Engineering with Nature (EWN) and Natural and Nature Based Features (NNBF) Integration into Dredging – Galveston District Perspective

WEDA 2018 Dredging Summit and Exposition
Norfolk, VA

Session 2A – Tools and Techniques
26 JUN 18

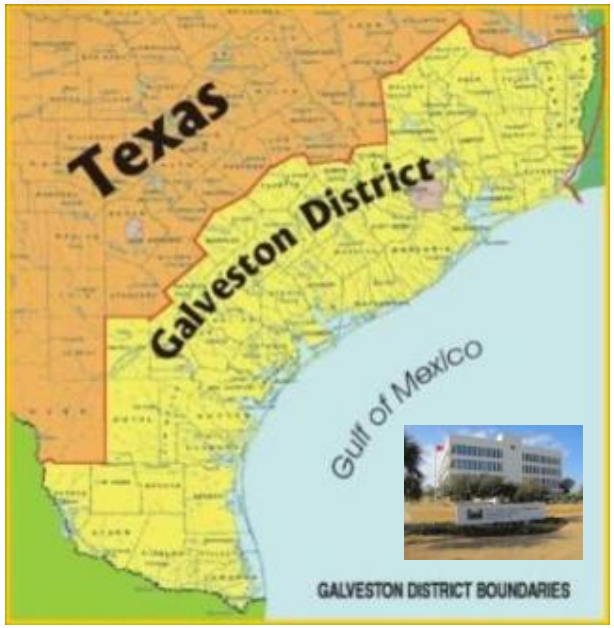
Edmond J. Russo, Jr., PhD, PE, D.CE, D.NE, D.WRE
Deputy District Engineer for Programs and Project Management
USACE, Galveston District

"The views, opinions and findings contained in this report are those of the authors(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other official documentation."

US Army Corps of Engineers.

U.S.ARMY

USACE Galveston District (SWG): History and Mission



- First engineer district in Texas, established 1880
- 50,000 square mile district boundary, ~100+ miles inland
- 28 ports handling 538 M tons of commerce annually (FY 16)
- 1,000+ miles of channels
  - 750 miles shallow draft
  - 270 miles of deep draft
- 367 miles of Gulf coastline
- 30-40 M cubic yards/yr material dredged
- 16 Congressional districts
- 48 Texas counties, 4 Louisiana parishes
- 18 Coastal counties - bays / estuaries
- 9 coastal basins

- **Navigation**
- **Flood Risk Management**
- **Regulatory**
- **Ecosystem Restoration**
- **Emergency Management**
- **Interagency & International Support**

US Army Corps of Engineers.

U.S.ARMY

Houston-Galveston Navigation Channels (HGNC) Complex

- The latest 45 ft x 530 ft channel improvement project performed 1998-2005
- 100+ MCY dredged
- $500M+ channel improvement cost
- Collaborators:
  - Port of Houston Authority (PHA)
  - Inter-agency Coordination Team (ICT)
  - Beneficial Uses Group (BUG)

US Army Corps of Engineers.

U.S.ARMY

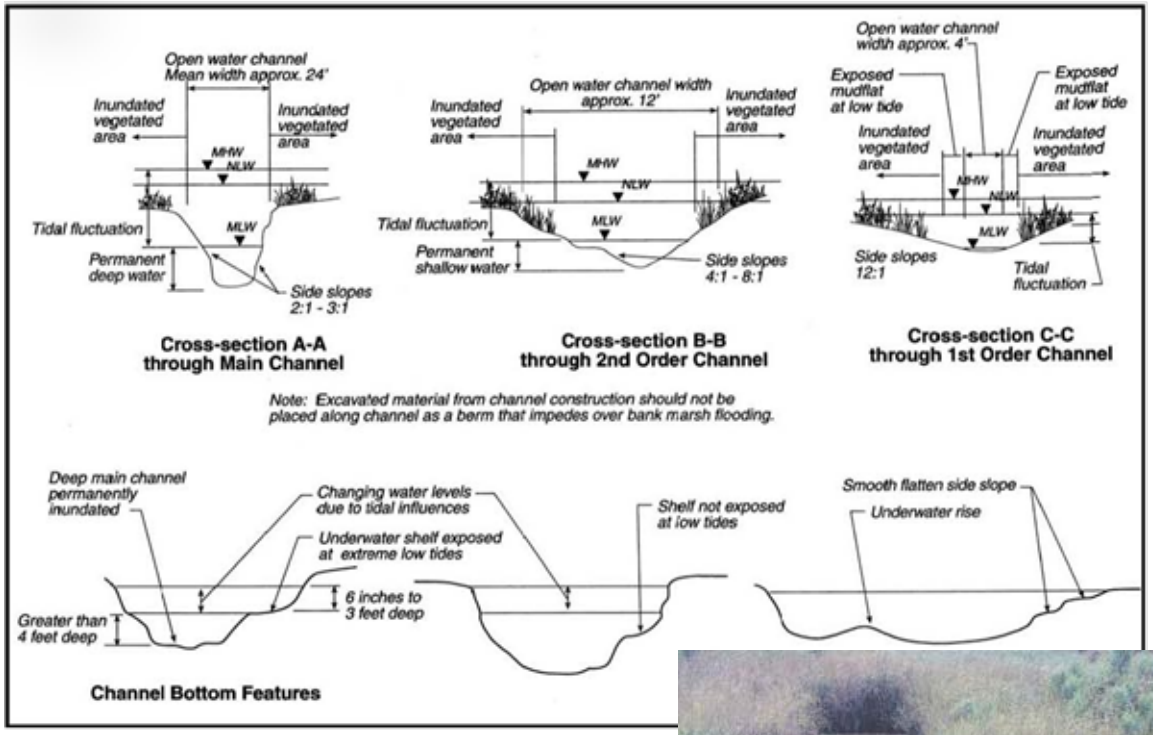
HGNC Beneficial Use (BU) Projects

- Channel improvement project was opportunity to restore some marsh losses in Galveston Bay
- 4250 ac marsh planned at Atkinson, Mid Bay, and Bolivar
- Created over 2,800 ac of marsh and 6-ac bird habitat at Evia Island
- Environmental restoration costs ~ $130 M
- Deferred environmental costs (post FY 07) ~ $100 M

US Army Corps of Engineers.

U.S.ARMY

EWN to Achieve NNBF on BU Projects



Emergent vegetated marsh interspersion

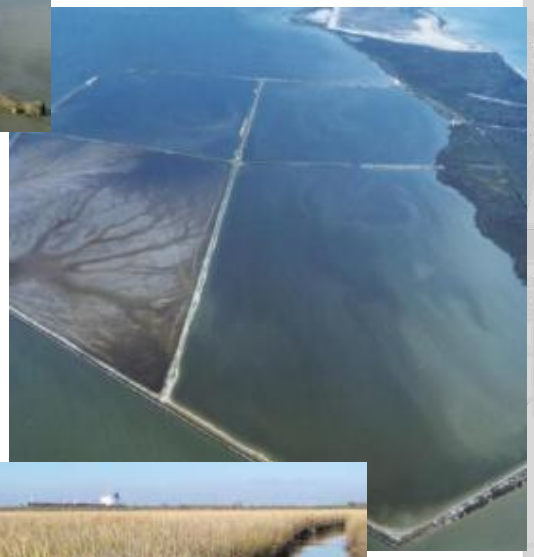
- Goal – Create functional wetlands for fish and wildlife
- Objectives
  - Tidal exchange and circulation
  - Elevation variability
  - Native vegetation diversity
  - Marsh interspersion

US Army Corps of Engineers.

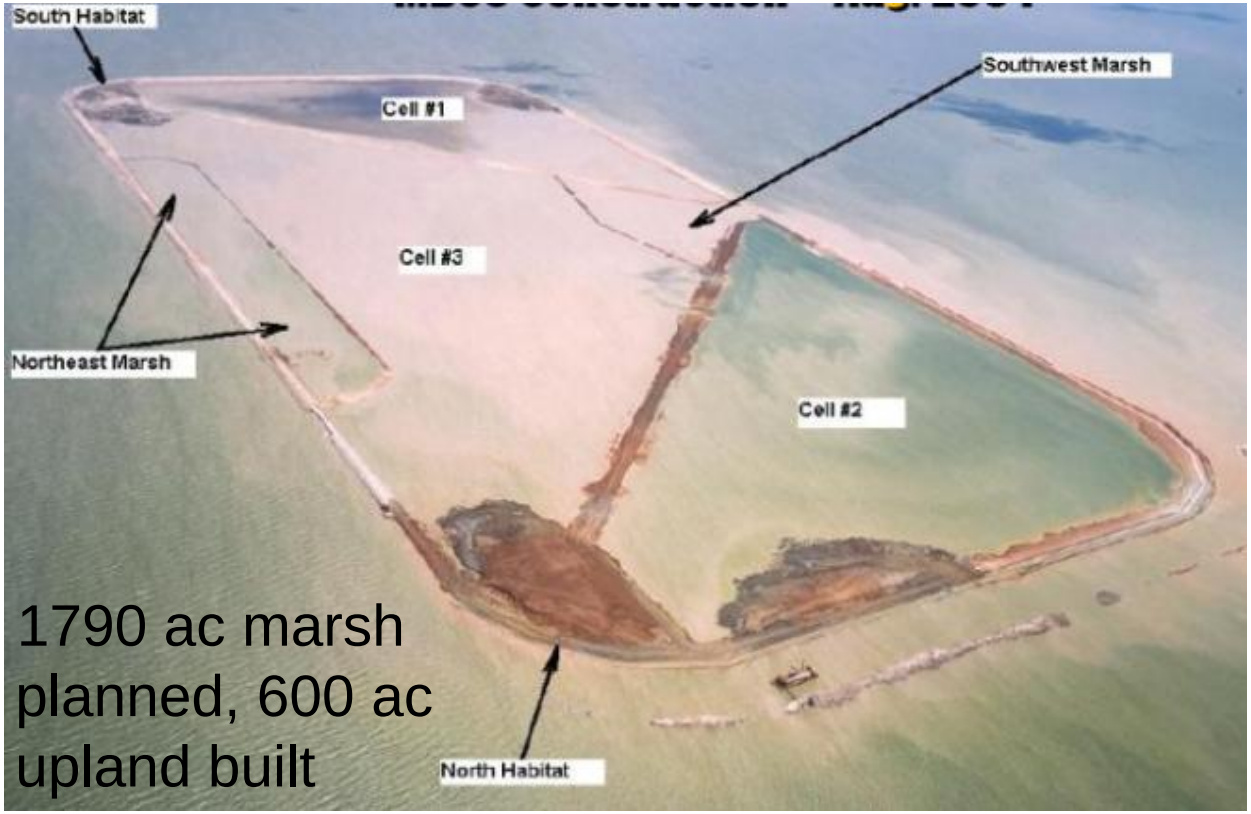
U.S.ARMY

Atkinson Island: Demo Marsh and Scaling Up BU

- Took performance criteria from reference marshes and other natural bay processes
- Set physical and biological design goals
- Engineered Placement Area (PA) dike cells
- Filled to establish a target elevation
- Achieved tidal exchange and circulation
- 1530 ac planned, 1842 ac at future completion of construction



Mid Bay Island Site Construction and BU Discovery Learning



1790 ac marsh planned, 600 ac upland built

- Initially a marsh and upland combination
- Became overfilled during a placement event
- Now valued mid bay upland habitat, resilient against sea level rise
- Increased size of Bolivar marsh creation as mitigation

US Army Corps of Engineers.

U.S.ARMY

HGNC BU Experience at Evia Island

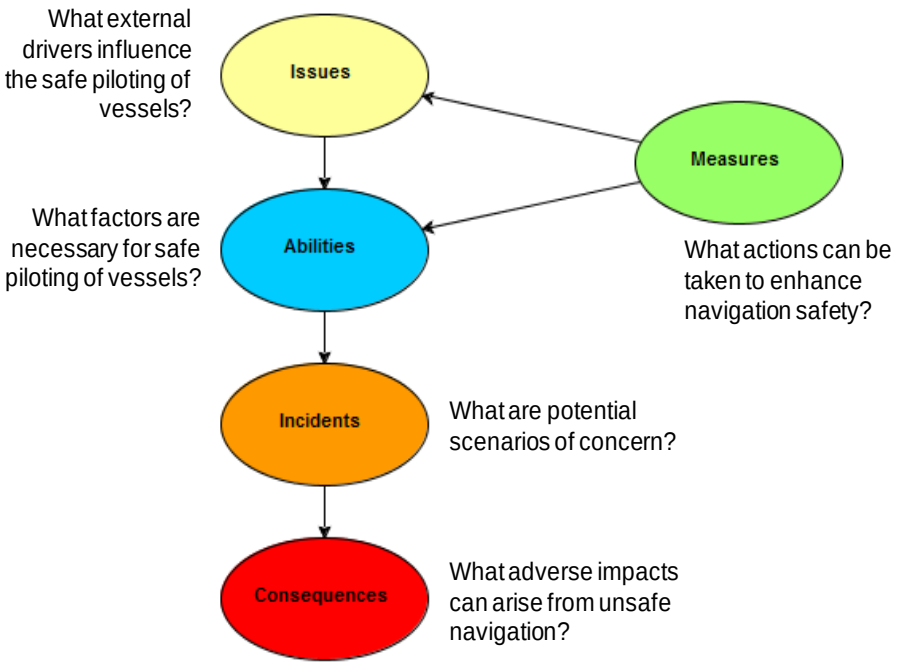
- Mixture of scrub-shrub and wetland habitats for refuge and nesting
- Incorporation of quiescent lagoon with tidal flushing for foraging and rearing
- Creation of channelized perimeter fish habitat
- Rock armor provides algal substrate and crustacean habitat

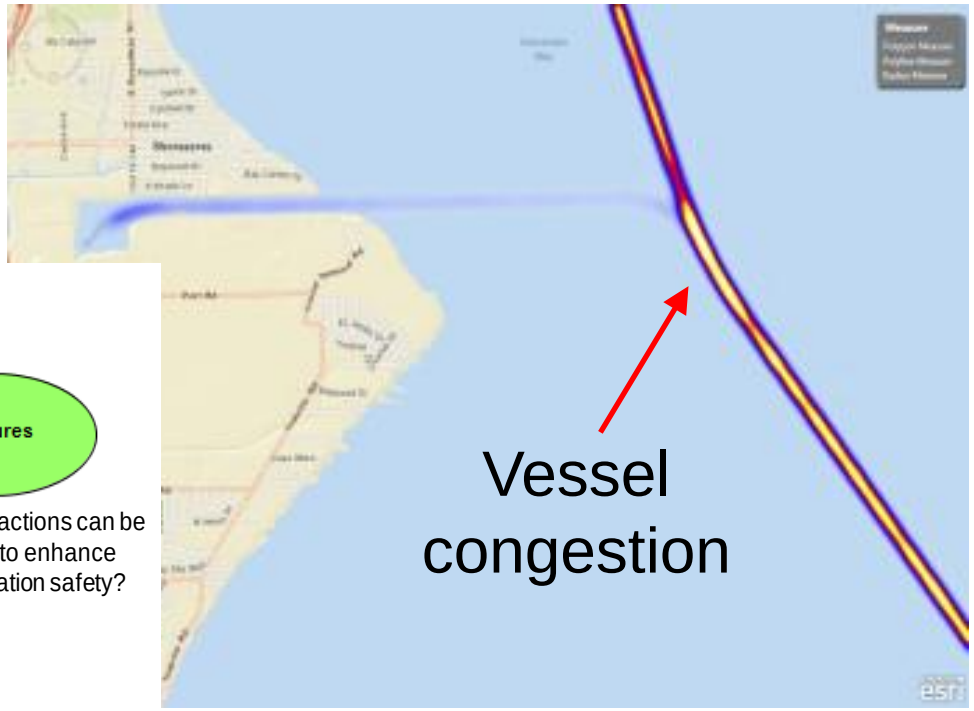
HGNC BU Experience at Bolivar Marsh

- Built with adapted channelization design
- 930 ac planned
- Actual:
  - 790 ac marsh
  - 200 ac pimple mounds

Identifying Houston Ship Channel (HSC) Navigation Deficiency

ERDC-SWG solution co-development to transform state of the practice



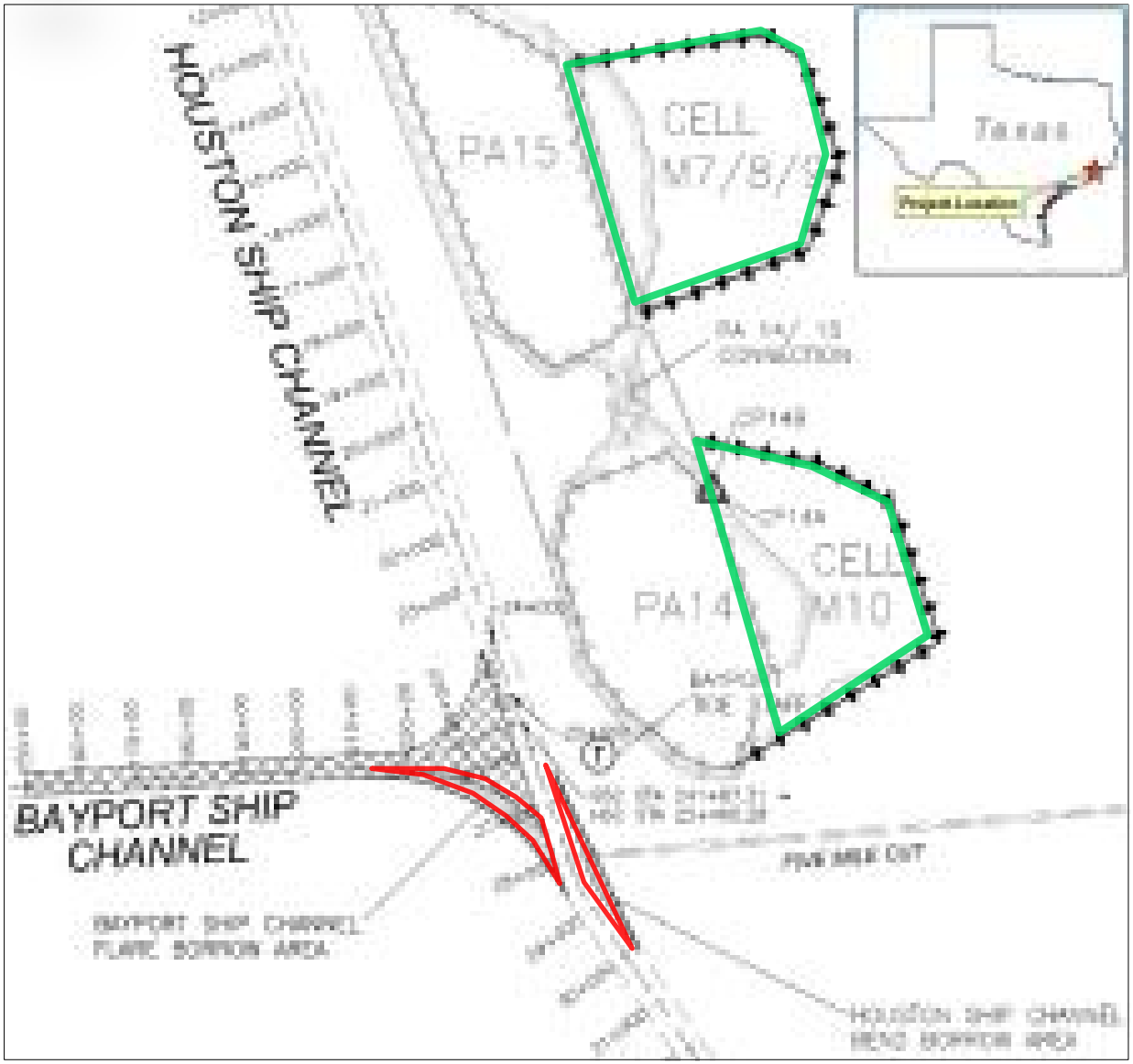


Expert Elicitation and Automatic Identification System data heat map solutions frame navigation safety issues on HSC and inform channel deficiency characterization

US Army Corps of Engineers.

U.S.ARMY

Correcting Channel Deficiency Matched with EWN to Create NNBF at Atkinson Island

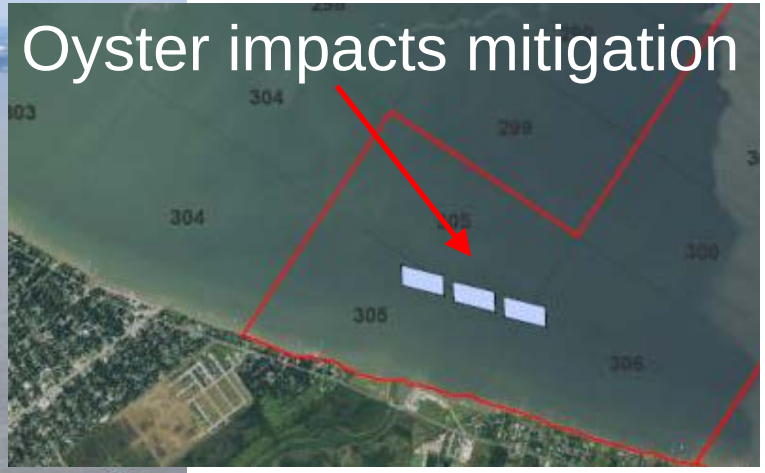


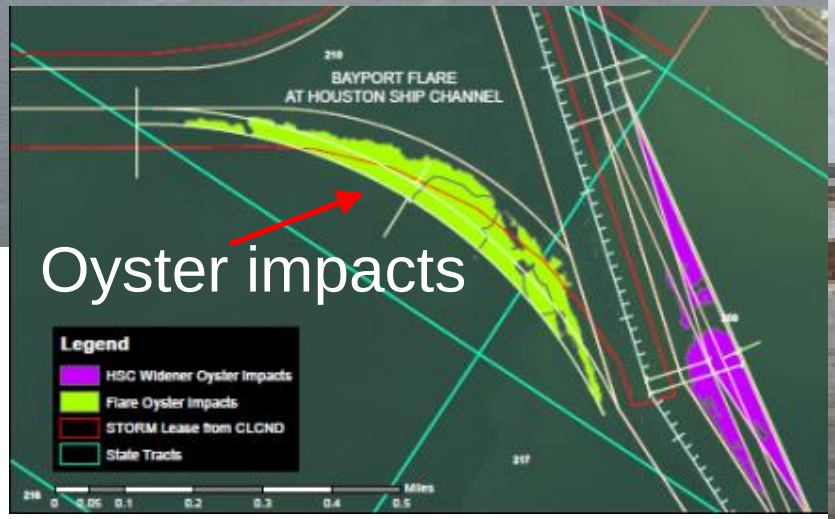
- $23 M project
- 687 wetland acres being created
- Award in SEP 16, expected completion SEP 18
- ERDC integrated into District team for technical innovation
- Managing execution risks and improving project outputs
- Integrated R&D directly into District project for testing efficacy of NNBF

US Army Corps of Engineers.

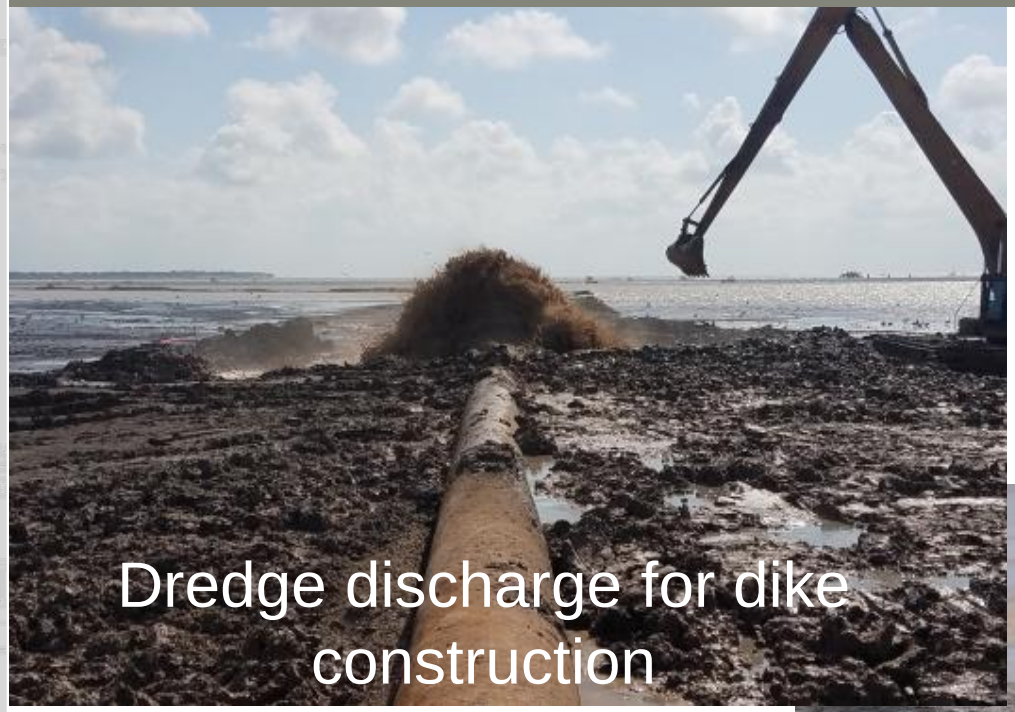
U.S.ARMY

Bend Easing at Bayport Ship Channel Flare and M 10 Initial Earthen Dike Construction





M 10 Earthen Retention Dike Construction



Dredge discharge for dike construction

Marsh cranes performing dike shaping

M 10 Oyster Foreshore Dike Construction

ERDC gauge station at oyster foreshore dike

M 10 Retention Dike Shaping and Foreshore Protection

Erodible wetlands creation retention dike construction at HSC marsh cells:

- Bare earth test section
- Native vegetation test section
- Oyster shell foreshore dike test section

M 10 Wetland Creation using HSC Channel Maintenance Materials

US Army Corps of Engineers.

U.S.ARMY

Lessons Learned / Best Practices

- Engage interested and affected parties early and often
  - Understand stakeholder values
  - Inform BU planning with stakeholder input
  - Follow up with stakeholder site visits, feedback, continuous process improvement
- Manage project performance expectations
  - Develop shared vision goals and objectives
  - Establish success criteria
  - Take manageable risks for testing/developing BU new techniques
  - Monitor performance
  - Adapt construction as required toward achieving goals/objectives
- Communicate BU
  - Document project construction achievements
  - Describe EWN / NNBF successes, challenges
  - Share information and continue building working relationships