

# NAVIGATION RD&T UPDATE

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**US Army Corps  
of Engineers®**



**ERDC**  
ENGINEERING RESEARCH & DEVELOPMENT CENTER

# Navigation analysis capabilities

## Port Performance

- Establish port performance metrics to inform decision making and answer targeted questions
- Fuse data from CPT, AISAP, CSAT to develop metrics
- Examples (in development):
  - Impact of COVID19 on west coast ports
  - Rapid estimation of additional shipping costs due to shoaling
  - Towing vessel delays and barge lane navigability along the Houston Ship Channel

## National MTS Network Analysis

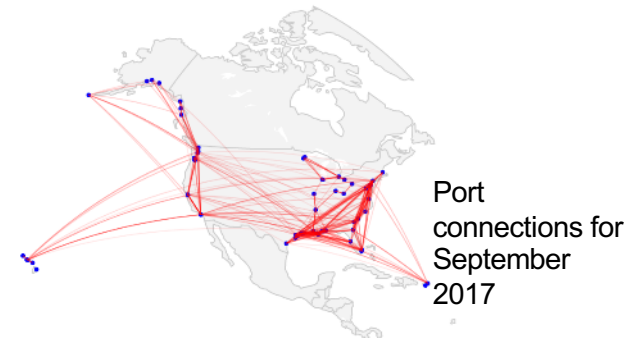
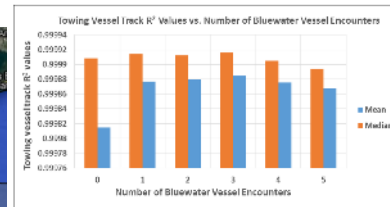


Figure 13. Trends in towing vessel track  $R^2$  values as bluewater vessel encounters increase - HSC-82, December 2015.



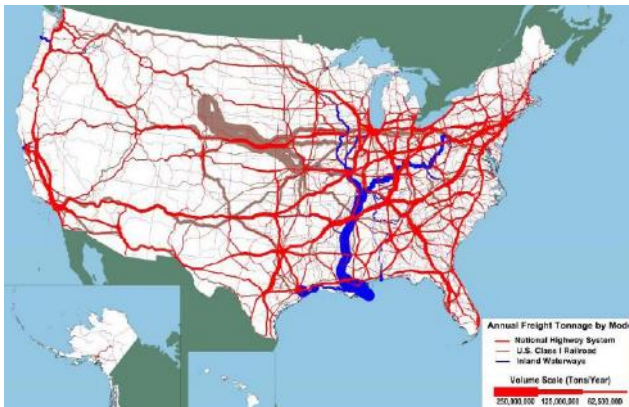
- Understand MTS resilience on a national and regional level
- Determine degree of connectivity of ports and critical ports
- Measure disturbances and identify trends



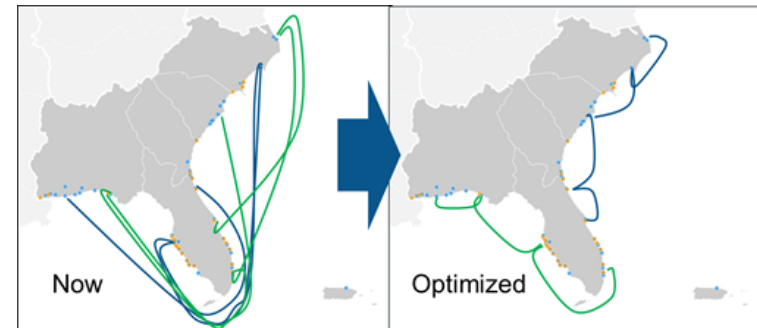
# Navigation connectivity and optimization capabilities

## Multimodal Freight Modeling

- Create intermodal transportation modeling and analysis tool
  - Include Road, rail, and water transportation
- Ability to query data, visualize results, preform scenario planning
- Inform infrastructural investments



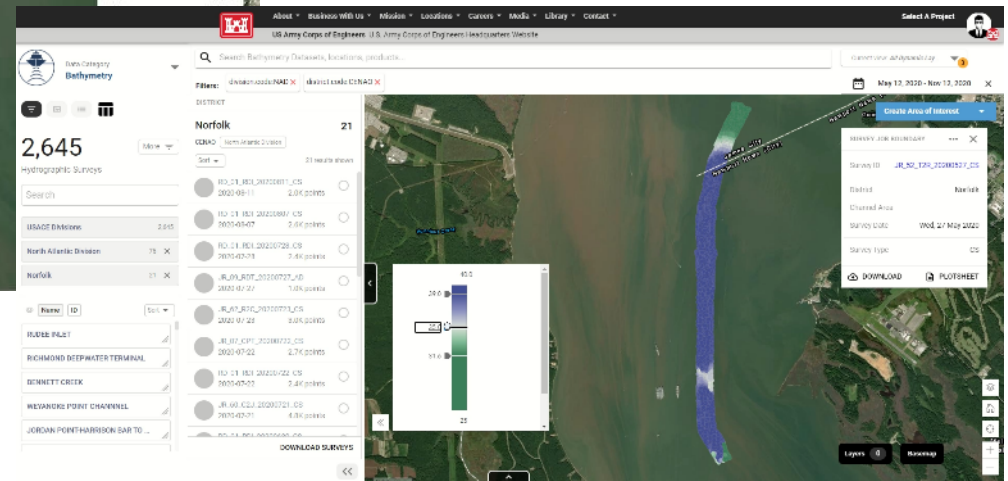
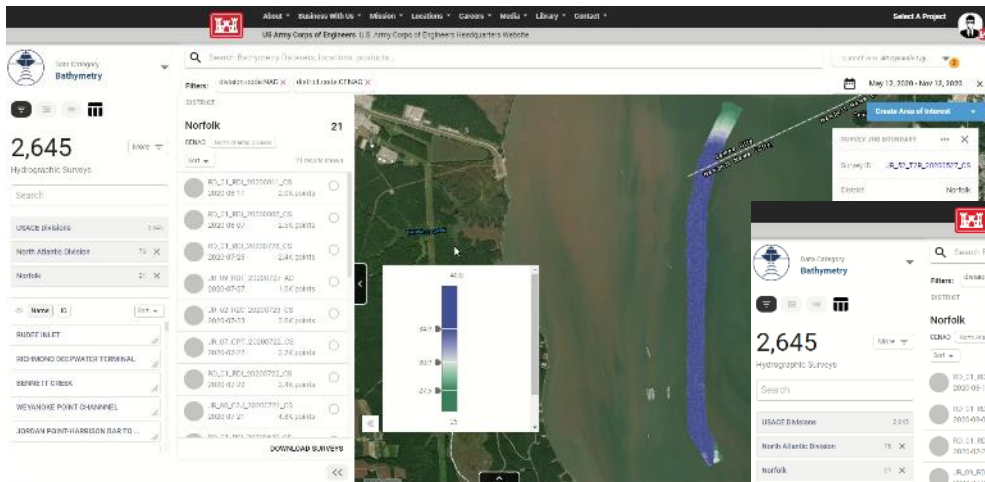
## Dredge Fleet Scheduling Optimization



- Understand the dredge fleet
- Recognize dredging requirements and cyclical patterns
- Optimize dredging schedules
- Use maintenance funding smarter

# USACE Navigation Portal

- **Concern:** Need a practical way to combine information and analysis capabilities from separate, targeted navigation tools and data sets
- **Capability:** Produce an engineering analysis and data science platform that integrates content from approximately 15 databases and tools.

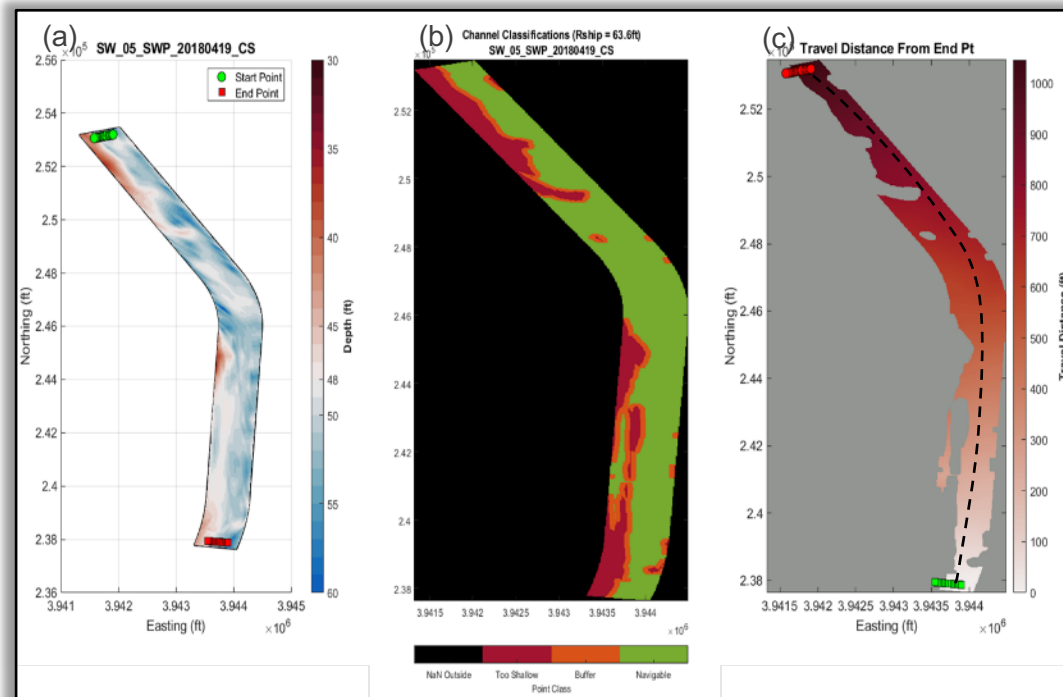


Survey data loaded into the portal through the eHydro tool are easily selected for display and color coded according to depth. Color palettes are quickly and easily adjusted to show areas of concern.

# Corps Shoaling Analysis Tool (CSAT) Applications

- **Concern:** USACE needs improved methods to assess and predict channel availability.
- **Capability:** CSAT shoaling rates, combined with eHydro survey results can inform present and predict future channel availability, thus better informing maintenance decisions.

These graphics depict, left to right, (a) depiction of controlling depths for a channel reach based on improved algorithms; (b) an assessment if controlling depths are navigable (depicted in green); and (c) a possible method of determining channel availability based on possible vessel travel path (black dashed line) that considers vessel maneuverability and buffer zones for shoaled areas.





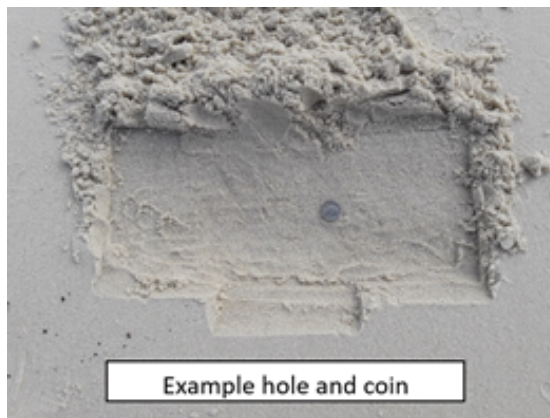
# Citizen Science – Beach grain size data collection

- **Concern:** Grain size often has the largest uncertainty in sediment transport modeling
- **Capability:** Tools for developing a nationwide beach grain size database will reduce uncertainty in the composition grain size of our beaches and coastlines



<https://arcg.is/05rDX8>

Sandsnap allows anyone to use their phone to take and upload an image depicting representative material.



Example hole and coin

Machine learning software, SediNet, processes the uploaded images to estimate the grain size information from the image (<12%  $d_{50}$  error)



# Hydrographic surveying modernization

- **Concern:** The USACE's capability to safely and efficiently perform hydrographic surveys in times of crisis/disaster should be improved.
  - **Capability:** Develop and implement autonomous survey capabilities to meet mission needs.
- New effort in USACE
  - Exploring COTS & GOTS capabilities
  - Identify capability gaps and fill

## Key Considerations:

- Platform(s)
- Object detection and avoidance
- Vessel behavior
- Communications
- Automation of survey components and software



# Ultra-high performance concrete panels

- **Concern:** Damaged and deteriorated lock walls need durable, lighter-weight repair options
- **Capability:** Panels constructed from ultra-high performance concrete panels are envisioned as an option to meet this need.

**Lock and Dam No. 2  
St. Paul District**



Precast normal strength panels:

- Thick and heavy → Large cranes for installation;
- Embedded steel → Corrosion → Moisture ingress → Concrete damage

Precast ultra-high performance concrete panels:

- Denser and no embedded steel → stronger, more durable, thinner, lighter

**Lock and Dam No. 13  
Rock Island District**



## **STATUS:**

- Developed a generic UHPC using materials typically on hand a precast plants
- Small-scale testing underway to quantify performance prior to constructing large-scale panels for further testing





# Other RD&T Topics and work efforts

- **Using machine learning / artificial intelligence (ML/AI) to:**
  - correlate and analyze vessel and sea condition data near coastal structures to describe structure performance;
  - examine underkeel clearance as a more complete picture of how channels are performing compared to vessel draft/cargo tonnage combined with channel controlling depth
- **Improving tools and models for sediment transport and inlet morphology to understand possible impacts to navigation and enable better beneficial use of dredged material**
- **Improving TES deterrents and monitoring capabilities to expand dredging windows**
- **3D Printed Design for Remediation & Monitoring of CoC in Dredged Material**
- **Cost-effective stabilization of dredged sediment for capping and nearshore placement applications**
- **Developing and improving design and monitoring methods for Engineering With Nature, Natural and Nature Based Features and Regional Sediment Management approaches to sediment use and management**
- **Continuing efforts to broaden implementation of composite materials for new assets and repairs**

# Questions

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