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**Coastal Science and Engineering Collaborative (CSEC)**

**Program Management Plan (PgMP) – Version 9.0**

**18 DEC 2016**

**PRELIMINARY DRAFT**

**CSEC PgMP – Version 9.0**

**18 DEC 2016**

**PRELIMINARY DRAFT**

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**CSEC PgMP – Version 9.0**

**18 DEC 2016**

**PRELIMINARY DRAFT**

**1.0 Executive Summary.**

This preliminary draft Program Management Plan (PgMP) charts development and implementation of a USACE Coastal Science and Engineering Collaborative (CSEC)at the intersection of practice, academics, and research and development (R&D) for timely production and infusion of innovative technical products to support lifecycle coastal infrastructure systems management decisions. The CSEC initiative is being advanced in context of USACE Civil Works Transformation for an improved method of delivery of Integrated Water Resources Management (IWRM) (USACE, 2014).

This PgMP is a preliminary draft document crafted by a team composed of USACE SWG, ERDC, and Texas Agricultural and Mechanical University (TAMU), Department of Ocean Engineering (OCEN) leadership and researchers that have a vision for sustainable and resilient regionally integrated infrastructure. This team will aspire to identify and strengthen collaborative partnerships to further PgMP development and funding source identification.

For the purpose of team visioning and innovative solutions in support of Sustainable and Resilient Regionally Integrated Infrastructure (SRRII) systems and lifecycle management, the PgMP is focused on delivering CSEC capabilities and products for use on the Gulf of Mexico (GoM) coast and similar coastal settings, with the Texas coast serving as a proving ground. It is envisioned that CSEC team learning will occur and technical requirements will be established in the process for transferring CSEC technical products and capabilities for USACE, other government agencies, industry, and other technology users where applicable.

The proposed CSEC program development process involves:

* Making strategic advances in innovation enabled by cutting-edge science, engineering, and technology supported by the vision, goals, and objectives for CSEC,
* Identifying and satisfying requirements through client partnering and business plan alignment between Science and Technology (S&T) developers and users, and
* Delivering high value innovative system solutions that sustain and enhance technology user mission execution for lifecycle coastal infrastructure systems management.

Collaboration across the public, private, and academic sectors is cardinal to fully identifying and exploiting the relevant knowledge, tools, and resources to fuel innovation and synchronize programs for timely application. A CSEC Board of Directors (BOD), consisting of leadership of involved organizations, will be established to steer the direction of the CSEC Program Delivery Team (PgMDT) in undertaking this value proposition. The BOD is proposed to include:

* Technical Director for CW R&D, USACE ERDC
* Senior Research Scientist for Hydrodynamic Phenomena, USACE ERDC
* Senior Research Scientist for Environmental Science, USACE ERDC
* Deputy District Engineer for Programs and Project Management, USACE SWG
* Chief, Engineering and Construction Division, USACE SWG
* Department Head, TAMU OCEN
* Director, Center for Dredging Studies, TAMU OCEN
* Director of Development, College of Engineering, TAMU Foundation

It is proposed the PgMDT elicit comments at stages of CSEC PgMP development using a CSEC Expert Review Group (ERG), consisting of select end users of GoM coastal infrastructure systems. The BOD will establish the members of the ERG. Key stakeholders will be kept informed on CSEC development/execution progress, including the ERG, USACE Coastal Engineering Research Board (CERB), Operations and Regulatory (O&R) Community of Practice (CoP), Planning CoP, Ecosystem Restoration CoP, and Hydrology and Hydraulics, and Coastal (HH&C) CoP, ERDC Board of Directors (BOD), TAMU Chancellor, and TAMU Department of Engineering.

The purpose of the above-described engagements will be to inform how CSEC will:

* Operate across business lines, focus areas, and organizations
* Leverage select components of related efforts at the frontier of research for meaningful, coherent contribution to the body of knowledge
* Create synergy across related efforts for accelerated advancement of technology development
* Organize and preserve results as a knowledge hub for optimal transfer and implementation by the practicing community
* Provide feedback for ensuring continuous relevancy in addressing future coastal infrastructure systems management challenges

**2.0 Introduction.**

The USACE, Galveston District (SWG), the US Army Engineer Research and Development Center (ERDC), and the Texas A&M University (TAMU) Department of Ocean Engineering (OCEN), will collaboratively establish a Coastal Science and Engineering Collaborative (CSEC) on the GoM coast. The synergies that will arise from strategically synchronizing resources, assets, and expertise of our organizations will deliver significant and enduring value for the Gulf coast and other coastal systems through advancement of education, research, and coastal infrastructure management.

This PgMP contains details on the underlying context, innovative concepts, and management organization of the CSEC. The CSEC will be guided by standard organizational leadership, project management, and resource management principles and practices to provide structure and discipline for effective, efficient, and productive program planning and execution. The PgMDT, in concert with client partners and agency collaborators, will continually develop and maintain this PgMP as a “living document” road map under user and oversight steering, to unify understanding, characterize program risk and uncertainty, and manage change. This will ensure focus of CSEC resources are sustained on established product delivery requirements.

**3.0 Background.**

During September, 2015, the USACE Coastal Engineering Research Board (CERB) convened its 92nd meeting in Galveston, Texas, to identify the GoM region’s engineering challenges with nature, and nature-based systems to enhance the resilience of coastal systems and marine transportation infrastructure and sustain the values they produce. The CERB also sought to identify research and development needs to enable USACE and the Nation to deliver innovative solutions to meet these challenges and opportunities. The concept of the CSEC arose and was discussed as an action item for follow up at the March, 2016 meeting of the CERB.

During the March, 2016 meeting, CERB members deliberated on a value proposition for SWG-ERDC co-development of nationally significant coastal science and engineering. They expressed support for SWG and ERDC to proceed with developing a 5-year PgMP that would inform CSEC establishment. The CERB will periodically provide feedback as the CSEC PgMP is developed and implemented to identify and recommend to the Chief of Engineers best practices that can be incorporated elsewhere in order to enhance USACE mission performance.

The SWG and ERDC met with TAMU OCEN faculty in March, 2016 to explore collaboration toward mutual objectives with a resounding interest by all to work toward a goal of developing leap ahead science and engineering knowledge, technologies, and expertise, toward a vision for sustainable and resilient regionally integrated coastal infrastructure that also provides opportunities for supporting the technical competencies of the future work force.

By OCEN combining two interrelated programs, Ocean Engineering in College Station and Offshore and Coastal Systems Engineering in Galveston, TAMU has combined the world-class infrastructure and resources of the very large engineering campus at College Station with the strategic waterfront location and unique resources at Galveston, which is ideal for scaling up laboratory experimentation to inform field-scale demonstrations. We envision this new OCEN organization, under its “Guardian of the Gulf” research theme thrust area, being a strong collaborator with the R&D programs and SME capabilities of ERDC under the “Regional Sediment Management (RSM)” and “Engineering with Nature (EWN)” themes, primarily at its Coastal and Hydraulics Laboratory (CHL) and Environmental Laboratory (EL), located in Vicksburg, Mississippi.

The CHL and EL have a combined suite of biophysical process experimental and field research facilities in Vicksburg, Mississippi and Duck, North Carolina. The SWG has developable field laboratory facilities and office building space located at the busiest commercial navigation intersection in the Western Hemisphere. These USACE facilities will work strategically in concert with the OCEN at College Station and Galveston to bring coastal and estuarine environments into a comprehensive experimental setting. This portfolio of laboratory assets and capabilities, coupled with the strategic location of the Galveston TAMU campus and Galveston District projects in the field, is where research scientists, research engineers, and educators, will be able to investigate the most challenging problems of near-shore, offshore and estuarine systems and processes for addressing prioritized knowledge delivery requirements according to the CSEC PgMP. During the CSEC PgMP development, there will be significant opportunities for leveraging this laboratory capability portfolio for charting scientific research discoveries that inform engineering practice across study/project lifecycle phases.

Once developed, the CSEC PgMP will be used to coordinate application of funding from SWG, ERDC, and industry programs for a blend of SWG, ERDC, and TAMU team members to execute. CSEC leadership will brief the OCEN Board of Industry Advisors (BIA) as members of the CSEC ERG, which are envisioned to be composed of interested members of offshore and coastal industries and resource conservationists, to align their revenue streams with CSEC PgMP funding needs as a business portfolio investment opportunity, in context of realizing next generation coastal infrastructure improvements that sustain businesses on the GoM and Nationally.

Discussion of a CSEC Public-Private Partnership (P3) agreement using existing available legal mechanisms will be held for establishment to support PgMP revenue receipts and disbursements. There is potential for engaging the Texas A&M Foundation for this purpose, which is a private, nonprofit corporation that was created to solicit, receive, invest and disburse private gifts for TAMU. The Foundation would be able to directly fund OCEN for PgMP activities. The foundation’s financial management for CSEC PgMP activities would also work in concert with an ERDC Cooperative Research and Development Agreement (CRADA). Under the ERDC CRADA, Foundation funds are able to be provided under the PgMP to ERDC and SWG staff for advancing activities in close collaboration with TAMU.

In summary, on the financial management mechanisms between collaborators, depending on how specific blends of organizational funds are proposed to address jointly executed activities under this PgMP:

* ERDC is able to send R&D funds to SWG via the Corps of Engineers Financial Management System (CEFMS) and SWG is able to do likewise with district funds to ERDC.
* The TAMU A&M Foundation is able to execute a CRADA with ERDC for ERDC to receive funds from the Foundation, where ERDC is able to distribute funds by extension via CEFMS to SWG.
* Funds are able to be sent to TAMU via ERDC using the Cooperative Ecosystem Studies Unit (CESU) cooperative agreement, which may consist of a combination of ERDC and/or SWG funds.

The 5-year CSEC PgMP will be updated annually to ensure relevancy, focus, and sustain CSEC research energies, team member mass, and product delivery momentum under the P3 paradigm.

**4. Vision.**

The CSEC will fully utilize partnership and collaboration in order to accelerate co-development, pilot demonstration, and mainstreaming of trans-disciplinary Gulf coastal science and engineering solutions to resolve national challenges and priorities.

**5. Intent.**

Immerse a TAMU and ERDC S&T incubator and Validation and Verification (V&V) prototype laboratory in a field USACE District setting in order to accelerate the infusion of emerging science and engineering into field practice so as to create tangible value for mission outcomes across business lines, which translate well on a broader scale nationally for delivering significant increases in economic, environmental, and social benefits. This could include embedding R&D personnel with districts to cultivate enhanced knowledge gap identification and accelerated technology/knowledge transfer.

**6 Strategy.**

Connect ERDC R&D and TAMU activities and Subject Matter Experts (SMEs) to USACE Civil Works (CW) program portfolios and industry needs from a multi-objective, regional, and life cycle perspective. This connection will provide an organic conduit of information to identify research needs, conceptualize feasible solutions, and rapidly and efficiently develop field-robust innovations as major new and challenging USACE projects become authorized and industry opportunities emerge. Specific Application Focus Areas (AFAs) will be developed in collaboration with partnering organizations and sponsors. These AFAs will be pursued by developing and executing research projects and demonstrations that draw from the following fundamental activities:

a. AFA 1. Discovering breakthrough science:

(1) using advanced methods of field/laboratory data acquisition, interrogation, and assimilation,

(2) to inform first principles numerical modeling and simulation techniques.

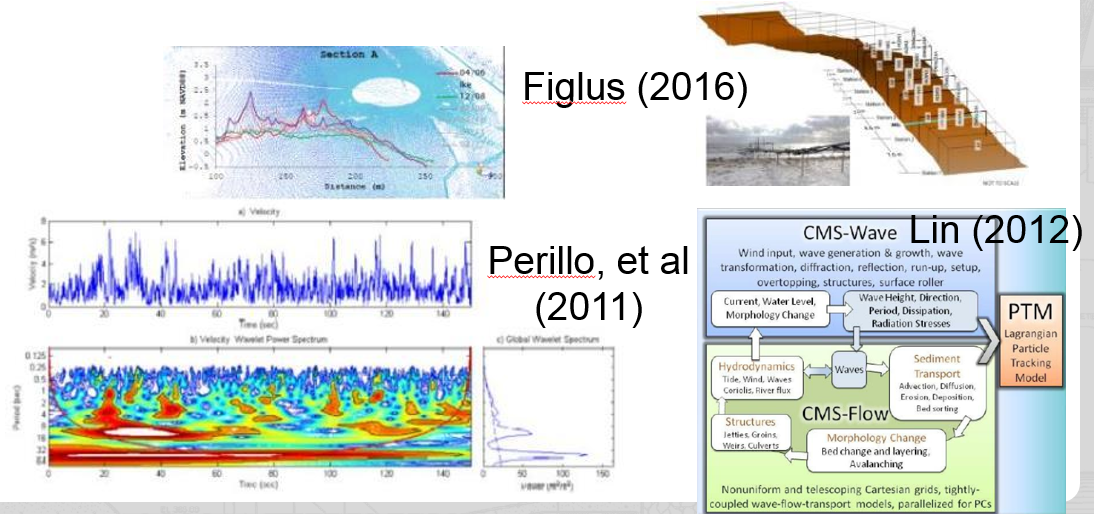


Figure 1. Illustrative concepts of AFA 1.

b. AFA 2. Understanding of flows and circulation of river, estuary, and coastal waters, sediment, and nutrients, with interactions on morphological evolution:

(1) on coastal biophysical systems, processes, and associated spatiotemporal changes at regional scale under relevant regimes (delta-, tide-, and wave dominated),

(2) on anthropogenic influences, extreme coastal weather forcings, and relative sea level change.

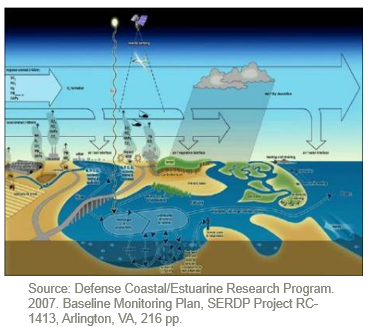


Figure 2. Illustrative concepts of AFA 2.

c. AFA 3. Understanding the future of coastal engineering material properties:

(1) of biological, biosynthetic, and manufactured/synthetic materials individually and collectively when forming natural and nature-based features,

(2) to include interactions with structural features, under stresses, strains, fatigue, and failure modes of ocean and coastal systems and processes.

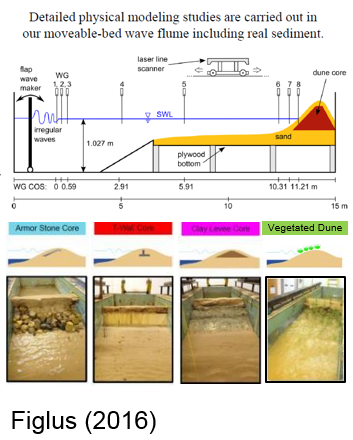


Figure 3. Illustrative concepts of AFA 3.

d. AFA 4. Advancement of reduced order model techniques:

(1) for reduction, parameterization, and application of scientific data and model simulation results of complex relationships,

(2) that inform multi-objective life cycle systems scale project planning, pre-construction, engineering and design, construction, operations, and maintenance.

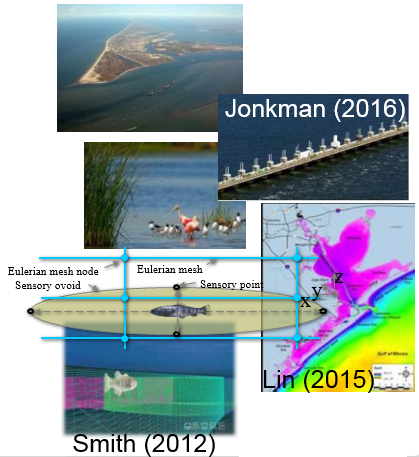


Figure 4. Illustrative concepts of AFA 4.

e. AFA 5. Evolution of engineering and design, construction, operations, and maintenance methods:

(1) for integration of natural, nature-based, and structural ocean and coastal systems and processes toward sustainable and resilient lifecycle performance:

(2) under significant stressors and drivers, considering spatiotemporal morphological changes, cyclic perturbations, and feedback signal responses.



Figure 5. Illustrative concepts of AFA 5 (Linkov, et al. 2006).

f. AFA 6. Infusion of principles and practices of ocean and coastal mega infrastructure decision support systems:

(1) for risk and reliability assessment, decision robustness, decision regret management, and adaptation, for life cycle realization of economic, environmental, and social objectives

(2) across phases of pre-construction, engineering, design, construction, operations, and maintenance.

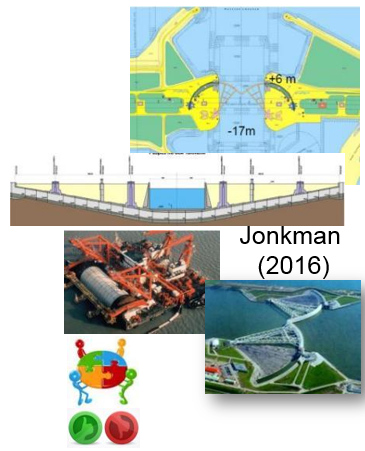


Figure 6. Illustrative concepts of AFA 6.

g. AFA 7. Integration of technology and science with USACE practice and policy:

(1) to infuse developed science and technology into USACE guidance and policy in a faster and more consistent manner.

(2) for relating knowledge, USACE guidance, and tools to each other in a holistic manner to enable faster, higher quality production of engineering works.

**7. Approach.**

a. Collaborate to lay out a 5 year co-development PgMP based on the vision, intent, and strategy, reviewed and updated annually under leadership steering, with a view towards technically informing high priority knowledge gaps on the SWG portfolio of studies and projects with relevant ERDC and TAMU R&D program priorities.

b. Develop a SME interdisciplinary team blend that leverages the expertise, perspectives, and resources of ERDC, SWG, Federal/state resource management agencies, regional academia (e.g., TAMU, Corpus Christi, Galveston, and College Station Campuses, Departments of Science and Engineering, Marine Sciences, and Ocean and Coastal Engineering), and industry.

c. Engage regional university faculty for exploring and identifying alignment between academic instruction programs and this value proposition. Integrate and inspire coastal science and engineering students with meaningful co-development work. Exploit USACE student employment programs of talented and energized students as a gateway for career onboarding at ERDC, SWG, or elsewhere in USACE, industry, and academia, where right fits exist.

d. Integrate a TAMU OCEN – USACE SWG-based GoM coastal field data collection capability to support study, project, and research requirements and align with the Duck Field Research Facility (FRF), TAMU, Conrad Blucher Institute, University of Texas, Bureau of Economic Geology, Texas Coastal and Ocean Observation Network (TCOON), and other regional assets and organizations to ensure a strategic measuring and monitoring program supporting nationally robust development of S&T solutions across a range of coastal settings.

e. Infuse principles of technology integration into the co-development setting for deriving continuity in accelerated enterprise learning, competency, and capacity building, which reduces levels of effort, increases quality, diminishes timeframes to delivery, and lowers costs, toward producing high value, actionable studies and project products that are not otherwise possible.

f. Organize a CSEC with strategically aligned partner campuses under cross-organization institutional leadership steering structure among USACE and cooperating partners for building relationships and commitments to provide continual program direction on the vision, strategy, actions, and nationally relevant capabilities and products. Use a cyclic business process, consistent with that for ERDC R&D program investments, for:

(1) Develop AFAs representing the business-relevant topic areas for research and development. Engage research sponsors in the development of these AFAs.

(2) Calling for concept proposals from among scientists and engineers of collaborating organizations in the CSEC AFAs.

(3) Reviewing concept proposals to further evolve/define the CSEC AFAs.

(4) Engaging the CSEC BOD and ERG for eliciting comments/suggestions on further development of the CSEC AFA scopes, product delivery timelines, and cost ranges, with a view towards seeking financial support for the CSEC PgMP as an investment prospectus.

(5) Cultivating technical proposals from among scientists and engineers of collaborating organizations in the CSEC AFAs, to include a coordination plan that intimately involves SWG practitioners and TAMU students throughout. See Appendix A for initial proposals developed thus far under the AFAs.

(6) Reviewing/commenting on technical proposals for refinement, Research Project Management Plan (RPMP) development, and consideration of funding under the CSEC PgMP.

(7) Conducting effective and efficient semi-annual reviews of progress on funded RPMPs for steering to product completion and infusion into practice.

(8) Developing and measuring key business process metrics for success on capability/product development and infusion into practice:

(a) Reduction in mission management levels of effort,

(b) Shortening of mission management turn-around times required,

(c) Lowering of mission management costs, and

(d) Increase in quality of knowledge, tools, and expertise delivered to support mission management.

The above-described CSEC business process with accompanying document templates will be developed for establishing practice standards that support acumen in the focus of resources on structured, disciplined product delivery.

**8. Goals.**

a. Foster new relationships between district practitioners, ERDC SMEs, TAMU OCEN professors/researchers/students, and industry that support vibrant exchange on knowledge of relevant S&T challenges/context toward co-development proposal development, attraction of supporting funding, and results achievement.

b. Synchronize district, ERDC, TAMU, and industry partner budget processes on co-development objectives.

c. Illuminate collaborating organizational enterprise leaders on the co-development value proposition for building and sustaining strategic support for CSEC.

d. Attract industry and agency resources and funding to support planning, execution and annual updating of the CSEC 5-year PgMP.

**9. Objectives.**

a. Inform ongoing studies/projects with ready S&T for increased product value delivery and milestone execution.

b. Opportunistically infuse emerging S&T into anticipated and new studies/projects through USACE guidance documents and tools for pilot demonstration and refinement toward mainstreaming across USACE Gulf coast districts and other similar coastal settings nationally.

c. Exploit data of ongoing and completed studies/projects to identify key extant uncertainties and knowledge gaps for formulating priority R&D that will provide closure into next phases of project life cycles.

d. Actively participate in district and ERDC sensing opportunities as a SME cadre to inform scoping of new studies/projects in context of existing S&T barriers that if scoped for R&D at that time, would become viable, valuable pursuits for co-development.

**10. Intended Capabilities and Products.**

a. Next Generation Coastal Science and Engineering Knowledge and Expertise. Establish a world-class S&T capability that technically informs district studies and projects across their respective phases and life cycles with laboratory and field scientific experimentation, scalable field pilot-learn demonstrations, and ERDC R&D programs on nationalizing results for wider relevancy. Opportunistically leverage opportunities on select SWG studies and projects for CSEC collaboration, which are being advanced under the General Investigations, Construction General, and Operations and Maintenance Programs, the Continuing Authority Program (CAP), Flood Plain Management Services (FPMS) Program, Planning Assistance to States (PAS) Program, and Silver Jackets Program. The hub of activities is envisioned to include a broad range of science and engineering relevant to the interface of infrastructure, environment, and social systems within the coastal context.

b. Coastal Science and Engineering Laboratory. The TAMU OCEN Haynes Coastal Engineering Laboratory in College Station, TX, is in the process of being dismantled to provide for other academic uses. TAMU OCEN has an interest in these laboratory assets being relocated in Galveston, TX, ideally on the TAMU campus, for renewed use in the new combined Ocean and Coastal Engineering Programs under OCEN.

The challenge for a facility location at the Galveston campus is that lands and buildings there are scarce. There has been discussion of these assets being relocated to ERDC in Vicksburg, MS, with the offer for TAMU to have full access and use. However, this option is deemed too distant for effective use by TAMU. Thus, there are currently no definite plans for these assets to be used elsewhere for similar or different purposes.

Once the facility is sited in Galveston, it would strategically enable the Coastal Science and Engineering Collaborative (CSEC) PgMP, among other intended purposes of TAMU OCEN. The PgMP would effectively become a revenue source for the facility, while it is used to develop and deliver best in class coastal science and engineering.

At their 11 NOV 16 meeting, the TAMU OCEN BIA offered the following on a vision for the facility.

(1) The larger the facility the better, for reducing adverse effects of scaling, and reducing the limitations of the scope of modeling that can be performed.

(2) Have at least one large flume and a basin. The intent for the flume is to generate the largest unidirectional waves possible. The basin would be for investigations involving wave refraction, diffraction, active reflective adsorption, multi-directional waves, etc. Make the basin completely modular, composing tanks using pony walls and movable wave generators/attenuators. This allows for odd geometry basins and multiple wave tanks within the same basin. With this the lab could be working on several projects at once.

(3) The laboratory would need to have heavy machinery available for setting up experiments. For NNBF experiments, efficient handling of soils and other natural materials is necessary, both for placement and clean up, e.g., vacuum/filtration system.

(4) High level data collection equipment is required to meet advance research requirements. For example, built in pressure sensors in the floor could provide for wave heights and measurements in multiple locations throughout the domain.

(5) The ability to model wind in coastal processes along with hydrodynamics should be included in the laboratory capability.

(6) The facility must have knowledgeable staff for operations and maintenance.

(7) The facility will need adequate storage and construction space.

(8) The laboratory needs a “seller-doer” leader that has strong contacts with industry and government, and a successful track record winning research grants, to meet facility technical achievement and revenue generation expectations.

(9) The facility should incorporate the multi-spectral wave generator and dredge loop and equipment from the Haynes Laboratory.

(10) The facility should provide space for geotechnical and other specialty equipment crossing over from coastal science and engineering to other related physical and ecological science and engineering disciplines.

(11) The laboratory should have a set of ocean and coastal mobile deployable field experimentation platforms. The ocean platform could consist of an instrument frame that is attachable to an offshore jack-up rig, which could be rented and deployed on demand for field data collection, pursuant to research objectives. The coastal deployable experimentation system could consist of a field-deployable tubular rubber bladder system that forms temporary prototype scale wave flume conditions for experimentation at select sites coast wide.

(12) The laboratory should have a state of the art collaboration room for hosting workshops that allow remote participation. High quality video and audio is desired along with a control station/podium.

c. Coastal Systems Manual. Create a web-interactive knowledge and tool interface with complementary linkage to the USACE Coastal Engineering Manual, as well as relevant journal articles, with contemporary themes that technically inform USACE SMART planning, engineering, design, construction, operations, maintenance, rehabilitation, and replacement of civil works infrastructure as an improved method of delivery under USACE Civil Works Transformation. The tool will include an automated data based process for entry and subsequent generation of engineering regulations and manuals and will include a process for automating the review and approval process as well as integrating guidance back into software developed by ERDC and TAMU researchers.

d. Knowledge Development and Technology Transfer.

(1) Coastal Science and Engineering Pedagogy. Work across academia, R&D, and practice to conceptualize, formulate, and develop a “coastal science and engineering with nature” curriculum, formed via knowledge discovery through CSEC activities, for degree program instruction at TAMU. Dovetail this instruction with CSEC activities in computational modeling and simulation centers, laboratories, and demonstration field sites. Develop a formal academic teaching publication on the topic for use in the process.

(2) Web Interactive Technology. For each collaborative demonstration project, knowledge and technology transfer will be conducted by utilizing web-interactive knowledge and tool interface that technically informs planning and design teams through the use of searchable fact sheets that link to design documentation, plans and specification, and lessons learned.

e. National Coastal Systems Training and Demonstration Collaboratorium. Provide for a USACE District- and industry-centric setting that coastal practitioners nationally are able to train at under the SME cadre located at the CSEC. Deploy ERDC and TAMU SMEs as required to augment the training cadre for maximizing effectiveness of technical transfer of locally generated technical solutions having national relevancy. Long term training opportunities for USACE coastal district staff will be supported for field scale demonstration projects.

Coupling this training collaboratorium with academia and the ERDC Graduate Institute (see: <http://www.erdc.usace.army.mil/%5Ccareers%5Ctrainingandeducation%5Cthegraduateinstitute.aspx>) will enable advanced training opportunities in an innovative technology testbed setting. There is crossover with academic programs where research has potential to support student graduate work at OCEN under Guardian of the Gulf, RSM, and EWN themes. Since TAMU is a university member of the ERDC Graduate Institute, there also are opportunities to extend this relationship for members of USACE enterprise wide to enroll in and take OCEN courses online via distance learning. This could include obtaining a USACE Coastal Engineering Certificate (see: <http://cirp.usace.army.mil/CECEC/_files/CECEC-Summary013014.pdf>).

**11. Path Forward.**

The CSEC PgMP contains AFA SONs to-date, summarized in Table 1 as follows (see Appendix A):

**Table 1. AFA Statements of Need (SONs) – Proposed Initial Multi-Year Annual Budget.**



The proposed next steps in developing the CSEC PgMP toward a value proposition for funding and implementation include the following:

a. Distribute the preliminary draft CSEC PgMP to the TAMU OCEN BIA for initial feedback on the general program approach, suggestions for technical improvement, and strategies/sources for eliciting funding to deliver the program (DEC 17).

b. Distribute the revised CSEC PgMP to intended collaborators for evolution, along with a companion draft technical workshop agenda (APR 17).

c. Execute a CRADA between TAMU Foundation and USACE ERDC (APR 17).

d. Back brief the TAMU OCEN BIA on progress and way forward (MAY 17).

e. Conduct workshops for interaction on collective further development toward convergence of agreeing to enter into partnership (AUG 17).

f. Present an evolved draft of the PgMP, including the developed agreements with proposed agency funding and expression of foundation financial support needs, to interested industry and conservationist investors as foundation stakeholders, for feedback on improvement and expression of interest for financial support (OCT 17).

g. Back brief the TAMU OCEN BIA on progress and needs for financial support (NOV 17).

h. Provided the required financial support is achieved, implement the PgMP (JAN 18).

i. Establish re-occurring engagements for engaging PgMP investors for reporting status/needs of execution and annual updating, which could be held in connection with the SWG Summer and Winter Stakeholder Partnering Forums (Bi-Annually).

**12. Collaborators (Living Listing).**

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**Appendix A – R&D SONS**

**AFA 1. Discovering breakthrough science.**

**Tracker – Title:** AFA-01-16-01 – Biophysical System Performance of Natural and Nature Based Features (NNBFs) for Coastal Storm Risk Management (CSRM) SMART Planning Studies.

**Need that Drives Requirement:** Scientific evidence suggests NNBFs dissipate coastal storm energy for dampening the effects of land-based flooding. If NNBFs are to be considered in CSRM planning studies, there is a need to reliably quantify this phenomena in an integrated biophysical systems context.

**Extent of Need Across USACE:** The need extends across USACE districts located in coastal areas that are: exposed to coastal storms; low-lying; actively morphodynamic; experiencing the effects of relative sea level change (RSLC); and have extensive coastal development and inhabitation at risk. This includes considerable portions of the Atlantic and Gulf Coasts.

**Requirement:** Reliable characterization of integrated biophysical and CSRM performance of NNBFs is required for rapid application by USACE districts under the SMART planning paradigm. This enables districts to consider NNBF measures during planning for developing the recommended plan, based on the identified Tentatively Selected Plan (TSP).

**Consequences if Requirement Not Met:** Without these requirements being met, districts are unable to reliably quantify and defend NNBF performance in providing CSRM benefits. Until this new knowledge, tools, and competencies are infused into practice, districts will continue to primarily use traditional structural and non-structural CSRM measures in planning. Projects implemented with continued traditional practice could potentially experience losses of sustainability and resilience that may otherwise have been preserved had NNBFs been considered in planning recommendations. In addition, lack of ability to defensibly incorporate NNBFs for CSRM into recommended plans has potential to result in NED BCRs that do not meet the minimum requirements for authorization and/or appropriations. This occurrence could result in coastal development and inhabitation remaining at risk of loss to coastal storm impacts that could have otherwise potentially been addressed via a CSRM project that incorporates NNBFs. Lack of CSRM project implementation where needed will also lead to otherwise higher costs for post-storm damage recovery, which has potential in extreme coastal storm events to be catastrophic and become a significant Federal cost.

**Product Recommendation:**

**Product Description.** The product is proposed to be a set of biophysically non-dimensional parametric relationships that are rapid and reliable to apply via geospatial techniques in the SMART planning process. The following is a conjectured approach for developing the product capability.

**Data Requirements.** The approach to develop this product is historical data-intensive. The coast of Texas has a rich data set that is relevant to the need. Additionally, the Texas coast has a wide range of coastal feature types and compositions that are similar parametrically to other Gulf of Mexico and Atlantic shores. These consist of a wide range of low-lying river deltas, chenier plains, barrier islands, peninsulas, beach and dune systems, headlands, wetlands, estuarine bays and lagoons, and maritime forest ridges. SWG has a data-rich series of historical coastal landscape aerial imagery from the Sabine to Rio Grande Rivers on the Texas coast. This region also has excellent historical coastal forcings of wind, wave, and water level data through the Texas Coastal and Ocean Observation Network (TCOON).

**Proposed Approach.** This research is dependent on applying methods that initially implicitly link coastal forcing energies to corresponding coastal landscape change. To advance this research, it is proposed that Texas coastal historical landscape change data, available since the 1960s-present on a 3-yr cycle, be cataloged by wave-, tide-, and delta-dominated regimes. Within each regime cataloged, similar landscape change episodes from mild to severe should be grouped using methods of cluster analysis. These should be paired with respectively corresponding time durations of coastal forcing energies, then statistically correlated and probabilistically quantified, based on a scientifically-informed process-based forcing cause and morphological effect. The results should be organized into a database catalog. A proxy for coastal forcing energy is proposed to be derived from time series integration of representative TCOON measured water level signals.

Use of non-dimensional analysis is proposed for application as a first principles approach to link time duration coastal forcing energies to corresponding landscape change episodes of each regime, episode, and cluster. This approach will implicitly relate biophysical causes and effects of waves, surges, tides, and circulation, on movement of sediments, changes in feature geometry, and influences of vegetation types on the coastal systems, for each regime, episode, and cluster. Likewise, where coastal structures exist (e.g., jetties, groins, shoreline protection, seawalls, etc.), the resulting influences will be implicitly incorporated. A battery of hypothesized non-dimensional parametric relationships with experimental exponents should be derived for each regime, episode, and cluster. The experimental exponents should represent the complexities on the interactions of coastal forcings with vegetated landscape features, to include, but not be limited to: hydrodynamic drag over vegetative features; sediment vegetative anchoring and retention; interaction between NNBFs and structures; substrate responses; and non-linear system feedback signals. The experimental exponents should be found through multiple non-linear regression analysis to identify the hypotheses producing the statistically best parametric pattern relationships. These should be stored as the solution sets for each regime, episode, and cluster in the database catalog.

The parametric pattern relationships should be leveraged in database recall using geospatial techniques to inform establishment of and/or refine characterization of the Future Without Project (FWOP) conditions, considering the applicable range of RCLC scenarios. Likewise, this technique should be performed to inform use of NNBFs, structural, and non-structural measures for developing the recommended plan, based on the TSP, as well as to support quantification of recommended plan CSRM benefits.

**Proposed Method of Delivery into Practice.** It is proposed that this research be co-developed by a combination of ERDC, SWG, and TAMU, via the Coastal Science and Engineering Collaborative (CSEC), as supported by the Coastal Engineering Research Board. In this approach, SWG practitioners will provide the foundational data, inform the need and requirements, and support ERDC and TAMU researchers in advancing the research work unit through regular engagement and direct linkage into district technical practice. Via this co-development approach, the district practitioners will become subject matter experts on field implementation of the capability and will be able to support wider infusion into practice nationally.

**Estimated Time and Cost.** Notionally, development of this capability should take approximately 2 years and cost about $1 M. SWG is in the process of digitizing and organizing the historical coastal landscape change data, which is valued at approximately $250K in addition to this amount. TAMU is actively engaged via CSEC and could provide academic support to ERDC via a CESU or BAA. Additionally, TAMU has funded research on this topic and may be able to participate via this mechanism.

**Future R&D Value.** The product completed under this SON will be foundational to advancing the following related SONS: AFA-02-16-01, AFA-04-16-01.

**Collaborators:** Edmond Russo/SWG, Todd Bridges/ERDC, Jane Smith/ERDC, Rob Thomas/SWG, Corragio Maglio/SWG, Tom White/SWG, Paul Hamilton/SWG, Jens Figlus/TAMU, Bert Sweetman/TAMU, Candice Piercy/ERDC, Todd Swannack/ERDC, Safra Altman/ERDC, Tosin Sekoni/ERDC, Joe Gailani/ERDC, Mark Gravens/ERDC, Julie Rosati/ERDC, Todd Bridges/ERDC, and Linda Lillycrop/ERDC.

**AFA 2. Understanding of flows and circulation of river, estuary, and coastal waters, sediment, and nutrients, with interactions on morphological evolution.**

**Tracker – Title:** AFA-02-16-01 – Biophysical System Performance of Natural and Nature Based Features (NNBFs) for Coastal Storm Risk Management (CSRM) Pre-Construction, Engineering, and Design (PED).

**Need that Drives Requirement:** Scientific evidence suggests NNBFs dissipate coastal storm energy for dampening the effects of land-based flooding. If NNBFs are to be incorporated as features in CSRM project PED for authorized projects, there is a need to reliably quantify this phenomena in an integrated biophysical systems context.

**Extent of Need Across USACE:** The need extends across USACE districts located in coastal areas that are: exposed to coastal storms; low-lying; actively morphodynamic; experiencing the effects of (RSLC); and have extensive coastal development and inhabitation at risk. This includes considerable portions of the Atlantic and Gulf Coasts.

**Requirement:** Reliable characterization of integrated biophysical and CSRM performance of NNBFs is required for defensible application by USACE districts to enable detailed engineering and design (E&D) of these measures during PED of authorized projects for construction.

**Consequences if Requirement Not Met:** Without these requirements being met, districts are unable to reliably quantify and defensibly incorporate NNBF into PED for providing authorized CSRM benefits. Until this new knowledge, tools, and competencies are infused into practice, districts will have challenges in attaining authorization for incorporating NNBFs with traditional structural and non-structural CSRM measures in PED. Projects authorized and implemented with continued traditional practice could potentially experience losses of sustainability and resilience that may otherwise have been preserved had NNBFs been considered for inclusion in construction authorization. In addition, lack of ability to incorporate NNBFs as value-added features contributed to landscape scale CSRM into PED with authorized structural and non-structural measures has potential to result in NED BCRs during required 3-yr cyclic economic updates during PED that do not meet the minimum requirements for budget appropriations competition. This occurrence could result in coastal development and inhabitation remaining at risk of loss to coastal storm impacts that could have otherwise potentially been addressed via a CSRM project that incorporates NNBFs. Lack of CSRM project implementation where needed will also lead to otherwise higher costs for post-storm damage recovery, which has potential in extreme coastal storm events to be catastrophic and become a significant Federal cost.

**Product Recommendation:**

**Product Description.** The product is proposed to be a biomorphological model capabilities and attendant results that are reliable to apply during the PED process. The following is a conjectured approach for developing the product capability.

**Data Requirements.** The approach to inform development of this product is dependent on completion of the product as described under AFA-01-16-01.

**Proposed Approach.** The database catalog solution sets (see AFA-01-16-01) should be parsed into equally distributed data groups for each regime, episode, and cluster, and used respectively for coastal biophysical process (biomorphodynamic) model formulation, calibration, and validation that results in a reliable predictive capability of coastal feature landscape changes under coastal forcings, as a function of sea level conditions. The integrated heterogeneous sediment-vegetative coastal features should be modeled homogeneously as “effective sediment grain size distributions” that serve as an implicit proxy for this complex phenomena characterization. The biomorphodynamic model should be applied under the known historical time series of coastal forcing energies corresponding to each regime, episode, and cluster, for automated convergence using the Newton-Raphson Method on respectively identifying the most statistically representative “effective sediment grain size distributions”. The results should be cataloged to the database as a coastal features performance atlas.

The coastal features performance atlas should be leveraged in database recall using geospatial techniques to inform E&D of authorized NNBFs, structural, and non-structural features of the PED phase for construction, considering the applicable range of RCLC scenarios.

**Proposed Method of Delivery into Practice.** It is proposed that this research be co-developed by a combination of ERDC, SWG, and TAMU, via the Coastal Science and Engineering Collaborative (CSEC), as supported by the Coastal Engineering Research Board. In this approach, SWG practitioners will provide the foundational data, inform the need and requirements, and support ERDC and TAMU researchers in advancing the research work unit through regular engagement and direct linkage into district technical practice. Via this co-development approach, the district practitioners will become subject matter experts on field implementation of the capability and will be able to support wider infusion into practice nationally.

**Estimated Time and Cost.** Notionally, development of this capability should take approximately 3 years and cost about $3 M.

**Future R&D Value.** The product to be completed under this SON is dependent on completion of SON AFA-02-16-01, and will be foundational to advancing the related SON AFA-04-16-01.

**Collaborators:** Edmond Russo/SWG, Todd Bridges/ERDC, Jane Smith/ERDC, Rob Thomas/SWG, Corragio Maglio/SWG, Tom White/SWG, Paul Hamilton/SWG, Jens Figlus/TAMU, Bert Sweetman/TAMU, Candice Piercy/ERDC, Todd Swannack/ERDC, Safra Altman/ERDC, Tosin Sekoni/ERDC, Joe Gailani/ERDC, Mark Gravens/ERDC, Julie Rosati/ERDC, Todd Bridges/ERDC, and Linda Lillycrop/ERDC.

**AFA 3. Understanding the future of coastal engineering material properties.**

**Tracker – Title:** AFA-03-16-01 – Stabilization of Erodible Clay Dike for Protection of Dredged-Material Placement Areas.

**Need that Drives Requirement:** Placement areas for dredged materials are used in nearly all coastal Districts. These areas are protected by some sort of physical barrier, commonly referred to as a dike or levee. Such dikes are made of a variety of materials in different settings and are subject to highly variable and site-specific combinations of the erosive forces. It is common for such dikes to require repeated maintenance and even entire re-construction.

Standard shore-protection design methods for these dikes are inadequate, because: (1) standard designs rely on hard (rock/concrete) structures, (2) little sand is available, so that the standard soft solution of a beach dune is not possible, and (3) vegetation is rarely used as a component of current design methods.

A variety of biological stabilization methods should be incorporated to protect placement-area dikes, especially erodible clay berms, because plant roots are vital fir sediment accretion (Feagin, 2009; Gedan et al., 2011). Anecdotal and conventional methods cannot be relied upon to yield new, cutting-edge information about dike stabilization methods. Biological stabilization methods are inadequately documented, and successes are almost entirely unquantified.

**Extent of Need across USACE:**

(1) Several Districts in coastal areas have placement areas in bays with very limited sand sources. Thus mixed sediments (less than half sand) need to be used to build protective dikes around placement areas that are filled with loose high-water-content muds.

(2) In Districts that have sand supplies, it is rare that the dredged-channel material is rich in sand. Therefore, in these Districts, a much more cost effective method of building protective dikes would be to utilize muddy sediments dredged from the navigation channel, thereby avoiding separate transport of sandy sediments from non-channel sites.

(3) In both coastal Districts and ones with inland waterways, current engineering practices could be enhanced by utilizing native plant species as additional features. Vegetation on traditional structures can synergistically stabilize the dikes in placement areas.

**Requirement:** Four other projects are already in place for this general topic:

(1) Construction contract for dike construction, surveying, and settlement-plate measurements in Galveston Bay has already been awarded.

(2) A Galveston District PMP is in place for measuring physical variables, such as sediment suspension, water levels, currents, and waves. Empirical correlations will be performed between these physical parameters and dike erosion.

(3) An ERDC research project has incorporated this site as an example for technology transfer to the Districts, regarding physical characteristics and behavior of the dike.

(4) A Galveston District project now in design phase will test a variety of different substrates and physical designs for oyster reefs just outside of the clay dike. The reefs would act as new oyster habitat, function as a partial breakwater to protect the dike, and hopefully will become a naturally growing breakwater, as sea level rises.

The need requested for this research is to quantify biological methods of stabilizing the clay dike. Methods should be investigated for both rapid establishment of the interior marsh with desirable plant species and vegetating/stabilizing the protective dike.

Goals for successful marsh-and-dike stabilization should include:

• Establishment of desirable plant communities

• Minimize erosion and maximize accretion

• Correlate relationships between dike characteristics and marsh growth

• Wave attenuation by plants

• Plant recruitment

• Inundation frequency and induced gains/losses

• Determination of the most effective native species

• Comparison of reef materials which facilitate oyster recruitment

• Growth and establishment of oyster populations

**Consequences if Requirement Not Met:**

(1) Placement areas may destabilize, requiring reconstruction of protection dikes.

(2) Although placement areas can continue to be used, opportunities for establishment of native species may be lost and result in establishment of undesirable/invasive species.

(3) Poor environmental stewardship.

**Product Recommendation:**

(1) Technical Report incorporating a summary of biological-stabilization techniques;

(2) Technical Note on species-specific planting recommendations, to include a variety of measureable markers of success, such as:

• Effect on interior marsh establishment

• Success or failure in stabilizing barrier dike

• Quantification of wave attenuation

• Plant recruitment

• Native species propagation

• Reef material comparison

• Oyster recruitment

(3) Publication of Journal Article on planting success by species, with specific results as measured by several variables, such as:

• Stem diameter

• Root biomass

• Aboveground biomass

• Drag, lift, and uprooting forces

• Plant-induced accretion of sediment

• Physical sediment characteristics (grain size, porosity, shear stress)

Already funded are dike construction, substrate placement, initial seeding, measurement of physical forcing (waves, water levels, currents, turbidity, suspension), and physical characterization of substrate (grain size, Shields’ yield shear stress, erodibility index).

This eco-geomorphic work unit would be responsible for all biological, ecological, and geomorphological measurements and analyses. Benefits to be derived from this project include the opportunity to quantitatively assess Engineering with Nature capabilities, using native plant species and artificial reefs in an erosive system.

Notionally, this R&D would cost approximately $0.5 M and have a 3 year duration.

**Originator:** Galveston District H&H Branch – Thomas E. White, Ph.D., P.E.

**References:**

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**AFA 4. Advancement of reduced order model techniques.**

**Tracker – Title:** AFA-04-16-01 – Lifecycle Adaptive Management of Biophysical System Performance for Constructed Natural and Nature Based Features (NNBFs) in Coastal Storm Risk Management (CSRM).

**Need that Drives Requirement:** Scientific evidence suggests NNBFs dissipate coastal storm energy for dampening the effects of land-based flooding. If NNBFs are constructed in authorized CSRM projects, there is a need to reliably and objectively monitor, assess, and adaptively manage these features from in an integrated biophysical-built coastal infrastructure systems context. The intent is to sustain the performance of these features over the project life cycle for the investments made during construction.

**Extent of Need Across USACE:** The need extends across USACE districts located in coastal areas that are: exposed to coastal storms; low-lying; actively morphodynamic; experiencing the effects of Relative Sea Level Change (RSLC); and have extensive coastal development and inhabitation at risk. This includes considerable portions of the Atlantic and Gulf Coasts.

**Requirement:** Reliable characterization of integrated biophysical and CSRM operations, maintenance, and adaptation (OMA) performance management of regional scale NNBF-built coastal infrastructure is required for application by USACE districts to enable resiliently sustaining delivery of authorized features/outputs after construction, considering future scenario uncertainties. A reliable NNBF-built infrastructure CSRM OMA performance management decision analytics system for district use is required to continually justify future appropriations for resiliently sustaining delivery of this outcome.

**Consequences if Requirement Not Met:** Without these requirements being met, districts are unable to reliably assess and manage NNBF-built coastal infrastructure performance in resiliently sustaining CSRM benefits on a regional scale. Until this new knowledge, tools, and competencies are infused into practice, districts will continue to primarily use traditional techniques for OMA performance management, which are currently intensively labor-intensive and dependent on SMEs. Projects implemented with continued traditional practice could potentially experience losses of sustainability and resilience that may otherwise have been preserved had this approach been considered in parallel with planning, PED, and construction for implementation during the OMA phase. In addition, lack of ability to have this assessment and management tool in place has potential to result in intended NED not being resiliently sustained over the project life cycle. This occurrence could result in coastal development and inhabitation becoming exposed to risk of loss to coastal storm impacts that could have otherwise potentially been addressed via an assessment and management capability in place to achieve resilience and sustainability of regionally integrated coastal infrastructure. Lack of tool implementation where needed will also lead to otherwise higher costs for post-storm damage recovery, which has potential in extreme coastal storm events to be catastrophic and become a significant Federal cost.

**Product Recommendation:**

**Product Description.** The product is proposed to be a performance assessment and management tool for quantifying conditions, functions, and outputs of constructed features that are in the OMA phase. The intent is to link the tool to field monitoring systems for quantifying performance and informing OMA requirements to ensure a lifecycle of sustainable and resilient regionally integrated coastal infrastructure system. The following is a conjectured approach for developing the product capability.

**Data Requirements.** The product to be completed under this SON is dependent on completion of products from SONs AFA-01-16-01, and AFA-02-16-01. Additionally, a coast wide field data collection program, tied to assessing and managing the conditions, functions, and outputs of constructed features in the OMA phase, will be required. Data from agencies and academic institutions currently being collected will serve as a basis for structuring remaining data collection needs.

**Proposed Approach.** The improved understanding of NNBF CSRM performance, in context of structural and non-structural measures, could be used in future R&D to extrapolate spatiotemporal Empirical Orthogonal Function (EOF) principal components that drive long-term coastal morphological changes. These EOFs could be used for parameterization and calibration of field prototype, laboratory scale model, and numerical flume studies of complex multi-dimensional coastal features, which are comprised of combinations of sediments, vegetation, and structures, for providing mechanistic coupling with landscape scale NNBF biophysics-based performance. This coupling of approaches will provide a critical capability for supporting OMA of NNBFs on constructed landscape scale projects. It would also represent a leap-ahead breakthrough capability in NNBF performance characterization, which could be used to inform development of a first principles nested mechanistic morphodynamic finite element large domain systems model. This breakthrough capability, in combination with a coordinated spatiotemporal network of biophysical field observations, could be used under a reduced order expert model decision framework to adaptively manage constructed NNBFs for resiliently sustaining CSRM objectives of integrated large-scale coastal infrastructure investments, considering system stressors and future uncertainty drivers.

**Proposed Method of Delivery into Practice.** It is proposed that this research be co-developed by a combination of ERDC, SWG, and TAMU, via the Coastal Science and Engineering Collaborative (CSEC), as supported by the Coastal Engineering Research Board. In this approach, SWG practitioners will provide the foundational data, inform the need and requirements, and support ERDC and TAMU researchers in advancing the research work unit through regular engagement and direct linkage into district technical practice. Via this co-development approach, the district practitioners will become subject matter experts on field implementation of the capability and will be able to support wider infusion into practice nationally.

**Estimated Time and Cost.** Notionally, development of this capability should take approximately 3 years and cost about $3 M. TAMU is actively engaged via CSEC and could provide academic support to ERDC via a CESU or BAA. Additionally, TAMU has funded research on this topic and may be able to participate via this mechanism.

**Future R&D Value.** The products of this R&D would be instrumental for informing landscape scale ecological models that are able to improve understanding of Ecosystem Goods and Services (EGS) performance of NNBFs.

**Collaborators:** Edmond Russo/SWG, Todd Bridges/ERDC, Jane Smith/ERDC, Rob Thomas/SWG, Corragio Maglio/SWG, Tom White/SWG, Paul Hamilton/SWG, Jens Figlus/TAMU, Bert Sweetman/TAMU, Candice Piercy/ERDC, Todd Swannack/ERDC, Safra Altman/ERDC, Tosin Sekoni/ERDC, Joe Gailani/ERDC, Mark Gravens/ERDC, Julie Rosati/ERDC, Todd Bridges/ERDC, and Linda Lillycrop/ERDC.

**AFA 5. Evolution of engineering and design, construction, operations, and maintenance methods.**

**Tracker – Title:** AFA-05-16-01 – Environmentally Acceptable Methods for Dredged-Material Disposal in Deep Holes.

**Need that Drives Requirement:** Many USACE navigation channels have dredge-disposal placement areas that are nearing capacity. One opportunity for new placement is in deep holes that were artificially created long ago with methods that would no longer be permitted today. Galveston District has a number of such large deep holes (>20 ft deeper than the Bay bed) that were the result of mining multiple old layers of oyster shells for use as construction materials. These holes have not been inventoried, but some non-systematic evidence indicates capacity in the tens of millions of cubic yards. In other Districts, such as Jacksonville, similar holes were mined for construction materials, but to a smaller extent, in both area and depth. Florida has since successfully filled in and capped some of these holes, but there are environmental concerns voiced by the Resource Agencies as to possible undesirable side effects caused by dredged-material disposal methods.

In addition to the opportunity for dredged-material disposal, there are desirable environmental reasons for eliminating the holes. The holes are considered to be “environmental deserts” that are known to be anoxic, toxic (with sulfur dioxide generated by anoxic bacteria), and devoid of desirable biota. Resource Agencies have expressed encouragement for eliminating these holes, but have concerns about side-effects caused by disposal methods. Specifically, the anoxic fluffy material at the bottom of these holes may be displaced to the surrounding shallow Bay and kill off bottom dwellers and filter feeders (oysters).

**Extent of Need across USACE:** These deep mining holes near navigation channels have not been inventoried, thus the total extent in other Districts is unknown. This engineer is aware of such holes in Puget Sound, New York Harbor, Barnegat Inlet (NJ), Mobile Bay (Brookley Hole), various locations in Florida, and in Galveston Bay (TX).

Mobile has successfully completed a one-time experimental placement in one hole. However, conditions vary widely between bays. There is a need to report to the entire Corps what procedures work under what conditions and extend this success to other Districts.

**Requirement:** A variety of methods should be investigated, as to dredged-material disposal methods within these holes. Final product would be a risk-based ranking of all possible placement methods, with pros and cons for each method, a listing of risks, and some relative quantitative ranking of the different methods. This statement of need (SoN) is recommending a planning-level tool be created that would enable each District to input the particular dimensions and content of each hole and determine the best disposal method.

**Consequences if Requirement Not Met:** (1) As current placement areas near capacity, substantially increased disposal costs will be incurred by transport to Offshore Disposal sites. (2) Opportunities for beneficial use of dredged material will be foregone. (3) “Environmental deserts” will remain.

**Product Recommendation:**

(1) Technical Note with a risk-based ranking of all possible disposal methods, to include:

• Detailed method description

• Pros and cons

• Relative ranking of risk

• Semi-quantitative ranking of risk for each method

• Increased disposal cost (if any) beyond current method

• Proposed capping method and cost

• Listing of initial comments on all methods from Resource Agencies

(2) Spreadsheet/Database inventory of deep holes in harbors/bays with Corps-maintained channels, to include Location, Depth, Area, Grain Size, Thickness of Mud Layer (leutokline), Water Content of mud, Dissolved Oxygen, Sulfur Dioxide, and history. This work unit would not be making measurements in the holes, but canvas the Districts on available data.

Notionally, this R&D would cost approximately $0.5 M and have a 3 year duration.

**Originator:** Galveston District H&H Branch – Thomas E. White, Ph.D., P.E.

**AFA 6. Infusion of principles and practices of ocean and coastal mega infrastructure decision support systems.**

**Tracker – Title:** AFA-06-16-01 – Decision tools for integration of dredged material management information and analyses.

**Related SONS:** AFA-01-16-01, AFA-02-16-01, AFA-03-16-01, AFA-04-16-01, AFA-05-16-01, AFA-07-16-01

**Need that Drives Requirement:** Opportunities for managing dredged material are often missed or informed by less than optimal available data. Research and related tools often have to be applied independently of other existing tools and knowledge. New planning constraints are leading to less time available for technical work on planning dredged material management.

**Extent of Need Across USACE:** USACE spends over $1B annually on dredging and placing material and still cannot keep all authorized channels available for navigation. A more efficient way to plan and manage dredged material would improve channel availability and provide greater ecosystem goods and services for the same budget expenditures.

**Requirement:** System that integrates knowledge and other tools to better plan and manage dredging activities.

**Consequences if Requirement Not Met:** USACE will continue to fail at its mission to have 100% channel availability. We will continue to miss opportunities for enhanced beneficial use of dredged material. Engineering products will continue to be lower quality than they could be.

**Product Recommendation:**

**Product Description.** The product is proposed to be a web and data based tool to integrate navigation data and knowledge. A demonstration product has already been completed under the CE-DREDGE program.

**Data Requirements.** The system should be developed to conform to existing data standards.

**Proposed Approach.** This SON addresses the central system needed to help bring the many other tools together to form a consistent picture for DMMP decision support. Build on existing knowledge gained through initial development by ERDC, SWG, and SAM. Use that springboard to integrate new tools as they come online. Initiate the program with existing tools that tend to focus on physical parameters, then focus on new modules to better quantify ecosystem goods and services.

**Proposed Method of Delivery into Practice.** It is proposed that this research be co-developed by a combination of ERDC, SWG, and TAMU, via the Coastal Science and Engineering Collaborative (CSEC), as supported by the Coastal Engineering Research Board. An ERDC researcher and SWG practitioner should serve as the CO-PI for development of the software needed.

**Estimated Time and Cost.** Notionally, development of this initial capability should take approximately 2 years and cost about $1.0 M. A useable prototype already exists that will be brought into full production and modified to accept module development of other navigation tools.

**Future R&D Value.** The product will be central to implementation of future R&D products.

**Collaborators:** Edmond Russo/SWG, Todd Bridges/ERDC, Jane Smith/ERDC, Rob Thomas/SWG, Corragio Maglio/SWG, Tom White/SWG, Paul Hamilton/SWG, Jens Figlus/TAMU, Rick Vera/SWG, Candice Piercy/ERDC, Todd Swannack/ERDC, Tosin Sekoni/ERDC, Joe Gailani/ERDC, Mark Gravens/ERDC, Julie Rosati/ERDC, Todd Bridges/ERDC, and Linda Lillycrop/ERDC.

**AFA 7. Integration of technology and science with USACE practice and policy.**

**Tracker – Title:** AFA-07-16-01 – Modern dissemination, access, and approval methods for USACE Engineering Regulations and Manuals.

**Need that Drives Requirement:** Advances in science and technology need to be implemented into USACE practice faster, more thoroughly, and more consistently. The current process for developing Engineering Regulations (ERs) and Engineering Manuals (EMs) is much too slow and there is no way to link knowledge contained in the ERs/EMs back to tools. The referencing method between ERs/EMs is also antiquated, leaving it up to the Engineer to do extensive research to ensure applicable guidance is consistently applied.

**Extent of Need Across USACE:** The need extends across USACE districts, ERDC, and academia. Districts need actionable guidance to use new science and technology. ERDC and academia need a process for full scale implementation of new methods and tools developed.

**Requirement:** Fast and reliable implementation of new science and technology into USACE guidance. Methods to ensure consistent implementation of current USACE guidance.

**Consequences if Requirement Not Met:** Most USACE coastal guidance documents are not up to the current state of the art. Engineers work around this by keeping up with current information through Communities of Practice, conferences, journal papers, and other non-USACE publications. However, the different level of education of Agency Technical Reviewers often leads to a consensus process for standard engineering design criteria (e.g. how to calculate water level for coastal levees for NED analysis). This leads to more expensive studies, less consistency across USACE projects, and overall lower quality in USACE products because of uncertainty related to current guidance. Because it takes so long to get new knowledge into guidance it also marginalizes the value of our research and development experts and reduces non federal funding by reducing certainty in a path to implementation for new research initiatives.

**Product Recommendation:**

**Product Description.** The product is proposed to be a web and data based tool to track data and knowledge to integrate into new guidance products. The tool should standardize guidance documents in a database format for automatic generation, review, and approval.

**Data Requirements.** A new guidance data standard will be needed to enable this approach.

**Proposed Approach.** Implement a demonstration project to build on earlier efforts to create an automated guidance development and integration system. Demonstrate the product on new guidance, potentially funded through GUMP. An initial demonstration project could be a new Coastal Systems Manual. When the demonstration is successful, phase implementation by discipline, starting with coastal engineering.

**Proposed Method of Delivery into Practice.** It is proposed that this research be co-developed by a combination of ERDC, SWG, and TAMU, via the Coastal Science and Engineering Collaborative (CSEC), as supported by the Coastal Engineering Research Board. An ERDC researcher and SWG practitioner should serve as the CO-PI for development of the software needed. TAMU researchers have previously been identified that have the capability to create this tool and can now be funded through the CESU, so the software could either be developed at ERDC or TAMU. SWG practitioners and ERDC researchers should serve as the drafters of guidance data for a new coastal systems manual based that includes knowledge from research efforts by ERDC and TAMU.

**Estimated Time and Cost.** Notionally, development of this capability should take approximately 3 years and cost about $1.9 M. A useable prototype should be developed in the first year of the program.

**Future R&D Value.** The product will be foundational to advancing the way ERDC and TAMU document future research and progress that research into practice.

**Collaborators:** Edmond Russo/SWG, Todd Bridges/ERDC, Jane Smith/ERDC, Rob Thomas/SWG, Corragio Maglio/SWG, Tom White/SWG, Paul Hamilton/SWG, Jens Figlus/TAMU, Bert Sweetman/TAMU, Julie Rosati/ERDC, Todd Bridges/ERDC, and Linda Lillycrop/ERDC.