Beneficially Using Dredged Sediment to Enhance Marshes, Build Resiliency and Restore Habitats in New Jersey's Back Bays

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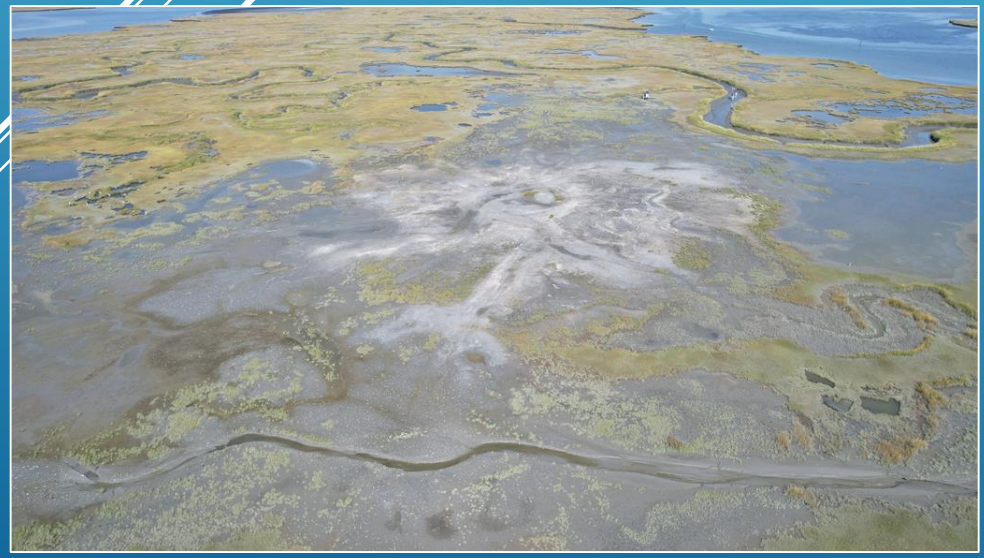


- A Proving Ground Using Natural and Nature-Based Features to Provide Ecological Uplift and Enhanced Resilience for Ecosystems and Coastal Communities
- A Test Bed to Advance and Improve Dredging Techniques and Marsh Restoration and Coastal Feature Creation Techniques in Coastal New Jersey
- Using a Landscape Approach and Adaptive Management to Move From Pilot Projects to Ecosystem Solutions
- Based on an International Concept Pioneered by the Dutch
- 24 sq mi Back Bay Marsh Dominated System with Shallow Bays, Sounds and Tidal Inlets Bisected by the NJ Intracoastal Waterway
- 50+ Member Working Group for Knowledge Sharing
- More than 30 Scientists Working in SMIIL

SEVEN MILE ISLAND INNOVATION LABORATORY

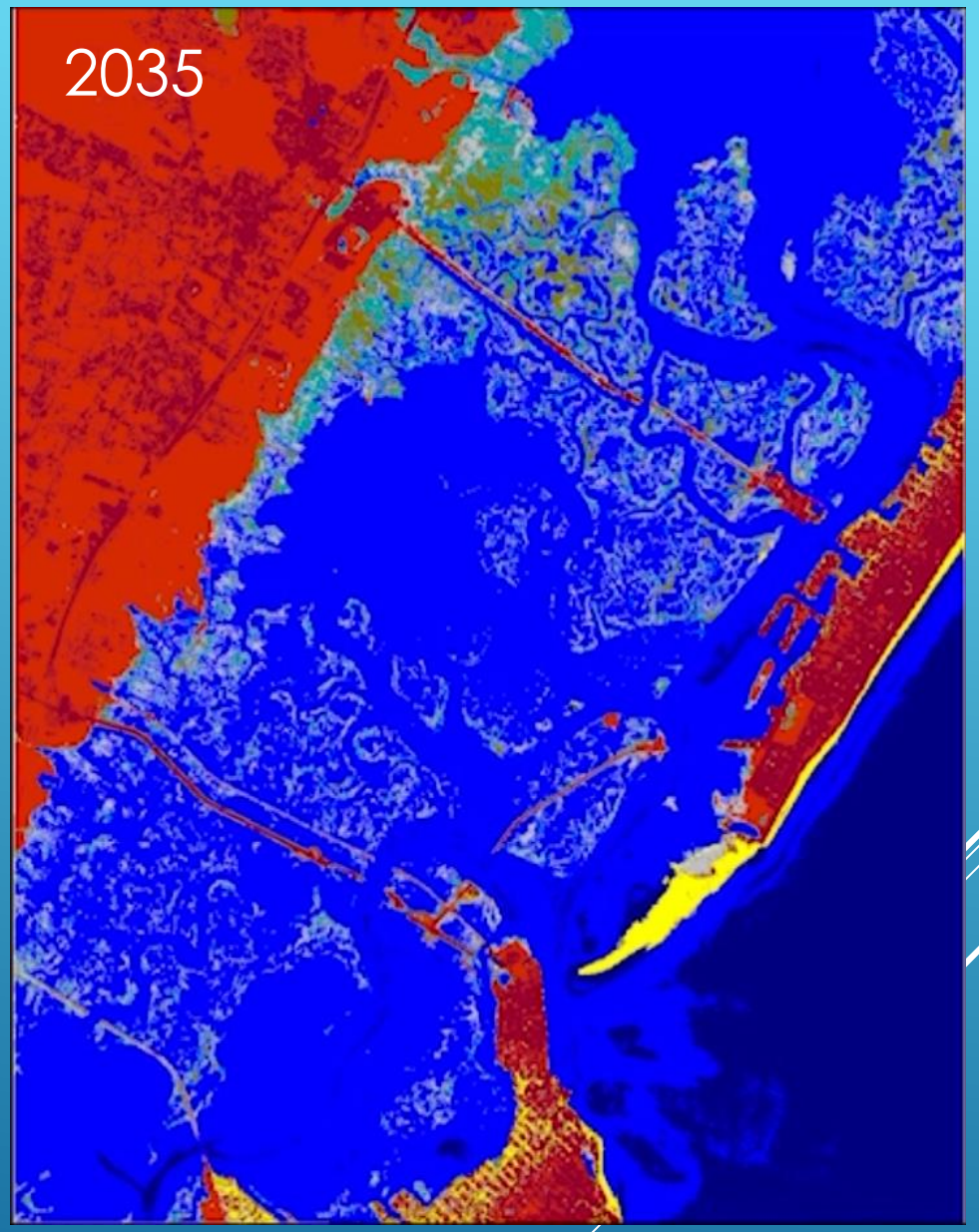
US Army Corps of Engineers®

Wetlands Institute

ERDC

New Jersey Department of Environmental Protection

NJ New Jersey Fish and Wildlife



HIGH TIDE FLOODING (MHW SLAMM) AND COASTAL RESILIENCE

Weitzman SCHOOL OF DESIGN
UNIVERSITY of PENNSYLVANIA

SMIIL BENEFICIAL USE PROJECTS

Sediment Type Mixed Fine Sand and Mud
Maintenance Dredging NJIWW
Hydraulic Dredging and Transport

Sediment Type: Fine to Medium Sand
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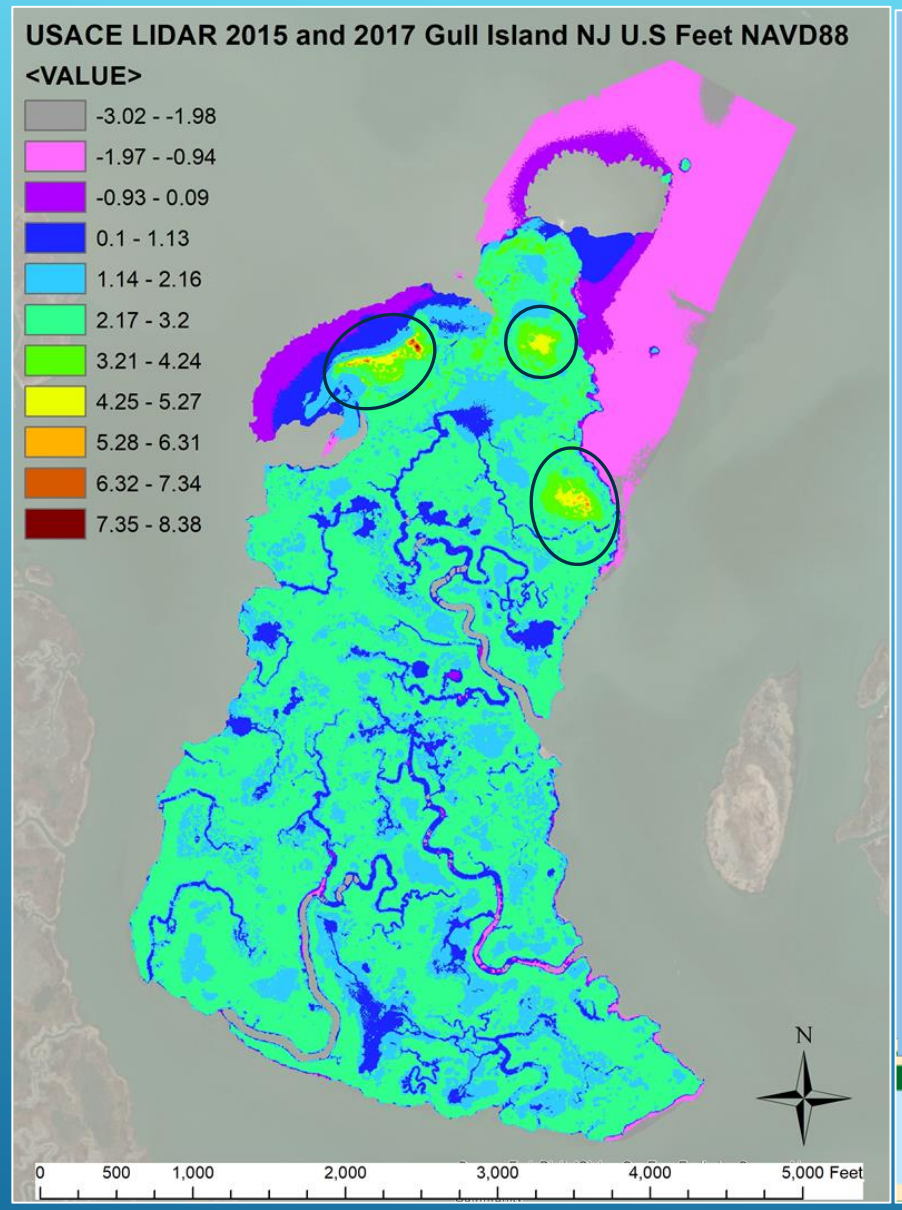
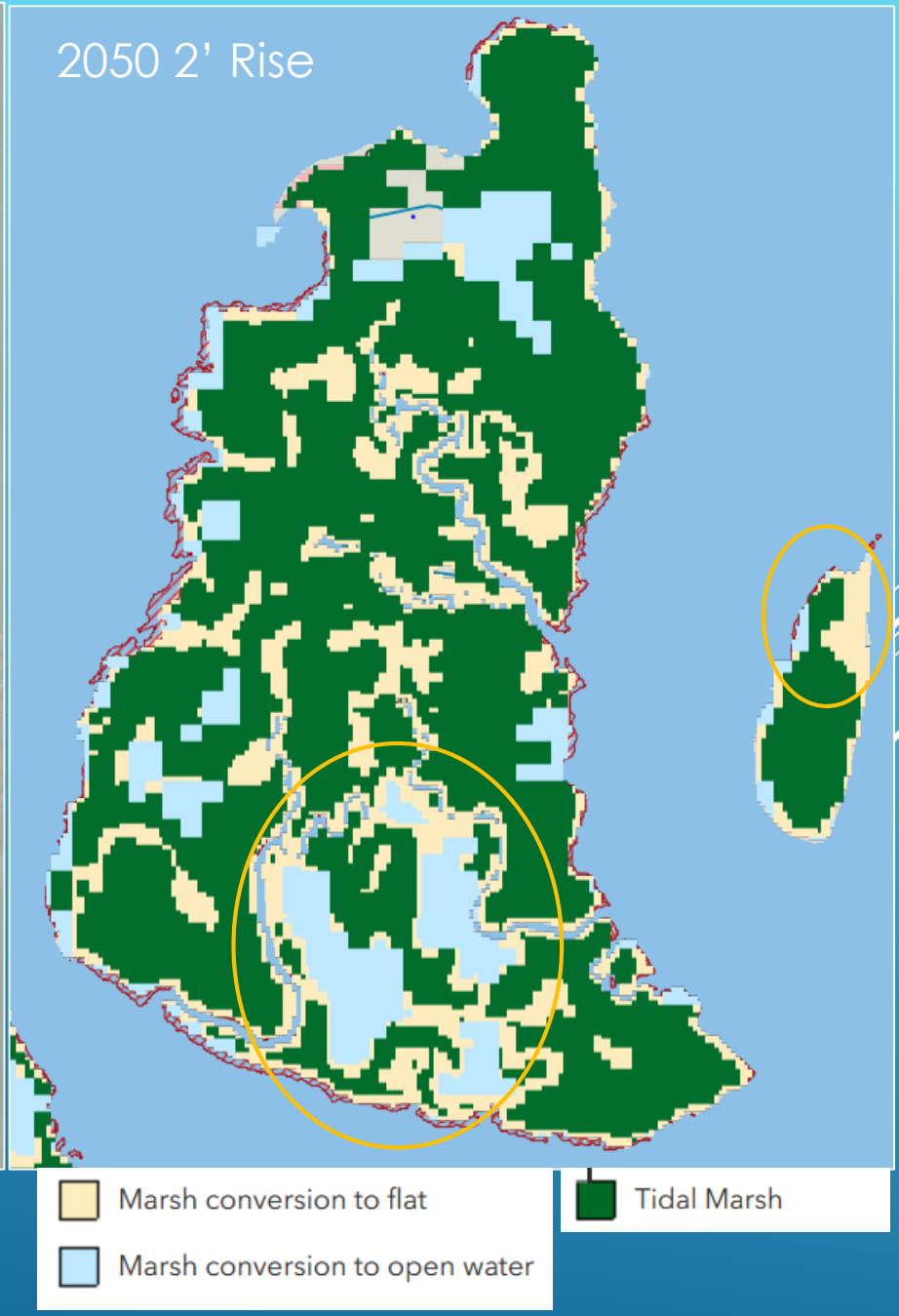
- Sturgeon and Gull Islands are low lying marsh islands that are drowning
- Historic dredge material placement sites created important wading bird habitat
  - Nesting areas account for nesting for 35% of all colonial wading birds in NJ
- Habitat degrading with elevation loss
- Island drowning destabilizing marshes

ECOLOGICAL CONDITION ASSESSMENTS & HABITAT NEEDS

- Gull Island
  - Large portion of tidal marsh projected to convert to mud flats and open water
  - Southern margin experiencing marsh edge erosion and risks of breaching
  - Pre-placement almost all of Gull Island flooded daily with vast areas of interior intertidal flats and open water area
  - High marsh areas are now restricted to prior dredged material placement sites
- Sturgeon Island
  - Northern portions of island at risk of conversion to flats and experiencing marsh edge erosion

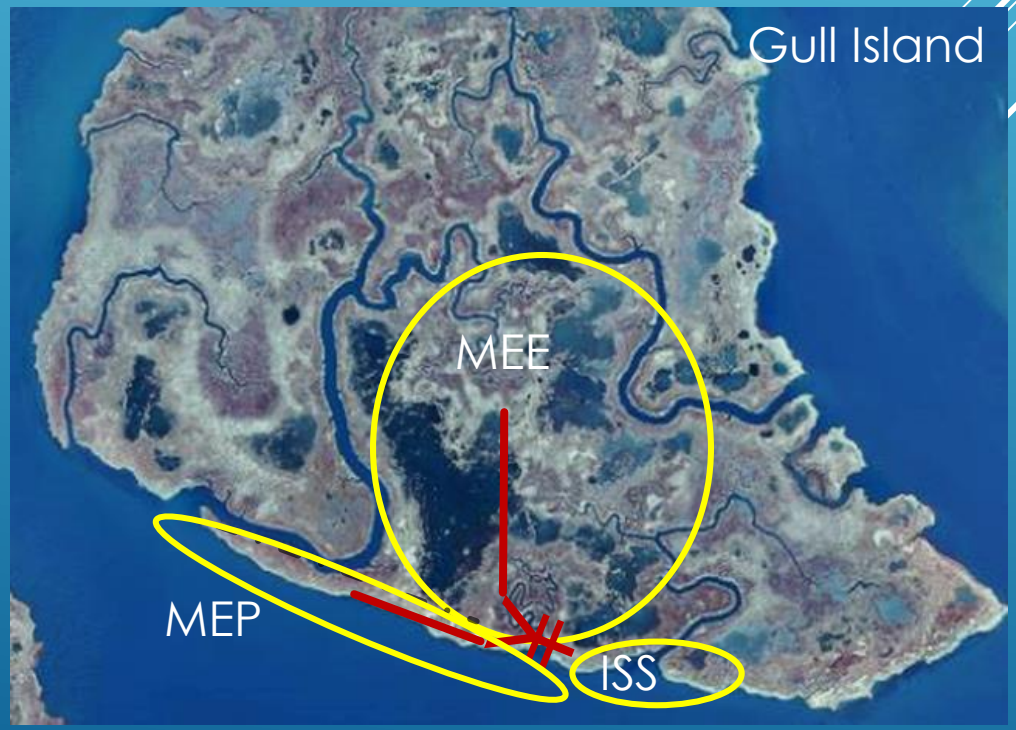




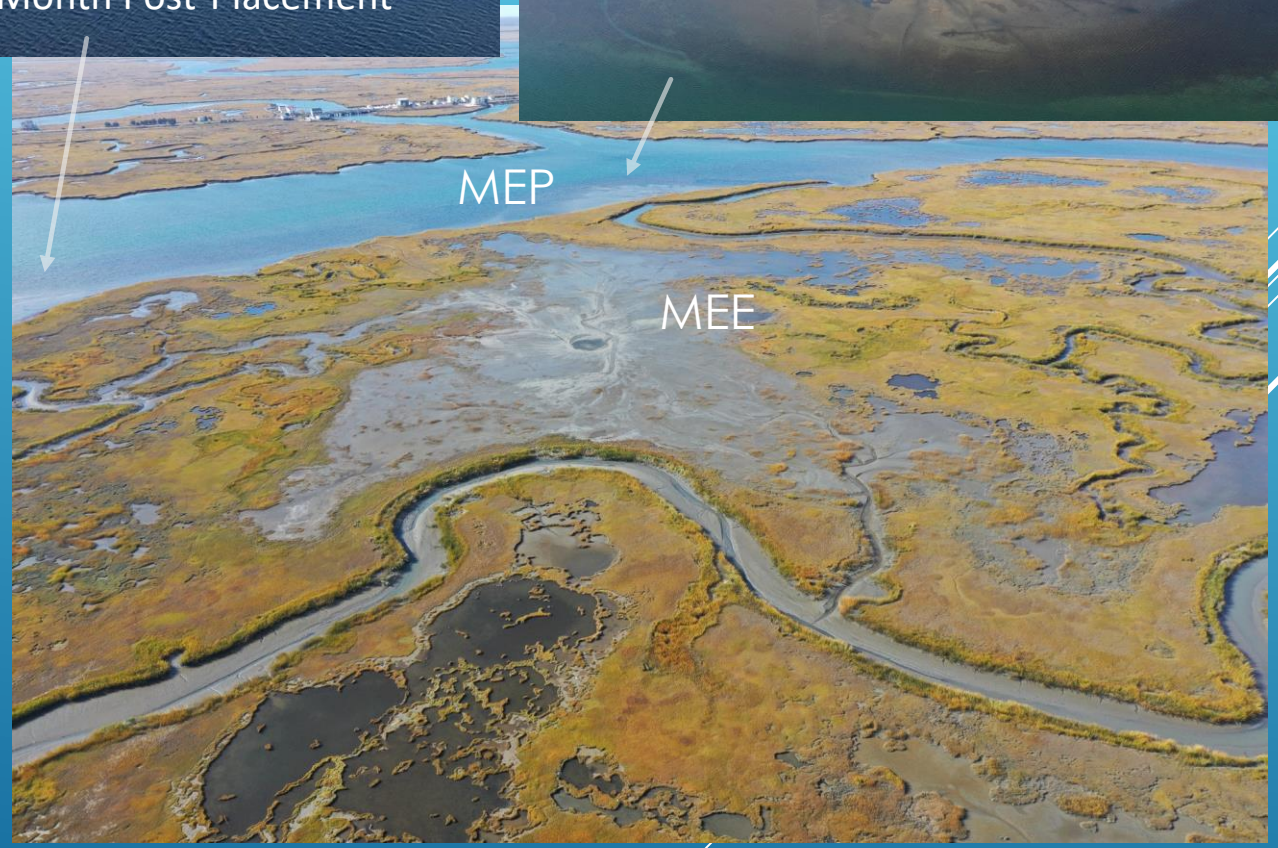
NJ Floodmapper

GULL AND STURGEON ISLAND ECOLOGICAL GOALS

- Ecologic Goals
  - Raise Elevations of Marsh Platforms Across a Gradient of Elevations – Gull and Sturgeon Islands (MEE)
    - Target Wading Bird Nesting Elevations - Transitional Upland Shrub Habitat (>3.5' NAVD88)
    - Target High Marsh Elevations for Salt Marsh Sparrow (2.7' – 3.1' NAVD88)
    - Target Low Marsh Elevation for Fish Habitat (2.0 – 2.7' NAVD88) and Shorebird and Wader Foraging
  - Create Marsh Edge Protection Zone - Gull and Sturgeon Islands (MEP)
    - More Natural Marsh Edge Slope and Wave Energy Buffer
    - Strategic Placement for Marsh Nourishment
    - Intertidal Shoal to Marsh Edge Elevation (2.0'NAVD88)
  - Enhance Intertidal and Subtidal Shallows – Gull and Sturgeon Islands (ISS)
    - Target Elevations to MLLW Where Macroalgal Flats Transition from Sparse to Densely Vegetated (-1.0 MLLW – 0' MLLW)



- Marsh Elevation Enhancement (MEE)
  - Unconfined placement of 40,000 cubic yards of mixed fine sand and mud
  - ~22 acres of elevation lift
  - 3.9’ NAVD88 1.8’ NAVD88
  - Excellent grass recovery
  - Migratory shorebird and sparrow use
- Marsh Edge Protection (MEP)
  - Built to marsh edge (2.0’ NAVD88) down to MLLW
  - Placed ~9000 cy and gained 1 – 2.5’ of elevation
  - 50% reduction in volume (~4700 cy) after 16 months and 1-1.5’ of elevation gain
  - ~Measured wave height and energy reduction along marsh edge during May Nor’easter (Perkey et al.)
- Enhanced Intertidal Shallows (ISS)
  - Placed ~8700 cy and gained 1-2.5’ of elevation gain and shallowed up to MLLW
  - Reduced to ~4100 cy after 16 months and 1-1.5’ of elevation gain so ~50% reduction in volume



OUTCOMES GULL ISLAND PROJECTS

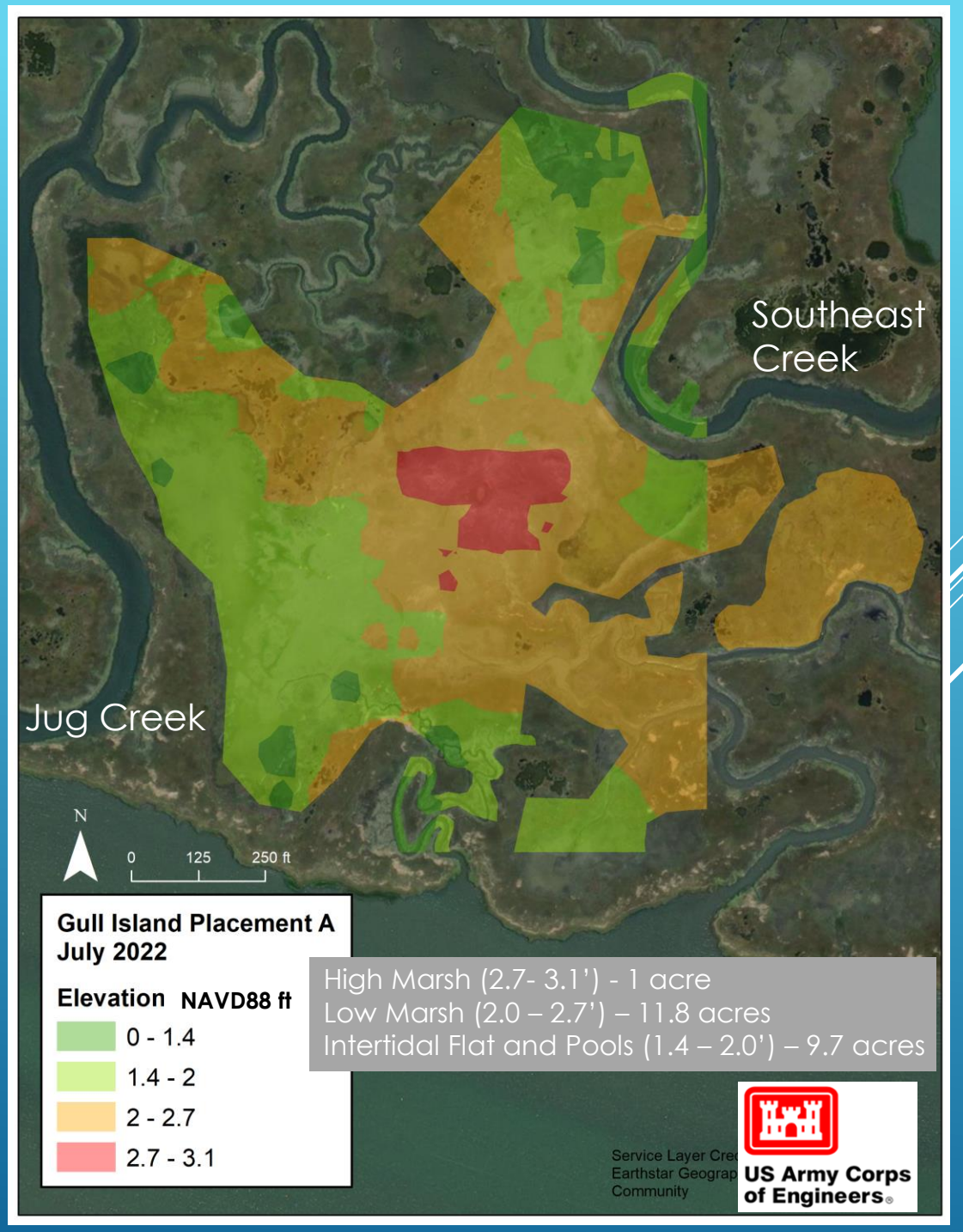
September 2020


1 month Post Placement (2020-11-10)


2 Years Post Placement (2022-08-19)

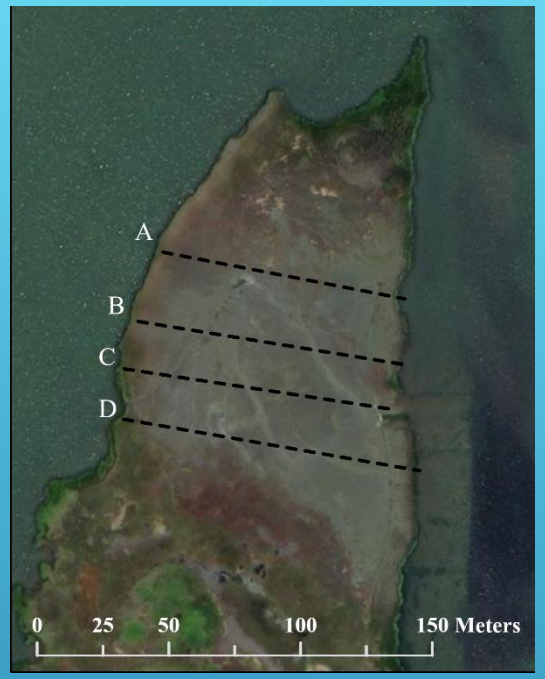
- Below target elevations for transitional wading bird habitat and only small area of high marsh
  - Acoustic monitoring detecting both Salt Marsh and Seaside Sparrows foraging on site
- Effectively created low marsh habitat and shallowed interior intertidal flats and pools
  - Avian surveys documenting more than 25 species utilizing placement area for foraging including several surveys with 500-1000 Semipalmated Sandpipers
- Vegetation recolonization and expansion proceeding well at 2 year post-placement timeframe
- Ecological benefits progressing along site evolutionary trajectory
- Return for additional uplift?

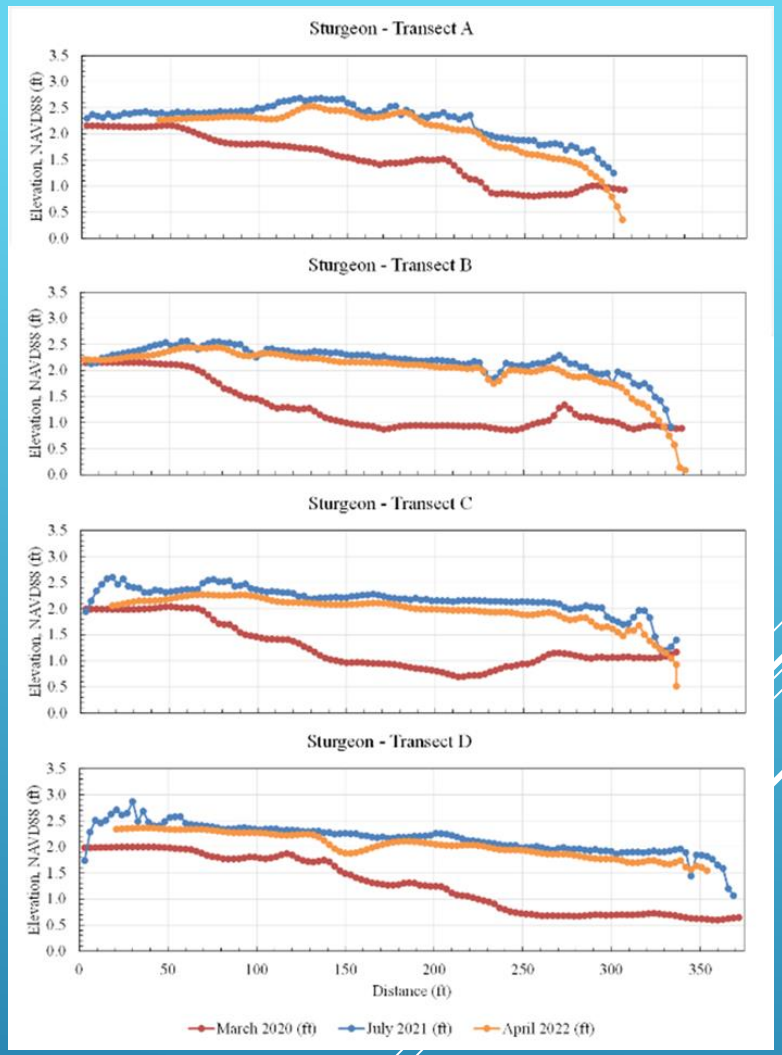
GULL ISLAND OUTCOMES 2 YEARS POST PLACEMENT



STURGEON ISLAND PLACEMENTS

- Placed in Two Phases in 2020
  - March 2020
    - 4,200 cubic yards
  - September 2020
    - 15,000 cubic yards
  - Mixed fine sand and mud
- Marsh Elevation Enhancement (MEE)
  - 3.5 acres of enhancement
  - 3.0' NAVD88 grading down to 1.9'
- Marsh Edge Protection (MEP)
  - Placed small sand ridge along toe of erosional slope
- Enhanced Intertidal Shallows (ISS)
  - Shallowed above MLLW along eastern island to extend flats northward
- Returned in Fall 2022 for Phase 3





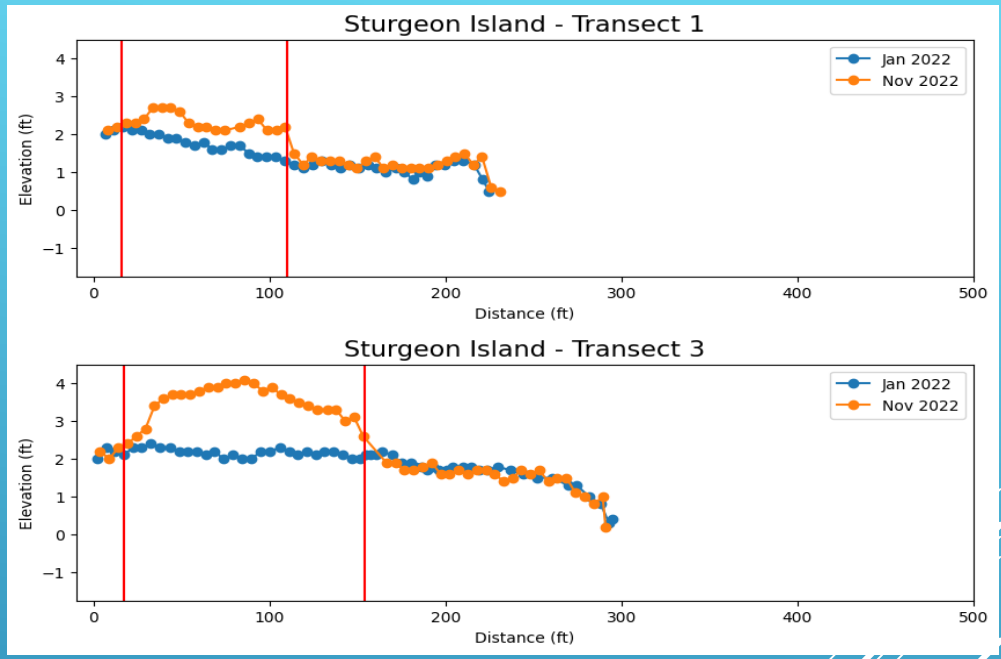
- 2020 uncontained placement achieved 1.5 – 2.5' of marsh elevation enhancement
- Vegetation recolonization is rapidly occurring naturally via seed bank in year 2

Courtesy of Harris et al.

ERDC

STURGEON ISLAND PHASE 3 – FALL 2022

- Placed 24,000 CY of fine sand to create sandy marsh edge protection features
  - Intercepting wave energy
- Used containment to elevate 0.4 acre for elevated bird nesting habitat
  - Placed more than 3' of material
  - Built to 4.0' NAVD88
- Employed Y-valve to switch between containment and subtidal features
  - Maintain dredging efficiency
  - Allow time for contained area to dewater
  - Slow and manage flow volumes and velocities



LESSONS LEARNED AND SOME GUIDING THOUGHTS

- Don't over engineer projects
  - Sediment containment is challenging, expensive, and often creates its own negative feedback loops
  - Unconfined placement allows material to spread over wide areas and for maintenance/development of tidal flushing
  - Building elevation may require multiple lifts or partial containment
  - BUDM projects are water management projects (Flow velocities from 24" dredge pipe are 22,000 gals/min and 80% water)
- Dredging efficiency and effectiveness of placements enhanced by:
  - Using Y-valves and other tools to allow placement in multiple sites easily and switching between sites/location s at a site
  - Can help control flow velocities and provide resting and settling times for placed material
  - Adaptive management during dredging and placement is very difficult
- Understanding progress towards construction/ecological goals during placement difficult
- Vegetation recovery takes ~two growing seasons to initiate
  - Recovery has been almost entirely by new seeding from the seedbank and below MHHW
  - Planting should be delayed for at least two growing seasons if needed at all
  - Balance placing in thin layers to preserve existing vegetation vs thicker placement for more ecological uplift
- Structure project goals to include habitat and species benefits during site evolution
- Consider role of monitoring and keep focused on adaptive management or to advance practices

ADVANCING SCIENCE AND PRACTICE AT THE SEVEN MILE ISLAND INNOVATION LABORATORY

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- Wetlandsinstitute.org/SMIIL

RELEVANT PUBLICATIONS

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- Tedesco, Chasten, Ferguson, Collins, and Davis (2021): Using Dredged Sediments to Uplift Marshes, Build Subtidal Shallows and Provide Marsh Edge Protection in the Seven Mile Island Innovation Lab, Delaware Estuary Science and Environmental Summit, https://delawareestuary.org/delaware-estuary-science-and-environmental-summit/