DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET, NW
WASHINGTON, DC 20314-1000

CECW-Z (2018-11) 14 September 2018

DIRECTOR'S POLICY MEMORANDUM FY2018

SUBJECT: Innovative Delivery of 2018 Emergency Supplemental Projects

1. References.

a. Public Law 115-123, Bipartisan Budget Act of 2018, 09 February 2018, URL: https://www.congress.gov/bill/115th-congress/house-bill/1892.

b. DPM CW 2018-09, Director's Policy Memorandum: Principles of Delivery for the 2018 Emergency Supplemental, 16 July 2018. https://pubs.usace.army.mil/SitePages/HQ.aspx.

2. Background.

a. Appropriated under Public Law 115-123 (Reference 1a), the 2018 Emergency Supplemental provides an immediate opportunity to demonstrate the Corps' ability to adopt innovative processes, tools, and techniques to expedite project execution and improve project, community, and national infrastructure resilience. Incorporating innovation will help us deliver on our commitments and provide the greatest value to the nation.

b. Innovation is defined as a new process, approach, practice, material, product, acquisition strategy, design application, construction practice, and/or contracting approach that results in improved scope, project performance, budget, schedule and/or quality. These methods of delivery may include, but are not limited to: integrated project delivery and acquisition strategies; planning and design methods and processes; value engineering / management techniques and processes; construction materials; contract administration; and operations and maintenance practices.

3. Purpose.

a. This Director's Policy Memorandum requires application of appropriate innovative methods of delivery to execute 2018 Emergency Supplemental projects. In order to be considered appropriate, an innovation must be within our authority, and should improve delivery, improve reliability, increase the quality, reduce costs, or demonstrate a new method with potential to improve the delivery of a quality reliable solution in a timely and cost-effective manner.

b. This DPM also promotes long-term cultural change by embracing the use of innovative technologies in Civil Works projects. These strategies reinforce commitment to the USACE Campaign Plan, Objective 2b, Deliver the Civil Works Program using Innovative Solutions and Objective 4a, Maintain and Advance DoD and Army Critical Enabling Technologies.

4. Applicability. This DPM applies to all Emergency Supplemental projects and studies executed by USACE as directed by DPM CW 2018-09 (Reference 1b).

5. Policy.

a. Each supplemental project funded by the appropriations of Public Law 115-123 will investigate, and if viable, cost effective, and within our legal authority, incorporate appropriate innovative methods of delivery. Proposals for innovative methods of delivery will be submitted by the executing District to the MSC with copy furnished to HQ Deputy Chief, Engineering & Construction and the HQ Supplemental Program Manager (PgM) in the fact sheet format included in Attachment D. The fact sheet must identify whether the innovation will require additional approval, and also address potential risks, possible barriers and suggested risk mitigation measures associated with the use of the innovation methods. The proposed methods may be generated by USACE Districts or MSCs, Headquarters, the Engineer Research and Development Center (ERDC), Centers of Expertise, industry, or project partners. For projects where innovations are considered but not recommended, an abbreviated factsheet stating what kinds of innovations were considered and rejected may be submitted to document the effort.

b. Innovative methods of delivery proposed for use must enable benefits to project delivery, to include faster design or construction, improved life-cycle performance or resilience, or reduced life-cycle cost. Our focus is on project delivery, not process, so the tactics selected must also be adaptable without reducing quality, increasing unacceptable costs, or introducing unnecessary complexity and bureaucratic processes that may offset the value of the innovation itself.

c. Examples of potential innovative delivery methods are included in Attachments A through C. These examples include possible materials, design practices, construction methods, and acquisition strategies that can be used, but are not explicitly required.

6. Implementation. The steps described below outline the implementation of this directive.

a. A Corps Innovation Team (CIT) of technical consultants and subject matter experts will be identified to support and promote innovation on Emergency Supplemental projects. The CIT will be led by the HQ Deputy Chief, Engineering & Construction and may include representatives from HQUSACE (Planning, Engineering & Construction, Operations, Contracting, and/or Research and Development), appropriate Community of Practice leads and technical experts, and others deemed appropriate by the CIT. The CIT will engage in the proposed innovation review process and will provide expertise to assess, identify, and assist the districts in application of the appropriate innovations. .

b. Deputy District Engineers for Programs and Project Management (DDE-PMs) will be responsible for approving district proposed innovations, with notification to the PgM through their MSC Program Directors. MSCs will review and provide those project-specific proposal factsheets to the CIT lead and the PgM by 15 November 2018. The CIT lead will maintain a record of proposed and approved innovations with monthly updates on progress provided by the DDE-PM.

c. Once these innovations are approved by the DDE-PM, future routine project briefings will be updated to include current status of innovation implementation.

7. Proponent. The point of contact for this memorandum is the Deputy Chief, Engineering and Construction Division, at 202-761-4828.

JAMES C. DALTON, P.E.
Director of Civil Works

Encl

Attachment A1:	Supplemental Project Groups, Potential Material Innovations
Attachment A2:	Potential Material Innovations, Categories and Performance Benefits
Attachment A3:	Potential Material Innovations, Examples
Attachment B:	Innovative Engineering & Construction Methods, Examples
Attachment C:	Innovative Acquisition Methods, Examples
Attachment D:	Project Innovation Fact Sheet, Format

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1. Attachment A1. Supplemental Project Groups, Potential Material Innovations.

a. The table below lists potential material innovations for consideration in Group 1 (Harvey, Irma, and Maria (HIM) affected states), Group 2 (non-HIM affected states), and Mississippi River & Tributaries construction projects. New start projects denoted with "*". List does not include Groups 1 and 2 studies.

Group 1: HIM Affected Construction Projects	Project Type	State	MSC	CWE	Material Types						
					Structural Materials	Soil Enhancement	Self-Sensing/Self-Healing	Natural Nature-Based	Health Monitoring	Construction & Repair	Coating Technologies
Dade County, FL	Beach & dune	FL	SAD	$158,300,000		X		X			
Nassau County, FL	Beach & dune	FL	SAD	$2,000,000		X		X			
Duval County, FL	Beach & dune	FL	SAD	$2,000,000		X		X			
St John's County, FL	Beach & dune	FL	SAD	$2,000,000		X		X			
Brevard County, FL	Beach & dune	FL	SAD	$2,000,000		X		X			
Palm Beach County, FL	Beach & dune	FL	SAD	$2,000,000		X		X			
Palm Beach County (Mid-Town Beach Segment), FL*	Beach & dune, near reach	FL	SAD	$25,000,000		X		X			
Broward County, FL	Beach & dune	FL	SAD	$2,000,000		X		X			
Lee County, FL	Beach & dune	FL	SAD	$2,000,000		X		X			
Sarasota County, FL	Beach & dune	FL	SAD	$2,000,000		X		X			
Flagler County, FL CSRM*	Beach & dune	FL	SAD	$17,500,000		X		X			
Herbert Hoover Dike, FL	Floodwalls, control structures,	FL	SAD	$514,208,000	X	X		X		X	X
Manatee County	Beach & dune	FL	SAD	$14,300,000		X		X			
St Lucie County, FL CSRM	Beach & dune	FL	SAD	$20,276,000		X		X			
St. John's County, FL CSRM	Beach & dune	FL	SAD	$36,834,000		X		X			
Tybee Island, GA	Beach & dune	GA	SAD	$13,000,000		X		X			
Folly Beach, SC	Beach & dune	SC	SAD	$2,000,000		X		X			
Comite River, LA	Control structures, bridges	LA	MVD	$343,000,000	X	X	X	X	X		X

East Baton Rouge Flood Control*	Channel improvements	LA	MVD	$255,000,000				X			
Grande Isle, LA*	Offshore segmented breakwaters	LA	MVD	$15,000,000				X			
West Shore, Lake Pontchartrain, LA*	Structures	LA	MVD	$760,000,000	X				X	X	X
Rio de La Plata, PR	Levee, floodwall, bridges, rec facilities	PR	SAD	$500,000,000	X	X		X		X	
Rio Grande de Arecibo, PR*	Levee and floodwall	PR	SAD	$82,892,000	X	X		X			
Rio Grande de Loiza, PR	Levee, floodwall, control structures	PR	SAD	$250,000,000	X	X		X			
Rio Guanajibo at Mayaguez, PR*	Channel improvements and levee	PR	SAD	$60,000,000		X		X			
Rio Nigua at Salinas, PR*	Levee, bridge, channel improvement	PR	SAD	$60,000,000	X	X		X		X	
Rio Puerto Nuevo, PR	Levee, channel improvements, bridges	PR	SAD	$1,552,453,000	X	X	X	X	X	X	X
Colleton County (Edisto Island, SC)*	Beach & dune	SC	SAD	$22,228,000		X		X			
Pawleys Island, SC*	Beach & dune	SC	SAD	$9,230,000		X		X			
Brays Bayou, TX	Detention basin, bridges, earthen channel	TX	SWD	$75,000,000	X	X		X			
Buffalo Bayou and Tributaries, TX	Outlet structures, dam rehab, detention basins	TX	SWD	$1,454,000	X	X		X			
Clear Creek, TX*	Channel enhancement	TX	SWD	$295,165,000		X		X			
Dallas Floodway (includes Extension)*	Levees, floodway	TX	SWD	$275,911,000	X	X		X		X	
Hunting Bayou, TX	Grass lined channels, basin, bridge, wetlands	TX	SWD	$65,000,000	X	X		X		X	
Lewisville Dam, TX	Seepage and instability repairs, erosion	TX	SWD	$91,959,000	X	X		X		X	
Lower Colorado River Ph 1 (Wharton). TX	Ecosystem restoration	TX	SWD	$73,290,000		X		X			
Sabine Pass to Galveston Bay, TX*	Coastal storm damage reduction	TX	SWD	$3,957,134,000	X	X		X	X	X	X
White Oak Bayou, TX	Detention basins, bikeways	TX	SWD	$45,000,000		X		X			
Total Group 1 Construction Projects:				$9,607,134,000							

Group 2: Non-HIM Affected Construction Projects	Project Type	State	MSC	CWE	Material Types						
					Structural Materials	Soil Enhancement	Self-Sensing/Self-Healing	Natural Nature-Based	Health Monitoring	Construction & Repair	Coating Technologies
American River – Common Feat, CA *	Fix seepage, slope stability, erosion, bypass	CA	SPD	$1,565,750,000		X		X			
American River Watershed (Folsom Dam Raise), CA	Dam raise and raise of dikes	CA	SPD	$216,523,185	X	X		X		X	
Isabella Lake, CA	Dam raise, emergency spillway	CA	SPD	$258,231,000	X	X		X		X	
Tule River/Lake Success Enlargement	Raise spillway, widen spillway	CA	SPD	$74,000,000	X	X				X	
Santa Ana River Mainstream, CA	Channel improvements, armoring, spillways	CA	SPD	$161,643,000	X	X		X		X	
South San Francisco Shoreline, CA	Restore wetlands	CA	SPD	$177,200,000				X			
Ala Wai Canal, Oahu, HI*	Detention basins, debris catchment, floodwalls	HI	POD	$345,076,000	X			X			
Cedar River, Cedar Rapids (FRM)*	Earthen levees, floodwalls, closure structures	IA	MVD	$117,480,000	X	X				X	X
Kansas City / Armour-dale, KS&MO*	Seepage and stability modifications	KS/MO	NWD	$453,821,341	X	X		X		X	
Johnson Country, KY	Floodwall, structures	KY	LRD	$118,000,000	X			X			
Town of Martin, KY	Floodwall, structures	KY	LRD	$80,000,000	X			X			
Bois Brule	Fix underseepage and regrade levee	MO	MVD	$11,300,000		X					
Alamogordo, NM	Diversion channels	NM	SPD	$6,500,000	X	X					
Mill (Seven Mile) Creek*	Storm water detention basin	TN	LRD	$15,900,000		X		X			
Lower Mud River, Milton, WV*	Earthen levee alignment and channel modification	WV	LRD	$96,200,000		X		X			
Bluestone Lake, WV	Anchors, stability modifications, stilling basin, new spillway	WV	LRD	$574,736,000	X	X	X	X	X	X	X
Section 202 WV	Floodwall	WV	LRD	$20,000,000	X					X	
Total Group 2 Construction Projects:				$4,305,946,526							

Mississippi River and Tributaries Projects	Project Type	State	MSC	CWE	Material Types						
					Structural Materials	Soil Enhancement	Self-Sensing/Self-Healing	Natural Nature-Based	Health Monitoring	Construction & Repair	Coating Technologies
Channel Improvements	Channel improvements, revetments	Multi	MVD	$98,500,000		X		X			
Mississippi River Levees	Floodwalls, levees, seepage remediation	Multi	MVD	$147,000,000	X	X		X			
Total Mississippi River and Tributaries Projects:				$245,500,500							

2. Attachment A2. Potential Material Innovations, Categories and Performance Benefits.

Category	Example Types and Performance Benefits
Structural Materials	Stronger, stiffer, tougher, lighter (density or form factor driven) including composites (fiber-reinforced polymers and new thermoplastic variants), high-performance and ultra-high performance concrete, high-strength steels and other alloys. Improved durability using corrosion-resistant steels (reinforcement, post tensioning, trunnion anchorages), composites (gates, reinforcement, piping, other components), and high-performance concretes for marine environments.
Soil Enhancement	Soil stabilization, geotechnical improvement such as geotextiles, and means of chemical stabilization of geomaterials for structural and geotechnical applications.
Self-Sensing / Self-Healing	Self-sensing, healing, actuating materials, stimuli responsive materials, such as polymers, composites, concrete, with multi-functional applications for infrastructure.
Natural and Nature-Based Features	Innovative uses of natural materials and systems through beneficial use, engineering with nature, and incorporation of biological and geomaterials in engineered systems. Innovative design approaches that take advantage of natural processes and materials to improve function and reduce lifecycle O&M costs.
Health Monitoring	Materials and systems with sensing and measurement / indicator capabilities that support structural, geotechnical, and environmental health monitoring as well as infrastructure assessment tools.
Construction Technologies, Rapid Repair	Innovative approaches for construction utilizing novel manufacturing approaches such as 3D printing at all scales, supported by robotics, sensing, and 3D design tools. Additive manufacturing of specialty low volume components using metals, polymers, and concrete. Underwater construction using innovative materials aided by novel sensing and robotics. Materials that enable rapid construction as well as repair and rehabilitation such as concrete repair or miter gate rehabilitation.
Coating Technologies	Polymeric, metallic, ceramic, and composite coating systems utilizing advanced materials to improve performance, durability, reduce environmental impacts, reduce life cycle cost, and ease construction / application procedures.

3. Attachment A3. Potential Material Innovations, Examples.

Category	Technology Name	Current Example Applications	Short Description
Structural Materials	FRP composites for small water control structures	In use in the private sector from Plasti-Fab, Ridgefield, WA. Other fabricators also available.	Corrosion-resistant fiber reinforced polymer composite slide gates, sluice gates, weir gates, and stop logs. May incorporate internal stiffeners depending on design loads. For use in Civil Works and Military flood control and spillways.
Structural Materials	Corrosion-resistant prestressing steels	Precast concrete piling in marine environments	Corrosion resistant high strength duplex stainless steel prestressed reinforcement for prestressed concrete applications. Use for marine construction as well as applications with extreme durability and service life requirements.
Structural Materials	Corrosion-resistant reinforcing bars	Many examples in marine substructures, piling, tunnels, and bridge decks where corrosion is a concern.	Austenitic and duplex stainless steel reinforcing bars produced by many manufacturers. Most can provide 100+ year service life with adequate concrete quality. Life cycle costs generally much less due to reduced maintenance and repair costs.
Structural Materials	FRP structural shapes, gratings and utility poles	Multiple examples within USACE and private industry.	The pultrusion process produces constant cross section FRP composite structural elements such as bars, angles, I-beams, C-channels, tubes, rods, plates, etc. Advantages of FRP composites are environmental durability, low maintenance, design optimization, high strength, lightweight, and lower life cycle costs.
Structural Materials	GFRP rebar and CFRP prestressing tendons for internal concrete reinforcement.	Mckinleyville Bridge deck reinforcement, WV. Advanced Waterfront Technology Test Site, Port Hueneme, CA.	GFRP rebar and CFRP prestressing tendons are used similar to steel in concrete construction.
Structural Materials	Ultra-high molecular weight polyethylene (UHMWPE) slides to replace steel rollers.	Various USACE Districts have included UHMWPE slides in floating mooring bits, vertical lift gates at Bankhead Dam, Mobile District, culvert valves on the Illinois Waterway, Rock Island District.	UHMWPE has a very low coefficient of friction, high environmental durability, and can be easily machined. Steel rollers are prone to corrosion and the frequent greasing is an environmental problem. UHMWPE slides provide lower maintenance, environmental advantages, and first cost saving over steel rollers.

Structural Materials	Fiber reinforced polymer (FRP) composites for large navigation and marine structures	Several navigation and marine applications including wicket gates, culvert valves, lift gates, miter gates, stoplogs, contact blocks, pilings, birthing camels for submarines and aircraft carriers, pier protection and guide walls.	The vacuum infusion process (VIP) allows the manufacture of large, monolithic FRP composite structures. Advantages of this process are high fiber contents, optimized fiber architectures, complex shapes, and application specific materials selection. Advantages of FRP composites are environmental durability, low maintenance, design optimization, high strength, lightweight, and incorporate embedded sensors for structural health monitoring. These materials offer lower life cycle costs and potentially lower first costs.
Structural Materials	Composite penstocks and large diameter piping	Many military and private industry applications. Bureau of Reclamation currently replacing steel penstocks with composites.	FRP composite penstocks and large diameter pipes are being used to replace metallic piping. The composite material is corrosion resistant, requires minimal maintenance, and has a 50+ year service life.
Structural Materials	Thermoplastic composite timber bridges for vehicular traffic	Three thermoplastic composite bridges currently in use at Camp Mackall (sub installation to Fort Bragg), NC. Also two plastic timber RR bridges at Langley-Eustis Joint Base.	Degradation-resistant and environmentally friendly alternative material to chemically treated wood timber. I-beam design for heavy load capacity is cost competitive with traditional timber construction and far better in life-cycle costs.
Structural Materials	Elastomeric bearings	Bridge bearings and building seismic isolation	Miter gate pintles are not designed to resist loads from hydrostatic pressures from the gate serving as a damming surface. However, degradation of the gate-to-wall boundary conditions results in loading through the pintles which in turn causes catastrophic fatigue cracking. An elastomeric bearing pad under a pintle, combined with an appropriate alignment device, may allow the bottom of a gate to translate toward and away from the wall, thereby removing the ability of the pintle to carry lateral loads when the gates are closed. In this way, fatigue stresses are reduced and cracking is no longer a problem.
Structural Materials	Multifunctional composites	Nano reinforcement, controlled electrical conductivity, embedded sensors, actuators, self-healing, self-decontaminating.	Composite materials allow for the incorporation of multiple materials that affect the functionality from the meso to the nano scales. Examples include carbon nanotubes, magnetostrictive particles, shape memory alloys, micro-encapsulated reagents, piezoelectrics.

Structural Materials	Low-cost, graphene reinforced structural plastics	None	Thermoplastic members reinforced with graphene made in a simple extrusion machine with special high-shear screws. Resulting product is a high-strength, low-cost member made from simple graphite and various thermoplastics starting materials.
Structural Materials	Rapid repair concrete materials for infrastructure	Many applications for airfield damage repair, bridge repair, lock wall rehabilitation.	Rapid repair materials such as calcium sulfoaluminate cement-based concrete have extensive experience in military and rapid infrastructure repair applications but are seldom applied for water resources infrastructure. Recent durability testing supports considering these for infrastructure applications.
Structural Materials	FRP composite grid-form for concrete bridge deck replacement	Bridge #4, Fort Knox, Kentucky.	A 3-D grid of FRP composite reinforcement bars with added advantage that system also acts as formwork. FRP composites for corrosion-resistant to common road salts Panel design is light weight and easy to handle and enables rapid construction. Higher material costs than traditional but overall cost savings due to constructability.
Structural Materials	Ultra-high performance concrete	Many military applications, bridge construction, navigation lock armoring, spillway retrofit in Europe	UHPC is a class of very high strength (>20ksi), high toughness, and durable concrete materials. Significant experience in development for a variety of applications. Many potential applications for civil works infrastructure where strong and tough materials are needed. Costly but in niche applications provide significant benefit.
Structural Materials	High-performance concrete	Many applications in DoD / GOV construction as well as in industry for high-strength and high-durability requirements.	HPCs are currently used in a variety of concrete construction applications. These use binary or ternary blends with supplementary cementitious materials and chemical admixtures to maintain workability. Can produce high strengths >10ksi and significant improvements in durability.
Structural Materials	Self-consolidating concrete	Many applications in DoD / GOV construction where congested reinforcement is present or labor for consolidation needs to be minimized.	SCC is an engineered concrete material that consolidates with no vibration. It is highly useful in applications with very dense reinforcement, poorly-accessible areas where concrete needs to be placed, and to increase the speed of construction by reducing the need for labor and time for concrete vibration and consolidation.

Structural Materials	FRP composite bridge decks	Currently in use in highways in Ohio and West Virginia. Also at Redstone Arsenal in Huntsville, AL.	Light-weight, corrosion resistant decking for replacement of concrete bridge decks. Because of weight differences, can significantly reduce dead load on the substructure. Also, much quicker replacement time then with conventional reinforced concrete deck. Care must be taken to assure proper design for expansion joints.
Structural Materials	Advanced concrete admixtures	Used in a variety of new construction and repair projects across DoD/GOV and industry.	Many new admixtures for concrete are available that can produce tremendous benefits for concrete construction. New shrinkage reducing admixtures are allowing for increased joint spacing and improved mitigation of cracks. Engineered superplasticizers allow for increased strength and durability while maintaining workability. Fiber reinforcement (polymer and metal) can provide increased toughness and crack resistance for concrete.
Structural Materials	Lightweight concrete	Used in a variety of applications such as precast concrete bridge components.	Lightweight concrete uses engineered lightweight aggregates to reduce the bulk density of concrete. This weight reduction allows for longer spans, larger precast components, and many design benefits gained by reducing dead loads.
Soil Enhancement	Bipolymers for beneficial use	Biopolymers have been applied for purposes of stabilizing and improving water retention of soils and as a stabilizing agent for thin layer placement in sediment caps	The beneficial use of fine grain, high water content dredged material for restoration, shoreline protection, and other beneficial use opportunities is often precluded as a consequence of concerns regarding potential turbidity impacts during placement and the potential for material loss due to scour and other factors in the near term prior to consolidation.
Soil Enhancement	Biopolymer soil amendment for enhanced vegetation root growth	Iowa Army Ammunition Plant; Kauffman Levee #1 (Fort Worth District)	Biopolymer spray increases vegetation root growth, thereby stabilizing soils (e.g., levees). Biopolymers have been successful on soils with normal salinity. Biopolymers enhance seed germination, stabilizes the soil, and increases above-ground plant growth and root density.

Soil Enhancement	Mesh materials and sediment additives	Maumee River, Ohio	Contaminated sediments are typically removed from navigation channels due to concern that buried contaminants can be re-exposed. Removal is expensive and includes significant risk because contaminants are released to the water column during removal. New capping methods which will permit in-place contaminated sediment management in navigation channels are being evaluated. Methods include mesh materials to reduce resuspension and transport as well as sediment amendments which will enhance resistance of surface sediments to erosion. In-place management of contaminated sediments will reduce remediation costs, reduce long-term risk, and avoid risks associated with removal.
Soil Enhancement	Lightweight-treated soil	Previously used as fill for highway embankments and airfields on soft soils (Japan and Thailand)	Cement stabilized mixtures of air foam and soil (similar to cellular concrete) used in place of soil as a fill material.
Soil Enhancement	Inorganic polymer / geopolymers	Used primarily in horizontal construction and precast concrete applications. Especially prevalent in Australia with many other examples in Europe and the Americas.	Reference a recent ERDC/CERL TR-17-DRAFT on the use of geopolymer technology for soil stabilization, this work unit resulted in developing a geopolymer formula using industrial by-products, such as flay ash and slag, on soil samples procured and analyzed from test sites on Sierra Army Depot. This effort encompassed the evaluation for commercial dust-control products that were used loosely for soil stabilization expedient pavements on Army Installation. These products showed low strength and durability resulting in frequent maintenance and loss of serviceability.
Self-Sensing / Self-Healing	Actuated miter gate diagonal tensioning	Smart materials and structures are being applied to morphing aircrafts, to optimize for the entire flight envelope	Smart material that is capable of tensioning the miter gate tension rod system if a loss of tension on the gate is detected.
Self-Sensing / Self-Healing	Morphing smart materials for discontinuous quoin block alignment	Smart materials and structures are being applied to morphing aircrafts, to optimize for the entire flight envelope	Research is indicating that discontinuous quoin blocks are feasible for miter gates. This proposed task is to embed smart morphing materials into the discontinuous blocks that allow for automated alignment, reducing the potential of fatigue cracking due to gaps developing in the quoin region

Natural and Nature Based Features	Bedload interceptor technology (BI)	Fountain Creek Pueblo CO and Cuyahoga River, Cleveland OH	BI captures the coarse sediment fraction in the bedload near the mouths of their sources such as creeks and small rivers, which can reduce localized shoaling that require frequent, expensive removal to maintain safe navigation.
Natural and Nature Based Features	Bioblocks, biorock and other rock-based, habitat-conducive, construction materials/structures	USACE- Milwaukee Harbor Breakwater Project (USACE Green Breakwaters); Colwyn Bay Waterfront Project (https://www.iema.net/.../Colwyn_Bay_Waterfront_NTS_Oct_2010.pdf)	Bioblocks, BioRock and other manipulations of construction materials have been used for the purpose of creating habitat while offering shoreline stability/reinforcement. Other stone/rock types have been used to increase habitat for different species while still satisfying the engineering purpose and need.
Natural and Nature Based Features	Pre-cast oyster castles, oyster bags and reef balls	Ubiquitous application of Oyster Castles, Oyster Bags and Reef Balls for Protect property / infrastructure and create habitat. SWG has multiple examples of Oyster Castle and Reef Ball use (ex. Goliath Reef Ball Use to protect shorelines on GIWW)	Pre-cast oyster castles, bagged oysters and reef balls have been historically used for the purpose of reducing coastal storm risk, reducing potential for erosion, and/or fostering habitat. There are opportunities to integrate these technologies into protective schemes for USACE infrastructure as well.
Natural and Nature Based Features	Vegetated terraces and woody vegetation	These technologies have been widely used for many applications around the world and described here. Example projects include: terracing and marsh creation south of big mar bs-24plaquemines parish, Louisiana, fish and wildlife service, ecological services Lafayette, Louisiana;	Historically, urbanized (and some rural) areas have attempted to manage stormwater by channelizing sections of rivers and streams and removing materials that may potentially impede water conveyance. In many instances, these practices have resulted in downstream flooding, decreased water quality, and loss of habitat.

Natural and Nature Based Features	Biochar	Numerous examples of BioChar application for remediation of contaminated soils and sediments and for improvements in soil fertility	Activated carbon has been found effective for the long-term sequestration of sediment associated organic contaminants and has been successfully used at a number of sites throughout the country to affect risk reduction at contaminated sediment sites. The use of activated carbon particularly at larger sites, however, can be cost prohibitive. Biochar can produce significant cost savings in affecting risk reduction at contaminated sediment sites as well as potential cost savings for the navigation dredging program (via increased capacity of upland CDFs and or reduced disposal cost) and provides an alternative, sustainable beneficial use for materials that not otherwise be suitable.
Natural and Nature Based Features	Chains curtain motivator (turtle tickler-innovation in support of endangered species act)	USACE Dredge ESSAYONS	Compliance with Endangered Species Act costs USACE $200M annually. Incidental entrainment of threatened and endangered species while dredging has not been eliminated. Protection requirements have a significant impact on U.S. Army Corps of Engineers (USACE) navigation projects, efforts continue to develop additional protective methods to minimize risk to T&E species while maintaining optimal dredging production and efficiency. This technology will reduce operational expenses for USACE by reducing the need for environmental restrictions on when dredging can be conducted.
Health Monitoring	Low cost, rapid deployment health monitoring cassette (RDMC)	Sediment profile imagery, passive sampling and other water quality instrumentation are in routine use for Health Monitoring of restoration and remediation sites throughout the world.	A unique and innovative sediment profile imaging platform utilizing high resolution flatbed scanning technology has been developed through the USACE Dredging Operations Environmental Research (DOER) and could be utilized as the central component of a "Rapid Deployment Health Monitoring Cassette" (RDMC) that will include passive sampling devices (e.g., polyethylene device, solid-phase micro-extraction fiber, diffusive gradient in thin films, etc.) and a water quality data logger for concurrent Health Monitoring of biological activity, sediment mixing and deposition, contaminant bioavailability, and water quality. The RDMC would be loaded into a deployment platform. The deployment platform will deliver and insert the RDMC into the sediment bed at the selected field Health Monitoring locations.

Health Monitoring	Mini-Argus nearshore video health monitoring stations	Beach Project Health Monitoring (SAJ in late FY18); Nearshore Health Monitoring (The Outerbanks, NC 2018-Present)	The mini-Argus systems provide quantitative imagery in near real time over a focused region of coast (1-5 km). Imagery of the coast can be exploited qualitatively and quantitatively to provide information on coastal processes, beach & dune topography, nearshore water depths, sandbar positions, wave runup elevations, as well as the condition of coastal infrastructure or navigability of harbor or inlet entrances. Self-contained, autonomous, and with a small form factor, mini-Argus stations can be deployed rapidly and provide a unique capability to address coastal management challenges before, during, and after natural disasters by providing cost-efficient and timely video Health Monitoring of coastal infrastructure.
Health Monitoring	Smart levees	An example is GeoBeads that uses signal processing methods developed by The Netherlands	Existing levees and levees with I-Walls who's stability is of concern during floods; there is insufficient real-time levee Health Monitoring technologies for detection of changes to the levee and its structural features (i.e., earthen levee, its foundation, I-Wall, etc.) and identify triggers that reduce levee performance that can serve as an early warning system for flood alerts. An approach that has been used successfully in The Netherlands (referred to as GeoBeads) uses time-frequency methods. A method that is currently under development at ERDC is Structural Health Monitoring and Analytics in Real-Time (SMART) for Levees. It's a real-time levee assessment merging sensor data with engineering analysis. The outcome will be a "Green/Yellow/Red" (traffic light) condition assessment to the District flood management personnel when there is a change in category during a flood event.
Health Monitoring	Smart wireless embedded sensors for use in non metallic structural components	Many examples from research on structural health monitoring and uses in other industries.	A system capable of measurement and processing of data under up to a foot of concrete that can be charged/powered and communicated with though magnetic inductive coupling

Construction Technologies, Rapid Repair	Electro-osmotic pulse and dehumidification technologies for prevention of corrosion	Underground ammunition storage facilities can have large volumes of water seeping through concrete walls, floors, and joints of the magazines. Also Lock and Dam chambers including USBR Trinity High Dam	Fundamental Principles of Electro Osmotic pulse Technology. The Basic requirement for electro-osmosis is a capillary with electrical double layer. The Electric field promotes cation, anion, and water molecule movement within the concrete. This creates a counterflow due to electro-osmotic pressure that opposes seepage. The Pulse technology allows some moisture to be retained within the concrete to prevent over-drying
Construction Technologies, Rapid Repair	Carbon and glass fiber reinforced composites (CFRP & GFRP) wraps for the repair/upgrade of structural concrete	Retrofit of reinforced concrete water tanks on US Army Garrison, Kwajalein Atoll, Marshall Islands. Repair and waterproofing of concrete beams and deck at Loyalhanna Dam, Pittsburg District	CFRP and GFRP are externally applied fabric and resin systems that provide reinforcement to concrete. These are "wet" with liquid resin systems and cure in place. They can conform to bends, curves and other complex shapes.
Construction Technologies, Rapid Repair	FRP composite shell & wrap pile repair system	East Fork Bridge, Huntington, WV	FRP shells act as a form for concrete or grout while the FRP wrap acts to confine the repair area and increase compressive strength of the structure. The repair is quick, easy, and 35% less expensive than a traditional repair. The FRP repair materials are corrosion resistant with a long service life (50+ years).
Construction Technologies, Rapid Repair	FRP composite wrap for underwater repair	Chickamauga Dam, Chattanooga, TN	The FRP wrap consists of a pre-preg moisture cure urethane resin that can cure underwater. Divers can quickly, easily, and safely wrap a deteriorated structure. The confinement of the wrap will increase the compressive strength of the structure. Sacrificial cathodic protection may also be incorporated to protect steel reinforcing (as done at Kawaihae Harbor).
Construction Technologies, Rapid Repair	Carbon FRP strips to arrest crack growth on hydraulic steel structures	Old Hickory and Pickwick Lock and Dam, TN	High tensile strength carbon fiber repair strips are adhered over cracks in hydraulic steel structures to arrest crack growth. The material is corrosion resistant and can be in an immersed environment.
Construction Technologies, Rapid Repair	Thin-layer placement (T) baffles and jet spray application	Fortescue, Ring Island, and Avalon, NJ	Wetland TLP is experiencing a renaissance due to a confluence of various forcing functions such as rising sea levels, degrading wetlands, limited dredged sediment placement and disposal areas, etc., but to date, relatively small volumes of dredged material have been placed on wetlands at large costs due to inefficient dredged material application technology.

Construction Technologies, Rapid Repair	3D concrete printed structures / advanced manufacturing	ERDC-CERL, Champaign, Illinois – Built 16'x32'x8' building in 21.5 print hours. Fort Leonard Wood, Missouri – Trained 5 EN & 943rd TEC on technology, 2 week demo outdoors	Ability to create custom shaped structures using concrete for additive manufacturing on a large-scale (up to 20'x40'). Requires less manpower and logistics for the creation of structures. High potential for use in civil works barriers, bridge abutments, and other custom concrete structures.
Construction Technologies, Rapid Repair	Protection of structures against internal erosion failure mechanisms	Not available	Light weight, mechanically restrained device that allows groundwater pressures to be relieved while simultaneously retaining foundation and embankment materials (patent pending, needs laboratory and field testing)
Construction Technologies, Rapid Repair	Underwater concrete placement methods	Many examples for Lock and Dam construction as well as oil and gas sector.	Use of novel admixtures for concrete construction to minimize washout and enable underwater placements for concrete. Have been used many years for portland cement concrete construction and recently also used for high-performance concrete and rapid repair materials to rapidly conduct repairs without shutting down infrastructure for operations.
Construction Technologies, Rapid Repair	Rapid repair concrete materials for infrastructure	Many applications for airfield damage repair, bridge repair, lock wall rehabilitation.	Rapid repair materials such as calcium sulfoaluminate cement-based concrete have extensive experience in military and rapid infrastructure repair applications but are seldom applied for water resources infrastructure. Recent durability testing supports considering these for infrastructure applications.
Construction Technologies, Rapid Repair	Additive manufacturing technologies	Rapidly growing field across many industries to produce polymer and metal components.	3D printing / additive manufacturing can be used to produce replacement low-volume parts in infrastructure systems. These can include polymers, fiber-reinforced polymers, and now even metallic parts. As opposed to making custom castings, injection molds, etc for specialty parts at a very high cost, additive manufacturing can be used to rapidly produce one-off parts using 3D solid models.
Coating Technologies	Self-cleaning concrete	Church in Europe, bridge collapse monument in Minnesota, others	Cement containing photocatalytic titanium oxide which gives a clean white appearance and is purported to reduce graying due to inorganic and organic pollutants and biofilm growth. Addition of active ingredient does not appear to impact structural performance.

Coating Technologies	Reactive vitreous-coating technologies on reinforcing steel	A 14,000ft² section of road at Corpus Christi Army Depot was redesigned and replaced using the vitreous reactive coated reinforcing bar.	A vitreous bonding enamel is applied to reinforcing steel that is used in concrete. The coating is a combination of a hydraulically reactive calcium silicate and a low melting-point glass frit. The coating triples the strength of the bond between the concrete and steel and provides an inert impervious coating that will not debond or delaminate
Coating Technologies	Advanced polymer chemistries for coatings	Many applications in various industries in DoD and GOV construction.	Novel coating technologies that utilize developments in polymer science to improve strength, durability, reduce permeation and weathering, etc. Functional fillers can also improve mechanical performance and effectiveness for corrosion mitigation.
Coating Technologies	Ceramic reinforced composite impact/abrasion resistant coating technologies	Many private industry applications.	There are a host of new ceramic reinforced epoxy Coating Technologies on the market for impact and abrasion resistance of steel structures.
Coating Technologies	Spray-on coating technologies for reducing the cost of icing control at Corps locks and waterway infrastructure	Miter gate at Mississippi River navigation lock	Numerous materials, Coating Technologies, and paints having low friction properties are commercially available. Many are even marketed as "icephobic," the name implying that ice accretion is reduced or eliminated. Many commercially available Coating Technologies do reduce the force or energy required to remove it (i.e., the bond strength of the ice to the treated material). In addition, multi-functional Coating Technologies are available and may be able to provide corrosion control and/or self-healing properties in addition to reducing the adhesion of ice.

1. Attachment B. Innovation in Processes and Procedures.

a. The following items may be considered for application as innovative methods based on the size and scope of the project, as well as the standard processes and procedures used extensively in a specific District. Each item should be taken as an example of a possible innovative delivery method that may be tailored to be project-specific.

2. Design Technologies.

a. Use 3D scanning of vertical site features to update existing as-built documents into electronic format that can be incorporated into Advanced Modeling (i.e., Building Information Model (BIM) or Civil Information Model (CIM)).

b. Use 3D scanning, LIDAR, photogrammetry and similar surveying technologies to create point-clouds that can be incorporated into Advanced Modeling (e.g., Building/Civil Information Models).

c. Use Virtual and Augmented Reality (VR/AR) in conjunction with point clouds to improve design quality and team-stakeholder communication.

d. Incorporate GIS information into Advanced Modeling throughout design. Integration of GIS and CIM can facilitate downstream consumption of geospatial information and expedite construction.

e. Leverage Local Notes Databases to maintain District-specific revisions to Unified Facility Guide Specifications (UFGS). These databases ensure that the most up-to-date UFGS are used on each project while consistently applying routine edits that reflect District or regional requirements.

f. Use collaborative project management software that links Advanced Modeling, design submittals, review comments, and other features into a single cloud-based platform to promote integrated design.

3. Design/Pre-Award Processes.

a. Reduce the number of design reviews to an appropriate number based on risk and complexity of the project. This can be applied to projects designed in-house, those that are contracted AE design, and those that are executed as design-build. For D-B, contracts need to be updated to reflect an appropriate number of design submittals.

b. Use facilitated model reviews at the schematic design phase (i.e., 35%) in place of traditional paper/2D submittal process. Eliminate unnecessary 2D drawings at early stages of design that are not necessary for design validation.

c. Plan and budget for the right subject matter experts to be a part of both the design and review teams. If the District does not have this competency or capacity, use regionalized and virtual PDTs, or augment with contracted staff as necessary.

(1) Create collocated design teams to include construction expertise for larger projects.

(2) Fully integrate construction staff into design pre-award design team. Ensure they are included in regular PDT meetings, participate in design reviews and review conferences.

(3) Assign the resident engineer to the design team full time for the largest projects in the pre-award phase.

(4) Incorporate standardized document management practices into information management systems (e.g., ProjectWise) from design through construction.

(5) Implement partnering pre-award with Government team.

d. Use design competitions during feasibility or early PED on complex and unique items, such as channel gate closures, or fences.

e. Market excavating sediment removal in reservoirs as a material source. Permit commercial interests to safety, excavate, sell, and haul at their cost.

4. <u>Construction/Post-Award Processes</u>.

a. Maximize the potential for off-site, pre-fabricated modular construction techniques.

b. Assign Lead Engineer to the construction office post award.

c. Effectively transmit and communicate risk registers developed during design phase into the construction phase.

d. Address joint risk register in preconstruction conference. Joint risk register is reviewed and updated throughout the construction performance period.

e. Enhance post award partnering.

f. Use Lean construction techniques such as just in time delivery, intensive subcontractor coordination, off-site fabrication, etc.

g. Use commercial construction management software to supplement RMS.

h. Use commercial information management systems as appropriate.

i. Maximize use of BIM in the construction phase.

j. Use work in place curves to monitor progress.

k. Hold change management meeting at the beginning of construction.

l. Annually, settle all open changes on the project with an interim release of claims from the prime and all subcontractors.

m. Integrate tablets in construction management.

n. Use texts, Face Time or other equivalent commercial technology to improve communication or problem resolution.

o. Hold change management meeting at the beginning of construction.

p. Conduct quarterly contractor performance reviews during progress meetings.

q. Carryout 360-degree reviews of project team to include feedback from the contractor and stakeholder.

r. Forward deploy Contracting Officer, Contract specialist, Lead Engineer or other appropriate technical staff.

5. Project Management Process.

a. Integrated Master schedules.

b. Use a tiered governance system for project oversight.

c. Establish fully integrated PDT at project initiation.

d. Use risk management techniques through all phases of the project.

e. Vertically integrate PDT through MSC, PARC and Headquarters.

f. Use EVMS for Program Management.

g. Develop a resource-loaded design schedules and maintain throughout the project life-cycle. Update as necessary and use as a tool to predict impacts to the project schedule, not just a reporting mechanism.

6. Resource and Staffing Process.

a. Increase use of interns.

b. Authority to use permanent change of station with return rights.

c. Establish regional AE design contracts and CM support contracts for staff augmentation.

d. Contract portions of in-house design work efforts.

7. Acquisition Process.

a. Use Programmatic Acquisition plans.

b. Industry days early in the process to facilitate market research.

c. One on one industry engagements to discuss capability and innovation.

d. Publish draft RFP documents for industry comment.

e. Use incentive or cost contracts if appropriate.

f. Use regional and/or national acquisition planning forums.

g. Use or place regional and/or national contract tools.

h. Use non-traditional contract types and methods such as Design-Build, Early Contractor Involvement (ECI), Incentive or cost type contracts if appropriate.

i. Consider use of Early Contractor Involvement (also known as CM@Risk), utilizing appropriate oversight and controls. This should be discussed and agreed upon in the Acquisition Planning phase.

j. Use Government furnished equipment as appropriate.

k. Establish MATOC's and SATOC's.

l. Effectively use consolidation to increase efficiency.

1. Attachment C. Innovative Acquisition Methods, Examples.

a. The following items may be considered innovative acquisition methods, based on the size and scope of the project as well as the standard processes and procedures used extensively in a specific District.

(1) Fully integrate PDT.

(2) Vertically integrate PDT through MSC, PARC and Headquarters.

(3) Use EVMS for Program Management.

(4) Integrate Master schedules.

(5) Use Programmatic Acquisition plans.

(6) Conduct Industry days early in the process to facilitate market research.

(7) Exercise one-on-one industry engagements to discuss capability and innovation.

(8) Publish draft RFP documents for industry comment.

(9) Institute incentive or cost contracts if appropriate.

(10) Use regional and/or national acquisition planning forums.

(11) Use or place regional and/or national contract tools.

(12) Employ Design-Build or Early Contractor Involvement type contracts.

(13) Capitalize on Government furnished equipment as appropriate.

(14) Establish MATOC's and SATOC's.

(15) Establish and use effective risk management processes.

(16) Provide lessons learned workshops.

(17) Effectively use consolidation to increase efficiency.

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1. Attachment D. Project Innovation Fact Sheet, Format.

a. Please use the following fact sheet format to describe and submit project innovations to the Supplemental PgM and HQ Deputy Chief, E&C.

PROJECT INNOVATION FACSTHEET, 2018 SUPPLEMENTAL: [Project Name, District]

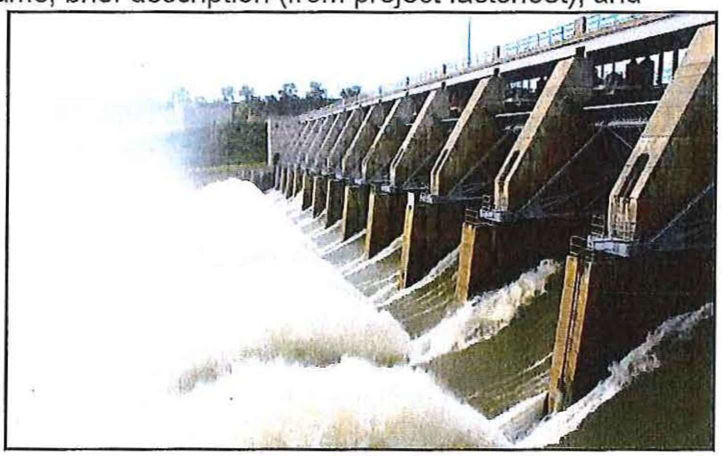
As of: DATE

U.S. ARMY CORPS OF ENGINEERSBUILDING STRONG®

INFORMATION PAPER: INNOVATION PROPOSAL(S)

Project Description

Extract from project factsheet: Project name, brief description (from project factsheet), and picture / graphic if available.



Project Phase: [Investigations/ PED/Construction]

Project Status

Extract from project factsheet.

Proposed Innovation 1 [- Name of proposal]

- **Type of Proposed Innovation:** (e.g., acquisition strategies, design method, construction materials; contract administration, etc.)
- **Description of Innovation:** (short description of what innovation is proposed in the context of the project)
    - o Basis for Innovation (describe how is this new or novel?)
    - o Enabled Project Delivery Benefits (describe in cost, performance, speed, etc?)
- **Qualitative or Quantitative Risk Assessment:** (e.g., evaluation of costs/ benefits / opportunities / possible downsides)
    - o Possible Barriers to Implementation
    - o Mitigation Measures
- **Compliant with Current Policy?** [Yes or No]
    - o Approval requirement [If applicable]
    - o Coordination accomplished / required
- **Proposed Schedule for implementation**
- **Proposed Metrics for implementation:** [if applicable]
- **Implementation Status:** [Updated periodically]

Proposed Innovation 2 [- Name of proposal]

- **Type of Proposed Innovation:** (e.g., acquisition strategies, design method, construction materials; contract administration, etc.)
- **Description of Innovation:** (short description of what innovation is proposed in the context of the project)
    - Basis for Innovation (describe how is this new or novel?)
    - Enabled Project Delivery Benefits (describe in cost, performance, speed, etc?)
- **Qualitative or Quantitative Risk Assessment:** (e.g., evaluation of costs/ benefits / opportunities / possible downsides)
    - Possible Barriers to Implementation
    - Mitigation Measures
- **Compliant with Current Policy?** [Yes or No]
    - Approval requirement [If applicable]
    - Coordination accomplished / required
- **Proposed Schedule for implementation**
- **Proposed Metrics for implementation:** [if applicable]
- **Implementation Status:** [Updated periodically]

Proposed Innovation n [- Name of proposal]

- **Type of Proposed Innovation:** (e.g., acquisition strategies, design method, construction materials; contract administration, etc.)
- **Description of Innovation:** (short description of what innovation is proposed in the context of the project)
    - Basis for Innovation (describe how is this new or novel?)
    - Enabled Project Delivery Benefits (describe in cost, performance, speed, etc?)
- **Qualitative or Quantitative Risk Assessment:** (e.g., evaluation of costs/ benefits / opportunities / possible downsides)
    - Possible Barriers to Implementation
    - Mitigation Measures
- **Compliant with Current Policy?** [Yes or No]
    - Approval requirement [If applicable]
    - Coordination accomplished / required
- **Proposed Schedule for implementation**
- **Proposed Metrics for implementation:** [if applicable]
- **Implementation Status:** [Updated periodically]

Project POC: [Name, office symbol, phone number, email]