RD&T UPDATE
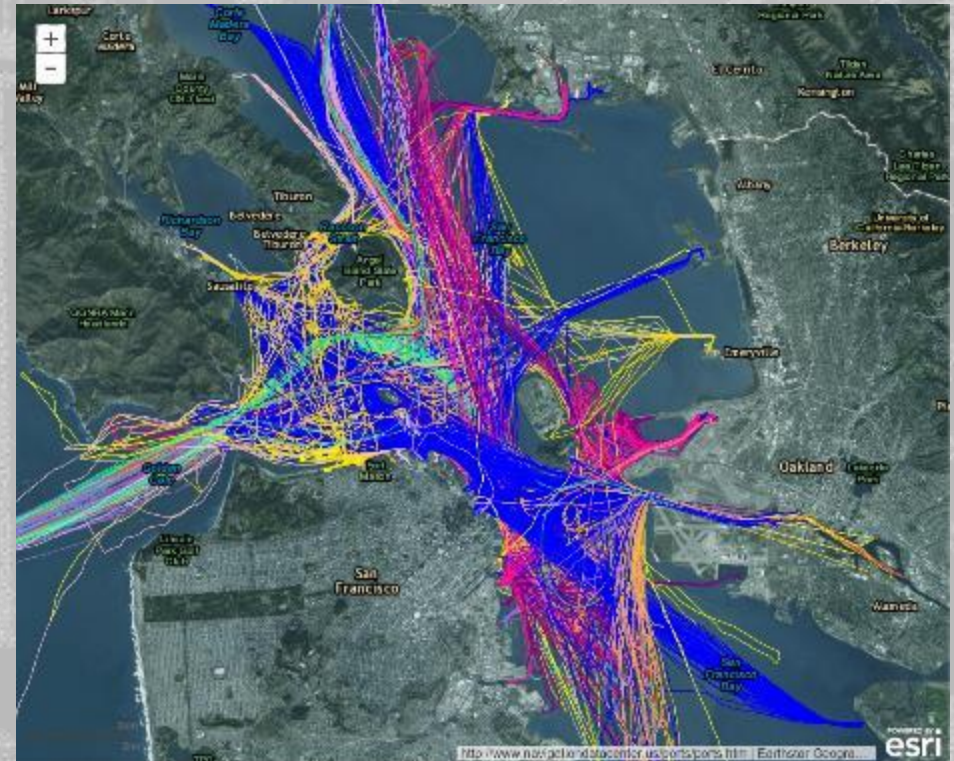
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Date: 31 March 2020

INTENT AND OUTLINE

Objective: Provide general information about USACE CW R&D activities supporting topics relevant to our Nation's ports and harbors.

Content:

Civil Works R&D Strategies

Emerging Strategic Targets

Examples of Relevant R&D

Questions

CIVIL WORKS RD&T STRATEGIES

FLOOD & COASTAL RD&T STRATEGIC NEEDS & PRIORITIES

- Develop tools for **lifecycle analysis** incorporating risk, uncertainty & consequences of alternatives
- Optimize design & management of **resilient coastal & estuarine systems**
- Assess comprehensive & multidisciplinary management of **watersheds**
- Improve FRM **infrastructure** resiliency & reliability
- Enable effective **Emergency Management** disaster preparation, response & recovery

Cross-cutting:
- *Provide tools to enhance ecosystems, processes, benefits & services*
- *Collaborate & leverage via multidisciplinary teams*
- *Deliver sound engineering & scientific solutions that meet Planning Modernization guidelines*
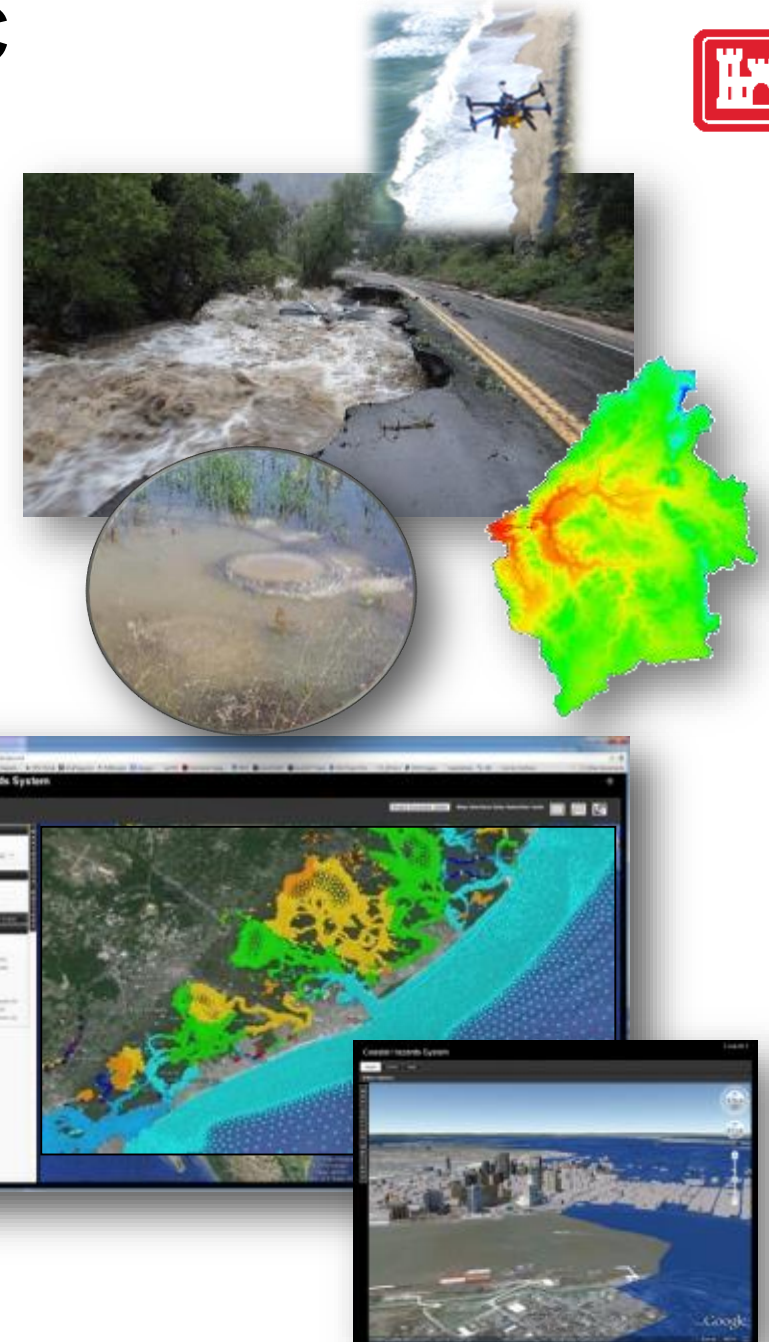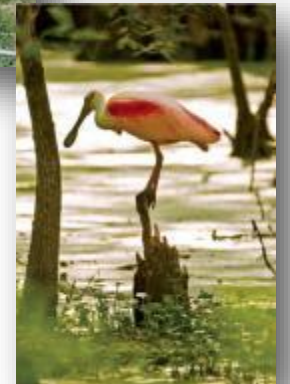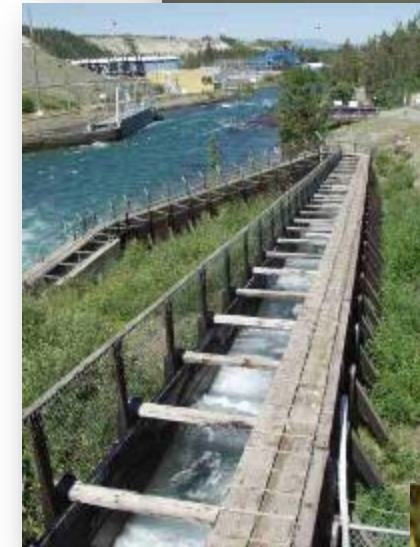
ENVIRONMENTAL RD&T STRATEGIC NEEDS & PRIORITIES

- Establish & Incorporate **Ecosystem Goods & Services** in Corps Planning and Environmental Benefits Evaluation
- Characterize Physical, Chemical and Biological Variations Affecting **Degradation in Coastal Environments**
- Improve Capabilities to Design and Implement **Aquatic Ecosystem Restoration** in Urban Settings
- **Optimize Management** of T&E and Invasive Species
- Optimize design & management of **resilient coastal & estuarine systems**

Cross-cutting:
- *Provide tools to enhance ecosystems, processes, benefits & services*
- *Collaborate & leverage via multidisciplinary teams*
- *Deliver sound engineering & scientific solutions that meet Planning Modernization guidelines*

NAVIGATION RD&T STRATEGIC NEEDS & PRIORITIES

- **Extend the useful life** of existing navigation infrastructure
- Improve Navigation operations and **Multimodal Freight Flow** through systems optimization
- Optimize design & management of **resilient navigation systems**
- Develop and Deploy **eNavigation** capabilities

Cross-cutting:
- *Provide tools to enhance ecosystems, processes, benefits & services*
- *Collaborate & leverage via multidisciplinary teams*
- *Deliver sound engineering & scientific solutions that meet Planning Modernization guidelines*

EMERGING STRATEGIC TARGETS

INNOVATIVE TECHNOLOGIES FOR RESILIENT & RELIABLE INFRASTRUCTURE

NATIONAL CHALLENGE
- **$60B construction** and **$130B maintenance backlog**
- Deferred construction and maintenance = **ever growing costs**
- **2x increase in navigation system downtime** in last decade

CAPABILITY NEEDS
- **Ultra-durable** and **rapid construction materials** and **processes**
- Models to predict performance and optimize maintenance
- Structural **health monitoring, rapid inspection techniques** and **infrastructure control** for asset management

IMPACT
- **Optimized investment** of **construction** and **O&M appropriations** for system reliability/resilience
- More than **2x economic benefit** of infrastructure - **20:1 Return on Investment**
- **75% reduction** in navigation system downtime

Materials, Predictive Models and Health Monitoring

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NATIONAL CHALLENGE
- Sedimentation in navigation channels and reservoirs represents >$1B/year cost, dredging costs continue to rise, and all dredging needs are not met
- Loss of water/flood storage capacity due to sedimentation
- Shoreline erosion and loss of function and value of natural features
- Only 30% of dredged sediment is used beneficially

CAPABILITY NEEDS
- Leap-ahead construction and operation technologies to lower costs and accelerate schedules
- Next generation sensors, monitoring and modeling technologies to reduce sediment imbalances, channel in-filling and dredging needs
- National physical modeling facility to test new marine/aquatic dredging and construction techniques
- Engineering With Nature® solutions for sediment that deliver multi-purpose value

IMPACT
- $80M annual investment in sediment innovation over five years delivers $10B in cost savings and added value over the first 15 years
- Increase national beneficial use from 30% to >70% over 10 years
- Advance USACE sustainability by expanding environmental and social benefits at navigation projects by 50% over 10 years

INNOVATION IN SEDIMENT MANAGEMENT

US Army Corps of Engineers • Engineer Research and Development Center

STRATEGIC INVASIVE & NUISANCE SPECIES PREVENTION, DETECTION, AND MANAGEMENT

NATIONAL CHALLENGE

- Aquatic and Terrestrial Invasive and nuisance species represent a significant threat to our nation's resources and economy, impacting operations of every Corps of Engineers District
- Invasive species cause an estimated $120B/year worth of damages

CAPABILITY NEEDS

- Deliver strategic aquatic and terrestrial invasive and nuisance species prevention, detection and management for the USACE
- Identify and develop innovative management and modeling strategies for aquatic and terrestrial nuisance species
- Advanced remote sensing tools to identify and detect Harmful Algal Blooms and terrestrial infestations in near real-time (e.g. Emerald Ash Borer and Feral Hogs)
- Targeted pest management technologies and novel application strategies for deployment at USACE facilities

IMPACT

Continued and increased return on investment that has exceeded 34:1 for past activities such as:

- Preventing Asian carp movement into the Great Lakes for 15+ years; preserving $7B/year fisheries
- $124M investment in research to develop effective water hyacinth management tools generated $4.2 billion in benefits to boating-dependent businesses, water treatment facilities, and recreationists

Harmful and Nuisance Algae

Feral Hogs

Emerald Ash Borer

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NATIONAL CHALLENGE

- U.S. inland and coastal damage has increased from **$5B to $50B/year** over the past 40 years and **fatalities have increased tenfold**
- Flood risk **assessment is reactive** and lacks critical hydro-terrestrial system context

CAPABILITY NEEDS

- **Common operating framework** to evaluate comprehensive flood hazard **on a continental scale**
- **Next generation remote and space-based observations** assimilated in real-time
- Innovative integration of high-fidelity simulation and observation data that leverages **machine learning and artificial intelligence**
- Advanced and modular numerical methods and physics packages for **interaction** of atmospheric, inland, and coastal processes
- Advanced tools for **uncertainty quantification**
- Hazard assessment tools for risk-based project design and operation based on **trade space analytics**

IMPACT

- Reduced uncertainties for **optimized infrastructure design** and less risk
- Increased real-time knowledge for **optimizing** emergency response, managing water quality and facilitating navigation
- Reducing flood risk by 5% nationally provides **80:1 return on investment and would save five lives annually**

**CONTINENTAL-SCALE CAPABILITY TO MANAGE HYDRO-TERRESTRIAL RISK**

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EXAMPLES OF RELEVANT R&D

EXAMPLE CAPABILITIES

o Electronic Capabilities Supporting Navigation
   • River Information Services

o Data and System Analysis
   • Improving shoaling predictions
   • Port performance and resilience

o Extending the Life of Infrastructure
   • Alternatives to vinyl and coal tar epoxy
   • Composite material gates
   • Use of composite materials for repairs
   • Ultra-High Performance Concrete panels
   • Structural Health Monitoring

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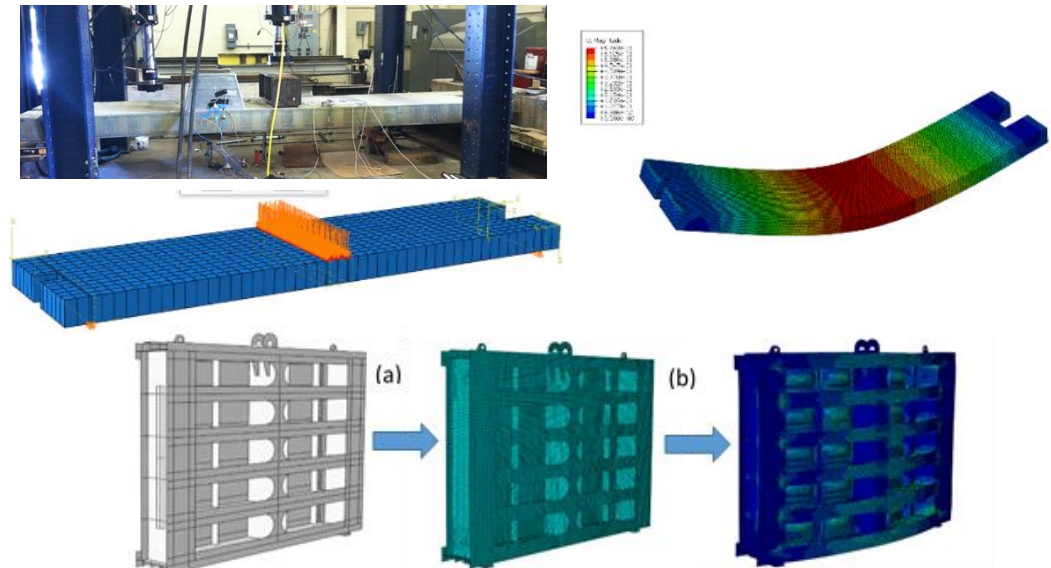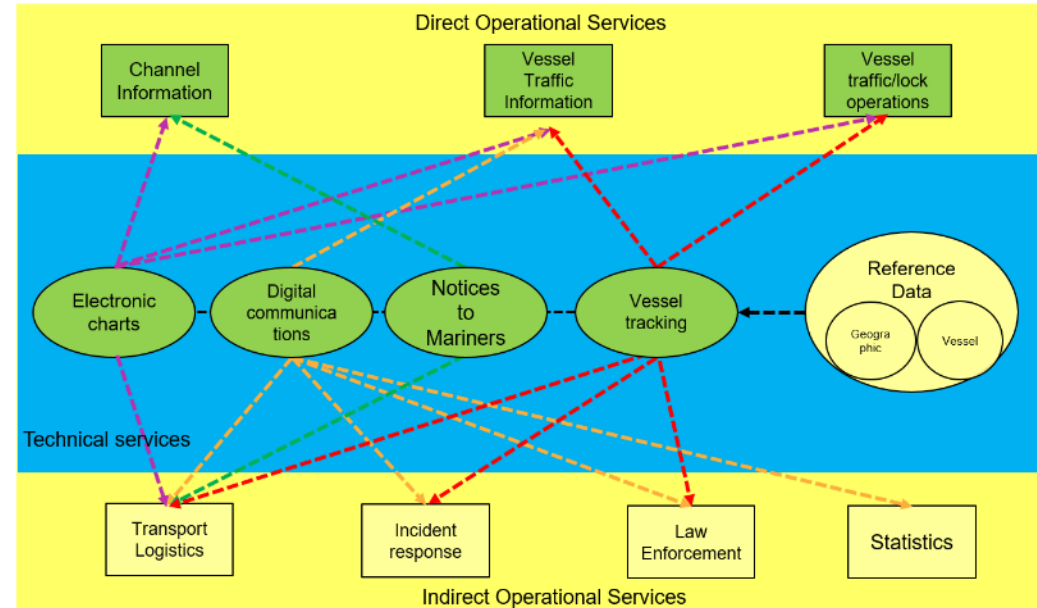
EXAMPLE CAPABILITIES

o Sediment Management
- Multiple efforts to characterize sediment behavior to enable:
  - Thin-layer placement
  - Near-shore placement
- Enhanced Sediment Resuspension Source Models for Dredging Operations

o Beneficial Use of Dredged Sediment
- Enhanced tools for planning for and beneficially using dredged materials
- Natural and Nature Based Features designs and assessments

Dredging material (beneficial use),
- Swan Island project

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EXAMPLE CAPABILITIES

o Vessel Wake Impacts
- Impacts to shorelines
- Tools to evaluate performance of features placed for shore protection from vessel wakes

o Long-term modeling effects of sea level rise on inlet geomorphology

1950
1962
1995
2017

2017

QUESTIONS

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