. Develop innovative methods to prepare and revise engineering manuals for hydraulic design of various hydraulic structures.

i. Develop innovative methods to conduct training courses on design of various hydraulic structures.

j. Develop innovative methods to prepare technical reports of all work conducted.

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### **C. Open Channel Flow and Sedimentation (CHL-3)**

1. The Stable Flood Control Channel research project consists of basic studies related to development of hydraulic design guidance for designing modifications to natural stream channels to provide for local flood protection. Emphasis is placed on channel stability as well as channel flow capacity.

2. Specific areas of required research include the following:

a. Studies related to the development of effective methods to analyze a natural stream's response to modifications made for flood control purposes.

b. Studies applicable to development of stream bank and streambed protection methods where channel instability exists.

c. Studies applicable to development of sediment transport, local scour, and stream form relationships for a broad range of stream types, bed and bank materials, and meteorological and hydrological conditions.

Collection and analysis of data that aid in evaluating existing methods and/or developing new methods to analyze channel stability for the variety of channel flow conditions and stream types existing in natural stream systems.

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#### **D. Dredging Research (CHL-4)**

Protection and enhancement of the environment associated with operation and maintenance of navigable U.S. waterway infrastructure through dredging activities is a national priority. Dredging operations and environmental requirements of navigation projects are inseparable. Research is required to predict the time-dependent movement of non-contaminated sand and sand/silt mixtures of dredged materials placed in the nearshore zone, and all materials placed in the offshore region.

The cost of dredging operations attributable to compliance with environmental windows that are determined to be over-restrictive, inconsistent, or technically unjustified can be reduced. More effective contaminated sediment characterization and management will reduce costs and enhance the reliability of methods associated with the assessment, dredging, placement, and control of sediments from navigation projects. Better instrumentation for dredge and site monitoring is required to implement automated dredge inspection and payment methods, and accurately monitor placement of contaminated materials.

Emerging technologies regarding innovative equipment and processes should be expeditiously introduced into the dredging arena. Enhanced ecological risk management for dredging and disposal projects through technically sound approaches for characterizing, managing, and conducting risk-based evaluations are required for expanding options regarding both contaminated and non-contaminated dredged materials.

(Contact: Charles (Eddie) Wiggins, (201) 761-4229, Email: [Charles.E.Wiggins@usace.army.mil](mailto:Charles.E.Wiggins@usace.army.mil) )

#### **E. Navigation Channel Design (CHL-5)**

1. The research program in navigation channel design involves basic research to develop design guidance for the design of new channels and modifications of existing waterways. It involves identifying maneuvering requirements in restricted waterways that affect the channel dimensions, alignment, and location of appurtenances in the navigation channel under various environmental and vessel traffic conditions. It also involves identifying the stability of the channel, maintenance requirements and designing structures that reduce or eliminate the maintenance requirements. Finally, it involves quantifying the flow and pressure fields generated by a tow or ship passing through a waterway and the related impacts on the sediment resuspension in the channel, channel border, and side channel/backwater areas. Studies involve deep and shallow draft navigation channels and physical and mathematical models. Human factors are included in research and project studies using a ship and tow simulator.

2. Specific areas of required research include the following:

a. Physical model investigations of a wide variety of navigation channel configurations in many environments with different type vessels to verify proposed designs and to develop more efficient and safe designs and to lower environmental impacts.

- b. Development and enhancement of mathematical models of vessels, both ships and push-tows, for use on the simulator to add vessel types not available or to increase the accuracy with which the model reproduces the vessels response.
- c. Development of methods and modeling techniques to predict the currents and sediment transport characteristics of various channel designs and integrate this with the navigation model studies, including those generated by the vessel movement.
- d. Development of methods and modeling techniques to predict the currents and sediment transport characteristics of various channel designs and integrate this with the navigation model studies.
- e. Development of methods and techniques to prepare and display visual information for the pilot on the simulator projection system.
- f. Development of methods and measurement equipment, techniques for measuring scale model performance in physical model navigation studies.
- g. Development of methods and techniques to improve the ship simulator and increase reliability of design estimates, including data and tools for ship motions, draw down, squat, ship-generated waves, and ship maneuvering.
- h. Development of methods and techniques for the analysis and evaluation of model results to optimize the channel design and to determine the level of safety, or conversely, risk involved with the various designs and ship transits.

(Contact: Charles E. Wiggins, (202) 761-4229, Email: [Charles.E.Wiggins@usace.army.mil](mailto:Charles.E.Wiggins@usace.army.mil))

## **F. Computer-Aided Hydraulic Engineering (CHL-6)**

The objective of this research program is to develop computer-aided design tools that can be used by hydraulic engineers in planning, design, construction, operation, and maintenance of navigation and flood control projects. The scope includes open channel and closed conduit flows, equipment, structures, and sediment transport analysis and modeling.

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## **G. Groundwater (CHL-7)**

The groundwater modeling research program is structured to enhance understanding and prediction of the flow of water and various transported constituents through the environment. We are interested in groundwater issues from contaminant remediation to levee erosion as well as surface water problems from flash flooding to nearshore coastal flows. Our main tools are computer models that solve (approximately) conservation equations for mass, momentum, and energy in various physical systems. Our work includes developing the numerical methods for solving these equations, writing the computer code to implement the approximations in desktop and high-performance computing environments, and applying the models as part of engineering studies to investigate processes like levee erosion and overtopping, seawater intrusion, and flow through vegetation.



(Contact: Dr. Julie Rosati, (202) 761-1850, Email: [Julie.D.Rosati@usace.army.mil](mailto:Julie.D.Rosati@usace.army.mil))

#### **H. Hydrology (CHL-8)**

1. Research in this area primarily addresses military applications related to mobility, counter mobility and water supply.
2. Specific research involves the following areas:
  - a. Large-scale hydrologic modeling.
  - b. Rapid procedures for flood forecasting.
  - c. Groundwater-surface water interaction processes.
  - d. Multi-scale, multi-physics hydrologic modeling.
  - e. Remote sensing and quantification of precipitation.
  - f. Development of spatially varying precipitation hydrology models.
  - g. Visualization of results for hydrology and dam break models.
  - h. Interfacing with existing and new hydrology models.
  - i. Interfacing watershed models with water quality and other environmental models.

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#### **I. H&H GIS/Database Development (CHL-9)**

Research involves the following areas:

- a. Electronic Navigation Charting.
- b. Integration of GIS/Database and H&H models.
- c. Watershed management for erosion control.
- d. Larger River System management for flood control navigation.
- e. Visualization Techniques.

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#### **J. Coastal Hydrodynamics, Coastal Processes (CHL-10)**

Research in shallow water wave estimation; forecasting and hindcasting of wind generated waves for oceanic to local regions; wave theory; statistical distribution of wave parameters; simulation of spectral conditions in wave basins; nearshore currents; wave breaking; wave/current and wave structure interactions; wave and sediment interactions with natural and nature-based features; long and short waves in ports and harbors; tsunami modeling; wind generated currents; storm surge; tidal circulation; two- and three dimensional numerical simulation models (including finite difference, finite element, finite volume and curvilinear coordinate techniques); coastal meteorology; explosion generated waves; ship response to winds, currents and waves; moored ship response; mooring design and analysis, ribbon bridge hydrodynamics and turbulence.

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#### **K. Coastal Inlets, Navigation Channels (CHL-11)**

Sediment shoaling in coastal inlet channels; stability and performance of inlet channels; scour at structures; sediment transport modeling; influence of structures such as jetties and breakwaters on wave, current, and sedimentation processes. numerical modeling of inlet hydrodynamics and sediment-transport processes, including long-term geomorphologic evolution of inlet channels, shoals, and adjacent beaches, and the interaction with navigation structures. Nearshore placement of dredged sediment to foster wave reduction and sediment supply to adjacent beaches. Short- and long-term dune evolution in vicinity of coastal inlets. Shoreline evolution modeling and storm erosion of beaches, particularly concerning over wash and breaching near inlets; wind and wave generated sediment transport; sediment budget analysis; coastal and inlet geomorphology; and PC-, workstation-, and mainframe-based automated coastal engineering software (including relational and GIS data bases).

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#### **L. Coastal Structure and Facility Design (CHL-12)**

Development of functional and stability design criteria for coastal structures and facilities (breakwaters, seawalls, jetties, groins, harbors, marinas, etc.); wave run-up, over-topping, refraction, diffraction, transmission, reflection, etc.; design of floating breakwaters; breakwater stability; application of spectral wave conditions to coastal engineering; stability of riprap to irregular wave attack; stability and functional design of overtopped rubble mound breakwaters; scale modeling of armor unit strength; analysis of structural data for floating breakwaters; investigation of numerical structural models for floating breakwaters; development of wave run-up gage for rough and porous slopes; investigation of attenuation/mooring force models of floating breakwaters; development of materials and techniques to produce high quality breakwater model armor units; analysis of wave run-up overtopping, refraction, diffraction, transmission and/or reflection data on coastal structures and beaches and design of structures for Logistics-Over-The-Shore (LOTS) operations.

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#### **M. Field and Laboratory Measurements, Data Collection, and Analysis (CHL-13)**

Technologies, instrumentation, and monitoring systems in coastal and riverine settings for

collecting, analyzing, and disseminating data related to measurements of coastal waves, surface currents, water levels, water quality, sediment, and wind, primarily in the field, but also in a sediment laboratory; advanced data analysis (spectral and non-spectral) techniques; remote sensing techniques; bedload and suspended sediment transport; monitoring and evaluating technical and structural stability of coastal projects; advanced hydrographic survey techniques, field measurement of coastal processes; bathymetric survey systems.

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#### **N. Experimental Coastal Model Equipment, Operation and Analysis (CHL-14)**

Development of equipment and techniques for specialized model construction, experimental wave generation equipment, specialized data acquisition and analysis systems, advanced model operations techniques, and laboratory and scale effects in movable bed model studies.

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#### **O. General Coastal Engineering, Coastal Geology, Dredging Investigations CHL-15)**

Sand bypassing systems and equipment; beach fill design; coastal geology and geomorphology; functional design and evaluation of coastal works and coastal structures; methodologies to assess and track coastal resilience performance; littoral transport; coastal and offshore dredging studies; agitation dredging systems and equipment; physical monitoring of dredged material; physical processes in coastal wetlands; application of Geographic Information Systems; design of nearshore and offshore dredged material placement; evaluation of dredged material disposal sites; analysis of dredging operations management.

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#### **P. Regional and Watershed Sediment Management (CHL-16)**

Regional Sediment Management (RSM) research is intended to provide knowledge and tools that the Corps and the Nation need for effective water resource projects. RSM implies the holistic management of sediment within systems or regions to produce environmentally and economically sustainable projects. Goals include improved project design, operation, and maintenance methods, minimized disruption of natural sediment pathways and processes, and mediation of natural processes that have adverse environmental or economic impact.

The approach of the Corps research is to produce targeted R&D serving multiple Corps business areas; to employ ongoing projects' experience (including Demonstration Projects) to provide data and lessons learned; to use enabling technologies of local-scale products and tools, including those generated by other R&D programs within and outside the Corps; to generate technologies that integrate the best available knowledge on sediment behavior and regional morphology into management decision support tools for a) regional and basin scale analyses and b) evaluation of the impacts of projects and management decisions on and by long-term, large-scale sedimentation processes. A key element in ERDC research is full coordination with other organizations with sediment management or monitoring expertise.

**Q. Marine Transportation Technologies (CHL-17)**

1. **OBJECTIVE:** The USACE has as one of its primary missions to provide safe, reliable, efficient, effective, and environmentally sustainable waterborne transportation systems for movement of commerce, national security needs, and recreation. To accomplish this mission, the USACE requires R&D to facilitate tracking of vessels on inland waterways (shallow draft) and coastal ports (deep draft). Knowing what vessels are arriving, when, the commodities being carried, etc., will provide lock operators and operations project managers valuable tools to improve safety, efficiency, asset management, and help to make decisions on performance-based funding for navigation project maintenance and improvements.

**2. DESCRIPTION:**

**Focus:** This topic focuses on software that uses the United States Coast Guard's (USCG) Automated Identification Systems (AIS) vessel mounted transmitters which broadcasts a radio signal with the vessels name, position, heading, velocity, and a wide range of other information. Proposals are sought for developing the following:

- a. Capability that will take the full suite of standard CG AIS messages and provide them in near real time to the Corps facilities in the immediate area of the vessel.
- b. Capability to allow collection of the full suite of standard AIS messages simultaneously at all pertinent Corps Inland and Deep Draft facilities.
- c. Capability to customize user interface to allow the Corps operations staff to view vessels in the vicinity of the Corps facilities to make decisions on the order in which to allow commercial tows to pass through lock.
- d. Provide the capability for Corps facilities to transmit pertinent information to the vessels in the immediate vicinity of the Corps facilities via AIS.
- e. System optimization methods and performance metrics for vessel operations.

**Special Considerations:** The level of understanding of AIS technology and signal processing, the number of successful installations of similar AIS software processing capabilities; experience with USCG staff, facilities, regulations and procedures.

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**R. Post-Wildfire Hydrologic, Sedimentation and Geomorphologic Management (CHL-18)**

The research program is focused on improving understanding of post-fire impacts through exploitation of affordable data acquisition methods and enhancement of numerical capabilities to assist with planning, management and mitigation in post-wildfire environments. Immediately

following a wildfire, vegetation is removed, organic soil horizons are reduced to ash and hydrophobic soils combine to result in increased water and sediment discharge and debris, mud and hyper concentrated flows. In the years following a wildfire, ecotone shifts, gully formation, and channel incision alter the hydrologic system response, resulting in dramatic changes in hydraulic and sediment impacts down system. Wildfires represent a significant perturbation to natural systems that dramatically alter the morphologic, hydrologic and sediment regimes of impacted watersheds. The overall purpose of this area of research and development is to investigate post-wildfire impacts on hydrologic and hydraulic response, geomorphic evolution, and sedimentation; with specific areas of needed research in the following areas:

- a. Studies related to cost-effective (in situ and remotely sensed) data acquisition and processing methods.
- b. Studies related to better understanding the longer term geomorphic impacts and subsequent recovery processes in post-fire environments.
- c. Studies related to hydrological physical processes, empirical approaches and numerical modeling
- d. Studies related to hydraulics and sediment transport physical processes and numerical modeling

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## **S. Nearshore Coastal Research in Support of the U.S. Coastal Research Program (CHL-19)**

Proposals are invited to address nearshore coastal research needs within three broad research themes as identified by the U.S. Coastal Research Program (USCRP) (see Nearshore Process Community, 2015 for more details). Nearshore systems include the complex interactions of physical, biological, chemical, and human influences within the transition region across the land and the continental shelf, spanning (from onshore to offshore) coastal plains, wetlands, estuaries, coastal cliffs, dunes, beaches, surf zones, and the inner shelf. Worldwide, nearly 1 billion people live at elevations within 10 m of present sea level, many of whom are at risk due to changing climate and storm intensity. The nearshore is a societally relevant region that requires and improved understanding of the feedbacks and couplings that shape, sustain, and alter coastal landscapes.

The Three broad research themes include a need to understand, better predict, and respond to (1) long-term coastal evolution due to natural and anthropogenic processes; (2) Extreme Events: Flooding, erosion, and the subsequent recovery; and (3) The physical biological and chemical processes impacting human and ecosystem health. Each is detailed below.

1. *Long-term coastal evolution due to natural and anthropogenic processes:* As global environmental change alters the rates of sea level rise and potentially storm patterns and coastal urbanization increases over the coming decades, an understanding of coastal evolution is critical. Improved knowledge of long-term morphological, ecological, and societal processes and their

interactions will result in an improved ability to simulate coastal change. This will enable proactive solutions for resilient coasts and better guidance for reducing coastal vulnerability.

2. *Extreme Events: Flooding, erosion and the subsequent recovery:* Hurricane Sandy caused flooding and erosion along hundreds of miles of shoreline, flooded New York City, and impacted communities and infrastructure. Overall U.S. coastal extreme-event related economic losses have increased substantially. Furthermore, climate change may cause an increase in coastal extreme events and rising sea levels could increase the occurrence of extreme events. Addressing this research theme will result in an improved understanding of the physical processes during extreme events, leading to improved models of flooding, erosion, and recovery. The resulting societal benefit will be more resilient coastal communities.

3. *The physical, biological and chemical processes impacting human and ecosystem health:* Nearshore regions are used for recreation, tourism, and human habitation, and provide habitat and valuable ecosystem services. These areas must be sustained for future generations, however overall coastal water quality is declining due to microbial pathogens, fertilizers, pesticides, and heavy metal contamination, threatening ecosystem and human health. To ensure sustainable nearshore regions, predictive real-time water- and sediment-based pollutant modeling capabilities must be developed, which requires expanding our knowledge of the physics, chemistry and biology of the nearshore. The resulting societal benefits will include better beach safety, healthier ecosystems, and improved mitigation and regulatory policies.

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## **GEOTECHNICAL AND STRUCTURES LABORATORY (GSL)**

### **I. Introduction**

Research performed by the Geotechnical and Structures Laboratory's (GSL) eight branches consists of investigations in the areas of soil mechanics, engineering geology, geophysics and seismology, earthquake engineering, pavements (both expedient and permanent), mobility and traffic ability of military vehicles, structural design and performance of structures under both static and dynamic loadings, earth dynamics, and the uses and performance of concrete, cement, and other construction materials. Research areas also include measurement and analysis of seismic and acoustic signals to locate airborne and ground military targets and buried objects (including unexploded ordnance) and to characterize earth media. Research on concrete and cement is predominantly related to current recognized needs, both civil and military. Military expediency focuses additional attention on ease and speed of concrete placement, development of very high-strength materials, and use of non-traditional, indigenous, and other special materials in concrete construction. Civil works research focuses primarily on the need to improve the performance of both new and old concrete structures. Structures research involves development, testing, and evaluation of a broad class of structures to resist the effects of static and dynamic loads induced by earthquakes and other sources. The Geotechnical and Structures Laboratory also conducts research involving all aspects for improving the survivability of fixed installations.

Research in numerical modeling and computer simulation of many of these topics is also undertaken. The following paragraphs provide a synopsis of the GSL's research responsibilities and, more specifically, describe those areas in which pre-proposals will be considered.

### **II. Research Areas**

#### **A. Earthquake Engineering (GSL-1)**

Research areas of interest include the dynamic behavior of soil and rock; liquefaction of soils, including coarse-grained and fine-grained soils; in-situ testing to evaluate properties related to dynamic behavior; in-situ testing to evaluate susceptibility to liquefaction; methods of analysis of dynamic behavior of earth materials; methods of analysis of dynamic soil-structure interaction; risk-based and probability-based methods of analysis; seismic wave propagation in earth materials; seismically induced settlements in soils and remedial treatment of soils potentially susceptible to earthquake-induced instability or strength loss; computer visualization and dynamic simulation; site response analysis; and strong motion instrumentation.

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**B. Geophysics (GSL-2)**

ERDC supports research in the development of land, air, or waterborne geophysical methods to be used for characterization of hazardous waste sites, detection and monitoring of seepage, nondestructive investigation of archeological sites, location of groundwater, and detection of buried objects; analytical and data-processing techniques, borehole surveys, cross hole seismic imaging, electromagnetic detection of anomalies, seismic surveys, sub bottom profiling, and acoustic impedance surveys; and uses of microgravity.

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**C. Mobility of Vehicles (GSL-3)**

The Mobility Systems Branch addresses engineering research on the performance of vehicles operating cross country and on-road, and/or in negotiating dry and wet obstacles in worldwide terrains. This is a highly specialized technical area involving engineering mechanics, vehicle dynamics, mathematics, statistics, computer specialties, geology, and soil mechanics. Research in this area includes developing fundamental relations between soil and vehicle running gear; improving criteria concerning the effects of vehicle vibration and ride shock on sensors and data streams from rapidly moving sensors over rough terrain; developing algorithms describing weather effects on terrain, multi-vehicle movements along road nets, stochastic processes describing influence of uncertainties of data elements, and developing modeling and simulation capabilities for near real-time assessments of mobility and counter mobility for battlefield operations and operations other than war.

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**D. Pavement Technology (GSL-4)**

Research in this area is conducted in support of the Corps mission to design and construct roads and airfields worldwide and other related engineering functions. This research includes the development of engineering criteria for the design, construction, evaluation, maintenance, and rehabilitation of permanent and expedient airfields, pavements, and ports. Research areas of interest include improved design procedures, structural performance modeling, material characterization and evaluation, nondestructive testing, rapid repair of structures, expedient surfacing (to include novel, composite, and metallic systems), aircraft and vehicular ground flotation, access/egress systems, gravel surfaced and non-surfaced areas, the use of geotextiles and geomembranes, grid-confining systems, soil stabilization, dust-control materials and techniques, advanced binder systems, remote assessment, earth anchoring, pavement evaluation, and advanced testing, monitoring, and evaluation equipment, software, and methods to support pavement and pavement related functions.

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## **E. Soil and Rock Mechanics (GSL-5)**

Research is needed to: (a) improve methods for prediction and control of erosion of unlined spillway channels during uncontrolled releases; (b) develop innovative methods for flood protection and flood fighting, including field evaluations of promising technologies; (c) develop guidance for applications of trenchless technology on Corps structures, including measures to ensure safety and stability of Corps structures when trenchless technology is used to install pipelines, cables, or conduits through or beneath levees and other structures; (d) develop improved methods, including risk-based methods for analyzing earth and rock fill dams and other water control structures for both static- and earthquake-induced stresses; (e) improve the state of knowledge of physical and engineering properties of soil, rock, and clay shales; earth-rock mixtures, granular filters, cohesive and non-cohesive fine-grained soils susceptible to liquefaction; and soils susceptible to drastic volume changes (collapse, consolidation, swell); (f) develop rational analytical procedures and more reliable prediction of behavior of partially saturated soils; (g) determine the response of soils in situ to static and dynamic loading and unloading; (h) determine the susceptibility of earth dams to cracking, hydraulic fracturing, and internal erosion; (i) evaluate improved defensive design measures in use of materials, particularly in filter and transition zones and impervious barriers; (j) improve procedures for monitoring and analysis of the performance of new and existing structures, particularly the use and interpretation of observations and data from specialized instrumentation, and expedient systems for rapid inspection and evaluation of the integrity of dams; (k) improve the understanding of the aging processes in dams and the influence of aging (particularly deterioration of safety-related features) on long-term maintenance and/or rehabilitation requirements for dams; (l) develop a better understanding of failure mechanisms to improve design of defensive measures, to provide information for remedial repairs, to assess potential damages resulting from failure, and to provide a basis for emergency actions; (m) develop expedient remedial measures when hazardous conditions are identified and, thus, reduce the damages and catastrophic potential of dam failures; (n) develop methodology to evaluate forces exerted on structural elements by adjacent soil masses that result from long-term variation in soil properties; (o) develop improved methodology for design and construction procedures for shallow and deep foundations, including mats, footings, piers, and piles for buildings, hydraulic structures and waterfront structures; (p) large-scale physical and numerical modeling of deep underground structures (tunnels, shafts, chambers, and intersections); (q) predictions of rock mass dredgability; (r) acoustic emission (micro-seismic) applications in geotechnical engineering; (s) geotechnical aspects of hazardous and low-level radioactive waste disposal; (t) evaluation of rock for use as riprap; (u) grouting of soil and rock masses; (v) sliding stability of gravity structures, and (w) centrifuge modeling of structures founded on or in rock.

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## **F. Engineering Geology (GSL-6)**

The GSL conducts a broad range of research in the field of engineering geology in support of federal or other Government technical missions. Specific areas of interest within this field include: application of remote sensing to geologic and geomorphic assessments; geo-archeological investigations; applied and numerical geomorphic analysis; computer

applications in geotechnical engineering; 3-D visualization systems; uses of geographic information systems; geo hydrology in military and civil applications; including water quality and supply issues; geologic mapping; geologic applications of mathematical techniques and geo statistics; groundwater monitoring, including well installation and design; geologic application of groundwater models; integration of geological and geophysical subsurface exploration techniques; land-loss studies; remedial measures at groundwater contamination sites; seismic hazard characterization and evaluation; subsurface exploration methods (drilling and sampling techniques); test site selection; conceptual and geologic and hydro geologic models.

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### **G. Excavation, Structural Demolition, and Obstacle Creation (GSL-7)**

Current criteria for improved demolitions call for significantly reduced manning levels and preparation times to accomplish assigned missions. Cost effectiveness, versatility, and safety are also of great importance. Current efforts involve technologies for the standoff creation and reduction of all types of battlefield obstacles, and the excavation of fighting positions. A prime consideration is the development of more efficient means for the application of various types of energetic materials to targets of interest. In addition, modern materials and design principles used in typical target structures must be incorporated into future plans and guidelines for demolitions. Typical missions of interest are road cratering, anti-tank ditching, bridge and tunnel demolition, and the breaching of walls, bunkers, levees, and dams.

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### **H. Ammunition Storage Safety (GSL-8)**

The military services must store large amounts of munitions, both for war reserves and for training purposes. New conceptual designs for components or systems for storage are needed to reduce the likelihood of an accidental detonation of stored munitions, limit the propagation of air blast and fragments, or mitigate the safety hazards produced by an accidental detonation. In addition, test data and simulation techniques are needed to aid in the definition of the safety hazards from such detonations, and the mechanics of blast propagation among munition stores. Obsolete munitions are often disposed of by deliberate, controlled detonation. Research is needed on new methods for safe, efficient, and environmentally acceptable methods for deactivation of a wide variety of munition types.

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### **I. Physical Simulation of Munition Phenomenology (GSL-9)**

The mechanical effects induced by munition detonations are physically simulated using a variety of energy sources. Simulations are performed at full- and small (1/2 to 1/10) scale.

The mechanical effects from conventional energetic materials are normally performed at small scale. These studies could benefit from improved (better fidelity, less expensive) simulators and simulation techniques. They could also enhance the development of test methodology for micro-scale (1/100 to 1/10) testing. Micro-scale test methodology includes the miniature high-fidelity energy sources, miniature sensors, advanced optical techniques, high-fidelity construction techniques for miniature structures, and theoretical developments in the scaling of material behavior.

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#### **J. Geophysical Phenomenology - Multi-Modal Geophysical Phenomenology, Modeling, Data Processing, and Data Management (GSL-10)**

The objectives include detecting, classifying, and locating airborne and ground military targets and buried objects using geophysical methods for homeland defense and homeland security applications. Also included are invasive and non-invasive approaches for measuring and quantifying the geophysical/geologic signatures of diverse geo-environments. This can include the development of new and/or improved analytical and numerical models, rapid data-processing techniques, and new subsurface imaging techniques that include active and passive sensor modalities in a variety of rural and urban terrains.

Of particular interest is the broadband propagation of energy including, but not limited to: seismic/acoustic/infrasonic/electromagnetic/ thermal/chemical, under variable conditions using a variety of sensing platforms (fixed, mobile, airborne, space). The development of new tactics, techniques, and procedures for the employment of novel sensing methods as well as the development and/or verification of empirical testing and evaluation techniques is also desirable. Data management and multi-mode integration techniques and platforms are also of interest.

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#### **K. Laboratory Tests and Constitutive Model Development for Geologic Materials (GSL-11)**

This research requires the formulation of mathematical constitutive models to simulate the mechanical behavior of geological and structural materials and incorporation of models into application-oriented prediction/analysis techniques. Also of interest are the development of dynamic test equipment and techniques and the experimental evaluation of geological and structural material response to high-pressure transient loadings.

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**L. Projectile Penetration (GSL-12)**

Theoretical and experimental studies of projectile stresses and trajectories due to impact and penetration into geologic and man-made targets and development of design criteria for shield systems include development of equipment and diagnostic techniques to examine the response of targets to low- and high-velocity impact of penetrators, rods, etc.

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**M. Computational Structural Mechanics for DOD Applications (GSL-13)**

The efficient use of scalable computers will require fundamentally new concepts in computational mechanics algorithms. Research includes mathematical formulations and development of scalable computational mechanics algorithms in the areas of structural response, penetration, contact impact, structure-medium interaction, multi-scale, multi-physics and interdisciplinary flow-thermal-structural interactions. This research area also includes development of computational models for new materials and composite construction (consisting of concrete, composite, and/or geologic materials), as well as the behavior and control of structures composed of such composite construction for military applications.

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**N. Concrete Materials (GSL-14)**

Research in this area includes improving the performance of concrete materials and systems. Performance could include very high tensile or compressive strength, high ductility, high fracture toughness, low shrinkage, rapid hardening, very low permeability, resistance to abrasion and erosion durability, chemical resistance, shock-attenuating properties, ultra-low density, thermal insulation properties, workability, and other unique attributes. This includes improvements in the materials typically used in a concrete mixture such as aggregate, cement, and chemical admixtures. Aggregates could include waste and/or manmade materials such as fly ash, silica fume, ground granulated blast-furnace slag, recycled concrete, lightweight aggregates other potentially low cost and/or green materials. Micro- and Nanoscale aggregates, inclusions, pozzolans, cements and reinforcements such as microspheres, nanosilicates, microfibers and low cost nanotubes or nanofibers would also be included in this research area. Chemical admixtures such as water reducers, set retarders, set accelerators, air-entraining admixtures, and foaming and defoaming agents that lend unique properties would also be considered in this research area. Since reinforcement is a critical element to the ductility and durability of concrete materials, advanced reinforcement materials that enhance these properties fall under this research area. Additionally, this topic area would include research involving nontraditional cement binders including polymer- impregnated concrete, polymer or resin concrete, polymer Portland-cement concrete and geopolymer concretes.

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## **O. Concrete Properties and Analysis (GSL-15)**

Research in this area is focused on the development of new nondestructive and destructive test methods and analysis techniques to better characterize the properties and performance of concretes and the constituents that they are composed of at scales ranging from the nano-level to the macro-level. There are a vast number of topics in testing and analysis that could be included in this area as related to the physical and chemical properties of aggregates, cements, pozzolans, admixtures, fibers and their interaction during the mixing, placing, curing, and service phases of a concrete. This could include but is not limited to:

1. Developing test methods and analysis techniques to better quantify material properties at aggregate-paste and fiber-paste transition zones.
2. Developing tools, test methods and analysis techniques to non-destructively define the spatial distribution of components in a concrete specimen.
3. Developing better assessment tools and criteria for predicting durability and longevity of concrete and grout.
4. Developing better methods to define and classify chemical admixtures by chemical composition and mechanism of performance.
5. Developing innovative systems to construct concrete materials and structures more economically.
6. Developing theoretical, computational, and experimental methods for effectively characterizing stress, strain, progressive damage, and fracture of engineering materials subjected to static and dynamic loads.

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## **P. Maintenance, Repair, and Rehabilitation of Concrete (GSL-16)**

Assessment of remaining life, maintenance and minor remedial measures, repair and rehabilitation, and surveillance and monitoring are topics of interest. Structures of interest include concrete locks and dams and appurtenant concrete and steel structures (outlet works, retaining walls, gates, piles, bulkheads, tunnels, intakes, etc.).

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## **Q. Other Areas of Materials Research (GSL-17)**

Research is needed in the development, properties and performance of a range of materials for military and civil applications. Needed materials research for concrete applications includes such materials as: curing compounds, coatings, and overlays; polymers or other agents for improving bond between old and new concrete; water stop materials for use in hydraulic structures, and methods for characterizing and testing such materials; grouts for injection underground in very fine fracture systems or porous media; organic and inorganic composites that are used in construction; and grout materials and technologies for waste-disposal and containment such as for both commercial and defense-related low-level and high-level radioactive wastes.

Other materials research needs include the development, testing, and prototyping of materials and composites exhibiting advanced mechanical, thermal, rheological, chemical, electrical, and multi-functional properties and performances. Research is performed on: energy absorbing materials for impact, ballistic and blast resistance; hierarchical, multi-layered, and functionally graded material systems; multi-scale reinforcement for macro performance; self-sensing and self-healing materials; and materials demonstrating advancements in durability, high strength-to-weight, fatigue resistance, and ease of application.

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#### **R. Bridge Research (GSL-18)**

Research is conducted in support of the Army's Bridge Safety and Waterfront Facilities Evaluation Programs. These programs require the design, construction, maintenance, repair and inspection of bridges and ports worldwide as well as other engineering functions as they relate to transportation structures. This involves the formulation of engineering criteria for the design, construction, evaluation, maintenance, and rehabilitation of permanent and expedient bridge and port facilities. Research areas of interest include improved design procedures, material characterization and evaluation, nondestructive testing, rapid repair, scour, unknown material properties, unknown foundations, traffic safety, underwater inspection, fracture critical and fatigue evaluations, load capacity and load ratings.

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#### **S. Structures Research (Civil Works) (GSL-19)**

Research is conducted in assessing the performance of critical structures to extreme loads, such as those resulting from seismic, terrorist attack, and storm events, as well as the effects of flow-induced vibrations. Efforts include assessing sensitivity of structural design and analysis procedures, vulnerability of structures, and critical design parameters to develop appropriate load-resistance factors. Techniques for retrofit, including use of new and innovative materials, of structures to resist extreme loads is of interest. Also, a better understanding of long-term behavior and deterioration of civil structures is needed, including factors such as material interactions, thermal stresses, and any issues affecting design of new structures and operation and maintenance of existing structures.

Nonlinear and linear system identification research includes vibration testing, data acquisition, data processing, and analysis techniques for determining linear and nonlinear dynamic and static response properties of structures and structural systems subjected to earthquakes, blast effects from mining (or other) operations, other transient random, harmonic dynamic loads, and static or pseudo static loads.

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## T. Structures Research (Military) (GSL-20)

1. Research is needed on the response of aboveground and shallow-buried structures subjected to military dynamic loads; specifically, the prediction of the load and response to failure of aboveground and shallow-buried structures. This effort will involve the following research:

a. Development of techniques to simulate military dynamic loads on aboveground and mounded structures.

b. Development of design procedures for components in semihardened and protected facilities.

c. Analysis of structural loading and damage resulting from internal or external detonations.

d. Development of fast-running models for PC based applications to predict the response of structures, both hardened and unhardened, to single and multiple explosive detonations.

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2. Research on deeply based structures and hardened existing systems involving the following:

a. Development of comprehensive structural design for deeply buried and surface-buried structures subjected to air blast-induced and direct-induced ground shock from surface and shallow earth-penetrating high-energy sources.

b. Formulation of computer models for SSI and pre- and post-test analysis of structural response to include correlation and comparison with experimental data.

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3. Research on surveillance and intrusion detection sensors involves the constraints of the environment on sensor systems used to detect intruders and placed along the perimeter of high-value military installations. Improved methods for rapid and accurate measurement of predetermined influential environmental parameters must be developed. Analytical techniques relating to specific sensing phenomenology's and target/nontarget-generated signatures and signature wave interactions to variations in environmental characteristics are required. Of particular interest is the integration of multiple sensor systems (both detection-type and

environmental/background monitoring transducers) that use various sensing phenomena for enhanced target detection and classification and increase nuisance and background signature rejection. Research studies are required in the determination of automated techniques for monitoring sensor system response and sensitivity to provide optimum and consistent performance as a function of time varying changes of influential environmental characteristics.

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**4.** The Corps of Engineers is involved with research on the design of military facilities for protection from high-energy sources. These efforts include the following research:

a. Prediction of the response of structural elements common to conventional or expedient construction to military loads.

b. Methods of retrofitting conventional buildings to harden them against nearby military high-energy sources.

c. Development of innovative design of structural components, such as windows and doors, subject to high-energy sources.

d. Development of analytical methods for predicting the effects of forced entry devices on structural components.

e. Development of innovative designs using low-density materials for expedient protection of troops and equipment from the effects of military high-energy sources.

f. Development of microprocessor-based software/hardware and supporting documentation to aid in the assessment of structural survivability to the effects of conventional and advanced weapons systems. The software will address the integration of databases, weapons effects calculations, and operational factors associated with engineer survivability missions.

g. Development of a procedure to ensure robust codes, user-friendly interfaces, and supporting documentation for use in the testing and development of microprocessor-based survivability and structural assessment software/hardware.

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**5.** Composite Materials for Force Protection-Research in this area includes developing, characterizing, modeling, and testing of layered composite materials for protection against air blast and penetration/fragmentation. These materials are intended for use in



lightweight expedient protective systems to protect against improvised explosive devices and conventional weapons such as small arms, standoff weapons, fragmenting weapons, and shape charges. It is envisioned that panels of these materials could be incorporated into protective structure designs to increase survivability of personnel or to protect mission-critical assets. Performance measures include such attributes as build time, low mass, cost, penetration resistance, ductility, and environmental durability. Additionally, this topic area includes methods to develop appropriate material anisotropic and or non-homogeneous material models for incorporation into advanced computational models such as Abaqus, LS-DYNA, and EPIC. Protocols for evaluation and performance testing of composite materials subjected to energetic, high-strain rate events are desired.

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**6. Worldwide Construction Practices-** This research includes capturing typical construction practices and construction material properties worldwide. Information of interest is material properties of structural components, building types and construction techniques, building footprints, construction timeframe/era of buildings, and location of the building (country, world region, urban terrain zone).

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#### **U. Multispectral Camouflage Research (GSL-21)**

This research area involves all aspects of fixed-facility survivability incorporating signature management and other technical effects. Fixed facilities include stationary and relocatable high-value targets. The general goal is to directly and indirectly increase the survivability of U.S. and Allied facilities and improve the U.S. and allied counter-Intelligence, Surveillance, and Reconnaissance (counter-ISR) capability against adversaries. Multispectral refers to those areas of the electromagnetic spectrum used by the United States and potential adversaries in reconnaissance and surveillance and in attack platform target acquisition and detection. Major objectives include: quantifying or otherwise evaluating counter-ISR technology effectiveness; investigating materials and techniques for signature modification; developing technical effects and physical countermeasures, procedures, and applications; developing computer-based analytical procedures for simulating scenes; developing instrumentation for and conducting target/background signature measurements; assessing the United States and threat operations and sensor capabilities with both currently fielded and new design reconnaissance and surveillance and attack platform sensors and systems; developing applications for intelligence information for military missions; providing guidance to field commanders and information for the RDT&E community; and studies of the interaction of camouflage technology with other operational factors, particularly in determining operational supportability, costs and manpower, interoperability, and joint interoperability requirements.

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## **V. Advanced Maneuver Technologies (GSL-22)**

This research addresses ground vehicle maneuver in urban environments which poses many new operational and tactical challenges for the Army and Joint Forces. While many improvements have been made in protecting ground vehicles in the last decade, these improvements come with a cost, namely limited situational awareness due to reduced visibility and limited maneuverability in tight spaces because of larger vehicle size. Both of these constraints seriously reduce the mobility of ground vehicles in urban environments. To address these constraints, research is needed to develop technologies to identify nearby dynamic hazards for ground vehicles in urban environments and provide early warning to ground vehicle operators or autonomous driving systems. Specifically, this research will address methods and procedures to develop advanced technologies that will be used for detecting dynamic hazards in urban environments such as traffic flow rates and congestion, pedestrians, buried threats, constricted roads, and other obstacles or anomalous objects in real-time. In addition, further research is needed to develop technologies that will deliver the information in a consolidated or data excerpt manner and report the locations of interest and concern to the driver and or operator. The performance of emerging technologies in sensors and data processing to provide better situational awareness in near real-time to ground vehicle operators maneuvering in dynamic urban terrain is also of interest.

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## **W. Railroad Technology (GSL-23)**

Research in this area is conducted in support of the Corps mission to design, construct, and operate railroad systems worldwide. This research includes railroad design, construction, inspection, evaluation, maintenance, and rehabilitation. Research areas of interest include advanced and composite materials, rapid repair, non-destructive evaluation, geotextile use in construction, in-situ additive manufacturing of components, soil stabilization, GIS, and remote assessment.

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## ENVIRONMENTAL LABORATORY (EL)

### ENVIRONMENTAL SENSING

#### I. Introduction

Current research is in the acquisition of information by remote sensor systems, the impact of the environment on imaging and other sensor systems, and advanced signal processing. Sensors using electromagnetic, seismic, and acoustic energy forms are of interest. In addition, work is conducted to determine terrain and other environmental effects on high-technology sensor systems. Sensor systems include optical and infrared millimeter wave (active and passive). Briefly described below are specific research areas.

**For all topic areas, white papers or “pre-proposals” will be evaluated to possibly initiate collaborative proposal development for third-party funding sources (e.g., Strategic Environmental Research and Development Program (SERDP), Environmental Security Technology Certification Program (ESTCP), DoD Basic 6.1 Research Program, research related to the RESTORE Act, etc.). White papers must clearly outline work to be conducted, public benefit of the work, appropriate technology transfer, personnel qualifications, and all associated costs. Funding of jointly prepared full proposals is contingent upon acceptance and funding by the third-party funding source.**

#### II. Research Area

##### A. Sensing (EL-1)

The EL has an ongoing program to develop and demonstrate advanced technologies that support the Army's requirements for improved detection and discrimination of unexploded ordnance (UXO), depleted uranium (DU) munitions, radiological threats, and deployment platforms. Additional research work is needed for subsurface (land-based) and underwater (proud and buried) UXO sensing, data analysis, display, and platform navigation/positioning. Special areas of interest include novel sensing concepts for the detection and relocation of buried objects (DU, metallic, and nonmetallic targets) using magnetic, electromagnetic induction, ground penetrating radar, seismic/acoustic, chemical, and/or radiological methods or a combination thereof. Fundamental measurements and models that define/predict the performance of these sensing methodologies in varying environmental conditions for UXO, DU and radiological targets are also of interest. Research is also needed to develop advanced data analysis techniques that can significantly reduce the number of false positives arising from natural anomalies and man-made sources.

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## **B. Environmental and Military Sensing (EL-2)**

1) Research in this area includes basic and applied research to develop environmental sensing, characterization, and monitoring capabilities necessary to quantify environmental site conditions and trends at local and regional scales. In the military area, research is conducted on basic signature research, to better understand target and environmental background signature characteristics.

2) Specific areas of required research include:

- a. Development, integration, and application of remote sensing technologies and the use of these data in geospatial models to characterize site conditions over large areas.
- b. Development of innovative data fusion approaches, particularly the combined use of hyper spectral and bathymetric and/or topographic LIDAR data for the extraction of environmental information.
- c. Research to identify, model, and mitigate the effects of the environment on novel sensing techniques that address environmental and military requirements.
- d. Development of ground-based and airborne remote sensing approaches, and associated modeling, for unexploded ordnance detection, minefield detection, military targets and vehicles, and smart weapons development.
- e. Rapid collection, analysis, and visualization of sensor data for environmental quality and military applications.

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## **C. Environmental Instrumentation (EL-3)**

1) Research and development in this area includes basic and applied research and technology demonstrations that support rapid measurement of biological and chemical hazards of the environment.

2) Specific areas of required research include:

- a. The integration and interoperability of environmental instrumentation with future and existing military robotic systems: this includes unmanned aerial systems, ground robotics, autonomous submersibles, and robotic surface watercraft.
- b. Provide new applications that support faster processing on small low-power hardware to triage environmental measurements to immediately identify biological and chemical hazards.
- c. Techniques that support biomimicry in robotic systems and the differentiation of biotic from abiotic systems. Instruments that are low-power, small, and compact to assess the biological and chemical characteristics of water, soil, and air, in surface and subterranean environments.
- d. Research into sensing of aerosols and/or plumes from either ground or airborne platforms.

- e. Research into novel uses of unmanned aerial systems for environmental characterization and change detection - including fusion of active and passive modalities.

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## **CONTAMINATED SITE CHARACTERIZATION, ASSESSMENT & REMEDIATION**

### **I. Introduction**

An extensive research and development program is being conducted by the Department of Defense to assist in the cleanup of contamination at military installations. The EL is developing technologies for characterizing, monitoring, and applying physical, chemical and biological treatment of toxic and hazardous waste in contaminated surface and ground waters and soils. The EL is also developing, evaluating, and verifying numerical models and guidance for solid waste disposal systems.

### **II. Research Areas**

#### **A. Innovative Technology for Environmental Sensors and Tools. (EL-4)**

The EL has an ongoing research program to develop advanced technologies for environmental sensing, characterization, and monitoring in order to quantify environmental conditions at sites of interest. The program is actively developing field-based tools and sensors to conduct rapid site characterization/screening for environmental contaminants. Additional research is needed in the areas of novel sensing technologies for detection of chemical and biological contaminants allowing for rapid field-based data acquisition. Also, research is needed to develop technologies and platforms allowing for rapid data analysis/interpretation/reporting. Fundamental measurements and models that define/predict the performance of new sensing methods in soil, water and air are also of interest.

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#### **B. Innovative Technologies for Treating Hazardous Waste and Contaminated Surface and Ground Waters (EL-5)**

Presently, EL is continuing to conduct research, develop technologies and apply strategies to treat complex organic- and metal-contaminated hazardous liquids, off-gases, soils sludges, sediments, and residuals from past disposal practices. Research is divided into two major categories: technologies for treating contaminated soils and sediments, and innovative technologies for treating contaminated surface and ground waters. Areas of R&D include: (1) physical and chemical technologies to minimize or reduce the quantity and toxicity of hazardous waste, (2) biological processes and methods to detoxify/destroy hazardous waste constituents, (3) techniques for in situ treatment of groundwater aquifers, (4) laboratory design criteria for and field implementation of piloting equipment for promising technologies, (5) computer-based techniques to assess operational performance of various treatment processes/systems and (6) improved analytical chemistry techniques and methodology to assess treatment technologies.

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### **C. Design, Evaluation, Verification and Modeling of Solid and Hazardous Wastes and Contaminated Sediments (EL-6)**

Efforts are continuing to develop water balance and leachate models for solid waste disposal systems and dredged material disposal facilities. Additional work is needed to model innovative designs, nonsoil surface materials, cobbled surfaces, preferential flow through heterogeneous waste materials and other layers, and effects of complex mixtures of vegetation including trees. Similarly, additional work is needed to verify the existing models.

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### **D. Artificial Intelligence and Machine Learning Models to Inform Materials Discovery (EL-7)**

There is an ongoing research program to develop and/or utilize existing Artificial Intelligence (AI) and Machine Learning (ML) algorithms to rapidly discern future trends in the field of Materials Science. These developed AI and ML algorithms will be used to inform future research directions in the development of novel materials with advanced properties in scientific fields, such as polymer chemistry, transducers, bio-materials, semiconductors, ceramics, metals, composites, high-capacity storage, etc. The output from the AI and ML algorithms must be experimentally validated through synthesis and fabrication of products with the predicted desirable properties/chemistry/etc.. Research is needed in the development of these novel AI and ML algorithms to predict future directions in high-performance products with the addition of experimental validation of the models.

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## **SEDIMENT GEOCHEMISTRY AND BIOLOGICAL EFFECTS**

### **I. Introduction**

Potential adverse environmental impacts of disposal of contaminated sediments must be assessed prior to permitting operations. This includes the determination of the impacts that contaminated dredged materials exert on the environment prior to dredging.

### **II. Research Areas**

## A. Environmental Risk Assessment (EL-8)

Current research on the fate and effects of environmental contaminants occurs under the general paradigm of Environmental Risk Assessment. Specific studies fall into one or more of the following areas:

1. Hazard Identification. This is the process of showing causality (i.e., a chemical or complex mixture can cause some adverse effect). If this causality can be demonstrated, the chemical is referred to as a "hazard." If there is no causal link, risk need not be quantified. Important target receptors are also identified by this stage (for example, humans, endangered species, and ecologically or economically important species). Research is conducted to develop the technology for hazard identification and the establishment of causality.

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2. Effects Assessment. While Hazard Identification decides if a chemical or complex mixture is toxic; Effects Assessment establishes the relationship of the toxicant dose and associated biological response. This is accomplished via experimental research in which surrogate species are exposed to gradients (spatial, concentration, etc.) of the hazard in question, and biological effects are monitored. Biologically important endpoints measured include survival, growth, reproduction and population-level parameters. These endpoints must be accompanied by technically sound interpretive guidance. Results are expressed in dose- response or exposure-response relationships. Research is conducted to develop the necessary experimental/statistical designs, technically sound tests (for example, chronic sub lethal sediment bioassays) and appropriate extrapolations (for example, high dose to low environmentally realistic exposures, and surrogate test species to receptor of interest). Analysis of the uncertainty associated with these effects assessments is also conducted.

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3. Exposure Assessment. In Exposure Assessment, the magnitude, frequency and duration of contaminant exposure relative to the target receptor(s) are determined. This research is model-intensive, with both descriptive and quantitative models being used to evaluate pathways and routes. A pathway exists if the hazard travels between the initial source of contamination and the ultimate biological receptor. An exposure route is pathway that the chemical contacts the receptor (for example, ingestion, inhalation, dermal absorption, bioaccumulation, trophic transfer). Analysis of the uncertainty associated with these exposure assessments is also conducted.

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4. Risk Characterization, Management, Communication, and Analysis. Outputs from the Effects Assessment and Exposure Assessments are joined in Risk Characterization to yield an estimate of risk. Research is conducted to determine the best ways to characterize risk both numerically and descriptively. Also, uncertainty analysis is undertaken to identify the qualitative and quantitative important sources of uncertainty. Techniques employed include error propagation, probability distributions, sensitivity analysis, Monte Carlo simulation and others. Once environmental risk has been quantified, management action may be required.

5. Research is conducted to develop management alternatives, which range from no action to extensive (and expensive) remediation. Results of the Environmental Risk Assessment are weighed and balanced with other factors such as applicable laws and regulations, engineering feasibility, potential benefits, costs, economic impacts, and the socio-political decision environment.

Risk Communication is a dialogue that occurs at two levels: between the risk assessor and the risk manager, and between the risk manager and the public. Research is conducted to identify optimal procedures for communicating environmental risks, including an appreciation for the limits and uncertainties of the numerical results. Risk Analysis is a broad, inclusive term encompassing the processes of Risk Assessment, Risk Management, and Risk Communication as well as any field verification or monitoring activities. Field verification is a study or studies carried out to determine the accuracy of laboratory observations and predictions. Field monitoring (in the context of Risk Assessment) is undertaken to ensure that steps taken to manage the chemical risks were successful. Field research studies are carried out for both verification and monitoring purposes.

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6. Engineering With Nature® (EWN®) Research Supporting Innovative Field Sampling Practices, Natural Infrastructure (NI) Construction/Deployment and Related Technologies. Conduct a broad array of EWN research and development that may include, but is not limited to: research pertaining to placement of scientific instruments and/or pursuit of novel experiments that advance field-based sampling and laboratory practices for the purpose of measuring and archiving the performance of natural infrastructure (NI); conduct research and/or test innovative instrumentation that records/monitors natural and engineering processes resulting from the placement of NI and/or hybrid infrastructure; conduct research and test new technologies that result in accelerated construction/placement of natural and nature based features and/or improved placement strategies for dredged sediment used to construct EWN projects.

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7. Technology Transfer Development for Engineering With Nature® (EWN®) Research Areas. Research, develop and analyze technology transfer concepts; analyze target audiences for technical information; test innovative methods of transferring EWN research results and technology to supplement conventional technology transfer. Included may be such items as interactive internet and PC technology applied to training and general information transfer; technology applications of electronic media using the Internet; and innovative public information systems/products. Audiences include Corps of Engineers and the Department of Defense; Congress and other Federal, State, and local agencies; port and transportation authorities; universities; environmentalists and other public interest groups; and the general public.

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## B. Sediment Water Interactions (EL-9)

Sediment/Soil Water Properties. Current research encompasses a wide range of investigations designed to increase understanding of sediment-water interactions. Emphasis is on conduct of investigations for determining the impacts that sediment/soil properties have on

sorption and transformation of explosives and release of semi-volatile contaminants to the atmosphere. Factors responsible for sorption and transformation of explosives include redox potential, pH, and the geochemical characteristics of the soil or sediment. Factors affecting the release of semi volatile contaminants from soil or sediment to the atmosphere include relative humidity, wind speed, contaminant concentration, moisture content, porosity, and organic carbon content. Research is also conducted on colloidal system contaminant transport, accelerated sediment oxidation, and the role of solution chemistry in contaminant partitioning between sediment and water.

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Diverse research activities focused on characterizing microorganisms and microbial communities in natural and engineered environments relevant to contaminant transformations, biogeochemical cycling, host-microbiome-contaminant interactions, bio-enabled materials, synthetic biology, and environmental biological threats are currently underway.

1. Biodegradation of Contaminants. Studies in the biodegradation area emphasize destruction of organic contaminants for remediation purposes. Emphasis is on (1) bioinformatics of microbial community diversity and activities in various ecosystems; (2) delineating biodegradation pathways, enzymes, and genes; (3) determining intermediate and final end-products; (4) assessing the role of environmental and genetic factors regulating the pathways utilized and the rate and extent of destruction of the parent compound; (5) determining the survival and activity of microorganisms added to ecosystems, and biotreatment systems; and (6) enhancing biodegradation to obtain the maximum destruction of organic contaminants within a soil, sediment, or treatment system.

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2. Microbial Sensing. Novel microbial, cellular, molecular and/or genomic approaches are sought and developed for the rapid functional and DNA-based identification, detection, and monitoring of microorganisms in various environmental matrices including soils, sediments and surface waters. Novel ecological approaches to detect, monitor and predict prokaryotic/eukaryotic microbes are sought that combine physiology, molecular tools, biochemistry, modeling and remote sensing for the management of high biomass events and environmental toxins.

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3. Biomaterials and Composite Structures. Novel biological materials and/or techniques are sought to manipulate bioprocesses and biomineralization pathways as additives to aggregate and composite products. These products will support advancements in material structural properties that support civil works and military operations.

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4. Insect and plant field collections, insect husbandry, plant maintenance with greenhouse access are sought for various microbiome projects. Needs will be seasonal and very specific to limited insect or plant systems as dictated by internal projects.

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### **C. Techniques for Contaminated Dredged Material Disposal and Treatment (EL-10)**

1. Development or enhancement of computer models to be included in the Automated Dredging and Disposal Alternatives Modeling System (ADDAMS) to evaluate the environmental impacts of dredged material disposal. Evaluations include water quality impacts of initial release in open water, effluent discharge, runoff and leachate, benthic impacts, plant and animal uptake, and volatilization.

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2. Development and/or application of new or improved environmental chemistry methodologies to assess contaminant concentrations of dredged material and other complex matrices (e.g. elutriates, bioaccumulation tissues, etc.) focusing on specific compounds or classes, cost effectiveness, quality assurance, lower detection limits, and removal/reduction of challenging matrix interferences.

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## **ENVIRONMENTAL AND WATER QUALITY MODELING**

### **I. Introduction**

The Corps of Engineers is involved in research and development related to water quality and contaminant fate/transport modeling for surface water, watersheds, and the subsurface, or groundwater. This encompasses a wide range of environmental issues, such as water quality and ecosystem linkages, contaminant transport and fate, eutrophication, effects of land use/management on watershed runoff quality, total maximum daily loads (TMDLs), and ecological and human health risk assessment as related to contaminants in the environment. Research may include model development and field and laboratory investigations to improve model descriptions and to provide required data for model validation.

### **II. Research Areas**

#### **A. Numerical Water Quality and Contaminant Modeling (EL-11)**

This area of work is oriented toward development and application of water quality and contaminant

fate/transport models for surface water and the subsurface, or groundwater. Surface water modeling includes watersheds and receiving waters, e.g., riverine, reservoir, wetland, estuarine, and coastal water bodies. Groundwater modeling includes modeling both the unsaturated and saturated zones,

as well as multi-component flow and transport. Models are utilized for conventional water quality (e.g., nitrogen, phosphorus, carbon, dissolved oxygen, etc.) and contaminants, i.e., toxic substances, such as organic chemicals, trace metals, radionuclides, explosives, and other military unique

compounds. Emphasis includes the following: formulation of appropriated physical, chemical, and biological algorithms; improvement of mathematical and numerical methods; collection and assemblage of data for model evaluation; conduct of field and laboratory process investigations designed to develop/improve model descriptions, dynamic linkage of water quality and biological models, including biomass-based, individual-based, and population- based biological models; integration of contaminant exposure models with biological effects data or models to quantify risk; incorporation of uncertainty analysis into modeling; linkage of physical/chemical models with biological population models; linkage of cross- domain models for system wide modeling; development of routines/linkages to include the effects on water quality of watershed landscape features (e.g., buffer zones) and vegetation management; development of a risk assessment modeling system; and development of software to provide graphical user interfaces and modeling environments to enhance model utility and ease of application.

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## **B. Complex Adaptive Systems (EL-12)**

The central goal of this effort is to identify the rules and feedback processes that govern how interactions between modular components in natural system shape important holistic properties, like the global resiliency to disturbances, and, invariably, the fate of the individual components themselves. These tasks are central to basic research efforts in Complex Adaptive Systems (CAS); an area that impacts a wide range of critical needs in both military and civil works (e.g., immune system responses, decision-making, social feedbacks, and ecosystem management). Current research focuses on ecological systems in which the use of different species and study systems is encouraged to provide diverse and novel solutions to understanding, predicting, or improving the resiliency of complex systems. Recent case studies range from a contaminant's (e.g., altered water quality, noise, chemical) impacts on individual development and performance, the social roots of information cascades in social vertebrates (spanning from fish and humans), to overall ecosystem functioning based on infrastructure design, overharvesting, or mismanagement. This topic area is inherently interdisciplinary and emphasizes team efforts in the combination of analytical, numerical, and laboratory experiments to test competing hypotheses.

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## **C. Water Quality and Behavior Modeling (EL-13)**

This research topic focuses on developing early warning indicators to demonstrate how changes in water quality can affect critical ecological processes, thereby raising the subsequent risks imposed on animal populations. We focus on demonstrating when environmental quality is not merely a

potential hazard, but how it elicits a functional (e.g., physiological) change during early exposure stages that can impact future performance and, invariably, population survival. Anthropogenic disturbances would include sediment plumes, temperature spikes, or contaminants. Animals typically

display stable and, generally, predictable physiological and behavioral patterns in non-stressful conditions.

However, sub-lethal (including chronic) or acute environmental changes can drastically alter behavior and activity, remain undetected, and invariably introduce unacceptable levels of error in model predictions. Current methodologies range from simple bioassays, to more complex physiological consequences at the individual level, to long-term costs/benefits at higher ecological levels (i.e., habitat use, populations, and communities). Hypothesis testing based on a combination of laboratory and modeling is encouraged, along with field data when possible. Findings from these efforts play an important role in both civil works and military activities.

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## **\*CONSERVATION**

### **Environmental Impact Prediction, Assessment and Management**

#### I. Introduction

This research program addresses environmental impact prediction, assessment, and remediation and is intended to provide Corps, Army, and other field operating elements with techniques and methodologies for environmental assessments and EIS preparation, guidance on selecting appropriate planning, design, construction, and operation alternatives, and implementation of the planning function pursuant to NEPA and other legislation and guidance.

Specific objectives include:

- A. Developing, verifying, and demonstrating practical prediction and assessment techniques including applying and refining habitat-based evaluation methods, evaluating mitigation measures, developing streamlined frameworks for environmental monitoring, applying ecosystem simulation principles to environmental analysis, and estimating future habitat quality.
- B. Documenting and quantifying environmental effects associated with various types of Corps, Army, and other activities. Research has included the effects of aquatic habitat modification on anadromous fishes, the effects of selective clearing and snagging on in stream habitat, and the benefits of channel modification for aquatic habitat in reservoir tail waters and local flood control channels.
- C. Developing and demonstrating design, construction, and management alternatives that will minimize adverse effects and protect natural and cultural resources. Research has included techniques for managing wildlife habitats, preserving archeological sites, and stabilizing eroding shorelines.

- D. Developing, validating and demonstrating novel systems biology-, computational biology- or bioinformatics-based approaches to understanding and quantifying toxicological impacts of environmental contaminants in environmentally relevant organisms.

## II. Research Areas

### A. Biotechnical Shore Stabilization (EL-14)

Biotechnical (sometimes called bioengineering) shore stabilization is the use of a combination of live vegetation and structural materials (for example, breakwaters, geotextiles, erosion control fabrics/mats, building materials) for erosion control of shores. Shores of particular interest are those of streams, lakes, or dredged material deposits and subject to erosion from waves, surface runoff, and wind. Research is needed to determine the causes and amounts of erosion and to identify and assess cost-effective biotechnical erosion control methods. Studies may include, but are not limited to, identifying, developing, and cultivating appropriate flood-tolerant plants and varieties or cultivars and cost-effective installation procedures of biotechnical techniques.

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### B. Freshwater Fishery Investigations (EL-15)

Primary areas of research are predicting environmental impacts of navigation and flood control projects on fishes, freshwater mussels, and other aquatic fauna; benefits of restoring aquatic habitat including environmental flows; conservation of endangered fish and mussel species; evaluating freshwater and coastal wetland fish communities; management of invasive species movement and colonization including Asian Carp; and fishery management in vegetated waterbodies. New and innovative approaches to determine physiological, behavioral, population and community level responses of fishes to habitat variables are of interest, along with technological advancements in sampling and multivariate data analysis capabilities. Demographic and landscape habitat models are anticipated products of this research

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### C. Freshwater Macro invertebrate Investigations (EL-16)

Research focuses on assessment of aquatic and terrestrial invertebrate communities, with emphasis on insects and mussels. Studies include stream and river biotic assessments, terrestrial and aquatic insect surveys, assessment of threatened and endangered invertebrate populations, feeding ecology of fishes, and evaluation of stream and river food webs and energetics. Assessments of environmental effects of USACE activities, including stream and river impoundments and structural changes, are also performed using naturally occurring macroinvertebrate and mussel communities as indicators of current and past ecological shifts. Restoration and management recommendations are also made through the analysis of these invertebrate communities in both freshwater and terrestrial ecosystems. Technical and analytical advancements, including sampling and data analysis are of interest.

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#### **D. Mitigation (EL-17)**

An avoidance, minimization, and/or compensation process is required for impacts from water resources projects on ecological resources (fish, wildlife, habitat, or installation activities). Planning and implementing mitigation is a complex process, and new ideas that contribute to success of mitigation are invited. Subjects such as Best Management Practices for avoiding or minimizing impacts, planning for mitigation based on impact analysis, incremental analysis to justify mitigation, mitigation banking, future predictions, and mitigation for indirect or cumulative impacts are included.

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#### **E. In Stream Flow Requirements for Aquatic Biota (EL-18)**

Research focuses on development and application of fish habitat assessment methods. Currently, the most widely used system, the Physical Habitat Simulation System (PHABSIM), is used to assess the effects of reservoir operations on downstream fish habitat. Research is needed to better quantify the relationships for fish preference and flow conditions, as well as habitat requirements for aquatic invertebrates. When appropriate, laboratory based studies can support field-based modelling efforts. Verification studies of these models will be required as development continues. Assessment methods must be able to evaluate the impacts of a variety of reservoir operations such as base load or peaking hydropower releases and at multiple scales from single project to basin – wide studies.

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#### **F. Behavioral and Structural Fish Barriers (EL-19)**

Entrainment of fish at Corps hydropower projects may result in passage of fish through turbines with attendant death or injury from impact with runner blades, pressure changes, or shear forces. Evaluations of a number of behaviorally based technologies and structural barrier designs conducted under laboratory and field conditions have yielded results that are generally inconsistent. Consequently, there currently exist no consistent guidelines for selection of appropriate technology for site-specific applications at Corps dams. Research is required to relate effectiveness of different technologies to size and species of fish, dam design, operations, season, and other site-specific conditions. The information produced by this research will be used to develop specifications and guidelines for fish protection technologies at Corps dams to reduce entrainment and mortality. This effort may involve literature synthesis, laboratory research, design and fabrication of prototype systems, or field studies as well as simulation analysis of fish movement/passage patterns.

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## G. Fish Guidance and Bypass Systems (EL-20)

CE water resource activities may result in blockage of historical fish migration routes through waterways. These blockages, with associated fragmentation of habitats, may have severe impacts on anadromous and catadromous fish populations. A variety of bypass system technologies are

available to guide fish around dams. However, many of these systems operate at reduced efficiencies because they damage fish, fish are unable to locate entrances to the systems, or because fish become disoriented and "fall back" after an initial successful passage. Research is required to better understand the hydraulic and behavioral characteristics of fish bypass systems, including the use of behavioral technologies to guide fishes towards these systems and to successfully orient them within the system.

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## H. Coastal Ecology (EL-21)

Research topics in coastal ecology include multidisciplinary investigations of the environmental impacts of engineering activities in the coastal zone, such as dredging, dredged material disposal, and construction of coastal structures (e.g., jetties, breakwaters, groins, seawalls, marinas). Emphasis is placed on improved technologies for assessment, protection, and management of fish and shellfish resources and their habitats. Of particular relevance are proposals dealing with endangered species (e.g., sea turtles, marine mammals), beneficial uses of dredged material and habitat restoration in the coastal zone (e.g., marsh, oyster reef or mudflat creation), and application of population dynamics and ecological models for impact prediction and assessment at population/community/ecosystem/watershed levels. Other areas of interest include effects of beach nourishment and use of offshore borrow areas, seasonal restrictions on dredging and disposal operations, artificial reef technologies, and cumulative impact determination and mitigation techniques.

Other focus areas include:

- Effects of beach nourishment on benthic communities and surf-zone (near-shore) fishes,
- Active and passive fisheries acoustics to assess fish migratory patterns, spawning habitat, fish density and spatial distribution patterns near dredging operations and placement sites.
- Essential Fish Habitat (EFH) protection from increases in turbidities and suspended sediments.
- Fish entrainment
- Behavioral changes to marine organisms (e.g. migratory blockage of migratory fishes due to the presence of the dredge, particularly in narrow or constricted waterways).
- Underwater noise impacts to aquatic species due to dredging and disposal operations.
- Ecosystem restoration (e.g. filling offshore/near-shore borrow areas to natural bathymetry).
- Artificial reef creation using dredged rock and other suitable material to enhance fisheries and shell fisheries resources.
- Thin-layer placement, re-contouring natural bathymetries.

Increased costs associated due to compliance with environmental windows/seasonal restrictions imposed on dredging and disposal operations, and cumulative impact determination and mitigation techniques.

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**I. Techniques for Designing, Operating and Managing Dredged Material Disposal Facilities and Beneficial Use Projects (EL-22)**

1. Refinement and verification of techniques for designing, operating, and managing dredged material disposal areas.
2. Development of a computerized economic database for costs associated with dredging sediments; disposing of dredged material; and constructing, rehabilitating, and operating and managing dredged material disposal areas.
3. Development and refinement of computer models for dredged material management and beneficial use to be included in the ADDAMS.

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**J. Systems Biology, Computational Biology, and Bioinformatics for Environmental Impact Assessment (EL-23)**

A wide spectrum of research in systems toxicology, biological networks, synthetic biology, predictive toxicology, genomics, bioinformatic data mining of next-generation sequencing data, adverse outcome pathway development, toxicological modes of action discovery, herbicide resistance mechanisms, structural biology, chemoinformatics, and molecular modeling is currently underway. Proposed research in mechanistic/predictive toxicology, structural biology, bioinformatics, or computational biology would complement current research areas.

1. Novel genomics, epigenetics and synthetic biology approaches are sought and developed to assess biochemical, physiological or other toxicological (adverse) effects on the biota at molecular, cellular, tissue/organ, individual, population, community or ecosystems levels.

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2. Novel in silico modeling and data mining approaches that are based on computational biology or bioinformatics principles and techniques are sought and developed to systematically analyze and interpret big data generated using cutting-edge and high-dimensional biotechnologies such as next-generation DNA sequencing, hybridization-based microarray, proteomics and metabolomics technologies.

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(Contact: Dr. Kevin Pilkiewicz, 601-634-5382; Email: [Kevin.R.Pilkiewicz@usace.army.mil](mailto:Kevin.R.Pilkiewicz@usace.army.mil))

3. Tools for assessing environmental impacts of synthetic biology. This work involves identifying



synthetic biology technologies and understand their current state of use, development, technology readiness, as well as their potential environmental impact. This includes hazard identification, effects assessment, fate, transport and transferability of various technologies. Moreover, the work entails quantifying environmental impacts of synthetic biological technologies through experimental and modeling approaches. This includes establishing screening mechanisms for genetic and physiological traits for synthetically derived systems,

microcosm experiments with tractable organisms to assess potential for spread/transfer of synthetic constructs.

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## **ENVIRONMENTAL CRITERIA FOR STREAM CHANNEL ALTERATION PROJECTS**

### **I. Introduction**

The Corps of Engineers is involved in the alteration of stream channels for flood control, navigation, channel stabilization, and stream relocation. Modifications to channels include removal of snags and vegetation, channel alignment (straightening), channel enlargement, construction of levees, stream bank protection, and grade control. The Corps is also involved in regulating and furnishing technical assistance to States in regard to other types of channel alterations such as gravel mining. Work at the EL and elsewhere has generated environmental design criteria for stream channel alterations to improve the net effect of these projects. Examples of environmental design features include low-flow channels, combinations of structure and vegetation, management of cutoff bend ways and other backwater areas, and recreational trails.

### **II. Research Areas**

#### **A. Riparian and In Stream Habitat Restoration (EL-24)**

Current research includes formulating guidelines for stream restoration and environmental enhancement of flood control projects. Among the general issues addressed are, in stream and riparian habitat assessment; benefits of habitat improvement, structures and techniques; impacts of vegetation on flow conveyance, channel stability, and sediment transport; construction practices; and monitoring and maintenance. Proposals are invited in these general areas and related efforts. In addition, specific needs include the following

:

(1) Techniques to quantify habitat and other environmental benefits of restoration efforts, (2) Algorithms that account for momentum losses at vegetated floodplain/channel interfaces, (3) Data supporting evaluations of the hydraulic impacts of in stream structures, (4) Case studies of monitoring and maintenance plans, and (5) Development and refinement of related computerized databases and models.

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#### **B. Assessing Benefits of Channel Modifications (EL-25)**

Dams and local flood control structures may degrade aquatic habitat conditions in tail waters and

streams. In some cases, habitat degradation can be eliminated, stabilized or reversed through channel modification for aquatic habitat (i.e., construction of low-cost, low head weirs to create pools) with minimal changes in dam operation or flood channel design. However, there are no widely accepted methods available to incrementally relate in stream aquatic habitat value, channel modifications, and in stream flows to allow trade-off analyses among cost, design, and habitat

benefits. It is desirable to modify existing in stream flow methods or develop new methods that will allow incremental assessment of habitat values, alternative flows, and different channel designs. This work may involve data collection, analysis, interpretation, and software development.

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## **NATURAL RESOURCE MANAGEMENT**

### **I. Introduction**

As a part of its mission, the Corps of Engineers must maintain and manage millions of acres of land, much of it surrounding over 700 water resource development projects throughout the United States. This includes fish and wildlife habitat sites, specific communities such as riparian zones and wetlands, and recreation sites. Technology needed for managing and enhancing these facilities includes research associated with endangered species, waterfowl, riparian zone management, range and turf grass management, insect pest management, and the general stewardship of these natural resources. Developed technology is provided to Corps Civil Works projects as well as military installations and other cooperating Federal agencies.

### **II. Research Areas**

#### **A. Natural Resources Stewardship (EL-26)**

1. Integrated Natural Resources Management. Research includes biological diversity, holistic ecology, and the stewardship and management of habitat-related natural resources at Corps water resource projects and military installations. Emphasis is on integrated natural resources management, which includes the analysis of human-related activities on biological resources and the effects of biological resources on other resources. Current research includes integrated ecosystem management, analysis of impacts to natural landscapes and their components, habitat delineation and analysis, and program development for natural resources management. Related components to complete stewardship include management of information and databases. The work involves literature synthesis, field studies, data analysis, and report preparation.

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2. Riparian Zone Management. Research addresses riparian habitat assessment, restoration, and management for natural resources stewardship on Civil Works lands and Department of Defense military installations. Emphasis is on the development of methods and technical guidelines appropriate for managing riparian zones and associated habitats on multiple-use lands. This also includes research on transition areas between riparian areas and other systems. Research includes literature searches, field investigations, restoration projects, data

analysis, and development of reports and management action plans. Priorities will depend on regional needs, as determined by study sponsors (i.e., Corps districts/sponsors and military installations).

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3. Tools for Natural Resources at Multiple Scales. Management of resources in today's climate requires an awareness of scale and context of those resources. Issues ranging from genetic diversity to watershed or landscape planning are relevant to management decisions. Planners, regulators, and land managers must be able to use existing tools (decision-support systems, models, databases, procedures, etc.) and adapt new tools for their needs. Although the general processes of resource inventory, impact assessment, and management or mitigation will remain applicable; those activities may be conducted in a different context or at more scales than before. Work under this announcement will supply tools for natural resources management in an ecosystem or holistic context.

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4. RESTORE Act Research addresses the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act of 2012 (RESTORE Act), or is associated with the Gulf Coast Restoration Trust Fund in connection with the Deepwater Horizon Oil Spill. Research topics include restoration, protection, and mitigation of damage to the natural resources, ecosystems, fisheries, marine and wildlife habitats, beaches, and coastal wetlands of the Gulf Coast region. Other areas of interest include research supporting infrastructure projects that benefit ecological resources, (e.g., port infrastructure) and coastal flood protection.

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## **B. Wildlife Resource Management (EL-27)**

The EL is developing user information for Department of Defense (DoD) personnel involved in the administration, planning, and operation of wildlife management programs and activities. The emphasis is to provide technology transfer on biologically sound, technically reliable, and cost-effective wildlife-related management strategies appropriate for Civil Works projects and DoD installations. The major product is the "U.S. Army Corps of Engineers Wildlife Resources Management Manual." Reports for the manual are arranged in nine chapters. Reports are currently needed on wildlife species, management techniques, and plant materials. Reports are primarily extensive literature reviews on a particular subject, which results in the presentation of appropriate information in a comprehensive and readable style. The basic format is established in the reports completed to date. Proposals should identify a specific section (or sections) to be prepared and should include an outline and description of topics to be developed for the report. Other tasks in this work area include habitat assessments, population surveys, and development of management plans.

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## **C. Animal Movement Behavior (EL-28)**

The management of civil infrastructure and rangelands often depends on understanding and

forecasting the response of animals to patterns in their environment (aquatic, terrestrial, aerial), such as patterns in water, forage, wind, and/or other individuals in the population.

Numerical models and empirical analyses may reveal the underlying behavioral, sensory, cognitive, social, and/or other internal/external factors that give rise to observed movement and distribution patterns. This understanding can be used to improve management, forecast future animal

movement/distributions, and/or inform the design of engineered systems.

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#### **D. Endangered Species (EL-29)**

This effort involves studies of endangered and threatened species on DoD and other Federal agency lands. Tasks would include site-specific surveys, habitat analysis, and development of management plans for species of concern. Individual studies would involve literature searches and synthesis of information, field investigations, data analysis, coordination with Federal and state agencies and conservation organizations, and preparation of endangered species survey reports and management guidelines.

Management recommendations will be specific to the region of study. Species of concern will vary, depending on requests from Civil Works projects and military installations.

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#### **E. Wetlands (EL-30)**

Wetlands research, especially as it pertains to wetland restoration and assessment, has been an ongoing activity of the Corps of Engineers since the 1970s. Specifically, wetlands play a key role in supporting environmental, navigation, or flood control objectives and are regulated under the Clean Water Act. The Corps of Engineers has been at the forefront in developing technologies and methodologies to evaluate wetland conditions under various scenarios and document ecological succession of wetlands following restoration/creation. In addition, approaches for delineating and assessing wetlands across the nation are required under the regulatory framework utilized by State and Federal agencies. Research supporting these objectives is expected to continue as part of a series of wetlands task areas. Research task areas outlined below will be conducted both in-house, with other agencies, or will be contracted. Studies must be short term (1-3 years) due to funding and time constraints, and must address one or more of the following research tasks.

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1. **Critical Processes of Wetlands.** This task examines the basic physical, chemical, and biological processes that allow wetlands to provide important functions, and applies those processes and functions to improve Corps of Engineers activities. Research may include evaluations of wetlands in areas undergoing management to improve wetland function, and the creation, restoration, or maintenance of wetlands. Critical processes in wetlands encompasses biogeochemical processes and/or interactions requiring interdisciplinary research approaches. As a result, research tasks may include investigations of nutrient cycling, soils, flora, fauna, invasive species, sea level rise, and other topics critical to improving our understanding of wetlands.

2. Wetlands Delineation, Assessment, and Evaluation. Objectives of this task address the needs of US Army Corps of Engineer staff to quantify ecological, structural, or other aspects of wetlands within the landscape, including the creation, restoration, or maintenance of wetlands. These investigations include but are not limited to the use of dredged materials or other substrates in the development or restoration of wetland ecosystems. Additional objectives include the examination of assumptions in the 1987 "Corps of Engineers Wetland Delineation Manual" and the development of techniques to assess wetland condition and function. Objectives will be accomplished through a combination of field and laboratory studies that examine hydrology/vegetation/soil relationships, morphological development of hydric soils, physiological response of vegetation to soil saturation, and other topics. This may include analysis of wetland response to management regimes, changing conditions (natural or anthropogenic), and site conditions at a variety of spatial and temporal scales.

Efforts will focus on development of technical guidance with the capacity to assess wetland resources for the purpose of improving management, public benefit, and ecological functional capacity within US Army Corps programs and Department of Defense lands.

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## **ENVIRONMENTAL CHEMISTRY**

### **I. Introduction**

Environmental chemistry at the EL provides chemical expertise in the areas of experimental geochemistry, computational, organic, inorganic, materials, and analytical chemistry for the other ERDC researchers and laboratories, for USACE district, Army, and other Department of Defense customers

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### **II. Research Areas**

#### **A. Experimental Chemistry (EL-31)**

This team seeks to characterize and understand the fate of metals, explosives, and other emerging compounds of interest in the environment by measuring relevant concentrations and physical properties, as well as environmental fate, degradation, and other geochemical reactions. All aspects of environmental geochemistry are of interest, including development of methods for unique compounds, assessing geochemical reactions in complex matrices, and environmental distribution and fate, related to the Corps of Engineers Military and Civil Works missions. Ongoing work includes the identification of intermediates in degradation pathways for explosives, ultralow detection methods for emerging compounds of interest, and development of unique analytical techniques to identify metals speciation and nanomaterials in complex environmental media. These unique capabilities are applied to the behavior of natural systems where fate and environmental attributes can be characterized and quantified.

(Contact Dr. Anthony J. Bednar, 601-634- 3652; Email: [Anthony.J.Bednar@usace.army.mil](mailto:Anthony.J.Bednar@usace.army.mil))

## B. Computational Chemistry (EL-32)

This team seeks to understand the fate, effects and transport of contaminants and explosives in the environment by predicting relevant physical and chemical properties and by delineating degradation pathways and understanding environment as a threat. Ongoing work includes the prediction of

rates of reactions for contaminants and explosives and for all intermediates in degradation pathways, prediction of optical properties, photodegradation, interfacial interactions, surface modification, surface sorption, development of multifunctional materials, complex environmental models using atomistic level to coarse-grained approaches.

Application of machine learning in the computational chemistry research is another area we are actively working. QSAR methods are also developed to aid in the prediction of physical properties and in relating the chemical structures of explosives and contaminants to their toxicity.

(Contact: Dr. Manoj Shukla, 601-634-5431; Email: [Manoj.K.Shukla@usace.army.mil](mailto:Manoj.K.Shukla@usace.army.mil))

## C. Characterization of Emerging Contaminants (EL-33)

This team seeks to investigate interactions of emerging contaminants, including nanomaterials, with environmental matrices. Ongoing projects include synthesis of novel materials and determination of analytical methodologies for adequately characterizing them. Degradation reactions of the materials themselves, but also reactions facilitated by the material surfaces are also of interest.

(Contact: Dr. Lee Moores, 601-634-3974; Email: [Lee.C.Moores@usace.army.mil](mailto:Lee.C.Moores@usace.army.mil))

# NONINDIGENOUS AQUATIC NUISANCE SPECIES MANAGEMENT

## I. Introduction

In a 1993 report, the U.S. Congress, Office of Technology Assessment estimated that nonindigenous pest species have resulted in U.S. losses of millions to perhaps billions of dollars annually. They reported documented losses of \$97 billion between 1906-1991.

When environmental conditions are favorable, non-indigenous species, such as hydrilla (*Hydrilla verticillata*) and the zebra mussel (*Dreissena polymorpha*), become established and disrupt the aquatic environment and economy of infested areas. The Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (Public Law 101-646) as reauthorized and amended by the National Invasive Species Act of 1996 (PL 104-332) and the River and Harbor Act of 1958 (Public Law 85-500) as amended, direct the Corps of Engineers to develop environmentally sound control methods to prevent, monitor, and control introductions of non-indigenous aquatic nuisance species.

## II. Research Areas

### A. Aquatic Plant Control (EL-34)

Aquatic plant research for the management of non-indigenous aquatic plant species in navigable waters, tributary streams, connecting channels, and other allied waters is a continuing activity of the

Corps of Engineers. The research thrust is to reduce non-indigenous plant populations to non-problem levels, enhancing and/or replacing these non-indigenous species with indigenous species as more beneficial and productive aquatic habitat. Areas of technology development include advanced management strategies and applications, techniques for establishing desirable aquatic vegetation, and computer-based systems for aquatic plant management planning.

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1. Aquatic Plant Ecology. Current ecological research on both non-indigenous nuisance plants and desirable native aquatic plant species is needed; including plant propagule ecology, modes of spread, methods of propagation and restoration (particularly desirable native species and effects of nuisance plant management on native plant communities and other ecosystem components). Development and evaluation of aquatic plant community quantification techniques are needed to support both research and operational needs. In addition, the development of PC-based simulation models of plant growth or effectiveness of management techniques is desired. Expansion of these models to include spatial distribution to 2-D and 3-D graphical displays to enhance management planning and implementation are also sought.

(Contact: Ms. Lynde Dodd, 972-436-2215, ext. 221; Email: [Lynde.L.Dodd@usace.army.mil](mailto:Lynde.L.Dodd@usace.army.mil))

2. Biological Control Methods for Aquatic Plants. Current research involves biological control of problem aquatic macrophytes using microorganisms, aquatic invertebrates and vertebrates. The objective is to develop an operational capability for biological agents to control aquatic plants. Research topics of interest include specificity and ecology of microflora of aquatic macrophytes, stimulants and attractants of invertebrates impacting aquatic macrophytes, and revegetation with desirable aquatic plants for the inhibition or prevention of problem plant species.

(Contact: Mr. Nathan Harms, 601-634-2976; Email: [Nathan.E.Harms@usace.army.mil](mailto:Nathan.E.Harms@usace.army.mil))

3. Chemical Control Methods for Aquatic Plants. A need exists for development of aquatic plant management methods, which utilize both herbicides and plant growth regulators to selectively control or maintain plant populations below nuisance levels. Research is needed on the physiological weak points in the growth cycle of nuisance aquatic plants for application of control measures, herbicide delivery systems (water-dispersible granules, emulsifiable concentrations, flowable suspensions, etc.) to deliver the active ingredient to the target plant, and field evaluations of the effects of aquatic herbicides and plant growth regulators on nuisance species as well as selected non-target plant species. Evaluation of the effects of chemical control on plant growth, flowering/seed production and reproductive structures is also needed.

(Contact: Dr. Kurt, 601-634-2498; Email: [Kurt.D.Getzinger@usace.army.mil](mailto:Kurt.D.Getzinger@usace.army.mil))

(Contact: Dr. Bradley Sartain, 601-634-2516; Email: [Bradley.T.Sartain@usace.army.mil](mailto:Bradley.T.Sartain@usace.army.mil))

4. Aquatic Plant Establishment and Succession. The presence of nuisance species in the U.S. has altered native vegetation community succession following environmental

disturbances often resulting in extensive formation of nuisance plant infestations in aquatic habitats. Proposals should examine methods establishing native aquatic plants or altering the species composition of aquatic plant communities to minimize the growth of exotic weedy species and encourage the growth of more desirable non-problem vegetation.

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5. Relationships between Fish and Aquatic Plants. Aquatic plant control methods are developed to be environmentally compatible, regardless of the situation and/or the control method being implemented. Aquatic plants, though problems to water uses, provide habitat for fisheries and organisms that support fish populations. Currently, there is insufficient data for developing the relationships between fish and aquatic plants that are needed to dictate the degree of control of the plants without destroying the habitat, thus ensuring compatibility.

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(Contact: Dr. Todd Slack, 601-634-4138; Email: [Todd.Slack@usace.army.mil](mailto:Todd.Slack@usace.army.mil))

## **B. Aquatic Nuisance Species (EL-35)**

1. Harmful Algal Blooms (HABs), which can be caused in freshwater by various cyanobacteria, represent a significant and costly threat to our Nation's economy and natural resources. Research proposals submitted under this topic area (EL-34-1) should examine methods, develop and/or demonstrate innovative technologies for HAB detection, prevention and management intended to reduce the frequency and effects of HABs on our Nation's freshwater resources. Proposed methods and technologies must be scalable to meet the need of very large freshwater HAB events. Explicitly addressing the scalability requirement in proposals is strongly encouraged. Note that water quality, including impacts to drinking water, is not an explicit USACE mission. Proposals that focus exclusively on water quality may be limitedly considered. Proposals that use UAS as a monitoring or surveying method will not be considered.

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2. Research is needed to better quantify and model the dynamics of invasive aquatic species through the development and application of a variety of integrated, multimedia models that can project spatio-temporal patterns of these species. This research involves the use of novel techniques for coupling models with different spatial and temporal resolutions.

Modeling frameworks should be developed to address a wide variety of invasive species, and should integrate models from different disciplines relevant to the study system. Models can include, but are not limited to, traditional engineering- and physics-driven models, population and community dynamics models (including, spatially-explicit, structured population, individual-based, among others), and socio-economic models. The integrated model suites will be utilized to analyze interrelations and dependence of environmental and anthropogenic factors that drive successful colonization of invasives.

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## **WATER QUALITY AND ECOLOGICAL SYSTEMS**

### **I. Introduction**

The Corps of Engineers is involved in research to develop water quality and ecological system models for riverine, reservoir, wetland, coastal and marine surface and groundwater.

Current research encompasses a wide range of environmental issues. Emphasis is on short- and long- term field and laboratory investigations to improve the techniques for evaluating water quality and developing water quality management guidelines. The research also emphasizes the development of biological models for terrestrial, lacustrine, palustrine, estuarine and coastal environments to assist in evaluating potential effects of natural and man-made alterations.

### **II. Research Areas**

#### **A. Ecological Modeling (EL-36)**

Research into the development and application of a variety of biological models for terrestrial, lacustrine, palustrine, estuarine, and coastal habitats. This research involves the use of traditional population and community dynamics models as well as spatially explicit, structured population and individual oriented models for addressing a wide variety of biological problems. Research is also ongoing for the integration of physical and biological models spanning different spatial and temporal scales. The integrated models can be utilized to analyze interrelations and dependence across trophic levels in a simulation mode and to determine the potential effects of alterations (natural and man-made perturbations) to the ecological system.

(Contact: Dr. Patrick Deliman, 601-634-3623; Email: [Patrick.N.Deliman@usace.army.mil](mailto:Patrick.N.Deliman@usace.army.mil))

## **OUTDOOR RECREATION**

### **I. Introduction**

Research and development is conducted in support of outdoor recreation planning and management at 463 multipurpose reservoirs located in 43 states. These projects include 11.5 million acres of an adjacent water and a total shoreline length over triple the coastline of the continental United States. The Corps of Engineers is the largest supplier of water- oriented outdoor recreation opportunities in the nation. All aspects of public use of multi- purpose water resource development projects are considered in recreation research and development. The trend is, where feasible, to develop automated tools for use by the planner and manager in the interest of efficiency of operation. This objective is considered in the context of providing high quality recreation experiences for the visitors to these lakes in a safe and pleasant atmosphere. Some current examples of research thrust in this area follow.

### **II. Research Areas**

#### **A. Carrying Capacity (EL-37)**

Ongoing research and technical support are currently concentrated on physical and social carrying capacity of lake water surface and lakeshores. Shoreline management aspects of this work addresses commercial marina development, public access for boating and related activities, and management of private use of public lands at approximately 450 projects. Land-based support facilities including boat-launching ramps, parking, and pedestrian access are important features.

(Contact: Ms. Dena Williams, 615-202-4095; Email: [Dena.K.Williams@usace.army.mil](mailto:Dena.K.Williams@usace.army.mil))

### **B. User Fees (EL-38)**

Investigate and develop automated systems for registration of users, collection and analysis of trends data, and special feature capabilities including differential pricing, reservations, and credit card use in support of camping and day-use recreation fees at Corps of Engineers' recreation sites. Automated systems are designed for onsite use of personal computers.

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## **RISK AND DECISION SCIENCE**

### **I. Introduction**

USACE increasingly relies on risk and decision science to improve decision-making and stakeholder engagement through application and development of formal quantitative methods and techniques. Research methods and tools of multi-criteria decision analysis, cognitive modeling, portfolio analysis help to describe relevant risks, identify and compare risk management alternatives, develop consensus among disparate stakeholder groups, and provide repeatable and transparent processes for future decisions.

### **II. Research Areas**

#### **A. Stakeholder Engagement with Technology Support (EL-39)**

Stakeholder Engagement with Technology Support (SETS) is an approach to stakeholder engagement that enhances the quality and fairness of decision making. Stakeholders collaborate to collectively identify the important criteria to consider when making some decision as well as ways to evaluate alternative courses of action against these criteria using the tools of decision analysis.

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#### **B. Decision Analysis (EL-40)**

This decision support can be provided in the form of a deliberate method for making a decision, for considering how best to incorporate different types of evidence into an existing decision framework, or for creating a mathematical tool to help clients to effectively manage complex

dynamic systems. Specific applications include Multi-Criteria Decision Analysis (MCDA), Weight of Evidence, Portfolio Analysis, Value of Information Analysis

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(Contact: Mr. Taylor Rycroft, 978-318-8960; Email: [Taylor.E.Rycroft@usace.army.mil](mailto:Taylor.E.Rycroft@usace.army.mil))

### **C. Resource Allocation and Adaptive Management (EL-41)**

Optimal resource allocation and adaptive management are necessary for management of environmental systems over time. Advice and guidance is needed on how to solve problems that require prioritizing or combining a collection of alternatives. These approaches use performance measures and advanced decision analytics to suggest management strategies.

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### **D. Systems Analysis and Resilience (EL-42)**

System dynamic and network science approaches are necessary to inform engineering solutions in complex systems. Efforts in the area of complex network assessment to facilitate design of engineered and ecological systems that perform well and gracefully recover from both known and unknown threats are especially important for the USACE.

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## **NATURAL AND MAN-MADE ENVIRONMENTAL DISASTERS**

### **I. Introduction**

ERDC supports US Government Agencies in understanding, forecasting, predicting, and assessing the impacts of natural and man-made environmental disasters. These include intentional release of chemicals into the environment within combat zones, the impacts of climate change related storms on civil society, workforces, and food security, environmental disasters resulting from intentional or accidental release of biological organisms, among many others. Research methods and tools in this area include horizon scanning and technology threat assessments, wargaming R&D to advance the ability for existential threat simulations and responses anywhere in the world, basic and applied research to advance game theory, computational toxicology and non-animal approaches for predicting chemical and biological effects in human systems.

### **II. Research Areas**

#### **A. Horizon Scanning and Technology Threat Assessments (EL-43)**

We use Horizon Scanning and Technology Threat Assessment approaches to forecast when new threat agents may emerge, and the probability that new threat agents will emerge. ERDC R&D in this area includes natural language processing approaches to cast a wider net, and

ingest open source intelligence more quickly. We are also developing threat communication visuals and infographics to facilitate understanding of complex concepts.

(Contact with Edward Perkins, email [Edward.J.Perkins@erdc.dren.mil](mailto:Edward.J.Perkins@erdc.dren.mil))

### **B. Biological Systems Assessment (EL-44)**

Understanding and predicting the response of biological systems (humans, agriculture plants/animals, microbial communities) to natural and man-made environmental disasters. We are also interested in predicting population effects using Bayesian approaches. Our biological systems simulations will also be incorporated in future wargames and simulations.

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### **C. Cryptic Ground and Environmental Signatures (EL-45)**

In the midst of, and following, natural and man-made environmental disasters we need to monitor and identify the movement of people and animals through the natural and built environments. As humans and animals move through the environment they leave behind cryptic traces and signatures.

Cryptic signatures include, but are not limited to, human gait, footprint information, vehicle tracks, speed, intent, biochemical signatures from breath, latent DNA, footprint depth. We are interested in sensor payloads for drone swarms that may allow us to monitor human, or latent animal movement in response to human movements, that cannot be observed by conventional remote sensing technologies due to tree canopy or other cover (e.g., tunnels or alleyways).

We are also interested in developing environmental signatures of cities and non-urban locales. Environments tend to have a certain “buzz” about them. We are interested in using still and video imagery and sound information to identify a particular locale and the time of day or day of the year. Having concurrent sound and imagery will also allow us to avoid deep fake situations, where the imagery and sounds do not match. This information will help us identify where videos and photos may have been taken before, during, or after a man-made or natural environmental disaster. This has many potential military uses from humanitarian to intelligence operations. Being able to use shadows and natural light to approximate time of day and latitude/longitude (if time of day were approximately known as well as potential weather effects) is also of interest.

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## INFORMATION TECHNOLOGY LABORATORY (ITL)

### Research Areas

#### A. Computational Science and Engineering (ITL-1)

Research in computer-aided interdisciplinary engineering; scientific and engineering software development and interoperability; and numerical analysis is conceived, planned, managed, conducted, coordinated with ERDC R&D programs and related reimbursable projects. ITL collaborates with researchers in other DoD research organizations, the DoD High Performance Computing Center, and the other ERDC laboratories to advance the state of practice in numerical modeling and assessment applied to civil engineering, military engineering, digital engineering and digital twinning, and environmental quality challenges. In this research area, ITL performs the following:

1. Researches, develops, refines, validates, and applies advanced computational methods and mathematics to model physical, biological, and sociological systems. Works to make these advanced computational systems more practical, meaningful, useful, and available to address problems of the Corps, Army, and Nation. Interacts with high performance computing centers to achieve optimum synergy between computational machine architecture and operating systems and computational techniques.
2. Researches, develops, refines, validates, and applies advanced mathematical and computational models that model the physical world. Works to transition these methods to address problems of the Corps, Army, and Nation.
3. Investigates a wide range of high-end data systems solutions in response to technical requirements. Researches and develops capabilities that address data display, data analysis, data visualization, data archiving, and mass storage. Design state-of-the-art algorithms, scientific data analysis, for large and small- scale software system configuration, sizing, and development methodologies utilizing recognized techniques and scientific data format standards.

(Contact: Dr. Jeffrey Hensley, 601-634-4596; E-mail: Jeffrey.L.Hensley@usace.army.mil)

#### B. Software Engineering and Informatics (ITL-2)

Best practices in software engineering and informatics are applied to the research and development of new uses of IT to solve multidisciplinary problems in military engineering, civil and environmental engineering, basic sciences, and geospatial and business applications. Integrated systems are developed for USACE and its customers; prototyping is performed in collaboration with other USACE and government organizations, universities, and commercial partners; and testbeds are developed to prove concepts in an operational environment.

Unique software, hardware, commercial off-the-shelf software, and data systems solutions are analyzed, designed, tested, developed, and integrated to meet customers' requirements. ITL performs the following in support of this research area:

1. Investigates software engineering methodologies; conducts research, development, and studies of information systems and applications; and develops, tests, operates, and maintains decision support systems for ERDC, USACE, and other federal agencies. Plans and develops systems and modules to provide for interoperability and reuse and to conform with applicable information assurance requirements; and provides technical assistance to internal and external customers in these areas.
2. Coordinates capabilities, requirements, and deployment for computer-aided design (CAD), building information modeling (BIM), and computer-aided facilities management (CAFM) technologies throughout the tri-services with an emphasis on maintaining the life-cycle use of facilities data through planning, design, construction, operation, maintenance, and disposal. Develops and maintains acquisition vehicles in support of the USACE, Army, DoD, and other partners and customers. Performs research, development, and technology transfer on a wide range of geospatial, geographic information system, CAD, BIM, CAFM, and related technologies in support of DoD and other federal agencies and customers across a wide range of activities. Conducts research and deployment on relevant hardware and software systems. Performs technology transfer to deliver improvements and new techniques to the user community.
3. Provides services and supports ERDC research and development projects through categorization, archiving, management, optimization and retrieval of information and knowledge to include library and information systems science services.
4. Technology transfer services include creation of technology transfer products, such as videos, Web sites, pamphlets, brochures, articles, bulletins, technical notes, pamphlets, brochures; and technical editing and document production management. Technology Transfer Specialists work with program managers of major Corps R&D programs and research laboratories to transfer technology that emerges from R&D work units to the appropriate audiences and assist the ERDC researchers in establishing a program identity for the Corps and its research programs.

(Contact: Mr. Quincy Alexander, 601-634-2905; E-mail: Quincy.G.Alexander@usace.army.mil)

### **C. High Performance Computing (HPC) and Networking (ITL-3)**

The ITL, maintains largescale, parallel computer systems for the DoD Science and Technology (S&T) community and computer networks for ERDC-specific use. In addition to providing computer access, the ITL conducts research related to the efficient use of high performance computing (HPC) systems and networking technologies by this geographically dispersed community. An area of interest is heterogeneous computing clusters. These clusters include nodes containing non-traditional computational elements such as field programmable gate arrays (FPGAs), general-purpose computing on graphics processing units (GPGPUs), cell broadband engines (BE), ClearSpeed Advance, and stream processors. The principal issues with these heterogeneous platforms include application partitioning, programming models, and tools. Of special interest are technologies, services, and techniques for innovative access to workflow management on HPC resources by a distributed user community, for example, remote visualization tools and techniques for content-based management and analysis of terabyte-

scale data. Also of interest are the development of parallel data-compression algorithms; the application of scalable parallel algorithms to DoD S&T applications, especially those supporting the computational design of novel materials; and exploration of technologies and techniques for managing operational resource utilization and modeling future requirements. Research is also planned in advancing collaborative capabilities combining evolving communications technology in support of distributed R&D teams. This may involve automation/integration of media presentation considering such areas as documents, graphic arts, audio, video, and interactive presentations. Electronic flow of R&D data including management, searching, routing, tracking, and simultaneous review is also of interest. Additional research is planned in other information technology areas such as advanced topics in data, voice, and video transmission using evolving communication systems and their integrations with other information systems as they apply to supporting distributed R&D efforts.

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#### **D. Cybersecurity (ITL-4)**

Cybersecurity is the state of being protected against the criminal or unauthorized use of electronic data and/or automated controls and the measures required to achieve this for information technology and operational technology systems. There is an interest to develop tools or algorithms to protect critical Research and Development and infrastructure networks, industrial control systems (ICS), supervisory control and data acquisition (SCADA) systems, and programmable logic controllers (PLC) against adversaries that continually develop, modify, and adapt threats to constrain the ability to effectively and securely operate in cyberspace. The new and innovative capability will leverage networked-, host-, and behavior-based concepts to provide a holistic cybersecurity defense approach and provide cyber situational awareness. These new products will contribute to assured compliance assessment solutions that include vulnerability assessment and scanning capability, host-based protection and defense capabilities, network-based monitoring and firewalls, multi-router traffic grapher, network flow statistics and cyber operational attributes.

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#### **E. High Performance Data Analytics (ITL-5)**

High performance data analytics is the process of examining data sets so large or complex that traditional data processing applications are inadequate for a variety of data types to uncover hidden patterns, unknown correlations, multidimensional trends, and other useful information. There is an interest to leverage High Performance Computing, emerging heterogeneous computing resources, next generation computational algorithms, and software tools to develop an ecosystem approach to manage and conduct high performance data analytics with complex data sets created by a combination of physics driven, high-fidelity model processes, experiments, and observations. It is desirable for these new and innovative high performance data analytic techniques to exploit heterogeneous hardware platform that are driven by applications and may include CPUs, GPUs, neuromorphic, neural network, and data sciences driven processors and associated heterogeneous storage systems. High performance data

analytics in context of this BAA can apply to additive manufacturing, compute at the edge, digital engineering/digital twinning and can include large-scale data processes such as; data capture, data curation, search, sharing, storage, transfer, and visualization.

(Contact: Dr. Jeffrey Hensley, 601-634-4596; E-mail: [Jeffrey.L.Hensley@usace.army.mil](mailto:Jeffrey.L.Hensley@usace.army.mil))

#### **F. High Performance Computing (HPC) Enabled Additive Manufacturing (AM) Technologies (ITL-6)**

Additive manufacturing or 3-D printing will lead to many opportunities in fabricating complex and innovative systems and components rapidly for wide class of certifiable DoD and Army applications at the point of need. AM provides higher degree of freedom beyond the geometry to fabricate new systems and components. However, DoD applications demand multi-functional, multi-scale, and multi-material AM technologies with tailored properties and desired functions. These applications are complex and difficult with current AM technologies that can provide rapid components and systems at the edge. Future developments in HPC driven computational approaches that seamlessly integrate and guide AM technologies are needed to rapidly fabricate reliable and certifiable components and systems. Research topics of interest for HPC enabled AM technologies include: (a) high-fidelity multi-physics, multi-scale computational AM approaches; (b) Optimization; (c) trade-space analytics; (d) integration of AM with deployable HPC; (e) Uncertainty quantification and validation; (f) data driven approaches; (g) Machine learning based simulation approaches to assist designers; (h) virtual testing; (i) AI enabled certification; (j) HPC enabled optimized process control; (k) innovative AM technologies.

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## **CONSTRUCTION ENGINEERING RESEARCH LABORATORY (CERL)**

### **A. Advanced Methods and Designs for Additive Construction (CERL-1)**

Proposals are sought for novel, basic and applied solutions in the areas of advanced construction, material and technology development, and designs that provide support for deployed force infrastructure. The military requires mobile means of production that enable rapid deployment and emplacement of infrastructure, minimize the logistics burden of materials, and automate reinforcing and repairing of infrastructure. As an alternative to stationary builds, this includes areas related to large/construction-scale printing of modular shelters that can withstand the spectrum of potential operating environments. Development of composite materials, particularly those incorporating indigenous or recycled materials, are sought that create structures capable of withstanding realistic structural and environmental loads. Innovative digital designs for additively constructed infrastructure are also of interest.

Advanced construction and additive manufacturing technologies using semi-autonomous to fully autonomous methods and architectural forms are needed for austere environments, lending themselves to an advanced construction process that requires little, if any, human intervention. Applicants are encouraged to submit evidence of their innovations performing a demonstration at full scale.

(Contact: Ms. Justine Yu 217-373-4526; Email: [Justine.A.Yu@usace.army.mil](mailto:Justine.A.Yu@usace.army.mil))

### **B. (CERL-2) (RESERVED)**

### **C. Innovative Construction Material Systems (CERL-3)**

Proposals are sought which investigate novel or innovative construction material systems for engineer operations or construction of temporary structures. Automation of mobility support missions in the military will require enhanced understanding of materials and manufacturing techniques that are massively scalable and broadly adaptable to various environments. Considering the needs of a rapid, mobile force, the ideal material systems would be locally or naturally available and reduce logistics requirements for military construction. Research in this area includes, but is not limited to:

1. Alternative binder technologies
2. Modeling and modification of material flow
3. Material sourcing strategies to reduce logistics burdens
4. Large-scale demonstrations of emerging binder technologies

(Contact: Dr. Peter Stynoski 217-373-3484; Email: [Peter.B.Stynoski@usace.army.mil](mailto:Peter.B.Stynoski@usace.army.mil))

#### **D. Innovative Energy Efficiency and Energy Security Initiatives (CERL-4)**

Proposals are sought which address the need for improved energy efficiency and improved energy security by federal, state, and private sector energy users. Federal agencies are required to meet stringent energy efficiency targets mandated by Executive Order.

Products/methods/techniques that will improve overall energy efficiency or reduce reliance on non-renewable energy sources are of interest. These include but are not limited to: combined heat and power generation, fuel cells, low Nox boilers/burners, natural gas cooling and compressed air, storage cooling, wind, geothermal, and solar power generation, and high efficiency heating/ventilating/and air-conditioning systems. In addition, proposals are also sought for products/methods/techniques that will improve the robustness of energy delivery systems and reduce the risk of loss of energy services due to economic dislocations, depletion of natural resources, natural or man-made disasters, as well as for products/ methods/techniques which will facilitate cost effective, reliable, and sustainable utility support to deployed forces in underdeveloped regions of the world.

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#### **E. Fuel Cell Technology Advancements (CERL-5)**

Proposals are sought which address the following research areas for fuel cell, reformers and electrolyzer technology:

1. Development of an advanced technology base
2. Innovative and/or lower-cost manufacturing, packaging, and assembly processes
3. Balance-of-plant (BOP) components
4. Experimental demonstrations of innovative system components.
5. Storage and transportation advancements

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#### **F. Contingency Basecamp Operational Energy (CERL-6)**

Definition of Operational Energy: The energy and associated systems, information and processes required to train, move, and sustain forces and systems for military operations.

This research would identify new opportunities for contingency base camp operational energy reduction (demand-side management) achieved through new and innovative technologies, improved system or operational modifications. This research would also identify new and innovative opportunities for improved power generation, to include renewables and energy storage (supply-side management) with the focus on;

1. Reducing reliance on vulnerable resupply operations (both fuel and water) -- this enables greater operational freedom of action and reduces the Soldier and system burden at the tactical edge,

2. Reducing the Soldier's individual carry load, and
3. Conserving resources

In addition, technologies considered should be able to withstand the harsh, demanding, and austere conditions of an operational environment. The research would provide results on the latest base camp operational energy technologies or operational changes, and quantify the associated cost/benefits for any proposed change.

(Contact: Mr. Charles Decker, 217-373-7611; Email: [Charles.T.Decker@usace.army.mil](mailto:Charles.T.Decker@usace.army.mil))

### **G. Autonomous Robotic Solutions for Engineer Operations in the Deployed Environment (CERL-7)**

Proposals are sought for novel, basic and applied solutions in the areas of ground/air robotics to enable the automation of complex Army Engineer operations such as horizontal/vertical construction, mechanical obstacle reduction/removal, etc. ERDC-CERL is conducting research in the broad area of robotic engineering support in challenging and highly dynamic operating environments. Focus is on integrating solutions into existing Engineer tasks and equipment in order to expand the Engineer's capacity and capability. Research in this area includes, but is not limited to

1. Creation of standoff capabilities through the use of non-line-of-sight teleoperation;
2. Multi-spectral, near real time mapping; creating semantic models of complex environments; continuous update of extracted site features through change detection;
3. Mission planning and control tool to visualize the semantic site models, monitor task completion, and coordinate tasks among multiple pieces of equipment; and
4. Semi-autonomous solutions specifically for end effector control of construction type equipment

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### **H. Robotic 4-D Printing of Geopolymer Composites for Extreme Environments (CERL-8)**

CERL is interested in the technology for rapid robotic 4-D printing of geopolymer composites for use under extreme environments of temperature (freezing or fire) or nuclear radiation. A variety of reinforcements or filler phases can be added to produce structural or radiation shielding geopolymer composites. Various geopolymer formulations can be developed capable of fire resistance to 2500°F. Pre-fabricated panels can be joined or hinged into rapidly deployable structures such as bush fire resistant huts. Protection of pavement subjected to excessive heat during helicopter or vertical lift off (VLO) aircraft take off and landings can also be achieved with heat resistant geopolymer pads.

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## **I. Fiber Reinforced Polymer (FRP) Composites for Infrastructure Applications (CERL-9)**

The research program in this area supports both the Military and Civil Works missions of the U.S. Army Corps of Engineers. This work focuses on research, development and field tests related to the use of fiber reinforced polymer (FRP) composite materials in infrastructure applications. This includes both thermoset and thermoplastic type composites along with other reinforced polymers.

For military installations, the Government seeks development of concepts and prototype demonstrations for facility construction applications using composite materials systems. This includes building construction, seismic retrofit, structural upgrade, force protection as well as other applications.

In civil works, there is interest for further development of the application of FRP composites for the rapid repair and rehabilitation of existing navigation structures and the components that make up an operational navigation system. These components include, but are not limited to: gates, valves, guide walls and bumpers, wall armor and fenders, recess panels, trash screens and sheet pilings.

The application of structural FRP composite materials/systems to military and civil works facility construction applications involves working knowledge of composites manufacturing, interfacial and laminar behavior, fracture mechanisms, joining technologies, design criteria, durability and aging, quality assurance, smart and multi-functional composites, repair and inspection techniques, and other appropriate phenomena and the ability to develop constitutive and other models of these phenomena for these applications.

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## **J. Steel Aircraft Hangars and Aircraft Sunshade Subjected to Hurricanes, Tornadoes, and Microburst (CERL-10)**

Many military aircraft steel hangars and sunshades are located on coasts of the USA. In marine environment, they are vulnerable to hurricanes, tornadoes, or microbursts. Such structures are expected to be of high importance, critical, and/or essential for mission readiness. These structures must be structurally adequate to withstand gravity, wind load, and their live loads in all possible scenarios.

Since steel aircraft hangars were built, codes have changed to include more detailed and stringent requirements. Unless detailed structural evaluations are performed, the adequacy of structural members under abnormal loading conditions will be unknown. A higher level of knowledge is required that is based on credible latest research to minimize or eliminate costly repair. The sole purpose Aircraft Sunshades is to provide minimal protection for personnel from the elements (sun, wind, rain, snow, etc., excluding lightning) with a roof and a maximum of two sides.

As of 2017, aircraft sunshades (and other shelter types under AF) will be defined as equipment items. By this definition, sunshades will be tracked on custodian authorization/custody receipt

listing (CA/CRL) and managed IAW AFMAN 23-122, Materiel Management Procedures. The sunshades are not considered temporary or relocatable facilities associated with Military Construction (MILCON) projects. They are also not intended to replace aircraft maintenance hangars and thus there are no current requirements associated with aircraft specifications or square footage allowance as contained in AFI 32-1024.

While hurricanes are well understood for relevant to closed structures such as aircraft steel hangars are not understood for an open structures such as sunshades. Design for tornados are also not well established. Microburst phenomena is far from been understood and requires further studies.

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### **K. Innovative Corrosion Control (CERL-11)**

This area focuses on research, development and field tests to prevent and reduce corrosion of building components and infrastructure at military and civil works facilities. The components most susceptible to corrosion include: building exteriors, HVAC (heating, ventilation and air conditioning) systems, underground pipes (gas water, steam, high temperature hot water), water storage tanks, water treatment plants, sewage treatment plants, bridges, and navigation and dam structures. The general areas of interest include the following corrosion control technologies:

1. Coatings,
2. Cathodic Protection,
3. Advanced (Corrosion Resistant) Materials Selection and Design,
4. Water Treatment, and
5. Remote Corrosion Assessment and Management.

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### **L. Geotechnical Scaled Physical Modeling at Normal Gravity (CERL-12)**

This research area seeks to capitalize on the unique capabilities of the Construction Engineering Research Laboratory's shake table, known as the Triaxial Earthquake and Shock Simulator, by focusing on the development, evaluation, or demonstration of techniques to perform scaled physical modeling of geotechnical structures at normal gravity for military and civil works applications. Research on this topic can be either basic or applied. It includes, but is certainly not limited to: (a) development of scaling relationships to overcome incompatibilities at normal gravity, (b) dynamic scaled physical modeling of geotechnical structures (e.g., earthquakes), (c) static (i.e., monotonic) scaled physical modeling of geotechnical structures, and (d) soil-structure interaction.

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(Contact: Dr. Peter Stynoski, 217-373-3484; Email: [peter.b.stynoski@usace.army.mil](mailto:peter.b.stynoski@usace.army.mil))

### **M. Novel Soil Stabilizing Agents (CERL-13)**

This research area focuses on the development, evaluation, or demonstration of novel soil stabilizing agents for construction or other purposes. The intent of this research area is to develop soil stabilizing agents that can be used in environments ranging from austere and extreme (i.e., military engineering) to the typical construction conditions (i.e., civil works). Research on this topic can be either basic or applied and includes, but is certainly not limited to: (a) development of new classes of soil stabilizing agents, and (b) novel soil stabilizing agents that impart unique properties to soil.

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### **N. Integrated Water Security for DOD Installations (CERL-14)**

Proposals are desired which address the need for an enhanced capability to protect facility/mission critical water supplies and infrastructure (i.e. fire hydrants) from chemical and/or biological attacks, as well as accidental contamination incidents. In particular, innovative and non-developmental methodologies and systems are sought. Ideally, the processes/equipment would have the capability to expeditiously retrofit/commission/operate and maintain technologies intended and designed to prevent, detect, treat, decontaminate and rehabilitate DOD water systems that have been accidentally and/or deliberately contaminated by acts of vandalism or terrorism. These enhancements would therefore protect and result in rapid rehabilitation of CONUS/OCONUS DOD installation and/or Forward Area Base Camp water supplies and water distribution networks.

The technologies should be integrated into the installation water infrastructure in such a way that systems and functions on the DOD base are not negatively impacted. We are also interested in ways to optimize the effectiveness of such prevention, detection, treatment, decontamination and rehabilitation systems while minimizing life cycle costs and improving reliability and confidence in the system's required levels of protection. In addition, we are interested cost effective methods of certifying and recertifying water supply/infrastructure protection enhancements.

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### **O. Ultra-High Performance Concrete for Additive Construction (CERL-15)**

Proposals are sought for novel and basic solutions for the use of ultra-high performance concrete (UHPC) in additive construction (construction 3D printing). Additive construction provides a deployable solution for the construction of on-demand infrastructure, mobility, and sustainment assets using locally available materials, which improves cost, reduces logistics, and saves lives. The focus is on the adaptation of UHPC materials for 3D printing to improve strength, durability, and serviceability of 3D printed elements. Required research includes, but is

not limited to: (a) innovative and novel deposition of printable mixtures; (b) printable material solutions that use locally available or indigenous materials, (c) innovative approaches to determining rheology or shape stability of printable mixtures; (d) approaches to complex geometries through topology optimization, (e) mixtures or comparison of mixtures that provides enhanced fire protection or high durability for severe environments; (f) methods for assessing and managing the performance of printed components; (g) advanced modelling of deposition process, material performance, or rheology, (h) standard serviceability tests and performance criteria for printed elements, and (i) novel and scalable approaches to performance and durability of pumping and process solutions, (j) novel design for efficient dispersion of fibers within matrix.

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#### **P. Critical Infrastructure Protection for Utility Systems (CERL-16)**

Utility systems provide the electricity, water, transportation fuel, heating, cooling, communications and compressed air that are required for carrying out military installation missions. The objective of this research is to develop methods, simulation tools, and models to enable installation and military planners to plan, assess, optimize, and monitor the ability of utility systems to support normal operations requirements, as well as, military force projection. New technologies and methods are needed for conducting utility system simulations using real-time data, as well as historical, generic, or hypothetical scenarios.

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#### **Q. Infrastructure Management, Facilities Maintenance (CERL-17)**

This research calls for facilities and infrastructure component-level modeling; condition and functional assessment; life cycle performance measurement and service life forecasting; maintenance, repair, sustainment, restoration, and modernization work identification and resource optimization; and long-term impact analysis under different investment policies and funding levels. Specifics include automated and/or continuous condition assessment, damage detection, condition monitoring and facility equipment diagnostics, reliability-centered maintenance, risk and resiliency analysis.

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#### **R. Modeling and Simulation/Analysis tools for Infrastructure Applications (CERL-18)**

This research supports facilities and infrastructure life cycle decision support tools for smart and resilient installations. This includes the development of tools and analysis methods that formally establish a connective link from infrastructure capacity and capability measures to mission objectives and installation readiness levels. Specifics include data-driven techniques for

strategic facility investment analytics; modeling and simulation of infrastructure risk, reliability, and resiliency; and system optimization under multiple scenarios, changing mission requirements, complex operational constraints, and general conditions of uncertainty.

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### **S. Innovative Coating Systems and Applications (CERL-19)**

This area focuses on research, development, and field validation tests for all aspects of protective paints and coatings for military and civil works infrastructure, including building surfaces and structural components, utility systems, industrial structures and systems, and navigation, hydropower, and flood protection structures. Required research includes, but is not limited to: (a) innovative methods for the preparation of surfaces for painting, including the removal of coatings containing lead and other hazardous materials and the assessment of prepared surfaces; (b) innovative approaches to paint application and curing; (c) reducing the cost or environmental impact of surface preparation and painting, (d) coating systems for the protection of steel immersed in abrasive, turbulent water, (e) specialty coating applications, such as fire protection, mold control, thermal insulating coatings or heat transfer coatings, and high durability coatings for severe environments; (f) methods for assessing and managing the performance of coatings; (g) the development of coatings performance and service life models, and (h) standard serviceability tests and performance criteria for coating systems.

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### **T. Global Warming Reduction Technologies or Studies (CERL-20)**

Proposals are sought for research, development, evaluation, and/or demonstration of technologies that reduce or eliminate the emission of substances with global warming potentials that are applicable to DoD installations, systems and federal facilities located in worldwide locations. This may also include studies of the global warming contributors and reduction opportunities for these facilities' operations. Topics of interest may include, but not limited to, refrigerant reduction/substitution/elimination, greenhouse gas control/reduction/elimination, and other emerging technologies with low to zero global warming potential that may replace current technologies with high global warming contributions. Technologies, proofs of concept and/or studies are sought to serve a variety of sites and applications including various sized contingency bases, permanent installations both CONUS and overseas, mobile sources, and weapon systems.

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### **U. CERL-21 (RESERVED)**



## **V. Inventory, Assessment, and Monitoring (CERL-22)**

This research develops innovative and improved technologies and procedures for (1) inventorying threatened and endangered plant and animal populations and assessing long term population viability and habitat health and (2) inventorying archeological sites, traditional cultural sites, and historic structures and landscapes; assessing their eligibility for listing on the National Register of Historic Places; and monitoring impacts to significant sites, structures, and landscapes, and (3) inventorying maneuver and range land landscapes. Research efforts should consider ecosystem and regional as well as local installation contexts when evaluating population viability, habitat health, significance of cultural sites, and effectiveness of ranges and maneuver areas. Specific research efforts are requested in the following areas:

1. Improved methods for inventorying threatened and endangered species and collecting related environmental data pertaining to endangered species management,
2. Improved methods for measuring a full range of habitat conditions and biological and abiotic environmental parameters,
3. Inventory and assessment of invasive species,
4. Predictive modeling of archeological sites,
5. Environmental reconstruction and geomorphological analysis related to identifying areas of past human habitation and use,
6. Geophysical techniques for surveying and assessing archeological sites, ranges, and maneuver lands, including improved methods for collecting, processing and dissemination of high definition 3-D laser scans and point clouds.
7. Identifying, documenting, creating digital models, and assessing the significance of historic structures and landscapes and archeological sites,
8. Condition assessment and monitoring systems for historic structures and landscapes,
9. Inventory and monitoring systems for archeological sites,
10. Acquiring, processing, integrating, and/or analyzing remotely sensed data and imagery for natural and cultural resources, ranges and training land-inventory, assessment, and monitoring, including automated delineation of vegetation properties, estimation of forest constituent properties, soil carbon, and carbon cycling.

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## **W. Land Management (CERL-23)**

The goal of research in land management is to develop and improve planning and management tools and procedures that enable land managers to address the priorities of the military mission, meet the requirements of environmental legislation, and support the stewardship of natural and cultural resources on military lands. Specific research efforts are requested in the following areas:

1. Impacts of military land use activities on species listed pursuant to the Endangered Species Act and developing management plans and mitigation strategies,
  2. Fragmentation of habitat of threatened and endangered species,
  3. Developing technologies for integrating cultural and natural resources management planning,
  4. Predicting and controlling erosion and dust associated with military training activities,
  5. Evaluating the carrying capacity of training lands and improving understanding of the impacts of military training on the environment,
  6. Developing new technologies designed to mitigate environmental effects of training on the landscape,
  7. Assessing and modeling the effects of helicopter, aircraft, blast, and small arms noise on animals and humans,
  8. Designing noise data collection systems for installations,
  9. Developing noise impact mitigation techniques,
  10. Developing technologies for control of invasive species,
  11. Developing sustainability indices and risk assessments for military training lands,
  12. Designing predictive computer models and decision support tools for assessing environmental change, the effects of both human and natural influences on the
  13. Developing a full range of land use planning tools to facilitate long term sustainability of defense installations,
  14. Developing databases relevant to land and ecosystem management and improving information flow for modeling and decision support purposes,
  15. Identifying, designing, and/or developing a computing system environment and/or protocols to facilitate interactions between analysis tools and common delivery mechanisms under development by CERL and ERDC.
  16. Developing technologies and approaches for hydrologic and hydraulic assessment of military lands,
  17. Developing technologies and approaches to quantify military lands and impacts using non-invasive remotely sensed technologies,
- (Contact: Dr. Chris Rewerts, 217-373-5825; Email: [Chris.C.Rewerts@usace.army.mil](mailto:Chris.C.Rewerts@usace.army.mil))

**X. Waste to Energy Conversion Systems - Energy, Diversion, Value Recovery (CERL-24)**  
Proposals are sought for research, development, evaluation, and/or demonstration of waste stream conversion systems applicable to DoD installations, federal facilities, and similar waste

generating locations. Technologies are sought to serve a variety of sites including various sized contingency bases or permanent installations both CONUS and overseas. This variation translates into a range of waste throughput from less than one ton to one hundred tons per day. The materials that could be processed include, but are not limited to, wastewater, energetic waste streams (e.g., munitions byproducts and wastewater), solvents, and the entirety of municipal solid waste streams or portions thereof, such as food, vegetative materials, construction debris and demolition materials, biosolids, or plastics. Integrated technology solutions are prioritized in this sequence: net electric power, net thermal energy, and conversion to, and subsequent storage of, fuels or specialty chemicals. The solutions offered must build a business case for cost avoidance, integrated operations, reduction in emissions, and residual waste remains with consideration given to novel methods including chemical, thermal, or other conversion process methods.

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(Contact: Ms. Dominique Gilbert, 217-373-3488, Email: [Dominique.S.Gilbert@usace.army.mil](mailto:Dominique.S.Gilbert@usace.army.mil),)  
(Contact: or Dr. Aaron Petri, 217-373-3377, [Aaron.C.Petri@usace.army.mil](mailto:Aaron.C.Petri@usace.army.mil))

#### **Y. Compliance at Troop Installations (CERL-25)**

This research calls for basic and applied research, and technology solutions to meet environmental regulation as it applies to installation activities. Research under this BAA includes technologies that enable continued operation of compliance sites, meeting regulatory requirements without negative impact on mission for CONUS installations. This includes, but is not limited to technologies that address compliance issues associated with solid waste, hazardous waste/hazardous materials, water quality, wastewater, storm water, air emissions, and soil remediation. This also includes compliance reporting tools to provide consistency in environmental assessment data.

(Contact: Ms. Angela Urban, 217-373-4421, Email: [Angela.B.Urban@usace.army.mil](mailto:Angela.B.Urban@usace.army.mil)) or  
(Contact: Ms. Dominique Gilbert, 217-373-3488, Email: [Dominique.S.Gilbert@usace.army.mil](mailto:Dominique.S.Gilbert@usace.army.mil))

#### **Z. Pollution Prevention (CERL-26)**

Proposals are sought for research into, or demonstration of pollution prevention technologies, methodologies, processes that support or eliminate environmental compliance issues. Topics of interest include technologies for alternative surface cleaning to eliminate or minimize solvent use; energy efficiency in wastewater treatment; food waste management; solid waste recycling systems; composting; and "green building" upgrades.

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(Contact: Ms. Angela Urban, 217-373-4421, Email: [Angela.B.Urban@usace.army.mil](mailto:Angela.B.Urban@usace.army.mil))

**AA. Business Process Reinvention (CERL-27)**

This research calls for new business processes and supporting technologies that will enable the DoD and civilian Federal agencies to efficiently and effectively exchange information, evaluate performance, and ensure regulatory compliance. Specific emphasis is on the support of Environment, Safety and Occupational Health (ESOH) regulatory compliance research and program development, including the application of audit business processes and Environmental Management System program development.

(Contact: Chris Rewerts, 217-373-5825, [Chris.C.Rewerts@usace.army.mil](mailto:Chris.C.Rewerts@usace.army.mil))

**BB. Socio-Cultural Analysis (CERL-28)**

Understanding urban and social environments requires the ability to model complex interactions between 1) infrastructure systems and services, 2) human populations and society, and 3) natural and man-made environments and their impact on military operations. Proposals are sought for the development of new and improved concepts, methods, and tools for acquiring and representing spatial-temporal information that can be combined with cognitive and behavioral processes to advance the fundamental understanding of the spatial-temporal, socio-cultural dimensions of human social dynamics. Specific research efforts are requested in the following areas:

1. Understanding human military theater phenomena including but not limited to: aggregate behavior, nonlinear phenomena, networks with distributed or local control, and combinations of continuous and discrete behavior;
2. Development of computation techniques that enable discovery of new information and relationships that cut across disciplines (spatial and behavioral);
3. Development of abstract models or ontologies to represent fundamental understanding of the complex urban environments;
4. Development of technology transfer methods to take theory/concepts to operational environments through use of novel computation and simulation techniques;
5. Develop improved methods to characterize non-trivial spatial and temporal patterns and define relationships between physical environment (i.e., soils, vegetation, climate, surface geology) and human/cultural aspects (i.e., population/ethnic group movement, human patterns and behaviors).

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**CC. CERL-29 (RESERVED)****DD. Adaptive Intelligence Systems Architecture (CERL-30)**

The following capabilities requirements regarding virtual capabilities to simulate a base camp in all phases of its life cycle Simulations will provide analytical tools for planning and design, tools

for optimization of construction management, systems monitoring and data collection/analysis for optimal base camp operations, training of base camp designers and operators, planning and analysis capabilities for transfer and closure of facilities.

The virtual capabilities to be provided include; but, are not limited to the following component systems: Power generation, distribution, and monitoring systems; water systems management analysis that are focused on use/demand requirements, collection/generation, distribution, storage, and reuse/recycle; waste component systems management that is used to address solid waste, hazardous waste, and sanitary waste; impact of human and natural dynamics on base camp systems; simulation of economics systems (costs, availability of material systems, labor and funding).

This effort will provide and understanding of the relationship dynamics of the operational base camps component systems as well as the dynamics between the component systems and the human, natural, and economic environments in which the base camp operated.

(Contact: Mr. Ahmet Soylemezoglu, 217-373-3481, Email:

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### **EE. Environmental Health and Soldier Protection (CERL-31)**

Proposals are sought for novel, basic and applied solutions in the areas of environmental health and soldier protection utilizing molecular and cellular biotechnology. In particular, technologies that enable rapid or real-time monitoring, detection of biomarkers, or biological recognition of membrane proteins or antigens are sought. Examples include but are not limited to technologies in the areas of cell based biosensors, nano- or micro-scale systems, biocompatible materials, protein and tissue engineering, and proteomics.

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### **FF. (CERL-32) RESERVED**

### **GG. Regional and Ecological Planning and Simulation (CERL-33)**

Research in this domain involves the design, development, and application of ecological, economic, social, climate change, and urban growth models to help forecast the direct, indirect, and cumulative consequences of proposed management plans. Research is intended to support military installation long-term planning and sustainability by finding local and regional plans over time and space that support current and future military missions.

Virtual Representation of Landscape Characteristics focuses on research and development to accurately represent real world landscape attributes in a virtual environment. Proposals are sought to address simulation of physical properties of real-world objects including visual, auditory, and tangible characteristics, accounting for natural variation in properties, novel methods for data acquisition and application, rapid and automated population of attributes, and

accurate depiction of the real world. The types of objects sought include: weather, water, rocks, soil, vegetation, and wildlife.

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## **HH. CERL-34 (RESERVED)**

## **II. Mitigation of Wide Area Biological Contamination Events (CERL-35)**

Proposals are desired which address the need for improved capabilities to respond to wide area biological contamination events that can impact critical equipment, infrastructure, or national resources. Contamination events might be naturally occurring or manmade. Research proposals for the development, integration, and research demonstration of physical, chemical, or biological mitigation approaches are of interest. Supporting detection and clearance methods are of interest. Candidate approaches should be efficient, safe, and practical for the target application. Target applications may include building protection and remediation, mitigation of Harmful Algal Blooms (HABs) in large water bodies, wide area decontamination of infrastructure, and decontamination of corrosion-sensitive equipment.

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## **JJ. CERL-36 (RESERVED)**

## **KK. Innovative Water Efficiency and Water Resilience Initiatives (CERL-37)**

Proposals are sought for evaluations and demonstrations of innovative technologies that will improve water efficiency, conserve water resources, and improve resilience of water delivery systems. Federal agencies are required to meet stringent water conservation targets mandated by Executive Order. In addition, the Army has set challenging goals for Net Zero Water attainment at installations.

Products/methods/techniques that will improve overall water efficiency or reduce reliance on potable water sources are of interest. These include but are not limited to: water conservation and ultra-efficient plumbing fixtures and controls, smart landscaping, smart irrigation controls, rainwater and storm water collection and reuse systems, condensate capture and reuse systems, water efficient energy technologies, distribution system leak detection, drain line transport issues, and net zero water. In addition, proposals are sought for products/methods/techniques that will improve the resilience of water delivery systems and reduce the risk of loss of water services due to economic dislocations, depletion of natural resources, and natural or man-made disasters.

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**LL. Bioelectrochemical Systems (CERL-38)**

Proposals are sought to evaluate, optimize, demonstrate and validate state-of-the-art bioelectrochemical systems (BES), such as microbial fuel cells (MFC) and microbial electrolysis cells (MEC), for applications to Army problems. BES utilize the natural biodegrading capacity of microbes to oxidize the organic matter content of an input water stream (e.g., waste water), thereby treating the water, while simultaneously generating electrical current. In this regard, BES have potential to be enabling components of effective wastewater treatment systems that do not require, or at least minimize, input of external energy at resource limited and remote military sites. Proposals can study key aspects of wastewater treatment or clean water production by BES including the type and design of BES used, the source of microbe inoculate used, the effectiveness of treatment, material performance, modes of operation that balance electrical current output with rate of organic matter oxidation, management of generated electrical current to power system components, scalability of BES volume to wastewater loading rate, and cost vs. benefit. Other possible topic areas include requirements, design, and standardization of BES, system fabrication, anaerobic digestion as a pretreatment step, the microbiology occurring within BES, materials research on BES components, process analysis and modeling, power management and self-powered autonomous diagnostics, scale-up designs, and demonstration.

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## **COLD REGIONS RESEARCH AND ENGINEERING LABORATORY (CRREL)**

**I. Introduction:** CRREL has two major organizational elements to perform its mission: the Research and Engineering Division (RED) and the USACE Remote Sensing/Geographic Information Systems Center of Expertise (RS/GIS CX). RED is composed of five research branches: Biogeochemical Sciences, Engineering Resources, Force Projection and Sustainment, Signature Physics, and Terrestrial and Cryospheric Sciences. The RS/GIS CX comprises three functional research groups: Water Resources/GIS, LiDAR and Wetlands, and Terrain and Ice Engineering.

### **II. Research Areas:**

#### **A. Signature Physics Technical Area (CRREL-1)**

The Signature Physics technical area focuses on research to increase knowledge and understanding of the variability in electromagnetic, acoustic, and seismic signatures of personnel, vehicles, aircraft and other military and non-military sources in response to weather, changing terrain state and complex terrain features and geometry. The understanding gained serves to improve our ability to predict signature behavior in support of materiel development, algorithm science and technology, sensor performance templates for tactical decision-making, force protection, and visualization for mission planning and rehearsal.

Military broadband wireless communication networks will operate in radio frequencies ranging from hundreds of MHz to several GHz. Terrain and environmental variability will significantly influence network performance. Research is focused on innovative approaches to gain fundamental understanding of geo-environmental influences, including terrain and terrain condition, on propagation at millimeter to meter wavelengths. Basic experimentation, theoretical formulation, and simulation activities in this technical area include: the description of propagation along the surface of the earth; novel techniques for characterizing impacts of large and small-scale topographic features; the electrical properties of surficial materials, including vegetation; and the effects of near-surface, tropospheric, and stratospheric atmospheric disturbances.

Seismic and acoustic spectrum research focuses on the development of fundamental understanding of the propagation processes in different terrestrial materials and in the lower atmosphere, and algorithm development for improved target detection and classification. Of particular interest, this technical area seeks to develop theory and validation for full three dimensional expression of (1) the character of seismic surface waves under strongly heterogeneous near-surface geological conditions and complex surface geometry at multiple scales; (2) the character of acoustic waves as affected by the atmosphere (predominantly the boundary layer, troposphere, and stratosphere), heterogeneous ground impedance; and topographic and terrain feature controls; (3) the phenomenology of seismic-acoustic coupling, and (4) novel materials for attenuating linear and nonlinear sound waves and vibrations. Other research focuses on the variation in personnel and vehicle signatures (seismic, infrared, visual) due to weather, terrain, and cultural activity, and mitigating the impacts of environmental impacts on signature recognition.



Products of this technical area support information superiority critical to military operations through improving terrain analysis support to command, control, communication, computer, information, surveillance, and reconnaissance (C4ISR) and tactical communications. By increasing our understanding of geo-environmental impacts on sensing (C4ISR) and signal propagation, this research will lead to improved terrain analysis and mission planning tools. Seismic-acoustic interest extends to applications in the Biogeochemical Processes in Earth Materials technical area (CRREL-3), such as reducing military generated noise and mitigating its adverse impacts. The research area operates in a unique niche that combines experimentation with physics based modeling and simulation, with an emphasis on the implications of the dynamics of the environment on systems performance. The Signature Physics technical area is highly complementary to CRREL's Terrain Properties and Processes technical area (CRREL-2).

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Specific research efforts are requested in the following areas:

1. Environmental effects on seismic and acoustic wave propagation and sensors.
2. Innovative and/or integrative research in geospatial research and engineering.
3. Seismic-acoustic target localization or anomalous activity detection in urban and other complex environments.
4. Acoustic/seismic sensor performance modeling.
5. Seismic signal modeling for battlefield sensors.
6. Site characterization for seismic-acoustic signal modeling.
7. Surface radio wave propagation.
8. Weather and terrain effects on intrusion detection sensor performance.
9. Seismic, acoustic, and infrasound propagation in complex environments.
10. Electromagnetic remote sensing and sub-surface detection of buried metal objects including UXOs.
11. Electromagnetic modeling and numerical methods.
12. Signature phenomena and other exploitation techniques for remote sensing of kinetic hazards.
13. Near-surface electromagnetic wave propagation over rough terrain.
14. Quantification of uncertainties in Unmanned Aircraft Systems (UAS) and counter UAS sensor performance due to weather and terrain.

## **B. Terrestrial and Cryospheric Sciences Technical Area (CRREL-2)**

The Terrain Properties and Processes technical area investigates fundamental processes and properties of terrain and terrestrial materials as affected by the atmosphere and applies this knowledge to solving a broad range of military and civil problems. The range of research topics is broad and involves laboratory experiments, field expeditions, and numerical modeling. Research focuses on environmental physics in such topic areas as electromagnetics, boundary layer processes, fluid flow in porous media, and thermodynamics. These topics include energy exchange with the terrain, transport of gas, water, and vapor in soils and snow, weather effects on sensor performance, ice accumulation, snow and ice mass balance, permafrost degradation, snow metamorphism, and snow, soil, and micrometeorological modeling. Terrestrial surfaces extend to permafrost, glaciers, as well as river, lake and sea ice covers. At the microscale, this technical area focuses on improving the understanding of the physical processes associated with

mass, momentum, and thermal transport in the atmosphere and at the terrain surface. This includes measurements and theoretical developments to improve prediction of processes and integrates our understanding into larger-scale models. Efforts to predict atmosphere-terrain interactions are focused on the impact of short vegetation on thermal and spectral signatures, developing computationally efficient models for very high spatial resolution, identifying terrain features and soil strength with spectral imagery, understanding and modeling impacts of pressure-driven flow on atmosphere-terrain exchange, and modeling freezing rain in complex terrain. Military research on terrain state aims to extend understanding of weather-driven terrain material property changes at tactical-relevant scales.

The Terrain Properties and Processes technical area contributes to Army, DoD, and national capabilities by defining the natural environment and the terrestrial-climate impacts on plans and operations as well as critical infrastructure. A key interest for the Army is the development of tactical decision aids for terrain reasoning and situational awareness. The relevance of the work relies on an ability to predict the state of the environment for any weather, any time of day, and any season. This allows the military to exploit the dynamics of the environment rather than conquer it, allowing the military commander to exercise a terrain advantage. This technical area also contributes to the body of knowledge supporting long range Corps programs in water resources planning and management and aiding other Federal agencies responsible for understanding changes in climate dynamics and its impacts on civilization. The Terrain Properties and Processes technical area is strongly synergetic with CRREL's Signature Physics Technical Area (CRREL-1).

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Specific research efforts are requested in the following areas:

1. Signature and scene prediction and synthesis for Infrared and the millimeter-wave spectral region
2. Algorithms to recover geophysical products from remote sensing measurements to drive models of surface energy balance and signature prediction
3. Methods to spatially distribute models of snow cover, soil, and vegetation energy and mass interactions in the boundary layer
4. Penetration of energy transfer components into snow
5. Characterization and modeling of weather, obscurants, and terrain conditions related to the spatial winter boundary layer
6. Environmental and atmospheric effects on winter battlefields
7. Physically accurate modeling to produce synthetic scenes and data for a global range of environmental conditions
8. Geophysics of snow, ice, and frozen ground
9. Spatial distribution of snow properties
10. Geological and geophysical processes of permafrost, glaciers, and ice sheets
11. Lunar and planetary analogue site characterization
12. Vapor-driven snow metamorphosis coupling Lattice-Boltzmann air flow with discrete element model of snow
13. Air-sea surface energy exchange and sea ice mass redistribution in the Arctic
14. High resolution sea ice modeling
15. Terrain and cultural factors effecting deterrence planning and operations

### C. Biogeochemical Processes in Earth Materials Technical Area (CRREL-3)

The Biogeochemical Processes in Earth Materials technical area focuses on understanding the interaction of biological systems, in particular the establishment, growth, and dynamics of plant and microbial communities, with a variety of earth and engineered materials (i.e., geomimetics). The properties of these materials are studied in situ, in the field and via laboratory experimentation. This technical area spans basic research to applied field demonstrations.

The goal of research in this technical area is to exploit understanding of biological, geological, and chemical interactions to further technology development in environmental remediation and ecosystem restoration, sustainable military training lands and ranges, biosensor development, and terrain reasoning and assessment. A further goal is to understand hierarchical or scalable relationships between the fundamental large-scale biogeochemical processes and smaller-scale “drivers” that constrain such processes, i.e., climate and physiography. Understanding the hierarchical linkage between fundamental processes and the drivers characterizing a particular biome or ecoregion can aid in the development of predictive capabilities at the landscape level, e.g., persistence and fate of harmful chemicals or microorganisms in the environment.

Research under this technical area is being impacted and enhanced by the following emerging concepts and technological developments applied to biogeochemical systems and materials:

**Omics.** Spin-offs of genome characterization (genomics), protein and other biomolecule characterization (proteomics), and metabolite and other daughter molecule characterization (metabolomics), will continue to provide new, rapid, high throughput bioanalytical techniques and novel methodological approaches to research in this technical area. This could revolutionize study and assessment of interactions between biological systems and the environment and make feasible real-time analytical and assessment capabilities available to end users.

**Nanomaterials development.** Research in chemistry and materials science on synthesis and properties of small particles ( $< 0.1\mu\text{m}$ ) with highly reactive surfaces may make possible development of materials that mimic natural geologies and soils (i.e., geomimetics), but exhibit enhanced properties such as mechanical strength, novel catalytic properties, or variable dielectric behavior.

**Informatics and knowledge management.** Advances in informatics and emerging concepts of knowledge management will have a major impact on the ability to analyze large amounts of diverse biological, physical, and chemical data. This field will enable the extraction of new information from datasets using sophisticated statistical, ontological, and reasoning techniques. New paradigms for understanding biological systems when merged with modern digital data processing power will make it possible to field complex, real-time assessment techniques and technologies.

**Computational chemistry and computational biology** refers to in silico techniques (i.e., via computer simulation) that make it possible to perform complex and numerous chemical and biological “virtual experiments”. These computational techniques promise a significant cost savings and increased productivity that will maximize knowledge gained and provide analytical input to future automated risk assessment and reduction applications for end users. Validation by in vitro experimentation will be conducted when appropriate.

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Specific research efforts are requested in the following areas:

1. Biological processes affecting the nature and rate of transformation of natural and/or anthropogenic constituents in environmental media (soil, water, air) or on artificial surfaces under environmental conditions
2. Restoration of plant communities at local and landscape scales
3. Plant and plant community adaptation to extreme environmental conditions
4. Behavior of soil microbes or microbial communities under natural or stressed environmental conditions or on artificial surfaces
5. Biogeochemical processes in natural and disturbed ecosystems and terrain to include the impact of disturbance on spatiotemporal patterns
6. Biosensor development employing microbes, microbial physiology, or principles of microbiology for detection of chemical and biological threats or contaminants
7. Application of advanced bioanalytical and omics methods to assess the nature and rate of biogeochemical processes in natural and artificial environments
8. Application of advanced concepts of complexity, computational biology, knowledge management, and related fields to studying and predicting the behavior of microbial and plant communities in a variety of environmental conditions

#### **D. Environmental Fate and Transport Geochemistry Technical Area (CRREL-4)**

Basic and applied research aimed at understanding earth surface conditions and associated environmental characteristics that affect the fate and transport of existing and emerging contaminants, military and industrial compounds, and natural substances. With this understanding, appropriate detection, assessment, and sampling technologies can be developed with specific application to military installations, existing and formerly used training ranges, and civil works projects. Applications target site remediation, restoration, and/or protection. Research in the technical area can be divided into four broad focus areas:

Characterization and sampling of energetic and munitions compounds. Research is ongoing on the distribution and fate of military munition explosive residues, propellants, and smokes on training range soils, and on the transport of explosive residues and other military-specific compounds, and their breakdown products, into surface- and ground-waters and into air. Emphasis is placed on the development of innovative analytical methodologies for current and emerging contaminants of concern and sampling techniques for accurate assessments of non-homogeneously distributed compounds. This research area produces field sampling protocols and laboratory analytical methods for explosive residues that are broadly accepted within and outside of the DoD.

Contaminated site characterization using geophysical methods. Transport of contaminants is difficult to predict in complex geological settings, such as in cold regions where discontinuous permafrost is present. Site investigations using innovative geophysical techniques to include two- and three-dimensional resistivity, electromagnetic instrumentation, ground penetrating or other types of radar, and/or standoff spectroscopic methods, provide the means to more effectively characterize variable site conditions. Combinations of these techniques often results in enhanced one, two, and three-dimensional conceptual site models for use in predict pathways for the

movement of surface and groundwater and associated contaminants.

Sub-surface investigations of anomaly discrimination using innovative geophysical methods. This research is directed at increasing understanding of the responses heterogeneous subsurface environments produce from surveys with different geophysical methods to enhance target discrimination. This is particularly important in cold regions where freeze-thaw cycling and the presence of frozen ground can impact soil moisture and other properties that some geophysical methods are particularly sensitive to. Improved numerical modeling that supports signal interpretation to determine size, location, orientation, magnetic permeability, and conductivity of a candidate target is an important facet of this work. Novel seismic and acoustic methods are also of potential application in this technical area.

Characterization of trace metals and organic contaminants in groundwater and soils. This area focuses on the development of techniques to assess chemical and biological agents in groundwater and soils, to include aeolian dust and volatile and semi-volatile organic compounds. Research under this technical area will be potentially be impacted and enhanced by the following emerging technologies that are shaping the expectations of how fate and transport data and information is collected, assessed, and conveyed to end users: Recent advances in the study and manufacturing of micro-electromechanical systems (MEMS), photoreactive bandgap materials (PRBs) and biosensors suggest eventual development of technologies leading to dispersible, active chemical sensors responsive to various environmental conditions or states, and therefore a future capability for geospatially-distributed, remotely-accessed sensing systems for either natural or built environments. Continued advances in robotics will spur demand for the development of a wide variety of on-board instrumentation to analyze soils and other environmental media qualitatively and quantitatively. Real-time, onsite analysis and assessment of munitions and energetics on training ranges and in other hazardous environments may become routine. Advances in the application and analysis of hyperspectral and other EM-sensor imaging data makes conceivable real-time, spatially-distributed assessment capabilities for simultaneous determination of environmental parameters and contaminant distributions. And, the continuing evolution of concepts in spatial organization and structure coupled with advances in informatics and knowledge management principles, practice, and technology is spurring the development of novel computational approaches in pattern recognition and change detection, which may lead to more holistic and sensitive approaches to environmental risk assessments.

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Specific research efforts are requested in the following areas:

1. Environmental investigation methods, techniques, and approaches adapted to extreme environmental conditions
2. Physics and chemistry of water and its behavior in cold-region soils and geological settings
3. Physics and chemistry of water and its behavior in extremely arid environments
4. Innovative detection and analysis methods for contaminants in soil, water, and air in situ or in the laboratory
5. Rates and magnitude of fundamental soil, water, and atmospheric processes in extreme environments as they affect the fate and transport of natural substances and contaminants

6. Development of computational approaches to evaluate the nature, reactivity, fate, and transport of trace metals and organic compounds in the environment
7. Development of innovative sampling methods and protocols for contaminants in environmental media (i.e., soil, water, air)
8. Application of informatics and knowledge management principles, practice, and techniques to natural product and contaminant fate and transport assessment and management in the environment

### **E. Force Projection and Sustainment Technical Area (CRREL-5)**

This technical area requires a combination of engineering research and practice to develop innovative technology solutions for challenging problems in a wide variety of environments. These environments include both temperate and extreme cold weather conditions and encompass remote, austere sites, such as those found at the earth's poles. Operations and logistics support in these challenging environments are often expensive, complex and extend beyond the state of current technology. Technologies that optimize mobility in a wide variety of developed and undeveloped terrains is a critical area of focus. This includes optimizing manned and unmanned vehicle performance, understanding all-season terrain mechanics, and developing advanced materials and engineered systems to provide all-season maneuver support. Other research in this technical area focuses on developing the engineering principals that support snow and ice runway construction and sustain operational capabilities when deployed to extreme cold environments.

Current efforts utilize manned and unmanned vehicles to gain an understanding of the complex vehicle-to-terrain and terrain-to-vehicle interactions that occur. The changing landscape of future conflicts also necessitates that research supporting mobility and maneuver include the nonlinear theater and urban environments. Vertical envelopment, inter-modal logistics, and environmental impacts are all critical considerations for real-time military planning. Specific needs include instrumentation for the measurement of porous media - strength and permeability, specialized heavy-vehicle mobility instrumentation, ice adhesion research, development and testing standardization, and extreme cold hardened instrumentation and analyses packages for operations support, to include expeditionary operations.

Models are also needed that accurately represent the interaction/adaptation of vehicles to challenging all-season terrains as well as the adaptation of the terrain (itself) to the vehicle. The presence of snow, ice, permafrost and the occurrence of multiple freeze-thaw cycles present unique modelling challenges. Developed models should not only predict the performance of "next generation" mobility technologies, but also consider cost/benefits, returns-on-investments and payback schedules when implementing said technologies.

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Specific research efforts are requested in the following areas:

1. Construction and evaluation of snow airfields and runways
2. All-season mobility modeling and field testing
3. All-season terra-mechanics modeling
4. All-season vehicle dynamics models

5. Vehicle simulation and visualization in complex environments
6. Weather and vehicle interactions
7. Obscured environment (non-weather) and vehicle interactions
8. Cold regions robotic vehicle performance
9. Cold regions equipment design and engineering
10. Robust logistics analyses
11. Polar and austere environment engineering
12. Unpaved airfields
13. Implications of new vehicle technology
14. Advanced materials for cold regions applications (including snow and ice as a construction and/or force protection material)
15. All-season air and ground vehicle operations
16. Manned and unmanned vehicle operations in complex environments
17. Military engineering in austere environments

## **F. Cold Regions Infrastructure Technical Area (CRREL-6)**

The Cold Regions Infrastructure technical area provides Cold Regions research and technology solutions for construction, operations, and maintenance of standard and strategic facilities worldwide. Key issues facing the DoD include 1) strategic national defense facilities will continue to be located in cold climate and remote locations; 2) critical defense facilities in remote locations require highly reliable transportation infrastructure including airfields to sustain all-weather and year-round operations; 3) facilities are frequently one-off adaptations of standard designs and many facilities require unique/prototypical designs, thus, performance criteria must be adapted to provide high reliability; 4) severe climate and lack of local infrastructure add significant costs to design, construct and sustain facilities, airfields and other transportation infrastructure in Cold Regions; and 5) in situ testing of operational facilities is expensive and acceptance criteria difficult to define.

The Cold Regions Infrastructure technical area is an activity with a primary mission of transferring knowledge and capability directly to individual users through technical support. Current focus is on providing services, often in partnership with USACE elements including Alaska District and New York District to agencies planning, constructing or operating facilities in winter environments. Research opportunities are leveraged with funding from other Federal agencies. Recent efforts have focused on technical support of the design, construction, and operation of missile defense facilities in Alaska and National Science Foundation facilities in Antarctica and the Arctic. Significant operational issues are solved and value engineering impacts related to building envelopes and airfields/pavements are realized. Other key military facility design and construction efforts have benefited from CRREL's Cold Regions infrastructure support in recent years. This has included work on military hospitals, flight simulators and strategic communications and surveillance facilities in cold regions where high interior humidity is required by users but presents substantial building operational challenges in cold regions.

In addition, this technical area evaluates coatings and materials for low ice adhesion applications in locks and dams, aviation, maritime operations, and utility installations. In addition to testing the adhesion of ice to freshly prepared surfaces, weathering tests to verify the durability of a broad range of coatings are also performed. CRREL has a versatile set of ice adhesion testing methods

that can both serve as an index test for comparing a set of samples during the R&D phase of a project or as a more quantitatively rigorous measurement on promising candidate coatings for low ice adhesion applications. These include: the current industry standard, the Zero Degree Cone Test, which is widely used as an index test for screening the adhesion of freshwater ice to coatings under development, the Double Lap Shear Test, which is an ASTM standard test index test configured to assess a flat test coupon (planar interface), and the more advanced Peel Test, which uses an open planar configuration and can be used with saline spray ice and accretion ice in addition to freshwater polycrystalline ice. Furthermore, the Peel Test can be configured for either Mode I tensile or Mode II shear loading. By gaining a better understand of the effects of ice adhesion on both military and civilian structures, advances can be made towards the development of a variety of preventive surface coatings and deicing methods.

New requirements will stem from the necessity to adapt to climate variability in the polar Regions. Thawing frozen ground in the Earth's Arctic Regions will be a formidable infrastructure challenge in the coming decades. Most current infrastructure design requirements are dated and no longer produce serviceable design lives for foundations, transportation facilities, and structures in these dynamic environments. Much of the technology adapted for use in the oil and gas industry in the 1970's is outdated. Virtually all new infrastructure projects need development of new requirements documents and technically advanced designs that operate well above the current minimum standards.

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Specific research efforts are requested in the following areas:

1. All-season airfields and pavements models
2. All-season geomaterials modeling and stabilization
3. All-season pavement testing and evaluation
4. Building envelopes in Cold regions facilities
5. Environmental loads and design criteria for facilities
6. Utilities and heat storage in Cold regions facilities
7. Permafrost engineering
8. Polar engineering
9. Low temperature concrete admixtures and placement
10. Novel materials for Cold regions infrastructure
11. Energy efficient systems and conservation techniques for remote and cold region facilities
12. Snow and ice (as construction materials) airfields and roads pavement design, testing, and evaluation
13. Ice adhesion testing, mitigation techniques and preventive surface coatings or materials

## **G. Water Resources Geospatial Applications Technical Area (CRREL-7)**

The Water Resources Geospatial Applications technical area conducts research to improve data collection, analyses, and decision support through appropriate use of remote sensing and geographic information systems (GIS) technologies and applications. Research in this technical area results in the development of software tools and methods to improve the use of geospatial technologies across all Corps business areas to effectively manage water resources, emergency



situations, real estate, environmental restoration, regulatory, navigation and operations projects and programs and support to the warfighter and Intelligence Communities (IC).

These technologies are being used to support stability, reconstruction, and homeland security operations, develop sound water resources solutions, and enhance life-cycle infrastructure management. The dedicated, highly technical staff has multidisciplinary expertise, which has allowed them to develop advanced hardware and software resources to provide around-the-clock database and application support. These developments have led to geospatial tools for data management and decision support for USACE Enterprise GIS, the CorpsWater Management System, the Formerly Used Defense Sites Program, The Geospatial Repository and Data management system (GRiD), Emergency Management (EngLink), the Wetlands Regulatory Program, the National Levee Database and the Defense Installation Spatial Data Infrastructure Strategic Viewer. Customer breadth and satisfaction with these products is demonstrated by steadily increasing funding for this research area, projects of larger scope, and an expanding customer base (e.g., moving from primarily Civil Works Corps of Engineers applications to larger DoD, IC and other nationwide projects). The approach of this technical area has led to a demonstrated unique capability to develop and deliver operational geospatial information systems, which are fully extensible and transferable across functional areas.

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Specific research efforts are requested in the following areas:

1. Geostatistical methods for accuracy assessment of derived geospatial information
2. Real-time precipitation and snowmelt runoff prediction through integration of remote sensing and GIS technologies
3. Advanced remote sensing methodologies for quantifying change
4. Algorithm development to support remote sensing analysis through the use of Machine Learning (ML) and Artificial Intelligence (AI)
5. GIS technologies for environmental and water resources applications
6. Geospatial decision support systems
7. Advanced methods for 3D terrain geospatial management and analytics.

## **H. Hydrology and Hydraulics Technical Area (CRREL-8)**

Research activities in the Hydrology and Hydraulics technical area address the fundamental aspects of cold regions hydrology and hydraulics. Specifically, this area includes direct and reimbursable research characterizing winter impacts on operation and management of Corps structures; ice jam mitigation measures and emergency operations; geospatial distribution and water equivalent estimation of snow pack; volume and timing of snowmelt soil infiltration and runoff; water quality, ecosystem restoration and environmental remediation in cold regions; and watershed and basin water management, hazard mitigation, and methodologies for regional watershed/water resources management systems in regions affected by seasonal dynamics.

Products in this technical area directly support USACE water resources, environment, homeland security, and warfighting missions through support of flood damage reduction, navigation, ecosystem restoration, water supply, recreation, hydroelectric power, shore protection, regulatory, and environmental stewardship. This technical area has demonstrated a unique ability to align

snow and ice science and engineering with operational needs to develop effective tools for direct operational use in both civil and military applications. The Hydrology and Hydraulics technical area is a unique niche within DoD and includes national and international experts in snowmelt hydrology, ice engineering, combined with extensive experience in hydrologic analyses and regional watershed and basin management.

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Specific research efforts are requested in the following areas:

1. Hydraulics, hydrology, and sediment transport in Cold Regions
2. Runoff and sediment yield of glacierized basins
3. Rapid flood control structure assessment
4. Ice scour around bridge piers
5. Cold regions coastal shoreline protection
6. Ice forces on riverine and coastal structures

## **GEOSPATIAL RESEARCH LABORATORY (GRL)**

### **TOPOGRAPHY, IMAGERY AND GEOSPATIAL (TIG) RESEARCH DIVISION**

#### **I. Introduction**

The Geospatial Research Laboratory (GRL) conducts research related to providing rapid collection, calibration, registration, processing, analysis, integration, compression, visualization, analysis, and dissemination of remotely sensed geospatial data acquired from various manned and unmanned sources to derive high fidelity spatiotemporal information. Multi-modal data is used to create integrated and tiered geospatial products for enhanced situational understanding based on forms and methods tailored toward dissemination to Warfighters and Civil Works applications.

Additional interest includes methods for terrain-based techniques for alternative positioning, navigation, and mapping capabilities in GPS-denied environments for mounted and/or dismounted units. GRL research efforts explore the incorporation of novel materials for tagging, tracking and locating; explores emerging lidar technologies, and the advancement of hardware and software systems related to geospatial intelligence.

#### **II. Research Area**

##### **A. Geospatial Intelligent Collection, Dissemination, Exploitation with GPS Denied Software/Hardware Tools and Techniques” (GRL-1)**

The objective is to conduct research and development techniques to perform within a GPS denied environment, specifically within the dense urban environment (DUE). Techniques can be utilized from single or multiple sources, architectural standards for interoperability with fusion issues should be addressed. A goal of this topic is to improve situational awareness through implementation of geospatial intelligence within the DUE and within GPS denied areas for mounted and/or dismounted operational environments.

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##### **B. Novel photon-counting LIDAR software and hardware development (GRL-2)**

The objective of this research area is to conduct investigations into new methods of collecting and processing photon-counting point cloud data through novel signal and image processing techniques. These techniques can focus on Geiger-mode LiDAR data, single photon LiDAR data, or any other emerging single photon-sensitive LiDAR sensing modality. Proposals concerning software and processing should focus on the differences between the proposed methods and the current state of the art. Hardware proposals can include modifications or improvements to existing GFE photon-counting LiDAR sensors or maturation/demonstrations of emerging capabilities. Successful proposals concerning hardware development or maturation will explicitly state the advantages of the proposed hardware configuration over existing capabilities.

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### **C. Photogrammetry & Rectification Software Tools and Techniques (GRL-3)**

The objective is to conduct research and develop techniques to perform automated/ semi-automated rectification and subsequent extraction of terrain data from frame, scanner and video imagery. Techniques can be based on single or multiple sources. If using multiple sources, fusion issues should be addressed. A goal of this topic is to improve spatial fidelity and geometric accuracy through new alignment techniques.

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### **D. Intelligent Spatio-Temporal Analytics (GRL-4)**

Proposals are sought for technologies that will help analysts efficiently and effectively interpret spatio-temporal data, support sensemaking and help Army personnel to make better decisions in near real time. Analysts across the Department of Defense rely heavily on spatio-temporal analytics to derive critical, timely information for decision-making. As multidomain operations are planned and executed, analysts need to quickly and thoroughly consider data that spans through interdisciplinary fields and gain a comprehensive knowledge of data implications when applied to work across different domains. Objectives for this topic include both how to process complex data more effectively and how to efficiently support analyst sensemaking.

We are soliciting proposals that fit within one of the following research directions

- Advanced methods and sensor agnostic tools which enable fusion of heterogeneous spectral-temporal sensors for terrain understanding and navigation under denied conditions and difficult to map areas.
- Techniques to combine unstructured text and imagery into meaningful semantic contexts. Not solidly imagery/geospatial data or text and technical data but both.
- Methods/techniques to automatically generate unbiased training data for deep learning applications and scene understanding of multiresolution data. Architectures that can learn from a continuous stream of new data in real time

Effective proposals will include: conceptual descriptions; technical methods/tools/techniques to be used; references to prior work and example data sources or collection plans; metrics that characterize how the proposed idea will measurably advance beyond current approaches; validation and documentation plans.

(Contact: Dr. Laura Harding, 703-428-6107; Email: [Laura.E.Harding@erdc.dren.mil](mailto:Laura.E.Harding@erdc.dren.mil))

### **E. Assured Position, Navigation and Timing and Visual Terrain Reference Navigation (GRL-5)**

The Geospatial Research Lab (GRL) is seeking novel research and development proposals and solutions in the area of Assured Position, Navigation and Timing (APNT) in support of program research in the application of geospatial data (especially 3D data) to the derivation of navigation terms in GPS/GNSS denied or degraded areas. Visual Terrain Reference and Navigation or

VTRAN is an area being researched by GRL to use EO and other sensors (active and passive) in the development of solutions for inertial measurement systems in order to re-set and accurately drive state estimations of air and ground vehicles.

(Contact: Dr. John Anderson, 804-314-6097; Email: [John.Anderson@usace.army.mil](mailto:John.Anderson@usace.army.mil))

#### **F. Advanced Terrain Analytics in Complex Environments (GRL-6)**

The objective of this research area is to investigate and develop models and tools for semi-automated/automated intelligence preparation of the battlefield (IPB) using multi-sensor, multi-modal, and multi-temporal remotely sensed data. Geospatial workflows will advance techniques for mobility and maneuver support in complex landscapes, including, urban environments, densely vegetated terrain, and arctic/subarctic regions. Methods can incorporate 2D and 3D geospatial layers acquired from terrestrial, airborne, and space-borne assets. Tools developed in this research area will provision feature foundation data as well as enhanced, multi-scale terrain products to support commander's critical information requirements. Geospatial data processing and terrain analysis techniques will leverage machine learning and geo-statistical algorithms, as well as reduce computational time and storage. Proposals to this research area should aim to be as sensor-agnostic as possible and include methods for quantitative accuracy and uncertainty estimates.

(Contact: Mr. Michael Campbell, 703-428-6538; Email: [Michael.V.Campbell@usace.army.mil](mailto:Michael.V.Campbell@usace.army.mil))

#### **G. Advanced Cyber Geospatial Science (GRL-7)**

The objective of this research area is to investigate and mature methods, algorithms, systems, database technologies, and collaborative platforms (both hardware and software) that advance computational and data intensive geospatial problem-solving challenges inherent to Army Modernization. Additional touchpoints include semi- and fully-autonomous methods for monitoring and mapping terrain features and characteristics. Proposals to this research area should aim to be scalable across various degrees of distributed computing infrastructure with various degrees of network constraints.

(Contact: Mr. Austin Davis, 703-428-6919; Email: [Austin.V.Davis@usace.army.mil](mailto:Austin.V.Davis@usace.army.mil))

## USACE Reachback Operations Center (UROC)

### I. Research Area:

#### A. USACE Reachback Operations Center (UROC-1)

The USACE Reachback Operations Center is an engineering analysis reach back (i.e., telepresence) capability to support personnel in the execution of their mission across the full operational spectrum. Research in this area includes the development and/or integration of models (empirical, analytical, numerical, etc.) and hardware to improve subject matter expert (SME) response time, provide highly accurate engineer analysis to deployed personnel, and improve the capability of personnel in the field to collect engineering data.

(Contact: Submit inquiries via email to the following: [ERDC-BAA@usace.army.mil](mailto:ERDC-BAA@usace.army.mil))

## PART II

### PRE-PROPOSAL AND PROPOSAL EVALUATION

**A.** All proposals initially submitted in response to this BAA will be considered pre-proposals. Should ERDC evaluation indicate a need for a full proposal, one will be requested from the offeror. Every pre-proposal and full proposal will include an Executive Summary prepared by the offeror. The Executive Summary will be no more than one page in length. The Executive Summary will not include any sensitive data or proprietary information. The purpose of the Executive Summary is to provide evaluators a comprehensive synopsis, an overview, of the pre-proposal/full proposal's key points. A pre-proposal will not exceed 5 pages. Upon receipt, the ERDC staff will perform an initial review of its scientific merit, its potential contribution to the Army/ERDC mission, and the current availability of funding. As prescribed in FAR 35.016(a), proposed efforts shall focus on supporting ERDC's requirements for scientific study and experimentation directed toward advancing the state-of-the-art or increasing knowledge or understanding, rather than focusing on a specific system or hardware solution. Offerors of pre-proposals receiving favorable initial review will be encouraged to submit a more detailed full proposal (in the format outlined in Part III), which will be evaluated in accordance with the criteria detailed below:

**B.** Pre-proposals and proposals must reference the code number for the specific research area (e.g., CHL-1, CRREL-10, CERL-15).

**C.** Pre-proposals may be only submitted only under "**ONE**" specific topic area.

**D.** Proposals submitted in response to this BAA which result in the award of a contract instrument will be evaluated as received using the following factors/criteria:

1. The overall scientific and/or technical merits of the proposal, including how the proposal meets the FAR requirements for scientific study and experimentation directed toward advancing the state-of-the-art or increasing knowledge or understanding, rather than focusing on a specific system or hardware solution.

2. The potential contributions of the effort to the ERDC mission.

3. The offeror's capabilities, related experience, facilities, techniques, or unique combinations of these; which are integral factors for achieving the proposal's objectives.

4. The qualifications, capabilities, and experiences of the proposed principal investigator, team leader, and other key personnel who are critical to achievement of the proposal's objectives.

5. The reasonableness and realism of proposed costs and fee, if any, and the availability of funds.

6. Past Performance

7. Subcontracting Plan (when required)

**E.** If a grant or cooperative agreement is contemplated by the offeror, they shall specifically describe in the proposal how the principal purpose of the research effort supports or stimulates a public purpose and, if applicable, the substantial involvement by the government. See Part III, Pre-Proposal and Proposal Preparation, Section 3 - Type of Contract.

**F.** Pre-proposals and proposals not considered having sufficient scientific merit or relevance to the Army's needs or those in areas for which funds are not expected to be available may be declined.



## PART III

### PRE-PROPOSAL AND PROPOSAL PREPARATION

#### SECTION 1 - INTRODUCTION

This part is intended to provide information needed in preparing research proposals for submission to ERDC.

In preparing pre-proposals and proposals it is important that the offeror keep in mind the characteristics of a suitable proposal acceptable for formal evaluation, including the focus on scientific study and experimentation directed toward advancing the state-of-the-art or increasing knowledge or understanding. It should include all the information specified in this announcement in order to avoid delays in evaluation. Pre-proposals will be responded to within 60 days of receipt, either encouraging submission of a complete proposal or advising the offeror not to submit. Contract award may be made electronically. Offerors are requested to provide their e-mail address upon submission of proposal and also the name, address, and phone number of their cognizant Defense Contract Audit Agency (DCAA) office, if known.

All offerors must be registered in the System for Award Management (SAM) at [www.sam.gov](http://www.sam.gov) before award can be made.

Proposals should include details on expected use of the DoD High Performance Computing (HPC) Center systems.

Applicants for grants and cooperative agreements must also provide their DUNS number (Duns and Bradstreet Data Universal Numbering System).

Organizations or individuals interested in submitting research proposals to ERDC are encouraged to make preliminary inquiries as to the general need for the type of research effort contemplated before expending extensive effort in preparing a detailed research proposal or submitting proprietary information. Points of contact are listed with the specific research areas for each laboratory. The research proposal often represents a substantial investment of time and effort by the offeror, and it should present the proposed research effort in sufficient detail to allow ERDC to evaluate the scientific merit and relevance of the proposed research and to determine funding availability.

Pre-proposals and proposals must reference the code number for the specific research area (e.g., CHL-1, CRREL-10, CERL-15).

Pre-proposal may be only submitted only under **“ONE”** specific topic area.

Proposals submitted under the BAA should clearly identify within the proposal any research that is expected to be fundamental in nature as defined in National Security Defense Directive 189. Fundamental research means basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are

restricted for proprietary or national security reasons.

Note that no funds available to the Department of Defense may be provided to any institution of higher education that either has a policy of denying or that effectively prevents the Secretary of Defense from obtaining, for military recruiting purposes, entry to campuses or access to students on campuses or access to directory information pertaining to students.

Note that there is a new requirement for contractor reporting if the contract is funded with military funds. The below info is provided for your assistance in complying. At the website listed, there are FAQs you may also find helpful.

“The Office of the Assistant Secretary of the Army (Manpower & Reserve Affairs) operates and maintains a secure Army data collection site where the contractor will report ALL contractor manpower (including subcontractor manpower) required for performance of this contract. The contractor is required to completely fill in all the information in the format using the following web address: <https://ww.ecrma.mil/Default.aspx> The required information includes: (1) Contracting Office, Contracting Officer, Contracting Officer’s Technical Representative; (2) Contract number, including task and delivery order number; (3) Beginning and ending dates covered by reporting period; (4) Contractor name, address, phone number, e-mail address, identity of contractor employee entering data; (5) Estimated direct labor hours (including sub- contractors); (6) Estimated direct labor dollars paid this reporting period (including sub- contractors); (7) Total payments (including sub-contractors); (8) Predominant Federal Service Code (FSC) reflecting services provided by contractor (and separate predominant FSC for each sub-contractor if different); (9) Estimated data collection cost; (10) Organizational title associated with the Unit Identification Code (UIC) for the Army Requiring Activity (the Army Requiring Activity is responsible for providing the contractor with its UIC for the purposes of reporting this information); (11) Locations where contractor and sub-contractors perform the work (specified by zip code in the United States and nearest city, country, when in an overseas location, using standardized nomenclature provided on website); (12) Presence of deployment or contingency contract language; and (13) Number of contractor and sub- contractor employees deployed in theater this reporting period (by country). As part of its submission, the contractor will also provide the estimated total cost (if any) incurred to comply with this reporting requirement. Reporting period will be the period of performance not to exceed 12 months ending 30 September of each government fiscal year and must be reported by 31 October of each calendar year. Contractors may use a direct XML data transfer to the database server or fill in the fields on the website. The XML direct transfer is a format for transferring files from a contractor’s systems to the secure web site without the need for separate data entries for each required data element at the web site. The specific formats for the XML direct transfer may be downloaded from the web site.”

## SECTION 2 - GENERAL INFORMATION

### A. AWARDS:

With the submittal of all required information as described herein and the favorable evaluation of your proposal, the Government may unilaterally make award; therefore, it is in the Contractor's best interest to review all requirements listed within. **Note that contract clauses are self-deleting; therefore, there is neither a requirement nor need for a modification to the award if any clause is found not applicable.** Performance after the receipt of an award signed by the Contracting Officer indicates your full acceptance of all terms and conditions within the award.

Awards will be made on SF-33, SF-26, DD-1155, or other document as appropriate. Offerors shall provide a completed Attachment C with their technical and cost proposals. Awards will consist of all applicable clauses and contracts shall be in accordance with the Uniform Contract Format (UCF), which follows:

SECTION A- SOLICITATION/CONTRACT FORM SF 33 SECTION

B- SUPPLIES OR SERVICES AND PRICES/COST

ITEM 1- Perform all work necessary for research and development efforts in accordance with Contractor's proposal dated \_\_\_\_\_, entitled \_\_\_\_\_, submitted under BAA Topic No. \_\_\_\_\_.

SECTION C- DESCRIPTION/SPECIFICATIONS/STATEMENT OF WORK

SECTION D (Packaging and Marking)

SECTION E (Inspection and Acceptance)

SECTION F (Deliveries or Performance) SECTION

G (Contract Administration Data) SECTION H

(Special Contract Requirements)

SECTION I (Contract Clauses). Note: If award is made unilaterally, offeror agrees to clauses mentioned within this BAA for their particular contract type.

SECTION K (Representations, Certifications, and Other Statements of Offerors) SEE ATTACHMENT C OF THIS BAA. ATTACHMENT C MUST BE COMPLETED BY EACH OFFEROR AND SUBMITTED WITH EACH PROPOSAL

SECTION L (Instructions, Conditions, and Notices to Offerors or Respondents) is included within this BAA solicitation

SECTION M (Evaluation Factors for Award) - is the evaluation criteria listed in Part II of this BAA.

## B. REPORT REQUIREMENTS:

The number and types of reports will be specified in the contractual document. The reports will be prepared and submitted in accordance with ERDC report procedures which will be provided to the awardees.

## C. PROPOSAL PREPARATION AND SUBMISSION:

Proposals should be submitted with a completed Attachment C, as stated in paragraph A of this Section 2, and also a signed and dated SF-33 available at <http://www.gsa.gov/portal/forms/download/116254>

For grants and cooperative agreements, use the SF-424 located at [https://apply07.grants.gov/apply/forms/sample/RR\\_SF424\\_2\\_0-V2.0.pdf](https://apply07.grants.gov/apply/forms/sample/RR_SF424_2_0-V2.0.pdf)

In preparing pre-proposals and proposals it is important that the offeror keep in mind the characteristics of a suitable proposal acceptable for formal evaluation. It should include all the information specified in this announcement in order to avoid delays in evaluation. Pre-proposals will be responded to within 60 days of receipt, either encouraging submission of a complete proposal or advising the offeror not to submit. Contract award may be made electronically. Offerors are requested to provide their e-mail address upon submission of proposal and also the name, address, and phone number of their cognizant Defense Contract Audit Agency (DCAA) office, if known.

ERDC prefers to receive pre-proposals and proposals electronically.

Pre-proposals and full proposals for **EL, GRL, GSL, ITL, and UROC** contact the following: [ERDC-BAA@usace.army.mil](mailto:ERDC-BAA@usace.army.mil) -or- For inquiries, please contact via email at [ERDC-BAA@usace.army.mil](mailto:ERDC-BAA@usace.army.mil). Andrea Knowles at 703-428-6519.

Pre-proposals and full proposals for **CERL** shall be submitted via email to [CERL-CT-Quotes@usace.army.mil](mailto:CERL-CT-Quotes@usace.army.mil). For inquiries, please contact Ms. Andrea Thomas via email at [CERL-CT-Quotes@usace.army.mil](mailto:CERL-CT-Quotes@usace.army.mil) or phone at 217-373-6746.

Pre-proposals and full proposals for **CHL** shall be submitted via email to [CHL-BAA@usace.army.mil](mailto:CHL-BAA@usace.army.mil). For inquiries, please contact Ms. : Christine Wilson via email at [CHL-BAA@usace.army.mil](mailto:CHL-BAA@usace.army.mil) or phone at 217-552-5258.

Pre-proposals and full proposals for **CRREL** shall be submitted via email to [CRREL-BAA@usace.army.mil](mailto:CRREL-BAA@usace.army.mil). For inquiries, please contact Ms. Melodie Fisher via email at [CRREL-BAA@usace.army.mil](mailto:CRREL-BAA@usace.army.mil) or phone at 601-634-4687.

The following information must be included in the body of the e-mail when submitting the proposal electronically:

1. Laboratory Name and Topic number (Spell out the complete name of the laboratory. Do not use the acronym.)
2. Vendor name and Address
3. Proposal Title
4. Total Dollar Amount

**\*\*Proposals SHALL NOT be submitted directly to Lab Personnel\*\***

**(IE technical personnel)**

### SECTION 3 - TYPE OF CONTRACT

Selection of the type of contract is based upon various factors, such as the type of research to be performed, the contractor's experience in maintaining cost records, and the ability to detail and allocate proposed costs and performance of the work.

A document commonly used because of its suitability in supporting research is a cost-reimbursable type contract. It permits some flexibility in the redirection of efforts due to recent research experiment results or changes in Army guidance.

Fixed-price contracts are used when the research projects costs can be estimated accurately, the services to be rendered are reasonably definite, and the amount of property, if any, is fixed. The negotiated price is not subject to any adjustment on the basis of the Contractor's cost experience in performing the contract.

Contracts awarded by ERDC will contain, where appropriate, detailed special provisions concerning patent rights, rights in technical data and computer software, reporting requirements, equal employment opportunity, etc.

This BAA affords the offeror the option of submitting proposals for the award of a contract, grant, cooperative agreement, or other transaction. However, the type of agreement may change based on the nature of the effort and as a result of negotiation.

A grant or cooperative agreement will be used only when the principal purpose of a transaction is to accomplish a public purpose of support or stimulation authorized by Federal statute. Contracts will be used when the principal purpose is acquisition of property or services for the direct benefit or use of the Federal Government. The statutory criterion for choosing between grants and cooperative agreements is that for the latter, substantial involvement is expected between the agency and recipient when carrying out the activity contemplated in the agreement.

An other transaction (OT) may be used when it has been determined a contract, grant, or CA is not appropriate. In accordance with Section 2371b, of title 10, U.S.C., the ERDC is authorized to award "other transactions" (OTs) in certain circumstances for prototype projects that are directly relevant to enhancing the mission effectiveness of military personnel and the supporting platforms, systems, components, or materials proposed to be acquired or developed by the Department of Defense, or to improvement of platforms, systems, components, or materials in use by the Armed Forces. OTs are a non-FAR based acquisition tool that offer flexibility for negotiations of agreement terms and conditions. OT resources may be accessed at the following link: [www.acq.osd.mil/dpap/cpic/cp/10USC2371bOTs.html](http://www.acq.osd.mil/dpap/cpic/cp/10USC2371bOTs.html).

In accordance with 10 U.S.C. § 2371b(f), the ERDC may award a follow-on production contract or Other Transaction (OT) for any OT awarded under this BAA if: (1) The OT participant, or a recognized successor in interest to the OT, successfully completed the entire prototype project provided for in the OT, as modified; and (2) The OT provides for the award of a follow-on production contract or OT to the participant, or a recognized successor in interest to the OT.

## SECTION 4 - CONTENTS OF PRE-PROPOSAL

Pre-proposals will not exceed five pages and will state the Topic Number under which they are being submitted. Three copies are requested (unless proposal is emailed to CERL). The pre-proposal should contain the following: (in addition to the Representations and Certifications at Attachment C)

1. A title descriptive of the research to be performed.
2. The name and address of the individual, company or Educational institution submitting the pre-proposal (to include the email address).
3. The name and phone number of the principal investigator or senior researcher who would be in charge of the project.
4. The duration of the project.
5. The detailed estimated cost (i.e., labor costs, material costs, burdens, etc.).
6. Statements describing the objective(s) or goal(s) of the working hypothesis to be proved or disproved, if appropriate.
7. Statements describing one or more paragraphs describing the technical approach to be taken in the course of the research. If experimental, it should include a description of the scope of the testing program. If analytical, it should include key assumptions to be made, the scientific basis for the analysis, and the numerical procedures to be used.
8. Statements describing one or more paragraphs describing the potential military and/or civil payoffs that might ultimately derive from the proposed research to the Corps of Engineers.
9. A one-page curriculum vitae of the principal investigator.
10. If a cooperative agreement or grant is contemplated, a description of how the principal purpose of the research effort supports or stimulates a public purpose and, if applicable, the substantial involvement by the government. See Part III, Pre-Proposal and Proposal Preparation, Section 3 - Type of Contract.
11. A one page Executive Summary describing the background, scope of work, deliverables, and total proposed price (no cost breakdown is required in the executive summary). The executive summary shall not contain any sensitive data or proprietary information and is excluded from the pre-proposal page limitation of five pages.

## SECTION 5 - CONTENTS OF FULL PROPOSAL

Proposals will be furnished in three copies (unless emailed to CERL), state the Topic Number under which they are being submitted, and contain the following: (in addition to the Representations and Certifications at Attachment C)

### TECHNICAL

The technical portion of the proposal will contain the following and any other information the offeror considers necessary to address the evaluation criteria mentioned in Part II:

1. A complete discussion stating the background and objectives of the proposed work, the approaches to be considered, the proposed level of effort, and the anticipated results/products, to include the proposed reports and deliverables to be furnished.
2. A recommended Quality Assurance Surveillance Plan, which includes proposed methods for the Government to evaluate performance and determine that the deliverables (results/products/reports, etc.) are properly executed.
3. The names, brief biographical information, experience, and a list of recent publications of the offeror's key personnel who will be involved in the research.
4. The names of other agencies to which the proposal has also been submitted.
5. A brief description of offeror's organization, to include name, address, phone numbers, and email address.
6. Past performance information to include the name, address, point of contact, phone number, email address, contract identification number, contract award date and amount for a minimum of three (3) customers for whom the offeror has performed similar services in the last three years.
7. If a cooperative agreement or grant is contemplated, a description of how the principal purpose of the research effort supports or stimulates a public purpose and, if applicable, the substantial involvement by the government. See Part III, Pre-Proposal and Proposal Preparation, Section 3 - Type of Contract.
8. A one page Executive Summary, revised as appropriate from the pre-proposal submission, describing the background, scope of work, deliverables, and total proposed price (no cost breakdown is required in the Executive Summary). The Executive Summary shall not contain any sensitive data or proprietary information.



## **COST**

The cost portion of the proposal will contain a cost estimate for the proposed effort sufficiently detailed by element of cost for meaningful evaluation. The estimate will be detailed for each task of the proposed work and should include the following:

1. A complete detail of direct labor to include, by discipline, hours or percentage of time and salary.
2. Fringe benefits rate and base.
3. An itemized list of equipment showing cost of each item.
4. Description and cost of expendable supplies.
5. Complete detail of travel to include reason/need for travel, destination, airfare, per diem, rental car, etc.
6. Complete detail of any subcontracts.
7. Other direct costs (reproduction, computer, etc.).
8. Indirect cost rates and bases with an indication whether rates are fixed or provisional and the time frame to which they are applied.
9. Proposed fee, if any.
10. Any documentation which supports the above.
11. Offerors will furnish the name and telephone number of their cognizant audit agency.

## SECTION 6 - SUBCONTRACTING PLAN

1. For proposed contract awards exceeding \$700,000, large businesses and non-profits (including educational institutions) shall provide a Subcontracting Plan that contains all elements required by FAR 19.704 and DFARS 219.704.
2. Subcontracting Plans will be reviewed for adequacy, ensuring that the required information, goals, and assurances are included. FAR 19.702(a)(1) requires an apparent successful offeror to submit an acceptable Plan. If the apparent successful offeror fails to negotiate a Plan acceptable to the contracting officer within the time limit prescribed by the contracting officer, the offeror will be ineligible for award.
3. Subcontracting plans are determined to be acceptable or unacceptable based on the criteria established at FAR 19.705-4, DFARS 219.705-4, and AFARS 5119.705-4. Goals are established on an individual contract basis and should result in realistic, challenging and attainable goals that, to the greatest extent possible, maximize small business participation in subcontracting for Small Business, Small Disadvantage Business (SDB), Woman-Owned Small Business (WOSB), Service-Disabled Veteran-Owned Small Business (SDVOSB), Veteran-Owned Small Business (VOSB), and Historically Underutilized Business Zone (HUBZone) Small Business.
4. Subcontracting goals should result in efficient contract performance in terms of cost, schedule, and performance and should not result in increased costs to the Government or undue administrative burden to the prime contractor.

NOTES: Small businesses are exempt from this requirement to submit a Subcontracting Plan.

Small Business Subcontracting Plan requirements do not apply to assistance instruments.

**ATTACHMENT A**  
**FIXED PRICE CONTRACTS**  
**FAR/DFARS CONTRACT CLAUSES**

ALL APPLICABLE CLAUSES WILL BE INCORPORATED WITHIN THE AWARD DOCUMENTS.

The full text of a clause and its complete prescription may be accessed electronically at the FAR site (clauses beginning with "52.") at <https://acquisition-staging.gsa.gov/browse/index/far>, and the DFARS site (clauses beginning with "252") at <https://acquisition-staging.gsa.gov/dfars>.

52.252-1 Solicitation Provisions Incorporated by Reference.  
This solicitation incorporates one or more provisions by reference.

52.252-2 Clauses Incorporated by Reference.  
This contract incorporates one or more clauses by reference.

252.201-7000, Contracting Officer's Representative

52.202-1 Definitions, in solicitations and contracts that exceed the simplified acquisition threshold. When a solicitation provision or contract clause uses a word or term that is defined in the Federal Acquisition Regulation (FAR), the word or term has the same meaning as the definition in FAR 2.101 in effect at the time the solicitation was issued, unless--

- (a) The solicitation, or amended solicitation, provides a different definition;
- (b) The contracting parties agree to a different definition;
- (c) The part, subpart, or section of the FAR where the provision or clause is prescribed provides a different meaning; or
- (d) The word or term is defined in FAR Part 31, for use in the cost principles and procedures.

52.203-3 Gratuities, in solicitations and contracts with a value exceeding the simplified acquisition threshold.

52.203-5 Covenant Against Contingent Fees, in all solicitations and contracts exceeding the simplified acquisition threshold.

52.203-7 Anti-Kickback Procedures, in solicitations and contracts exceeding the simplified acquisition threshold.

252.203-7001 Prohibition on Persons Convicted of Fraud or Other Defense-Contract-Related Felonies, in all solicitations and contracts exceeding the simplified acquisition threshold.

In solicitations and contracts that exceed the simplified acquisition threshold, insert the clauses at 52.203-8, Cancellation, Rescission, and Recovery of Funds for Illegal or Improper Activity, and 52.203-10, Price or Fee Adjustment for Illegal or Improper Activity.

52.203-12, Limitation on Payments to Influence Certain Federal Transactions, shall be included in solicitations and contracts expected to exceed \$150,000.

52.204-2 Security Requirements, in solicitations and contracts when the contract may require access to classified information.

52.204-4 Printed or Copied Double-Sided on Postconsumer Fiber Content Paper, in solicitations and contracts that exceed the simplified acquisition threshold.

52.204-6 Unique Entity Identifier.

52.204-7 System for Award Management, plus 252.204-7004 Alternate A instructs to substitute the following paragraph (a) for paragraph (a) of the clause at FAR 52.204-7:

(a) Definitions. As used in this provision—

*“Data Universal Numbering System (DUNS) number”* means the 9-digit number assigned by Dun and Bradstreet, Inc. (D&B) to identify unique business entities.

*“Data Universal Numbering System+4 (DUNS+4) number”* means the DUNS number means the number assigned by D&B plus a 4-character suffix that may be assigned by a business concern. (D&B has no affiliation with this 4-character suffix.) This 4-character suffix may be assigned at the discretion of the business concern to establish additional System for Award Management records for identifying alternative Electronic Funds Transfer (EFT) accounts (see the FAR at Subpart 32.11) for the same concern.

*“Registered in the System for Award Management (SAM) database”* means that—

(1) The Offeror has entered all mandatory information, including the DUNS number or the DUNS+4 number, the Contractor and Government Entity (CAGE) code, as well as data required by the Federal Funding Accountability and Transparency Act of 2006 (see Subpart 4.14), into the SAM database; and

(2) The offeror has completed the Core, Assertions, and Representations and Certification, and Points of contact sections of the registration in the SAM database;

(3) The Government has validated all mandatory data fields, to include validation of the Taxpayer Identification Number (TIN) with the Internal Revenue Service (IRS). The Offeror will be required to provide consent for TIN validation to the Government as a part of the SAM registration process.

(4) The Government has marked the record “Active”.

(b)(b)

(1) By submission of an offer, the offeror acknowledges the requirement that a prospective awardee shall be registered in the SAM database prior to award, during performance, and through final payment of any contract, basic agreement, basic ordering agreement, or blanket purchasing agreement resulting from this solicitation.

(2) The offeror shall enter, in the block with its name and address on the cover page of its offer, the annotation "DUNS" or "DUNS+4" followed by the DUNS or DUNS+4 number that identifies the offeror's name and address exactly as stated in the offer. The DUNS number will be used by the Contracting Officer to verify that the offeror is registered in the SAM database.

(c) If the offeror does not have a DUNS number, it should contact Dun and Bradstreet directly to obtain one.

(1) An offeror may obtain a DUNS number—

(i) Via the internet at <http://fedgov.dnb.com/webform> or if the offeror does not have internet access, it may call Dun and Bradstreet at 1-866-705-5711 if located within the United States; or

(ii) If located outside the United States, by contacting the local Dun and Bradstreet office. The offeror should indicate that it is an offeror for a U.S. Government contract when contacting the local Dun and Bradstreet office.

(2) The offeror should be prepared to provide the following information:

(i) Company legal business name.

(ii) Tradestyle, doing business, or other name by which your entity is commonly recognized.

(iii) Company physical street address, city, state and Zip Code.

(iv) Company mailing address, city, state and Zip Code (if separate from physical).

(v) Company telephone number.

(vi) Date the company was started.

(vii) Number of employees at your location.

(viii) Chief executive officer/key manager.

(ix) Line of business (industry).

(x) Company Headquarters name and address (reporting relationship within your entity).

(d) If the Offeror does not become registered in the SAM database in the time prescribed by

the Contracting Officer, the Contracting Officer will proceed to award to the next otherwise successful registered Offeror.

(e) Processing time, which normally takes 48 hours, should be taken into consideration when registering. Offerors who are not registered should consider applying for registration immediately upon receipt of this solicitation.

(f) Offerors may obtain information on registration at <https://www.acquisition.gov>.

52.204-24 Representation Regarding Certain Telecommunications and Video Surveillance Services or Equipment.

52.204-25 Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment.

52.204-26 Covered Telecommunications Equipment or Services-Representation.

252.204-7000 Disclosure of Information, in solicitations and contracts when the contractor will have access to or generate unclassified information that may be sensitive and inappropriate for release to the public.

252.204-7003 Control of Government Personnel Work Product.

252.204-7004 (Alt A) System for Award Management

252.204-7005 Oral Attestation of Security Responsibilities, in solicitations and contracts that include the clause at 52.204-2, Security Requirements.

252.205-7000 Provision of Information to Cooperative Agreement Holders, in solicitations and contracts expected to exceed \$1,000,000.

52.207-5 Option to Purchase Equipment, in solicitations and contracts involving a lease with option to purchase.

52.208-8 Required Sources for Helium and Helium Usage Data, in solicitations and contracts if it is anticipated that performance of the contract involves a major helium requirement.

52.209-6 Protecting the Government's Interests when Subcontracting with Contractors Debarred, Suspended, or Proposed for Debarment, in solicitations and contracts where the contract value exceeds \$35,000.

252.209-7002 Disclosure of Ownership or Control by a Foreign Government, in all solicitations when access to proscribed information is necessary for contract performance.

252.209-7004 Subcontracting with Firms That Are Owned or Controlled by the Government of a Terrorist Country, in solicitations and contracts with a value of \$150,000 or more.

252.209-7005 Reserve Officer Training Corps and Military Recruiting on Campus, in all solicitations and contracts with institutions of higher education.

52.211-14 Notice of Priority Rating for National Defense, Emergency Preparedness, and

Energy Program Use in solicitations when the contract to be awarded will be a rated order.

52.211-15 Defense Priority and Allocation Requirements, in contracts that are rated orders.

52.213-4 Terms and Conditions -- Simplified Acquisitions (Other Than Commercial Items) in orders under the simplified acquisition threshold.

52.214-34 Submission of Offers in the English Language.

52.214-35 Submission of Offers in U.S. Currency.

52.215-1, Instructions to Offerors -- Competitive Acquisition, in all competitive solicitations where the Government intends to award a contract without discussions.

52.215-2 Audit and Records-Negotiation (10 U.S.C. 2313, 41 U.S.C. 254d, and OMB Circular No. A-133), in solicitations and contracts except those for acquisitions not exceeding the simplified acquisition threshold.

52.215-5 Facsimile Proposals.

52.215-8 Order of Precedence -- Uniform Contract Format.

52.215-10 Price Reduction for Certified Cost or Pricing Data.

52.215-11 Price Reduction for Certified Cost or Pricing Data – Modifications.

52.215-14 Integrity of Unit Prices, in solicitations and contracts except for acquisitions at or below the simplified acquisition threshold.

52.215-15 Pension Adjustments and Asset Reversions in solicitations and contracts for which any preaward or postaward cost determinations will be subject to Part 31.

52.215-16 Facilities Capital Cost of Money, in solicitations expected to result in contracts that are subject to the cost principles for contracts with commercial organizations (see FAR 31.2).

(a) Facilities capital cost of money will be an allowable cost under the contemplated contract, if the criteria for allowability in FAR 31.205-10(b) are met. One of the allowability criteria requires the prospective Contractor to propose facilities capital cost of money in its offer.

(b) If the prospective Contractor does not propose this cost, the resulting contract will include the clause Waiver of Facilities Capital Cost of Money.

52.216-1 Type of Contract, in a solicitation unless it is for a fixed-price acquisition made under simplified acquisition procedures.

252.219-7003 Small Business Subcontracting Plan (DoD Contracts), in solicitations and contracts that contain the clause at FAR 52.219-9 Small Business Subcontracting Plan. In contracts with contractors which have comprehensive subcontracting plans approved under the test program described in 219.702(a), use the clause at 252.219-7004 Small Business Subcontracting Plan (Test Program), instead of the clauses at 252.219-7003 Small Business Subcontracting Plan (DoD Contracts), and FAR 52.219-9 Small Business Subcontracting Plan. In contracts with contractors that have comprehensive subcontracting plans approved

under the test program described in 219.702(a), do not use the clause at FAR 52.219-16 Liquidated Damages--Subcontracting Plan.

52.219-8 Utilization of Small Business Concerns, in solicitations and contracts when the contract amount is expected to be over the simplified acquisition threshold unless the contract, together with all its subcontracts, is to be performed entirely outside of the United States and its outlying areas.

52.219-9 Small Business Subcontracting Plan, in solicitations and contracts that offer subcontracting possibilities, are expected to exceed \$750,000 (\$1,500,000 for construction of any public facility), and are required to include the clause at 52.219-8 Utilization of Small Business Concerns. When contracting by negotiation, and subcontracting plans are required with initial proposals as provided for in 19.705-2(d), the contracting officer shall use the clause with its Alternate II.

52.219-16 Liquidated Damages --Subcontracting Plan, in all solicitations and contracts containing the clause at 52.219-9 Small Business Subcontracting Plan, or the clause with its Alternate II.

52.222-3 Convict Labor, in solicitations and contracts above the micro-purchase threshold, (a) Except as provided in paragraph (b) of this clause, the Contractor shall not employ in the performance of this contract any person undergoing a sentence of imprisonment imposed by any court of a State, the District of Columbia, Puerto Rico, the Northern Mariana Islands, American Samoa, Guam, or the U.S. Virgin Islands.

(b) The Contractor is not prohibited from employing persons--

(1) On parole or probation to work at paid employment during the term of their sentence;

(2) Who have been pardoned or who have served their terms; or

(3) Confined for violation of the laws of any of the States, the District of Columbia, Puerto Rico, the Northern Mariana Islands, American Samoa, Guam, or the U.S. Virgin Islands who are authorized to work at paid employment in the community under the laws of such jurisdiction, if--

(i) The worker is paid or is in an approved work training program on a voluntary basis;

(ii) Representatives of local union central bodies or similar labor union organizations have been consulted;

(iii) Such paid employment will not result in the displacement of employed workers, or be applied in skills, crafts, or trades in which there is a surplus of available gainful labor in the locality, or impair existing contracts for services;

(iv) The rates of pay and other conditions of employment will not be less than those paid or provided for work of a similar nature in the locality in which the work is being performed; and



(v) The Attorney General of the United States has certified that the work-release laws or regulations of the jurisdiction involved are in conformity with the requirements of Executive Order 11755, as amended by Executive Orders 12608 and 12943.

52.222-26 Equal Opportunity.

52.222-21 Prohibition of Segregated Facilities.

52.222-24 Preaward On-Site Equal Opportunity Compliance Evaluation, in when the amount of the contract is expected to be \$10 million or more.

52.222-29 Notification of Visa Denial, in contracts if the contractor is required to perform in or on behalf of a foreign country.

52.222-35 Equal Opportunity for Veterans in solicitations and contracts if the expected value is \$100,000 or more, except when work is performed outside the United States by employees recruited outside the United States.

52.222-36 Equal Opportunity for Workers with Disabilities, in solicitations and contracts that exceed \$15,000 or are expected to exceed \$15,000, except when work is to be performed outside the United States by employees recruited outside the United States (for the purpose of this, United States includes the several states, the District of Columbia, the Virgin Islands, the Commonwealth of Puerto Rico, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, and Wake Island).

52.222-37 Employment Reports on Veterans, in solicitations and contracts containing the clause at 52.222-35, Equal Opportunity for Veterans.

52.223-3 Hazardous Material Identification and Material Safety Data, in solicitations and contracts if the contract will require the delivery of hazardous materials as defined in FAR 23.301.

52.223-5 Pollution Prevention and Right-to-Know Information, in all solicitations and contracts that provide for performance, in whole or in part, on a Federal facility. Use Alt II if the contract provides for Contractor activities on a Federal facility.

52.223-6 Drug-Free Workplace, (b) The Contractor, if other than an individual, shall -- within 30 days after award (unless a longer period is agreed to in writing for contracts of 30 days or more performance duration), or as soon as possible for contracts of less than 30 days performance duration --

(1) Publish a statement notifying its employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the Contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition;

(2) Establish an ongoing drug-free awareness program to inform such employees about --

(i) The dangers of drug abuse in the workplace;

- (ii) The Contractor's policy of maintaining a drug-free workplace;
    - (iii) Any available drug counseling, rehabilitation, and employee assistance programs; and
    - (iv) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace;
  - (3) Provide all employees engaged in performance of the contract with a copy of the statement required by subparagraph (b)(1) of this clause;
  - (4) Notify such employees in writing in the statement required by subparagraph (b)(1) of this clause that, as a condition of continued employment on this contract, the employee will --
    - (i) Abide by the terms of the statement; and
    - (ii) Notify the employer in writing of the employee's conviction under a criminal drug statute for a violation occurring in the workplace no later than 5 days after such conviction;
  - (5) Notify the Contracting Officer in writing within 10 days after receiving notice under subdivision (b)(4)(ii) of this clause, from an employee or otherwise receiving actual notice of such conviction. The notice shall include the position title of the employee;
  - (6) Within 30 days after receiving notice under subdivision (b)(4)(ii) of this clause of a conviction, take one of the following actions with respect to any employee who is convicted of a drug abuse violation occurring in the workplace:
    - (i) Taking appropriate personnel action against such employee, up to and including termination; or
    - (ii) Require such employee to satisfactorily participate in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency; and
  - (7) Make a good faith effort to maintain a drug-free workplace through implementation of subparagraphs (b)(1) through (b)(6) of this clause.
- (c) The Contractor, if an individual, agrees by award of the contract or acceptance of a purchase order, not to engage in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance while performing this contract.
- (d) In addition to other remedies available to the Government, the Contractor's failure to comply with the requirements of paragraph (b) or (c) of this clause may, pursuant to FAR 23.506, render the Contractor subject to suspension of contract payments, termination of the contract or default, and suspension or debarment.
- 252.223-7001 Hazard Warning Labels, in solicitations and contracts which require submission of hazardous material data sheets.

252.223-7002 Safety Precautions for Ammunition and Explosives, and 252.223-7003 Change in Place of Performance--Ammunition and Explosives, in all solicitations and contracts for acquisition to which this section applies.

252.223-7004 Drug-Free Work Force, in all solicitations and contracts-(1) That involve access to classified information; or(2) When the contracting officer determines that the clause is necessary for reasons of national security or for the purpose of protecting the health or safety of those using or affected by the product of, or performance of, the contract.(b) Do not use the clause in solicitations and contracts when performance or partial performance will be outside the United States, its territories, and possessions, unless the contracting officer determines such inclusion to be in the best interest of the Government; or When the value of the acquisition is at or below the simplified acquisition threshold.

252.223-7006 Prohibition on Storage and Disposal of Toxic and Hazardous Materials, in all solicitations and contracts which require, may require, or permit contractor performance on a DoD installation. Use the clause at 252.223-7006 with its Alternate I, when the Secretary of the military department issues a determination under the exception at 223.7102(a) (9).

252.223-7007 Safeguarding Sensitive Conventional Arms, Ammunition, and Explosives, in all solicitations and contracts to which DoD 5100.76-M applies, in accordance with the policy at 223.7201. Complete paragraph (b) of the clause based on information provided by cognizant technical or requirements personnel.

252.225-7003 Report of Intended Performance Outside the U. S. and Canada – Submission with Offer in solicitations greater than \$15 million.

252.225-7004 Report of Intended Contract Performance Outside the U. S. and Canada – Submission after award in solicitations greater than \$15 million.

252.225.7012 Preference for Certain Domestic Commodities.

252.225-7031 Secondary Arab Boycott of Israel.

252.225-7040 Contractor Personnel Authorized to Accompany U.S. Armed Forces Deployed Outside the United States.

252.225-7041 Correspondence in English, in solicitations and contracts when contract performance will be wholly or in part in a foreign country.

252.225-7042 Authorization to Perform, in solicitations and contracts when contract performance will be wholly or in part in a foreign country.

252.225-7043 Antiterrorism/Force Protection Policy for Defense Contractors Outside the United States, in solicitations and contracts that require performance or travel outside the United States

52.225-13 Restrictions on Certain Foreign Purchases, in solicitations and contracts, unless an exception applies.

52.225-14 Inconsistency Between English Version and Translation of Contract, in solicitations and contracts if anticipating translation into another language. Insert the clause with its Alternate I in all R&D solicitations and contracts unless both complete performance and

delivery are outside the United States, its possessions, and Puerto Rico. When a proposed contract involves both R&D work and supplies or services, and the R&D work is the primary purpose of the contract, the contracting officer shall use this alternate. In all other proposed contracts involving both R&D work and supplies or services, the contracting officer shall use the basic clause. Also, when a proposed contract involves either R&D or supplies and materials, in addition to construction or architect-engineer work, the contracting officer shall use the basic clause.

52.226-2 Historically Black College or University and Minority Institution Representation, in solicitations set aside for HBCU/MIs.

52.227-1 Alternate 1, Authorization and Consent. If, in the Government's interest, it is appropriate to exempt one or more specific United States patents from the patent indemnity clause, the contracting officer shall obtain written approval from the agency head or designee and shall insert the clause at 52.227-5, Waiver of Indemnity, in solicitations and contracts in addition to the appropriate patent indemnity clause.

52.227-6 Royalty Information.

252.227-7013 Rights in Technical Data--Noncommercial Items, in solicitations and contracts when the successful offeror(s) will be required to deliver technical data to the Government. Do not use the clause when the only deliverable items are computer software or computer software documentation (see 227.72), commercial items (see 227.7102-3), existing works (see 227.7105), special works (see 227.7106). Use the clause at 252.227-7013 with its Alternate I in research contracts when the contracting officer determines, in consultation with counsel, that public dissemination by the contractor would be--(1) In the interest of the Government; and (2) Facilitated by the Government relinquishing its right to publish the work for sale, or to have others publish the work for sale on behalf of the Government.

252.227-7014 Rights in Noncommercial Computer Software and Noncommercial Computer Software Documentation, in solicitations and contracts when the successful offeror(s) will be required to deliver computer software or computer software documentation. Do not use the clause when the only deliverable items are technical data (other than computer software documentation), commercial computer software or commercial computer software documentation, commercial items (see 227.7102-3), special works (see 227.7205). Use the clause at 252.227-7014 with its Alternate I in research contracts when the contracting officer determines, in consultation with counsel, that public dissemination by the contractor would be--(i) In the interest of the Government; and (ii) Facilitated by the Government relinquishing its right to publish the work for sale, or to have others publish the work for sale on behalf of the Government.

Except as provided in paragraph (b) of this subsection, use the clause at 252.227-7015, Technical Data--Commercial Items, in all solicitations and contracts when the contractor will be required to deliver technical data pertaining to commercial items, components, or processes. Do not require the contractor to include this clause in its subcontracts.

(b) Use the clause at 252.227-7013 Rights in Technical Data--Noncommercial Items, in lieu of the clause at 252.227-7015 if the Government will pay any portion of the development costs. Do not require the contractor to include this clause in its subcontracts for commercial items or



Use the following clauses in solicitations and contracts that include the clause at 252.227-7013: (1) 252.227-7016 Rights in Bid or Proposal Information; (2) 252.227-7030 Technical Data--Withholding of Payment; (3) 252.227-7036 (RESERVED) Declaration of Technical Data Conformity; and (4) 252.227-7037 Validation of Restrictive Markings on Technical Data (paragraph (e) if the clause contains information that must be included in a challenge).

252-227-7017 Identification and Assertion of Use, Release, or Disclosure Restrictions

252.227-7019 Validation of Asserted Restrictions--Computer Software.

252.227-7020 Rights in Special Works.

252.227-7021 Rights in Data--Existing Works, in lieu of the clause at 252.227-7013 Rights in Technical Data--Noncommercial Items, in solicitations and contracts exclusively for existing works when--(1) The existing works will be acquired without modification; and (2) The Government requires the right to reproduce, prepare derivative works, or publicly perform or display the existing works; or (3) The Government has a specific need to obtain indemnity for liabilities that may arise out of the content, performance, use, or disclosure of such data. (b) The clause at 252.227-7021 provides the Government, and others acting on its behalf, a paid-up, non-exclusive, irrevocable, world-wide license to reproduce, prepare derivative works and publicly perform or display the works called for by a contract and to authorize others to do so for government purposes.(c) A contract clause is not required to acquire existing works such as books, magazines and periodicals, in any storage or retrieval medium, when the Government will not reproduce the books, magazines or periodicals, or prepare derivative works.

252.227-7025 Limitations on the Use or Disclosure of Government Furnished Information Marked with Restrictive Legends, in solicitations and contracts when it is anticipated that the Government will provide the contractor, for performance of its contract, technical data marked with another contractor's restrictive legend(s).

252.227-7028 Technical Data or Computer Software Previously Delivered to the Government, in solicitations when the resulting contract will require the contractor to deliver technical data. The provision requires offerors to identify any technical data specified in the solicitation as deliverable data items that are the same or substantially the same as data items the offeror has delivered or is obligated to deliver, either as a contractor or subcontractor, under any other federal agency contract.

252.227-7032 Rights in Technical Data and Computer Software (Foreign), may be used in contracts with foreign contractors to be performed overseas, except Canadian purchases (see paragraph (c) of this subsection), in lieu of the clause at 252.227-7013 Rights in Technical Data--Noncommercial Items, when the Government requires the unrestricted right to use, modify, reproduce, perform, display, release or disclose all technical data to be delivered under the contract. Do not use the clause in contracts for existing or special works. (b) When the Government does not require unlimited rights, the clause at 252.227-7032 may be modified to accommodate the needs of a specific overseas procurement situation. The Government should obtain rights in the technical data that are not less than the rights the Government would have obtained under the data rights clause(s) prescribed in this part for a

comparable procurement performed within the United States or its possessions. (c) Contracts for Canadian purchases shall include the appropriate data rights clause prescribed in this part for a comparable procurement performed within the United States or its possessions.

252.227-7037 Validation of Restrictive Markings on Technical Data, in all solicitations and contracts for commercial items that include the clause at 252.227-7015 or the clause at 252.227-7013. Do not require the contractor to include this clause in its subcontracts for commercial items or commercial components.

Pursuant to FAR 27.304-1(e), the contracting officer shall insert the clause at 252.227-7039 Patents--Reporting of Subject Inventions, in solicitations and contracts containing the clause at FAR 52.227-11, Patent Rights--Ownership by the Contractor (Short Form). Report of Subject Inventions and Subcontracts is located at:

<http://www.dtic.mil/whs/directives/infomgt/forms/eforms/dd0882.pdf>

52.227-10 Filing of Patent Applications -- Classified Subject Matter, in all classified solicitations and contracts and in all solicitations and contracts where the nature of the work or classified subject matter involved in the work reasonably might be expected to result in a patent application containing classified subject matter.

52.227-11 Patent Rights -- Ownership by the Contractor, unless an alternative patent rights clause is used in accordance with paragraph (c), (d), or (e) of this section, insert the clause at 52.227-11, Patent Rights--Ownership by the Contractor. To the extent the information is not required elsewhere in the contract, and unless otherwise specified by agency supplemental regulations, the contracting officer may modify 52.227-11(e) or otherwise supplement the clause to require the contractor to do one or more of the following: (i) Provide periodic (but not more frequently than annually) listings of all subject inventions required to be disclosed during the period covered by the report. (ii) Provide a report prior to the closeout of the contract listing all subject inventions or stating that there were none. (iii) Provide the filing date, serial number, title, patent number and issue date for any patent application filed on any subject invention in any country or, upon request, copies of any patent application so identified. (iv) Furnish the Government an irrevocable power to inspect and make copies of the patent application file when a Government employee is a co-inventor.

52.227-14 Rights in Data -- Generally, a contract should contain only one data rights clause. However, where more than one is needed, the contract should distinguish the portion of contract performance to which each pertains. (b)(1) Insert the clause at 52.227-14, Rights in Data--General, in solicitations and contracts if it is contemplated that data will be produced, furnished, or acquired under the contract, unless the contract is-- (i) For the production of special works of the type set forth in 27.405-1, although in these cases insert the clause at 52.227-14, Rights in Data--General, and make it applicable to data other than special works, as appropriate (see paragraph (e) of this section); (ii) For the acquisition of existing data, commercial computer software, or other existing data, as described in 27.405-2 through 27.405-4 (see paragraphs (f) and (g) of this section); (iii) A small business innovation research contract (see paragraph (h) of this section); (iv) To be performed outside the United States (see paragraph (i)(1) of this section); (v) For architect-engineer services or construction work (see paragraph (i)(2) of this section); (vi) For the management, operation, design, or

construction of a Government-owned facility to perform research, development, or production work (see paragraph (i)(3) of this section); or (vii) A contract involving cosponsored research and development in which a clause providing for less than unlimited right has been authorized (see 27.408).

52.228-5 Insurance -- Work on a Government Installation, in solicitations and contracts when a fixed-price contract is contemplated, the contract amount is expected to exceed the simplified acquisition threshold, and the contract will require work on a Government installation.

52.228-7 Insurance -- Liability to Third Persons.

52.229-3 Federal, State, and Local Taxes, in solicitations and contracts if the contract is to be performed wholly or partly within the United States, its possessions, or territories, Puerto Rico, or the North Mariana Islands, when the contract is expected to exceed the simplified acquisition threshold.

52.229-6 Taxes -- Foreign Fixed-Price Contracts, in solicitations and contracts expected to exceed the simplified acquisition threshold when a fixed-price contract is contemplated and the contract is to be performed wholly or partly in a foreign country, unless it is contemplated that the contract will be with a foreign government.

52.230-2 Cost Accounting Standards, in negotiated contracts, a) Unless the contract is exempt under 48 CFR 9903.201-1 and 9903.201-2, the provisions of 48 CFR Part 9903 are incorporated herein by reference and the Contractor, in connection with this contract, shall -

(1) (CAS-covered Contracts Only) By submission of a Disclosure Statement, disclose in writing the Contractor's cost accounting practices as required by 48 CFR 9903.202-1 through 9903.202-5, including methods of distinguishing direct costs from indirect costs and the basis used for allocating indirect costs. The practices disclosed for this contract shall be the same as the practices currently disclosed and applied on all other contracts and subcontracts being performed by the Contractor and which contain a Cost Accounting Standards (CAS) clause. If the Contractor has notified the Contracting Officer that the Disclosure Statement contains trade secrets and commercial or financial information which is privileged and confidential, the Disclosure Statement shall be protected and shall not be released outside of the Government.

(2) Follow consistently the Contractor's cost accounting practices in accumulating and reporting contract performance cost data concerning this contract. If any change in cost accounting practices is made for the purposes of any contract or subcontract subject to CAS requirements, the change must be applied prospectively to this contract and the Disclosure Statement must be amended accordingly. If the contract price or cost allowance of this contract is affected by such changes, adjustment shall be made in accordance with subparagraph (a)(4) or (a)(5) of this clause, as appropriate.

(3) Comply with all CAS, including any modifications and interpretations indicated thereto contained in 48 CFR Part 9904, in effect on the date of award of this contract or, if the Contractor has submitted certified cost or pricing data, on the date of final agreement on price as shown on the Contractor's signed certificate of current cost or pricing data. The Contractor



shall also comply with any CAS (or modifications to CAS) which hereafter become applicable to a contract or subcontract of the Contractor. Such compliance shall be required prospectively from the date of applicability to such contract or subcontract.

(4) (i) Agree to an equitable adjustment as provided in the Changes clause of this contract if the contract cost is affected by a change which, pursuant to subparagraph (a)(3) of this clause, the Contractor is required to make to the Contractor's established cost accounting practices.

(ii) Negotiate with the Contracting Officer to determine the terms and conditions under which a change may be made to a cost accounting practice, other than a change made under other provisions of subparagraph (a)(4) of this clause; provided that no agreement may be made under this provision that will increase costs paid by the United States.

(iii) When the parties agree to a change to a cost accounting practice, other than a change under subdivision (a)(4)(i) of this clause, negotiate an equitable adjustment as provided in the Changes clause of this contract.

Agree to an adjustment of the contract price or cost allowance, as appropriate, if the Contractor or a subcontractor fails to comply with an applicable Cost Accounting Standard, or to follow any cost accounting practice consistently and such failure results in any increased costs paid by the United States. Such adjustment shall provide for recovery of the increased costs to the United States, together with interest thereon computed at the annual rate established under section 6621(a)(2) of the Internal Revenue Code of 1986 (26 U.S.C.6621(a)(2)) for such period, from the time the payment by the United States was made to the time the adjustment is affected. In no case shall the Government recover costs greater than the increased cost to the Government, in the aggregate, on the relevant contracts subject to the price adjustment, unless the Contractor made a change in its cost accounting practices of which it was aware or should have been aware at the time of price negotiations and which it failed to disclose to the Government.

(b) If the parties fail to agree whether the Contractor or a subcontractor has complied with an applicable CAS in 48 CFR 9904 or a CAS rule or regulation in 48 CFR 9903 and as to any cost adjustment demanded by the United States, such failure to agree will constitute a dispute under the Contract Disputes Act (41 U.S.C.601).

(c) The Contractor shall permit any authorized representatives of the Government to examine and make copies of any documents, papers, or records relating to compliance with the requirements of this clause.

(d) The Contractor shall include in all negotiated subcontracts which the Contractor enters into, the substance of this clause, except paragraph (b), and shall require such inclusion in all other subcontracts, of any tier, including the obligation to comply with all CAS in effect on the subcontractor's award date or if the subcontractor has submitted certified cost or pricing data, on the date of final agreement on price as shown on the subcontractor's signed Certificate of Current Cost or Pricing Data. If the subcontract is awarded to a business unit which pursuant to 48 CFR 9903.201-2 is subject to other types of CAS coverage, the substance of the applicable clause set forth in subsection 30.201-4 of the Federal Acquisition Regulation shall be inserted. This requirement shall apply only to

negotiated subcontracts in excess of \$750,000, except that the requirement shall not apply to negotiated subcontracts otherwise exempt from the requirement to include a CAS clause as specified in 48 CFR 9903.201-1.

#### 52.230-7 Proposal Disclosure—Cost Accounting Practice Changes

52.231-7000 Supplemental Cost Principles, in all solicitations and contracts, which are subject to the principles and procedures described in FAR Subparts 31.1, 31.2, 31.6, and 31.7.

#### 52.232-2 Payment under Fixed-Price Research and Development Contracts.

##### 52.232-7003 Electronic Submission of Payment Requests and Receiving Reports.

52.232-7007 Limitation of Government's Obligation, in solicitations and resultant incrementally funded fixed-price contracts. The contracting officer may revise the contractor's notification period, in paragraph (c) of the clause, from "ninety" to "thirty" or "sixty" days, as appropriate.

##### 52.232-7010 Levies on Contractor Payments.

52.232-9 Limitation on Withholding of Payments, in solicitations and contracts when a supply contract, research and development contract, service contract, time-and-materials contract, or labor-hour contract is contemplated that includes two or more terms authorizing the temporary withholding of amounts otherwise payable to the contractor for supplies delivered or services performed.

52.232-16 Progress Payments, in solicitations that may result in contracts greater than the SAT providing for progress payments based on cost. If the contractor is a small business concern, use the clause with its Alternate I.

52.232-17 Interest, in solicitations and contracts. It may be inserted if the contract will be in one or more of the following categories: Contracts at or below the simplified acquisition threshold; Contracts without any provision for profit or fee with a nonprofit organization; Any other exceptions authorized under agency procedures.

52.232-23 Assignment of Claims, in solicitations and contracts expected to exceed the micro-purchase threshold, unless the contract will prohibit the assignment of claims (see 32.803(b)). The use of the clause is not required for purchase orders. However, the clause may be used in purchase orders expected to exceed the micro-purchase threshold that are accepted in writing by the contractor, if such use is consistent with agency policies and regulations. If a no-setoff commitment has been authorized (see 32.803(d)), the contracting officer shall use the clause with its Alternate I.

52.232-24 Prohibition of Assignment of Claims, in solicitations and contracts for which a determination has been made under agency regulations that the prohibition of assignment of claims is in the Government's interest.

52.232-25 Prompt Payment, in all solicitations and contracts, except when payment terms and the late payment penalties are established by other governmental authority (e.g., tariffs). (1) As authorized in 32.904(b)(1)(ii)(B)(4), the contracting officer may modify the date in paragraph (a)(5)(i) of the clause to specify a period longer than 7 days for constructive acceptance, if required to afford the Government a reasonable opportunity to inspect and test the supplies furnished or to evaluate the services performed. (2) As provided in 32.903, agency policies and procedures may authorize amendment of paragraphs (a)(1)(i) and (ii) of the clause to insert a period shorter than 30 days (but not less than 7 days) for making contract invoice payments.

52.232-33 Payment by Electronic Funds Transfer—System for Award Management.

52.233-1 Disputes. If it is determined under agency procedures that continued performance is necessary pending resolution of any claim arising under or relating to the contract, the contracting officer shall use the clause with its Alternate I.

52.233-2 Service of Protest, in solicitations for contracts expected to exceed the simplified acquisition threshold.

52.233-3 Protest After Award, in all solicitations and contracts. If a cost reimbursement contract is contemplated, the contracting officer shall use the clause with its Alternate I.

52.233-4 – Applicable Law for Breach of Contract

Claim. 252.233-7001 Choice of Law (Overseas).

252.235-7010 Acknowledgment of Support and

Disclaimer. 252.235-7011 Final Scientific or Technical

Report.

52.239-1 Privacy or Security Safeguards, in solicitations and contracts for information technology which require security of information technology, and/or are for the design, development, or operation of a system of records using commercial information technology services or support services.

252.239-7000 Protection Against Compromising Emanations

52.242-13 Bankruptcy, in all solicitations and contracts exceeding the simplified acquisition threshold.

52.242-15 Stop-Work Order. If a cost-reimbursement contract is contemplated, the contracting officer shall use the clause with its Alternate I.

52.243-1 Changes -- Fixed-Price.

52.243-6 Change Order Accounting, in solicitations and contracts for research and development contracts of significant technical complexity, if numerous changes are anticipated.

52.243-7 Notification of Changes, in research and development for principal subsystems.

252.243-7001 Pricing of Contract Modifications, in solicitations and contracts when anticipating and using a fixed price type contract.

252.243-7002 Requests for Equitable Adjustment, in solicitations and contracts estimated to exceed the simplified acquisition threshold.

52.244-6 Subcontracts for Commercial Items.

52.245-1, Government Property, Except as provided in paragraph (d) of this section, the contracting officer shall insert the clause at 52.245-1, Government Property, in- (i) All cost reimbursement, time-and-material, and labor-hour type solicitations and contracts; and (ii) Fixed-price solicitations and contracts when the Government will provide Government property. (iii) Contracts or modifications awarded under FAR Part 12 procedures where Government property that exceeds the simplified acquisition threshold, as defined in FAR 2.101, is furnished or where the contractor is directed to acquire property for use under the contract that is titled in the Government.

52.245-9, Use and Charges, when Government will furnish property for performance of the contract.

52.246-7, Inspection of Research and Development -- Fixed-Price, in solicitations and contracts for research and development when the primary objective of the contract is the delivery of end items other than designs, drawings, or reports, and the contract amount is expected to exceed the simplified acquisition threshold; unless use of the clause is impractical and the clause prescribed in 46.309 is considered to be more appropriate. Use a clause substantially the same as the clause at 252.246-7001, Warranty of Data, in solicitations and contracts that include the clause at 252.227-7013, Rights in Technical Data and Computer Software, and there is a need for greater protection or period of liability than provided by other contract clauses, such as the clauses at-(i) FAR 52.246-3, Inspection of Supplies--Cost- Reimbursement;(ii) FAR 52.246-6, Inspection--Time-and-Material and Labor- Hour;(iii) FAR

52.246-8, Inspection of Research and Development--Cost-Reimbursement; and(iv) FAR 52.246-19, Warranty of Systems and Equipment Under Performance Specifications or Design Criteria.(2) Use the clause at 252.246-7001, Warranty of Data, with its Alternate I when extended liability is desired and a fixed price incentive contract is contemplated.(3) Use the clause at 252.246-7001, Warranty of Data, with its Alternate II when extended liability is desired and a firm fixed price contract is contemplated.

52.246-9 Inspection of Research and Development (Short Form), in solicitations and contracts for research and development when the clause prescribed in 46.307 or the clause prescribed in 46.308 is not used.

52.246-11 Higher-Level Contract Quality Requirement, in solicitations and contracts when the inclusion of a higher-level contract quality requirement is appropriate (see 46.202-4).

52.246-16 Responsibility for Supplies.

52.246-18 Warranty of Supplies of a Complex Nature, in solicitations and contracts for deliverable complex items when a fixed-price supply or research and development contract is contemplated and the use of a warranty clause has been approved under agency procedures. If the contractor's design rather than the Government's design will be used, insert the word "design" before "material" in paragraph (b)(1). If it is anticipated that recovery of the warranted item will involve considerable Government expense for disassembly and/or reassembly of larger items, the contracting officer may use the clause with its Alternate IV.

52.246-19 Warranty of Systems and Equipment under Performance Specifications or Design Criteria, in solicitations and contracts when performance specifications or design are of major importance; a fixed-price research and development contract for systems and equipment is contemplated; and the use of a warranty clause has been approved under agency procedures.

In (1) contracts requiring delivery of end items that are not high-value items, insert the clause at 52.246-23, Limitation of Liability. (2) In contracts requiring delivery of high-value items, insert the clause at 52.246-24, Limitation of Liability -- High Value Items. (3) In contracts requiring delivery of both high-value items and other end items, insert both clauses prescribed in (1) and (2) of this section, Alternate I of the clause at 52.246-24, and identify clearly in the contract schedule the line items designated as high-value items.

In (1) contracts requiring delivery of end items that are not high-value items, insert the clause at 52.246-23, Limitation of Liability.

(2) In contracts requiring delivery of high-value items, insert the clause at 52.246-24, Limitation of Liability -- High Value Items.

(3) In contracts requiring delivery of both high-value items and other end items, insert both clauses prescribed in (1) and (2) of this section, Alternate I of the clause at 52.246-24, and identify clearly in the contract schedule the line items designated as high-value items.

52.247-63 Preference for U. S.-Flag Air Carriers.

52.247-64 Preference for Privately Owned U. S.-Flag Commercial

Vessels. 252.247-7023, Transportation of Supplies by Sea.

252.247-7024 Notification of Transportation of Supplies by Sea, in all contracts for which the offeror made a negative response to the inquiry in the provision at 252.247-7022, Representation of Extent of Transportation by Sea.

52.249-1 Termination for Convenience of the Government (Fixed-Price) (Short Form), as prescribed in 49.502(a) (1), in solicitations and contracts when a fixed-price contract is contemplated and the contract amount is expected to be \$150,000 or less, except

(a) if use of the clause at 52.249-4, Termination for Convenience of the Government (Services) (Short Form) is appropriate

(b) in contracts for research and development work with an educational or nonprofit institution on a no-profit basis,

(c) or if one of the clauses prescribed or cited at 49.505(a), (b), or (e), is appropriate:

- Fixed-price contracts of \$150,000 or less (short form).

(1) General use. Insert the clause at 52.249-1, Termination for Convenience of the Government (Fixed-Price) (Short Form), in solicitations and contracts when a fixed-price contract is contemplated and the contract amount is expected to be \$150,000 or less, except --

(i) If use of the clause at 52.249-4, Termination for Convenience of the Government (Services) (Short Form) is appropriate,

(ii) In contracts for research and development work with an educational or nonprofit institution on a no-profit basis,

(iii) if one of the clauses prescribed or cited at 49.505(a), (b), or (e), is appropriate.

(b) Fixed-price contracts over \$150,000.

(i) General use. Insert the clause at 52.249-2, Termination for Convenience of the Government (Fixed-Price), in solicitations and contracts when a fixed-price contract is contemplated and the contract amount is expected to be over \$150,000, except in contracts for Research and development work with an educational or nonprofit institution on a no-profit basis. It shall not be used if the clause at 52.249-4, Termination for Convenience of the Government (Services) (Short Form), is appropriate (see 49.502(c)), or one of the clauses prescribed or cited at 49.505(a), (b), or (e), is appropriate.

(e) Subcontracts.

(1) General use. The prime contractor may find the clause at 52.249-1, Termination for Convenience of the Government (Fixed-Price) (Short Form), or at 52.249-2, Termination for Convenience of the Government (Fixed-Price), as appropriate, suitable for use in fixed-price subcontracts, except as noted in subparagraph (e)(2) of this section; provided, that the relationship between the contractor and subcontractor is clearly indicated. Inapplicable conditions (e.g., paragraph (d)) in 52.249-2 should be deleted and the periods reduced for submitting the subcontractor's termination settlement proposal (e.g., 6 months), and for requesting an equitable price adjustment (e.g., 45 days).

(2) Research and development. The prime contractor may find the clause at 52.249-5, Termination for the Convenience of the Government (Educational and Other Nonprofit Institutions), suitable for use in subcontracts placed with educational or nonprofit institutions on a no-profit or no-fee basis; provided, that the relationship between the contractor and subcontractor is clearly indicated. Inapplicable conditions (e.g., paragraph (h)) should be deleted, the period for submitting the subcontractor's termination settlement proposal should be reduced (e.g., 6 months), the subcontract

should be placed on a no-profit or no-fee basis, and the subcontract should incorporate or be negotiated on the basis of the cost principles in Part 31 of the Federal Acquisition Regulation

52.249-5 Termination for the Convenience of the Government (Educational and Other Nonprofit Institutions), in solicitations and contracts when either a fixed-price or cost-reimbursement contract is contemplated for research and development work with an educational or nonprofit institution on a nonprofit or no-fee basis.

52.249-9 Default (Fixed-Price Research and Development), in solicitations and contracts for research and development when a fixed-price contract is contemplated and the contract amount is expected to exceed the simplified acquisition threshold, except those with educational or nonprofit institutions on a no-profit basis.

52.251-1 Government Supply Sources, in solicitations and contracts when the contracting officer may authorize the contractor to acquire supplies or services from a Government supply source.

252.251-7000 Ordering From Government Supply Sources, in solicitations and contracts which include the clause at FAR 52.251-1, Government Supply Sources.

52.253-1 Computer Generated Forms, in solicitations and contracts that require the contractor to submit data on Standard or Optional Forms prescribed by this regulation and forms prescribed by agency supplements.

**ATTACHMENT B**  
**COST-REIMBURSABLE CONTRACTS**  
**FAR/DFARS CONTRACT CLAUSES**

ALL APPLICABLE CLAUSES WILL BE INCORPORATED WITHIN THE AWARD DOCUMENTS.

The full text of a clause and its complete prescription may be accessed electronically at the FAR site (clauses beginning with "52.") at <https://www.acquisition.gov/far/current/html/FARTOCP52.html#wp372482> and the DFARS site (clauses beginning with "252.") at <http://www.acq.osd.mil/dpap/dars/dfars/html/current/tochtml.htm>

52.252-1 Solicitation Provisions Incorporated by Reference.  
This solicitation incorporates one or more provisions by reference.

52.252-2 Clauses Incorporated by Reference.  
This contract incorporates one or more clauses by reference.

252.201-7000, Contracting Officer's Representative.

52.202-1 Definitions, in solicitations and contracts that exceed the simplified acquisition threshold. The contracting officer may include additional definitions, provided they are consistent with the clause and the FAR.

52.203-3 Gratuities, in solicitations and contracts with a value exceeding the simplified acquisition threshold.

52.203-5 Covenant Against Contingent Fees, in all solicitations and contracts exceeding the simplified acquisition threshold.

52.203-7 Anti-Kickback Procedures, in solicitations and contracts exceeding the simplified acquisition threshold.

252.203-7001, Prohibition on Persons Convicted of Fraud or Other Defense-Contract-Related Felonies, in all solicitations and contracts exceeding the simplified acquisition threshold.

52.203-12 Limitation on Payments to Influence Certain Federal Transactions, shall be included in solicitations and contracts expected to exceed \$150,000.

52.203-14 Display of Hotline Posters, Unless the contract is for the acquisition of a commercial item under part 12 or will be performed entirely outside the United States--

...

(b) Insert the clause at FAR 52.203-14, Display of Hotline Poster(s), if--(i) The contract exceeds \$5,500,000 or a lesser amount established by the agency; and(ii)(A) The agency has a fraud hotline poster; or(B) The contract is funded with disaster assistance funds. In paragraph (b)(3) of the clause, the contracting officer shall--(i) Identify the applicable posters; and(ii)



Insert the website link(s) or other contact information for obtaining the agency and/or Department of Homeland Security poster. In paragraph (d) of the clause, if the agency has established policies and procedures for display of the OIG fraud hotline poster at a lesser amount, the contracting officer shall replace "\$5,500,000" with the lesser amount that the agency has established.

52.204-2 Security Requirements, in solicitations and contracts when the contract may require access to classified information.

52.204-4 Printed or Copied Double-Sided on Recycled Paper, in solicitations and contracts that exceed the simplified acquisition threshold.

52.204-6 Unique Entity Identifier

52.204-7 System for Award Management, plus 252.204-7004 Alternate A instructs to substitute the following paragraph (a) for paragraph (a) of the clause at FAR 52.204-7:

(a) Definitions. As used in this clause--

"Central Contractor Registration (CCR) database" means the primary Government repository for contractor information required for the conduct of business with the Government.

"Commercial and Government Entity (CAGE) code" means—

- (1) A code assigned by the Defense Logistics Information Service (DLIS) to identify a commercial or Government entity; or
- (2) A code assigned by a member of the North Atlantic Treaty Organization that DLIS records and maintains in the CAGE master file. This type of code is known as an "NCAGE code."

"Data Universal Numbering System (DUNS) number" means the 9-digit number assigned by Dun and Bradstreet, Inc. (D&B) to identify unique business entities.

"Data Universal Numbering System +4 (DUNS+4) number" means the DUNS number assigned by D&B plus a 4-character suffix that may be assigned by a business concern. (D&B has no affiliation with this 4-character suffix.) This 4-character suffix may be assigned at the discretion of the business concern to establish additional CCR records for identifying alternative Electronic Funds Transfer (EFT) accounts (see Subpart 32.11 of the Federal Acquisition Regulation) for the same parent concern.

"Registered in the CCR database" means that—

- (1) The Contractor has entered all mandatory information, including the DUNS number or the DUNS+4 number, into the CCR database;
- (2) The Contractor's CAGE code is in the CCR database; and
- (3) The Government has validated all mandatory data fields and has marked the records "Active."

52.204-24 Representation Regarding Certain Telecommunications and Video Surveillance Services or Equipment.

52.204-25 Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment.

52.204-26 Covered Telecommunications Equipment or Services-Representation.

252.204-7000 Disclosure of Information, in solicitations and contracts when the contractor will have access to or generate unclassified information that may be sensitive and inappropriate for release to the public.

252.204-7003 Control of Government Personnel Work

Product. 252.204-7004 Alt A, System for Award

Management

252.204-7005 Oral Attestation of Security Responsibilities, in solicitations and contracts that include the clause at FAR 52.204-2, Security Requirements.

252.205-7000 Provision of Information to Cooperative Agreement Holders, in solicitations and contracts expected to exceed \$1,000,000.

52.207-5 Option to Purchase Equipment, in solicitations and contracts involving a lease with option to purchase.

52.208-8 Required Sources for Helium and Helium Usage Data, in solicitations and contracts if it is anticipated that performance of the contract involves a major helium requirement.

52.209-6 Protecting the Government's Interests when Subcontracting with Contractors Debarred, Suspended, or Proposed for Debarment, in solicitations and contracts where the contract value exceeds \$30,000.

252.209-7002, Disclosure of Ownership or Control by a Foreign Government, in all solicitations when access to proscribed information is necessary for contract performance.

252.209-7004, Subcontracting with Firms that are Owned or Controlled by the Government of a Country that is a State Sponsor of Terrorism.

252.209-7005, Reserve Officer Training Corps and Military Recruiting on Campus, in all solicitations and contracts with institutions of higher education.

52.211-14 Notice of Priority Rating for National Defense, Emergency Preparedness, and Energy Program Use, in solicitations when the contract to be awarded will be a rated order.

52.211-15 Defense Priority and Allocation Requirements, in contracts that are rated orders.

52.213-4 Terms and Conditions -- Simplified Acquisitions (Other Than Commercial Items) in orders under the simplified acquisition threshold. 52.214-34 Submission of Offers in the English Language. 52.214-35 Submission of Offers in U.S. Currency.

52.215-1 (Alt I) Instructions to Offerors -- Competitive Acquisition, in all competitive solicitations where the Government intends to award a contract without discussions.

52.215-2 Audit and Records-Negotiation (10 U.S.C. 2313, 41 U.S.C. 254d, and OMB Circular No. A-133), in solicitations and contracts except those for acquisitions not exceeding the simplified acquisition threshold. For cost-reimbursement contracts with educational

institutions, and other nonprofit organizations, the contracting officer shall use the clause with its Alternate II.

52.215-5 Facsimile Proposals.

52.215-8 Order of Precedence -- Uniform Contract

Format. 52.215-10 Price Reduction for Certified Cost or Pricing Data.

52.215-11 Price Reduction for Certified Cost or Pricing Data – Modifications.

52.215-14 Integrity of Unit Prices, in solicitations and contracts except for acquisitions at or below the simplified acquisition threshold.

52.215-15 Pension Adjustment and Asset Reversions in solicitations and contracts for which any preaward or post award cost determinations will be subject to Part 31.

52.215-16 Facilities Capital Cost of Money, in solicitations expected to result in contracts that are subject to the cost principles for contracts with commercial organizations (see FAR 31.2).

If the prospective contractor does not propose facilities capital cost of money in its offer, the contracting officer shall insert the clause at 52.215-17 Waiver of Facilities Capital Cost of Money, in the resulting contract.

52.216-1 Type of Contract, in a solicitation unless it is for a fixed-price acquisition made under simplified acquisition procedures.

52.216-7 Allowable Cost and Payment, in solicitations and contracts when a cost-reimbursement contract is contemplated. If the contract is with an educational institution, modify the clause by deleting from paragraph (a) the words "Subpart 31.2" and substituting for them "Subpart 31.3." If the contract is with a nonprofit organization other than an educational institution or a nonprofit organization exempted under OMB Circular No. A-122, modify the clause by deleting from paragraph (a) the words "Subpart 31.2" and substituting for them "Subpart 31.7."

52.216-8 Fixed Fee, in solicitations and contracts when a cost-plus-fixed-fee contract is contemplated.

52.216-11 Cost Contract -- No Fee, in solicitations and contracts when a cost-reimbursement contract is contemplated that provides no fee. If a cost-reimbursement research and development contract with an educational institution or a nonprofit organization that provides no fee or other payment above cost is contemplated, and if the contracting officer determines that withholding of a portion of allowable costs is not required, the contracting officer shall use the clause with its Alternate I.

52.216-15 Predetermined Indirect Cost Rates.

252.219-7003, Small, Small Disadvantaged and Women-Owned Small Business Subcontracting Plan (DoD Contracts), in solicitations and contracts that contain the clause at FAR 52.219-9, Small Business Subcontracting Plan. In contracts with contractors which have comprehensive subcontracting plans approved under the test program described in 219.702(a), use the clause at 252.219-7004, Small, Small Disadvantaged and Women-Owned Small Business Subcontracting Plan (Test Program), instead of the clauses at 252.219-7003, Small, Small Disadvantaged and Women-Owned Small Business Subcontracting Plan (DoD Contracts), and FAR 52.219-9, Small Business Subcontracting Plan. In contracts with contractors that have comprehensive subcontracting plans approved under the test program described in 219.702(a), do not use the clause at FAR 52.219-16, Liquidated Damages-- Subcontracting Plan.

52.219-8 Utilization of Small Business Concerns, in solicitations and contracts when the contract amount is expected to be over the simplified acquisition threshold unless the contract, together with all its subcontracts, is to be performed entirely outside of the United States and its outlying areas.

52.219-9 Small Business Subcontracting Plan, in solicitations and contracts that offer subcontracting possibilities, are expected to exceed \$700,000 (\$1,500,000 for construction of any public facility), and are required to include the clause at 52.219-8, Utilization of Small Business Concerns. When contracting by negotiation, and subcontracting plans are required with initial proposals as provided for in 19.705-2(d), the contracting officer shall use the clause with its Alternate II.

52.219-16 Liquidated Damages --Subcontracting Plan, in all solicitations and contracts containing the clause at 52.219-9 Small Business Subcontracting Plan, or the clause with its Alternate II.

52.222-2 Payment for Overtime Premiums, in solicitations and contracts when a cost-reimbursement contract is contemplated and the contract amount is expected to be over \$150,000.

52.222-3 Convict Labor, in solicitations and contracts above the micro-purchase threshold, when the contract is to be performed in the United States, Puerto Rico, the Northern Mariana Islands, American Samoa, Guam, or the U.S. Virgin Islands; unless --

(a) The contract will be subject to the Walsh-Healey Public Contracts Act (see Subpart 22.6), which contains a separate prohibition against the employment of convict labor;

(b) The supplies or services are to be purchased from Federal Prison Industries, Inc. (see Subpart 8.6); or

(c) The acquisition involves the purchase, from any State prison, of finished supplies that may be secured in the open market or from existing stocks, as distinguished from supplies requiring special fabrication.

52.222-26 Equal Opportunity.

52.222-21 Prohibition of Segregated Facilities.

52.222-24 Preaward On-Site Equal Opportunity Compliance Evaluation, in when the amount of the contract is expected to be \$10 million or more.

52.222-29 Notification of Visa Denial, in contracts if the contractor is required to perform in or on behalf of a foreign country.

52.222-35 Equal Opportunity for Special Disabled Veterans, Veterans of the Vietnam Era, and Other Eligible Veterans, in solicitations and contracts if the expected value is \$150,000 or more, except when work is performed outside the United States by employees recruited outside the United States.

52.222-36 Equal Opportunity for Workers with Disabilities, in solicitations and contracts that exceed \$10,000 or are expected to exceed \$15,000, except when work is to be performed outside the United States by employees recruited outside the United States (for the purpose of this, United States includes the several states, the District of Columbia, the Virgin Islands, the Commonwealth of Puerto Rico, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, and Wake Island).

52.222-37 Employment Reports on Special Disabled Veterans, Veterans of the Vietnam Era, and Other Eligible Veterans, in solicitations and contracts containing the clause at 52.222-35 Equal Opportunity for Special Disabled Veterans, Veterans of the Vietnam Era, and Other Eligible Veterans.

52.223-3 Hazardous Material Identification and Material Safety Data, in solicitations and contracts if the contract will require the delivery of hazardous materials as defined in FAR 23.301.

52.223-5, Pollution Prevention and Right-to-Know Information, in all solicitations and contracts that provide for performance, in whole or in part, on a Federal facility. Use Alt II if the contract provides for Contractor activities on a Federal Facility.

52.223-6, Drug-Free Workplace, except as provided in paragraph (b) of this section, in solicitations and contracts of any dollar value if the contract is expected to be awarded to an individual or expected to exceed the simplified acquisition threshold if the contract is expected to be awarded to other than an individual. Contracting officers shall not insert the clause at 52.223-6, Drug-Free Workplace, in solicitations and contracts, if the resultant contract is to be performed entirely outside of the United States, its territories, and its possessions or inclusion of these requirements would be inconsistent with the international obligations of the United States or with the laws and regulations of a foreign country.

252.223-7001, Hazard Warning Labels, in solicitations and contracts which require submission of hazardous material data sheets.

252.223-7002, Safety Precautions for Ammunition and Explosives, and 252.223-7003, Change in Place of Performance--Ammunition and Explosives, in all solicitations and contracts for acquisition to which this section applies.

252.223-7004, Drug-Free Work Force, in all solicitations and contracts--(1) That involve access to classified information; or(2) When the contracting officer determines that the clause is necessary for reasons of national security or for the purpose of protecting the health or safety of those using or affected by the product of, or performance of, the contract.(b) Do not use the clause in solicitations and contracts when performance or partial performance will be outside the United States, its territories, and possessions, unless the contracting officer determines such inclusion to be in the best interest of the Government; or When the value of the acquisition is at or below the simplified acquisition threshold.

252.223-7006, Prohibition on Storage and Disposal of Toxic and Hazardous Materials, in all solicitations and contracts which require, may require, or permit contractor performance on a DoD installation. Use the clause at 252.223-7006 with its Alternate I, when the Secretary of the military department issues a determination under the exception at 223.7102(a)(9).

252.223-7007, Safeguarding Sensitive Conventional Arms, Ammunition, and Explosives, in all solicitations and contracts to which DoD 5100.76-M applies, in accordance with the policy at 223.7201. Complete paragraph (b) of the clause based on information provided by cognizant technical or requirements personnel.

When the design, development, or operation of a system of records on individuals is required to accomplish an agency function, insert the following clauses in solicitations and contracts:

(a) 52.224-1, Privacy Act Notification. (b) 52.224-2, Privacy Act.

252.225-7003, Report of Intended Performance Outside the U. S., in solicitations greater than \$13.5 million.

252.225-7004, Report of Intended Contract Performance Outside the U.S. and Canada in solicitations greater than \$12.5 million.

252.225.7012, Preference for Certain Domestic

Commodities. 252.225-7018, Photovoltaic Devices –

Certificate

252.225-7031, Secondary Arab Boycott of Israel.

252.225-7040, Contractor Personnel Authorized to Accompany U.S. Armed Forces Deployed Outside the United States.

252.225-7041, Correspondence in English, in solicitations and contracts when contract performance will be wholly or in part in a foreign country.

252.225-7042, Authorization to Perform, in solicitations and contracts when contract performance will be wholly or in part in a foreign country.

252.225-7043, Antiterrorism/Force Protection Policy for Defense Contractors Outside the United States, in solicitations and contracts that require performance or travel outside the United States

52.225-13, Restrictions on Certain Foreign Purchases, in solicitations and contracts with a value exceeding \$2,500 (\$15,000 for acquisitions as described in 13.201(g)), unless an exception applies.

52.225-14, Inconsistency between English Version and Translation of Contract, in solicitations and contracts if anticipating translation into another language. Insert the clause with its Alternate I in all R&D solicitations and contracts unless both complete performance and delivery are outside the United States, its possessions, and Puerto Rico. When a proposed contract involves both R&D work and supplies or services, and the R&D work is the primary purpose of the contract, the contracting officer shall use this alternate. In all other proposed contracts involving both R&D work and supplies or services, the contracting officer shall use the basic clause. Also, when a proposed contract involves either R&D or supplies and materials, in addition to construction or architect-engineer work, the contracting officer shall use the basic clause.

52.226-2, Historically Black College or University and Minority Institution Representation, in solicitations set aside for HBCU/MIs.

52.227-1 Alternate 1, Authorization and Consent. If, in the Government's interest, it is appropriate to exempt one or more specific United States patents from the patent indemnity clause, the contracting officer shall obtain written approval from the agency head or designee and shall insert the clause at 52.227-5, Waiver of Indemnity, in solicitations and contracts in addition to the appropriate patent indemnity clause.

52.227-6, Royalty Information.

252.227-7013, Rights in Technical Data--Noncommercial Items, in solicitations and contracts when the successful offeror(s) will be required to deliver technical data to the Government. Do not use the clause when the only deliverable items are computer software or computer software documentation (see 227.72), commercial items (see 227.7102-3), existing works (see 227.7105), special works (see 227.7106). Use the clause at 252.227-7013 with its Alternate I in research contracts when the contracting officer determines, in consultation with counsel, that public dissemination by the contractor would be-(1) In the interest of the Government; and (2) Facilitated by the Government relinquishing its right to publish the work for sale, or to have others publish the work for sale on behalf of the Government.

252.227-7014, Rights in Noncommercial Computer Software and Noncommercial Computer Software Documentation, in solicitations and contracts when the successful offeror(s) will be required to deliver computer software or computer software

documentation. Do not use the clause when the only deliverable items are technical data (other than computer software documentation), commercial computer software or commercial computer software documentation, commercial items (see 227.7102-3), special works (see 227.7205). Use the clause at 252.227-7014 with its Alternate I in research contracts when the contracting officer determines, in consultation with counsel, that public dissemination by the contractor would be-

(i) In the interest of the Government; and (ii) Facilitated by the Government relinquishing its right to publish the work for sale, or to have others publish the work for sale on behalf of the Government.

Except as provided in paragraph (b) of this subsection, use the clause at 252.227-7015, Technical Data--Commercial Items, in all solicitations and contracts when the contractor will be required to deliver technical data pertaining to commercial items, components, or processes. Do not require the contractor to include this clause in its subcontracts.

(b) 252.227-7013, Rights in Technical Data--Noncommercial Items, in lieu of the clause at 252.227-7015 if the Government will pay any portion of the development costs. Do not require the contractor to include this clause in its subcontracts for commercial items or commercial components.

Use the following clauses in solicitations and contracts that include the clause at 252.227-7013: (1) 252.227-7016, Rights in Bid or Proposal Information; (2) 252.227-7030, Technical Data--Withholding of Payment; (3) 252.227-7036, Declaration of Technical Data Conformity; and (4) 252.227-7037, Validation of Restrictive Markings on Technical Data (paragraph (e) if the clause contains information that must be included in a challenge).

252-227-7017, Identification and Assertion of Use, Release, or Disclosure

Restrictions 252.227-7019 Validation of Asserted Restrictions--Computer

Software.

252.227-7020 Rights in Special Works.

252.227-7021, Rights in Data--Existing Works, in lieu of the clause at 252.227-7013, Rights in Technical Data--Noncommercial Items, in solicitations and contracts exclusively for existing works when-(1) The existing works will be acquired without modification; and (2) The Government requires the right to reproduce, prepare derivative works, or publicly perform or display the existing works; or (3) The Government has a specific need to obtain indemnity for liabilities that may arise out of the content, performance, use, or disclosure of such data. (b) The clause at 252.227-7021 provides the Government, and others acting on its behalf, a paid-up, non-exclusive, irrevocable, world-wide license to reproduce, prepare derivative works and publicly perform or display the works called for by a contract and to authorize others to do so for government purposes.(c) A contract clause is not required to acquire existing works such as books, magazines and periodicals, in any storage or retrieval medium, when the Government will not reproduce the books, magazines or periodicals, or prepare derivative works.



252.227-7025, Limitations on the Use or Disclosure of Government Furnished Information Marked with Restrictive Legends, in solicitations and contracts when it is anticipated that the Government will provide the contractor, for performance of its contract, technical data marked with another contractor's restrictive legend(s).

252.227-7028, Technical Data or Computer Software Previously Delivered to the Government, in solicitations when the resulting contract will require the contractor to deliver technical data. The provision requires offerors to identify any technical data specified in the solicitation as deliverable data items that are the same or substantially the same as data items the offeror has delivered or is obligated to deliver, either as a contractor or subcontractor, under any other federal agency contract.

252.227-7032, Rights in Technical Data and Computer Software (Foreign), may be used in contracts with foreign contractors to be performed overseas, except Canadian purchases (see paragraph (c) of this subsection), in lieu of the clause at 252.227-7013, Rights in Technical Data--Noncommercial Items, when the Government requires the unrestricted right to use, modify, reproduce, perform, display, release or disclose all technical data to be delivered under the contract. Do not use the clause in contracts for existing or special works. (b) When the Government does not require unlimited rights, the clause at 252.227-7032 may be modified to accommodate the needs of a specific overseas procurement situation. The Government should obtain rights in the technical data that are not less than the rights the Government would have obtained under the data rights clause(s) prescribed in this part for a comparable procurement performed within the United States or its possessions. (c) Contracts for Canadian purchases shall include the appropriate data rights clause prescribed in this part for a comparable procurement performed within the United States or its possessions.

252.227-7037, Validation of Restrictive Markings on Technical Data, in all solicitations and contracts for commercial items that include the clause at 252.227-7015 or the clause at 252.227-7013. Do not require the contractor to include this clause in its subcontracts for commercial items or commercial components.

Pursuant to FAR 27.304-1(e), the contracting officer shall insert the clause at 252.227-7039, Patents--Reporting of Subject Inventions, in solicitations and contracts containing the clause at FAR 52.227-11, Patent Rights--Retention by the Contractor (Short Form). Report of Subject Inventions and Subcontracts is located at:

<http://www.dtic.mil/whs/directives/infomgt/forms/eforms/dd0882.pdf>

252.227-7038, Patent Rights--Ownership by the Contractor (Large Business), Use the clause at 252.227-7038, Patent Rights--Ownership by the Contractor (Large Business), instead of the clause at FAR 52.227-11, in solicitations and contracts for experimental, developmental, or research work if--(A) The contractor is other than a small business concern or nonprofit organization; and (B) No alternative patent rights clause is used in accordance with FAR 27.303(c) or (e).

52.227-10, Filing of Patent Applications -- Classified Subject Matter, in all classified solicitations and contracts and in all solicitations and contracts where the nature of the work or classified subject matter involved in the work reasonably might be expected to result in a patent application containing classified subject matter.

52.227-11, Patent Rights -- Ownership by the Contractor (Short Form), if all the following conditions apply: (i) The contractor is a small business concern or nonprofit organization as defined in 27.301 or, except for contracts of the Department of Defense (DOD), the Department of Energy (DOE), or the National Aeronautics and Space Administration (NASA), any other type of contractor. (ii) No alternative patent rights clause is used in accordance with paragraph (c) or (d) of this section or 27.304-2. To the extent the information is not required elsewhere in the contract, and unless otherwise specified by agency supplemental regulations, the contracting officer may modify 52.227-11(f) to require the contractor to do one or more of the following: (i) Provide periodic (but not more frequently than annually) listings of all subject inventions required to be disclosed during the period covered by the report. (ii) Provide a report prior to the closeout of the contract listing all subject inventions or stating that there were none. (iii) Provide, upon request, the filing date, serial number and title, a copy of the patent application, and patent number and issue date for any subject invention in any country in which the contractor has applied for patents. (iv) Furnish the Government an irrevocable power to inspect and make copies of the patent application file when a Federal Government employee is a coinventor. If the acquisition of patent rights for the benefit of a foreign government is required under a treaty or executive agreement, or if the agency head or a designee determines at the time of contracting that it would be in the national interest to acquire the right to sublicense foreign governments or international organizations pursuant to any existing or future treaty or agreement, the contracting officer shall use the clause at 52.227-11, with its Alternate I. If other rights are necessary to effectuate the treaty or agreement, Alternate I may be appropriately modified. In long term contracts, Alternate II shall be added if necessary to effectuate treaties or agreements to be entered into.

52.227-10 Filing of Patent Applications -- Classified Subject Matter, in all classified solicitations and contracts and in all solicitations and contracts where the nature of the work or classified subject matter involved in the work reasonably might be expected to result in a patent application containing classified subject matter.

52.227-11 Patent Rights -- Ownership by the Contractor, unless an alternative patent rights clause is used in accordance with paragraph (c), (d), or (e) of this section, insert the clause at 52.227-11, Patent Rights--Ownership by the Contractor. To the extent the information is not required elsewhere in the contract, and unless otherwise specified by agency supplemental regulations, the contracting officer may modify 52.227-11(e) or otherwise supplement the clause to require the contractor to do one or more of the following: (i) Provide periodic (but not more frequently than annually) listings of all subject inventions required to be disclosed during the period covered by the report. (ii) Provide a report prior to the closeout of the contract listing all subject inventions or stating that there were none. (iii) Provide the filing date, serial number, title, patent number and issue date for any patent application filed on any subject invention in any country or, upon request, copies of any patent application so identified. (iv) Furnish the Government an irrevocable power to inspect and make copies of the patent application file when a Government employee is a co-inventor.

52.227-13, Patent Rights -- Ownership by the Government, unless an alternative patent rights clause is used in accordance with paragraph (c), (d), or (e) of this section, insert

the clause at 52.227-11, Patent Rights--Ownership by the Contractor. To the extent the information is not required elsewhere in the contract, and unless otherwise specified by agency supplemental regulations, the contracting officer may modify 52.227-11(e) or otherwise supplement the clause to require the contractor to do one or more of the following:(i) Provide periodic (but not more frequently than annually) listings of all subject inventions required to be disclosed during the period covered by the report.(ii) Provide a report prior to the closeout of the contract listing all subject inventions or stating that there were none.(iii) Provide the filing date, serial number, title, patent number and issue date for any patent application filed on any subject invention in any country or, upon request, copies of any patent application so identified.(iv) Furnish the Government an irrevocable power to inspect and make copies of the patent application file when a Government employee is a co-inventor.

52.227-14 Rights in Data -- Generally, a contract should contain only one data rights clause. However, where more than one is needed, the contract should distinguish the portion of contract performance to which each pertains. (b)(1) Insert the clause at 52.227-14, Rights in Data--General, in solicitations and contracts if it is contemplated that data will be produced, furnished, or acquired under the contract, unless the contract is-- (i) For the production of special works of the type set forth in 27.405-1, although in these cases insert the clause at 52.227-14, Rights in Data--General, and make it applicable to data other than special works, as appropriate (see paragraph (e) of this section); (ii) For the acquisition of existing data, commercial computer software, or other existing data, as described in 27.405-2 through 27.405-4 (see paragraphs (f) and (g) of this section); (iii) A small business innovation research contract (see paragraph (h) of this section); (iv) To be performed outside the United States (see paragraph (i)(1) of this section); (v) For architect-engineer services or construction work (see paragraph (i)(2) of this section); (vi) For the management, operation, design, or construction of a Government-owned facility to perform research, development, or production work (see paragraph (i)(3) of this section); or (vii) A contract involving cosponsored research and development in which a clause providing for less than unlimited right has been authorized (see 27.408).

52.228-7, Insurance -- Liability to Third Persons.

52.229-8, Taxes -- Foreign Cost-Reimbursement Contracts, in solicitations and contracts when a cost-reimbursement contract is contemplated and the contract is to be performed wholly or partly in a foreign country.

52.229-10, State of New Mexico Gross Receipts and Compensating Tax, in solicitations and contracts when all three of the following conditions exist:

- (1) The contractor will be performing a cost-reimbursement contract.
- (2) The contract directs or authorizes the contractor to acquire tangible personal property as a direct cost under a contract and title to such property passes directly to and vests in the United States upon delivery of the property by the vendor.
- (3) The contract will be for services to be performed in whole or in part within the State of New Mexico.

52.230-2, Cost Accounting Standards, in negotiated contracts, unless the contract is exempted (see 48 CFR 9903.201-1 (FAR Appendix)), the contract is subject to modified coverage (see 48 CFR 9903.201-2 (FAR Appendix)), or the clause prescribed in paragraph (c) of this subsection is used.

(2) The clause at FAR 52.230-2 requires the contractor to comply with all CAS specified in 48 CFR 9904 (FAR Appendix), to disclose actual cost accounting practices (applicable to CAS-covered contracts only), and to follow disclosed and established cost accounting practices consistently.

(b) Disclosure and Consistency of Cost Accounting Practices.

(1) 52.230-3, Disclosure and Consistency of Cost Accounting Practices, in negotiated contracts when the contract amount is over \$750,000, but less than \$50 million, and the offeror certifies it is eligible for and elects to use modified CAS coverage (see 48 CFR 9903.201-2 (FAR Appendix)), unless the clause prescribed in paragraph (c) of this subsection is used.

(2) 52.230-3 requires the contractor to comply with 48 CFR 9904.401, 9904.402, 9904.405, and 9904.406 (FAR Appendix) to disclose (if it meets certain requirements) actual cost accounting practices, and to follow consistently its established cost accounting practices.

(c) Consistency in Cost Accounting Practices. The contracting officer shall insert the clause at 52.230-4, Disclosure and Consistency in Cost Accounting Practices – Foreign Concerns, in negotiated contracts that are exempt from CAS requirements solely on the basis of the fact that the contract is to be awarded to a United Kingdom contractor and is to be performed substantially in the United Kingdom (see 48 CFR 9903.201-1(b)(12) (FAR Appendix)).

(d) Administration of Cost Accounting Standards.

(1) The contracting officer shall insert the clause at 52.230-6, Administration of Cost Accounting Standards, in contracts containing any of the clauses prescribed in paragraphs (a), (b), or (e) of this subsection.

(2) The clause at 52.230-6 specifies rules for administering CAS requirements and procedures to be followed in cases of failure to comply.

(e) Cost Accounting Standards -- Educational Institutions.

(1) The contracting officer shall insert the clause at 52.230-5, Cost Accounting Standards -- Educational Institution, in negotiated contracts awarded to educational institutions, unless the contract is exempted (see 48 CFR 9903.201-1 (FAR Appendix)), the contract is to be performed by an FFRDC (see 48 CFR 9903.201-2(c)(5) (FAR Appendix)), or the provision at 48 CFR 9903.201-2(c)(6) (FAR Appendix) applies.

(2) The clause at 52.230-5 requires the educational institution to comply with all CAS specified in 48 CFR 9905 (FAR Appendix), to disclose actual cost

accounting practices as required by 48 CFR 9903.202-1(f) (FAR Appendix), and to follow disclosed and established cost accounting practices consistently.

52.230-7, Proposal Disclosure—Cost Accounting Practice Changes.

252.231-7000, Supplemental Cost Principles, in all solicitations and contracts, which are subject to the principles and procedures described in FAR Subparts 31.1, 31.2, 31.6, and 31.7.

252.232-7003, Electronic Submission of Payment Requests and Receiving Reports

252.232-7010, Levies on Contractor Payments.

52.232-9, Limitation on Withholding of Payments, in solicitations and contracts when a supply contract, research and development contract, service contract, time-and-materials contract, or labor-hour contract is contemplated that includes two or more terms authorizing the temporary withholding of amounts otherwise payable to the contractor for supplies delivered or services performed.

52.232-16, Progress Payments, in solicitations that may result in contracts greater than the SAT providing for progress payments based on cost. If the contractor is a small business concern, use the clause with its Alternate I.

52.232-17, Interest, in solicitations and contracts. It may be inserted if the contract will be in one or more of the following categories: Contracts at or below the simplified acquisition threshold; Contracts without any provision for profit or fee with a nonprofit organization; Any other exceptions authorized under agency procedures.

52.232-20, Limitation of Cost, in solicitations and contracts if a fully funded cost-reimbursement contract is contemplated whether or not the contract provides for payment of a fee.

52.232-22, Limitation of Funds, in solicitations and contracts if an incrementally funded cost-reimbursement contract is contemplated.

52.232-23, Assignment of Claims, in solicitations and contracts expected to exceed the micro-purchase threshold, unless the contract will prohibit the assignment of claims (see 32.803(b)). The use of the clause is not required for purchase orders. However, the clause may be used in purchase orders expected to exceed the micro-purchase threshold that are accepted in writing by the contractor, if such use is consistent with agency policies and regulations. If a no-setoff commitment has been authorized (see 32.803(d)), the contracting officer shall use the clause with its Alternate I.

52.232-24, Prohibition of Assignment of Claims, in solicitations and contracts for which a determination has been made under agency regulations that the prohibition of assignment of claims is in the Government's interest.

52.232-25, Prompt Payment, in all solicitations and contracts, except when payment terms and the late payment penalties are established by other governmental authority (e.g., tariffs).

(1) As authorized in 32.904(b)(1)(ii)(B)(4), the contracting officer may modify the date in paragraph (a)(5)(i) of the clause to specify a period longer than 7 days for constructive acceptance, if required to afford the Government a reasonable opportunity to inspect and test the supplies furnished or to evaluate the services performed, (2) As provided in 32.903, agency policies and procedures may authorize amendment of paragraphs (a)(1)(i) and (ii) of the clause to insert a period shorter than 30 days (but not less than 7 days) for making contract invoice payments.

#### 52.232-33, Payment by Electronic Funds Transfer—System for Award Management

52.233-1, Disputes. If it is determined under agency procedures that continued performance is necessary pending resolution of any claim arising under or relating to the contract, the contracting officer shall use the clause with its Alternate I.

52.233-2, Service of Protest, in solicitations for contracts expected to exceed the simplified acquisition threshold.

52.233-3, Protest After Award, in all solicitations and contracts. If a cost reimbursement contract is contemplated, the contracting officer shall use the clause with its Alternate I.

#### 52.233-4 – Applicable Law for Breach of Contract

Claim. 252.233-7001, Choice of Law (Overseas).

#### 252.235-7010, Acknowledgment of Support and

Disclaimer. 252.235-7011, Final Scientific or

#### Technical Report

52.239-1, Privacy or Security Safeguards, in solicitations and contracts for information technology which require security of information technology, and/or are for the design, development, or operation of a system of records using commercial information technology services or support services.

#### 252.239-7000, Protection Against Compromising

Emanations 52.242-1, Notice of Intent to Disallow

Costs.

52.242-3, Penalties for Unallowable Costs, in all solicitations and contracts, over \$500,000.

52.242-4, Certification of Indirect Costs, into all solicitations and contracts which provide for establishment of final indirect cost rates.

52.242-13, Bankruptcy, in all solicitations and contracts exceeding the simplified acquisition threshold.

52.242-15, Stop-Work Order, Alternate I.

52.243-2, Changes -- Cost-Reimbursement, Alternate V.

52.243-6, Change Order Accounting, in solicitations and contracts for research and development contracts of significant technical complexity, if numerous changes are anticipated.

52.243-7, Notification of Changes, in research and development for principal subsystems.

252.243-7001, Pricing of Contract Modifications, in solicitations and contracts when anticipating and using a fixed price type contract.

252.243-7002, Requests for Equitable Adjustment, in solicitations and contracts estimated to exceed the simplified acquisition threshold.

52.244-2, Subcontracts, Alternate 1.

52.244-5, Competition in Subcontracting, when the contract amount is expected to exceed the simplified acquisition threshold.

52.244-6, Subcontracts for Commercial Items.

52.245-2, Government Property Installation Operation Services Government Property, Except as provided in paragraph (d) of this section, the contracting officer shall insert the clause at 52.245-1, Government Property, in-(i) All cost reimbursement, time-and-material, and labor-hour type solicitations and contracts; and(ii) Fixed-price solicitations and contracts when the Government will provide Government property.(iii) Contracts or modifications awarded under FAR Part 12 procedures where Government property that exceeds the simplified acquisition threshold, as defined in FAR 2.101, is furnished or where the contractor is directed to acquire property for use under the contract that is titled in the Government.

52.245-9, Use and Charges.

52.246-8, Inspection of Research and Development -- Cost-Reimbursement, in solicitations and contracts for research and development when the primary objective of the contract is the delivery of end items other than designs, drawings, or reports, unless use of the clause is impractical and the clause prescribed in 46.309 is considered to be more appropriate. If it is contemplated that the contract will be on a no-fee basis, the contracting officer shall use the clause with its Alternate I.

52.246-9, Inspection of Research and Development (Short Form), in solicitations and contracts for research and development when the clause prescribed in 46.307 or the clause prescribed in 46.308 is not used.

52.246-11, Higher-Level Contract Quality Requirement, in solicitations and contracts when the inclusion of a higher-level contract quality requirement is appropriate (see 46.202-4).

In (1) contracts requiring delivery of end items that are not high-value items, insert the clause at 52.246-23, Limitation of Liability. (2) In contracts requiring delivery of high-value items, insert the clause at 52.246-24, Limitation of Liability -- High Value Items. (3) In contracts requiring delivery of both high-value items and other end items, insert

both clauses prescribed in (1) and (2) of this section, Alternate I of the clause at 52.246-24, and identify clearly in the contract schedule the line items designated as high-value items.

52.247-63, Preference for U. S.-Flag Air Carriers.

52.247-64, Preference for Privately Owned U. S.-Flag Commercial

Vessels. 252.247-7023, Transportation of Supplies by Sea.

252.247-7024, Notification of Transportation of Supplies by Sea, in all contracts for which the offeror made a negative response to the inquiry in the provision at 252.247-7022, Representation of Extent of Transportation by Sea.

52.249-5, Termination for the Convenience of the Government (Educational and Other Nonprofit Institutions), in solicitations and contracts for research and development work with an educational or nonprofit institution on a nonprofit or no-fee basis.

52.249-6, Termination (Cost Reimbursement), in solicitations and contracts except in contracts for research and development with an educational or nonprofit institution on a no-fee basis.

52.249-14, Excusable Delays, in solicitations and contracts for supplies, services, construction, and research and development on a fee basis, when a cost-reimbursement contract is contemplated.

52.251-1, Government Supply Sources, in solicitations and contracts when the contracting officer may authorize the contractor to acquire supplies or services from a Government supply source.

252.251-7000, Ordering From Government Supply Sources, in solicitations and contracts which include the clause at FAR 52.251-1, Government Supply Sources.

52.253-1, Computer Generated Forms, in solicitations and contracts that require the contractor to submit data on Standard or Optional Forms prescribed by this regulation and forms prescribed by agency supplements.



**ATTACHMENT C**  
**ADDITIONAL REPRESENTATIONS AND CERTIFICATIONS FROM OFFERORS**  
**FAR/DFARS CERTIFICATION, SIGNATURE**

(If the person signing this contract/offer is other than the secretary/treasurer, vice-president, or president of the organization and the amount of the contract/offer is in excess of \$150,000, the following certificate must be completed.)

I, \_\_\_\_\_, certify that I am secretary to the organization named as Contractor herein; that \_\_\_\_\_, who signed this contract on behalf of the Contractor, was then \_\_\_\_\_ of said organization; that said contract was duly signed for on behalf of said organization by authority of its governing body and is within scope of its power.

\_\_\_\_\_  
 SECRETARY

52.204-8 – Annual Representations and Certifications

The Offeror has completed the annual representations and certifications electronically in SAM accessed through <https://www.sam.gov>. After reviewing the SAM information, the Offeror verifies by submission of the offer that the representations and certifications currently posted electronically that apply to this solicitation as indicated in paragraph (c) of this provision have been entered or updated within the last 12 months, are current, accurate, complete, and applicable to this solicitation (including the business size standard applicable to the NAICS code referenced for this solicitation), as of the date of this offer and are incorporated in this offer by reference (see FAR 4.1201); except for the changes identified below [offeror to insert changes, identifying change by clause number, title, date]. These amended representation(s) and/or certification(s) are also incorporated in this offer and are current, accurate, and complete as of the date of this offer.

FAR Clause	Title	Date	Change

Any changes provided by the offeror are applicable to this solicitation only, and do not result in an update to the representations and certifications posted on SAM.

(End of Provision)

## DFARS 252.209-7002 DISCLOSURE OF OWNERSHIP OR CONTROL BY A FOREIGN GOVERNMENT

(a) *Definitions.* As used in this provision—

(1) “Effectively owned or controlled” means that a foreign government or any entity controlled by a foreign government has the power, either directly or indirectly, whether exercised or exercisable, to control the election, appointment, or tenure of the Offeror’s officers or a majority of the Offeror’s board of directors by any means, e.g., ownership, contract, or operation of law (or equivalent power for unincorporated organizations).

(2) “Entity controlled by a foreign government”—

(i) Means—

(A) Any domestic or foreign organization or corporation that is effectively owned or controlled by a foreign government; or

(B) Any individual acting on behalf of a foreign government.

(ii) Does not include an organization or corporation that is owned, but is not controlled, either directly or indirectly, by a foreign government if the ownership of that organization or corporation by that foreign government was effective before October 23, 1992.

(3) “Foreign government” includes the state and the government of any country (other than the United States and its outlying areas) as well as any political subdivision, agency, or instrumentality thereof.

(4) “Proscribed information” means—

(i) Top Secret information;

(ii) Communications security (COMSEC) material, excluding controlled cryptographic items when unkeyed or utilized with unclassified keys;

(iii) Restricted Data as defined in the U.S. Atomic Energy Act of 1954, as amended;

(iv) Special Access Program (SAP) information; or

(v) Sensitive Compartmented Information (SCI).

(b) *Prohibition on award.* No contract under a national security program may be awarded to an entity controlled by a foreign government if that entity requires access to proscribed information to perform the contract, unless the Secretary of Defense or a designee has waived application of 10 U.S.C. 2536(a).

(c) *Disclosure.* The Offeror shall disclose any interest a foreign government has in the Offeror when that interest constitutes control by a foreign government as defined in this provision. If the Offeror is a subsidiary, it shall also disclose any reportable interest a foreign government has in any entity that owns or controls the subsidiary, including reportable interest concerning the Offeror’s immediate parent, intermediate parents, and the ultimate parent.

Use separate paper as needed, and provide the information in the following format:

Offeror's Point of Contact for Questions about Disclosure  
(Name and Phone Number with Country Code, City Code  
and Area Code, as applicable)

Name and Address of Offeror

Name and Address of Entity Controlled  
by a Foreign Government

Description of Interest, Ownership  
Percentage, and Identification of  
Foreign Government

(End of provision)

#### FAR 52.227-7 PATENTS-NOTICE OF GOVERNMENT LICENSEE

(use if Government is obligated to pay a royalty on a patent involved in the prospective contract)

The Government is obligated to pay a royalty applicable to the proposed acquisition because of a license agreement between the Government and the patent owner. The patent number is

\_\_\_\_\_[Contracting Officer fill in], and the royalty rate is \_\_\_\_\_[Contracting Officer fill in]. If the offeror is the owner of, or a licensee under, the patent, indicate below:

\_\_\_ Owner

\_\_\_ Licensee

If an offeror does not indicate that it is the owner or a licensee of the patent, its offer will be evaluated by adding thereto an amount equal to the royalty.

(End of Provision)

#### FAR 52.230-1 COST ACCOUNTING STANDARDS NOTICES AND CERTIFICATION

(Applicable if proposed contract subject to CAS as specified in 48 CFR 9903.201 (FAR Appendix)

Note: This notice does not apply to small businesses or foreign governments. This notice is in three parts, identified by Roman numerals I through III.

Offerors shall examine each part and provide the requested information in order to determine Cost Accounting Standards (CAS) requirements applicable to any resultant contract.

If the offeror is an educational institution, Part II does not apply unless the contemplated contract will be subject to full or modified CAS coverage pursuant to 48 CFR 9903.201-2(c)(5) or 9903.201-2(c)(6), respectively.

## I. DISCLOSURE STATEMENT--COST ACCOUNTING PRACTICES AND CERTIFICATION

Note: This notice does not apply to small businesses or foreign governments. This notice is in three parts, identified by Roman numerals I through III.

Offerors shall examine each part and provide the requested information in order to determine Cost Accounting Standards (CAS) requirements applicable to any resultant contract.

If the offeror is an educational institution, Part II does not apply unless the contemplated contract will be subject to full or modified CAS coverage pursuant to 48 CFR 9903.201-2(c)(5) or 9903.201-2(c)(6), respectively.

### I. Disclosure Statement—Cost Accounting Practices and Certification

(a) Any contract in excess of \$750,000 resulting from this solicitation will be subject to the requirements of the Cost Accounting Standards Board (48 CFR Chapter 99), except for those contracts which are exempt as specified in 48 CFR 9903.201-1.

(b) Any offeror submitting a proposal which, if accepted, will result in a contract subject to the requirements of 48 CFR Chapter 99 must, as a condition of contracting, submit a Disclosure Statement as required by 48 CFR 9903.202. When required, the Disclosure Statement must be submitted as a part of the offeror's proposal under this solicitation unless the offeror has already submitted a Disclosure Statement disclosing the practices used in connection with the pricing of this proposal. If an applicable Disclosure Statement has already been submitted, the offeror may satisfy the requirement for submission by providing the information requested in paragraph (c) of Part I of this provision.

Caution: In the absence of specific regulations or agreement, a practice disclosed in a Disclosure Statement shall not, by virtue of such disclosure, be deemed to be a proper, approved, or agreed-to practice for pricing proposals or accumulating and reporting contract performance cost data.

(c) Check the appropriate box below:

(1) Certificate of Concurrent Submission of Disclosure Statement. The offeror hereby certifies that, as a part of the offer, copies of the Disclosure Statement have been submitted as follows:

(i) Original and one copy to the cognizant Administrative Contracting Officer (ACO) or cognizant Federal agency official authorized to act in that capacity (Federal official), as applicable; and

(ii) One copy to the cognizant Federal auditor.

(Disclosure must be on Form No. CASB DS-1 or CASB DS-2, as applicable. Forms may be obtained from the cognizant ACO or Federal official and/or from the loose-leaf version of the Federal Acquisition Regulation.)

Date of Disclosure Statement: \_\_\_\_\_  
 Name and Address of Cognizant ACO or Federal Official Where Filed:  
 \_\_\_\_\_

The offeror further certifies that the practices used in estimating costs in pricing this proposal are consistent with the cost accounting practices disclosed in the Disclosure Statement.

(2) Certificate of Previously Submitted Disclosure Statement. The offeror hereby certifies that the required Disclosure Statement was filed as follows:

Date of Disclosure Statement: \_\_\_\_\_  
 Name and Address of Cognizant ACO or Federal Official Where Filed:  
 \_\_\_\_\_

The offeror further certifies that the practices used in estimating costs in pricing this proposal are consistent with the cost accounting practices disclosed in the applicable Disclosure Statement.

(3) Certificate of Monetary Exemption. The offeror hereby certifies that the offeror, together with all divisions, subsidiaries, and affiliates under common control, did not receive net awards of negotiated prime contracts and subcontracts subject to CAS totaling \$50 million or more in the cost accounting period immediately preceding the period in which this proposal was submitted. The offeror further certifies that if such status changes before an award resulting from this proposal, the offeror will advise the Contracting Officer immediately.

(4) Certificate of Interim Exemption. The offeror hereby certifies that (i) the offeror first exceeded the monetary exemption for disclosure, as defined in (3) of this subsection, in the cost accounting period immediately preceding the period in which this offer was submitted and (ii) in accordance with 48 CFR 9903.202-1, the offeror is not yet required to submit a Disclosure Statement. The offeror further certifies that if an award resulting from this proposal has not been made within 90 days after the end of that period, the offeror will immediately submit a revised certificate to the Contracting Officer, in the form specified under paragraph (c)(1) or (c)(2) of Part I of this provision, as appropriate, to verify submission of a completed Disclosure Statement.

Caution: Offerors currently required to disclose because they were awarded a CAS-covered prime contract or subcontract of \$50 million or more in the current cost accounting period may not claim this exemption (4). Further, the exemption applies only in connection with proposals submitted before expiration of the 90-day period following the cost accounting period in which the monetary exemption was exceeded.

## II. Cost Accounting Standards—Eligibility for Modified Contract Coverage

If the offeror is eligible to use the modified provisions of 48 CFR 9903.201-2(b) and elects to do so, the offeror shall indicate by checking the box below. Checking the box below shall mean that the resultant contract is subject to the Disclosure and Consistency of Cost Accounting Practices clause in lieu of the Cost Accounting Standards clause.

The offeror hereby claims an exemption from the Cost Accounting Standards clause under the provisions of 48 CFR 9903.201-2(b) and certifies that the offeror is eligible for use of the Disclosure and Consistency of Cost Accounting Practices clause because during the cost accounting period immediately preceding the period in which this proposal was submitted, the offeror received less than \$50 million in awards of CAS-covered prime contracts and subcontracts. The offeror further certifies that if such status changes before an award resulting from this proposal, the offeror will advise the Contracting Officer immediately.

Caution: An offeror may not claim the above eligibility for modified contract coverage if this proposal is expected to result in the award of a CAS-covered contract of \$50 million or more or if, during its current cost accounting period, the offeror has been awarded a single CAS-covered prime contract or subcontract of \$50 million or more.

### III. Additional Cost Accounting Standards Applicable to Existing Contracts

The offeror shall indicate below whether award of the contemplated contract would, in accordance with paragraph (a)(3) of the Cost Accounting Standards clause, require a change in established cost accounting practices affecting existing contracts and subcontracts.

(End of provision)

### FAR 52.242-4 CERTIFICATION OF FINAL INDIRECT COSTS

(a) The Contractor shall --

(1) Certify any proposal to establish or modify final indirect cost rates;

(2) Use the format in paragraph (c) of this clause to certify; and

(3) Have the certificate signed by an individual of the Contractor's organization at a level no lower than a vice president or chief financial officer of the business segment of the Contractor that submits the proposal.

(b) Failure by the Contractor to submit a signed certificate, as described in this clause, may result in final indirect costs at rates unilaterally established by the Contracting Officer.

(c) The certificate of final indirect costs shall read as follows:

**CERTIFICATE OF INDIRECT COSTS**

This is to certify that I have reviewed this proposal to establish final indirect cost rates and to the best of my knowledge and belief:

1. All costs included in this proposal \_\_\_\_\_ (identify proposal and date) to establish final indirect cost rates for \_\_\_\_\_ (identify period covered by rate) are allowable in accordance with the cost principles of the Federal Acquisition Regulation (FAR) and its supplements applicable to those contracts to which the final indirect cost rates will apply; and

2. This proposal does not include any costs, which are expressly unallowable under applicable cost principles of the FAR or its supplements.

FIRM:

\_\_\_\_\_

SIGNATURE:

\_\_\_\_\_

NAME OF CERTIFYING OFFICIAL:

\_\_\_\_\_

TITLE:

\_\_\_\_\_

DATE OF EXECUTION:

\_\_\_\_\_

(End of Clause)

**DFARS 252.204-7004 ALTERNATE A, SYSTEM FOR AWARD MANAGEMENT**

As prescribed in 204.1105, substitute the following paragraph (a) for paragraph (a) of the provision at FAR 52.204-7:

(a) Definitions. As used in this provision—

“System for Award Management (SAM) database” means the primary Government repository for contractor information required for the conduct of business with the Government.

“Commercial and Government Entity (CAGE) code” means—

(1) A code assigned by the Defense Logistics Information Service (DLIS) to identify a commercial or Government entity; or

(2) A code assigned by a member of the North Atlantic Treaty Organization that DLIS records and maintains in the CAGE master file. This type of code is known as an “NCAGE code.”

“Data Universal Numbering System (DUNS) number” means the 9-digit number assigned by Dun and Bradstreet, Inc. (D&B) to identify unique business entities.

“Data Universal Numbering System +4 (DUNS+4) number” means the DUNS number assigned by D&B plus a 4-character suffix that may be assigned by a business concern. (D&B has no affiliation with this 4-character suffix.) This 4-character suffix may be assigned at the discretion of the business concern to establish additional SAM records for identifying alternative Electronic Funds Transfer (EFT) accounts (see FAR 32.11) for the same parent concern.

“Registered in the System for Award Management (SAM) database” means that—

- (1) The contractor has entered all mandatory information, including the DUNS number or the DUNS+4 number, and Contractor and Government Entity (CAGE) code into the SAM database; and
- (2) The contractor has completed the Core Data, Assertions, Representations and Certifications, and Points of Contact sections of the registration in the SAM database;
- (3) The Government has validated all mandatory data fields, to include validation of the Taxpayer Identification Number (TIN) with the Internal Revenue Service (IRS). The Contractor will be required to provide consent for TIN validation to the Government as part of the SAM registration process; and
- (4) The Government has marked the record “Active.”

(End of clause)

252.247-7022 REPRESENTATION OF EXTENT OF TRANSPORTATION BY SEA  
(Applicable if procurement greater than SAT).

(a) The Offeror shall indicate by checking the appropriate blank in paragraph (b) of this provision whether transportation of supplies by sea is anticipated under the resultant contract. The term "supplies" is defined in the Transportation of Supplies by Sea clause of this solicitation.

(b) Representation. The Offeror represents that it-

\_\_\_\_\_ Does anticipate that supplies will be transported by sea in the

\_\_\_\_\_ Does not anticipate that supplies will be transported by sea in the performance of any contract or subcontract resulting from this solicitation.

(c) Any contract resulting from this solicitation will include the Transportation of Supplies by Sea clause. If the Offeror represents that it will not use ocean

transportation, the resulting contract will also include the Defense FAR Supplement clause at 252.247-7024, Notification of Transportation of Supplies by Sea.

(End of provision)