



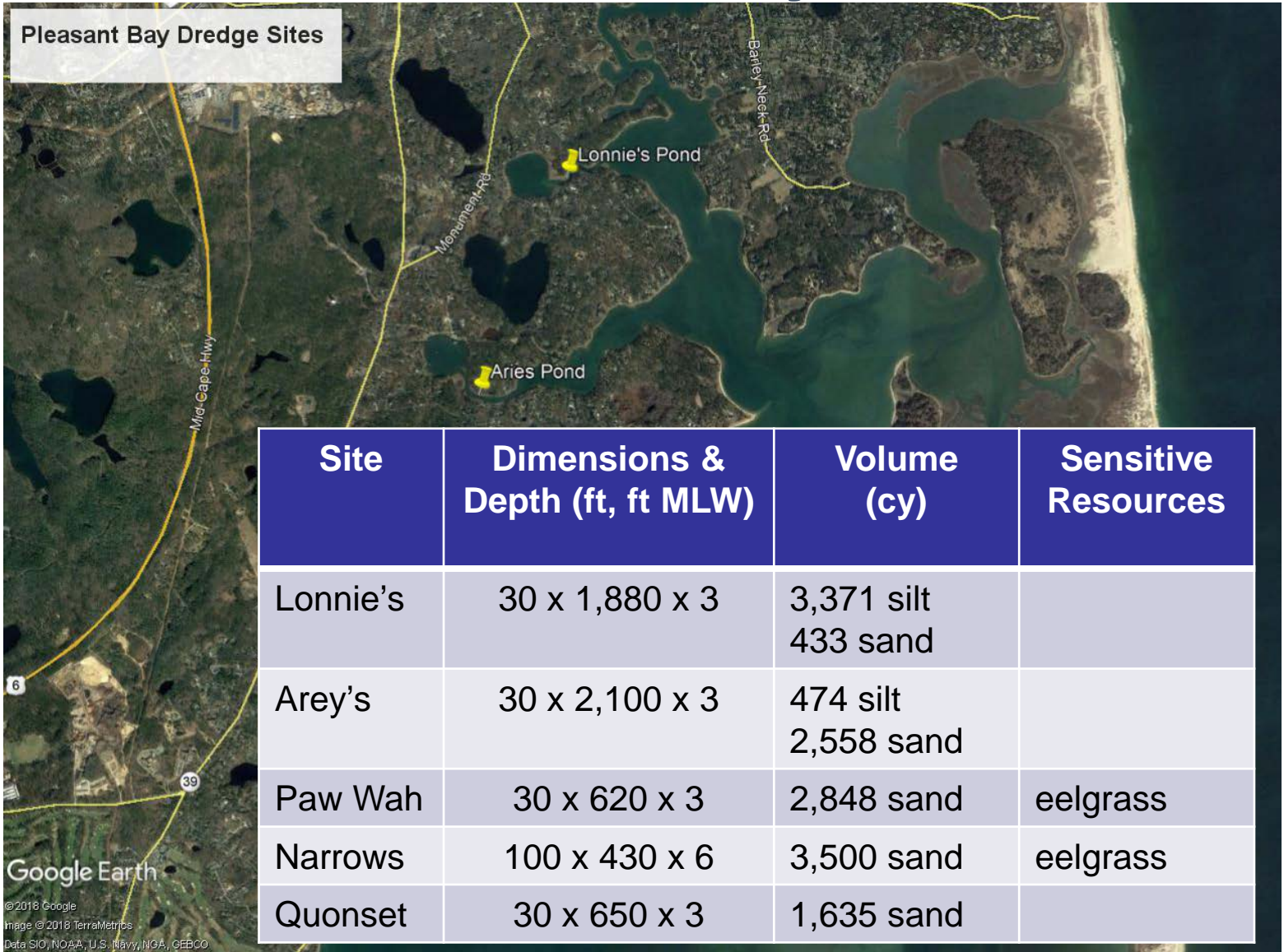
Pleasant Bay & Nauset Estuary

Project Updates

Pleasant Bay

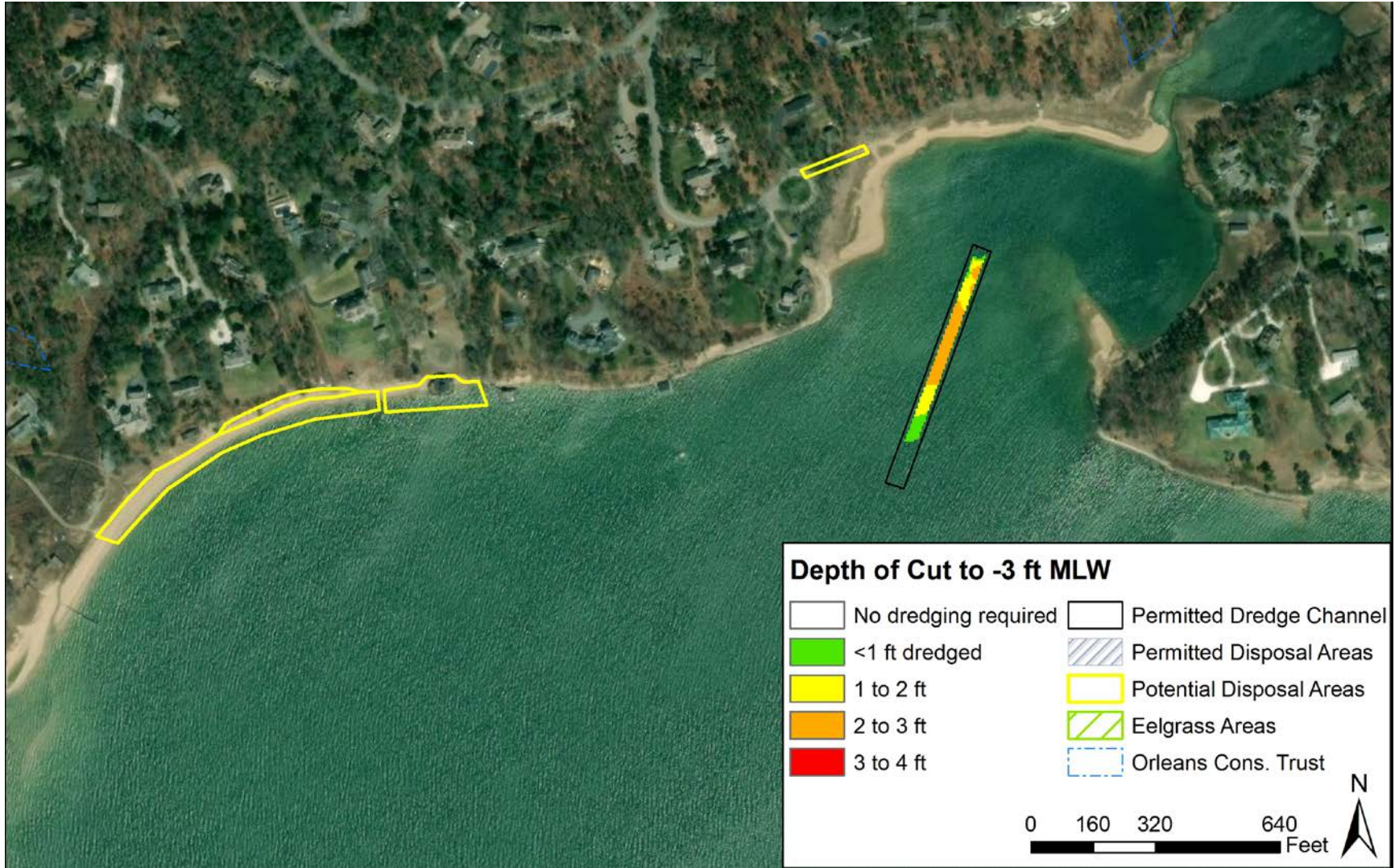


Pleasant Bay

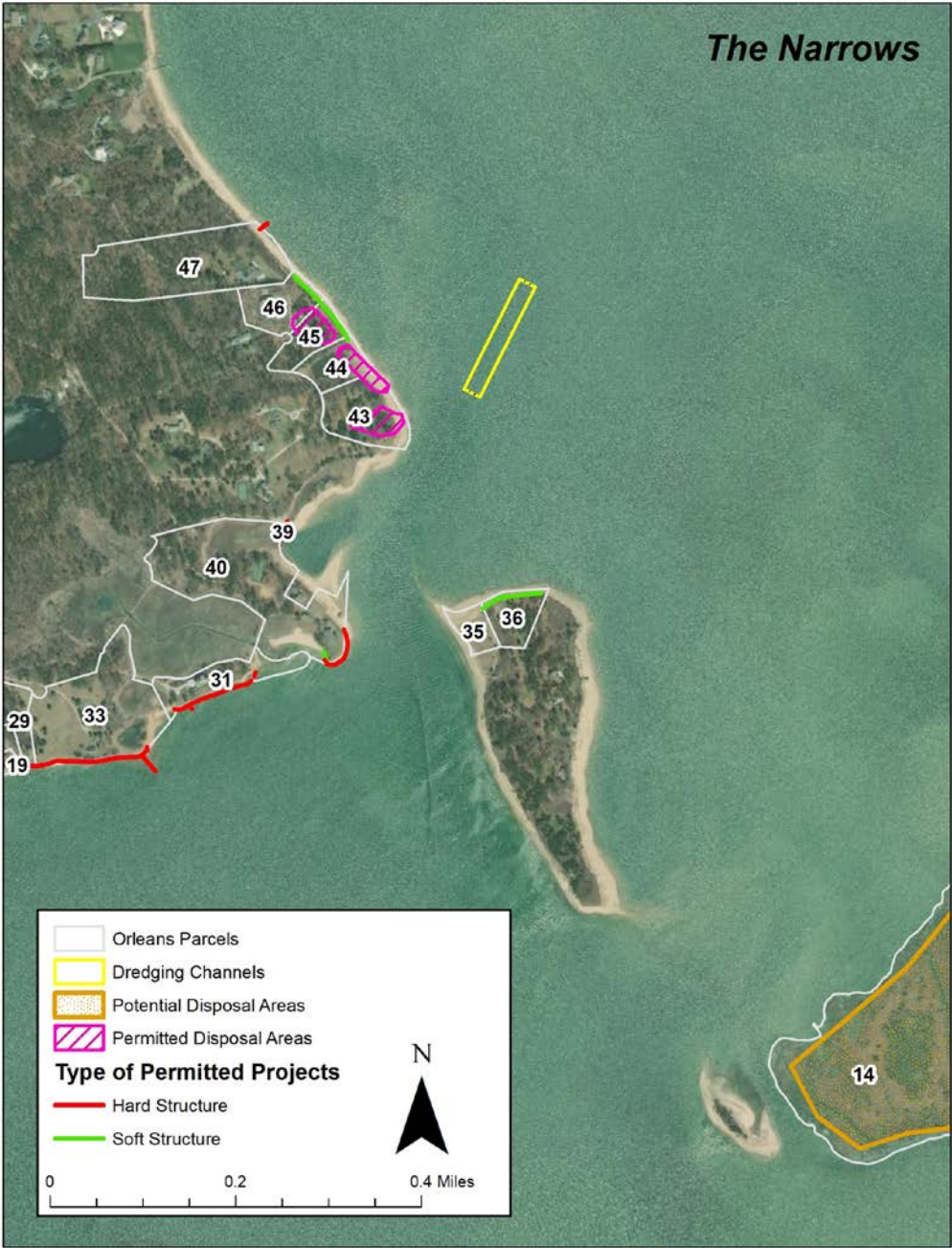


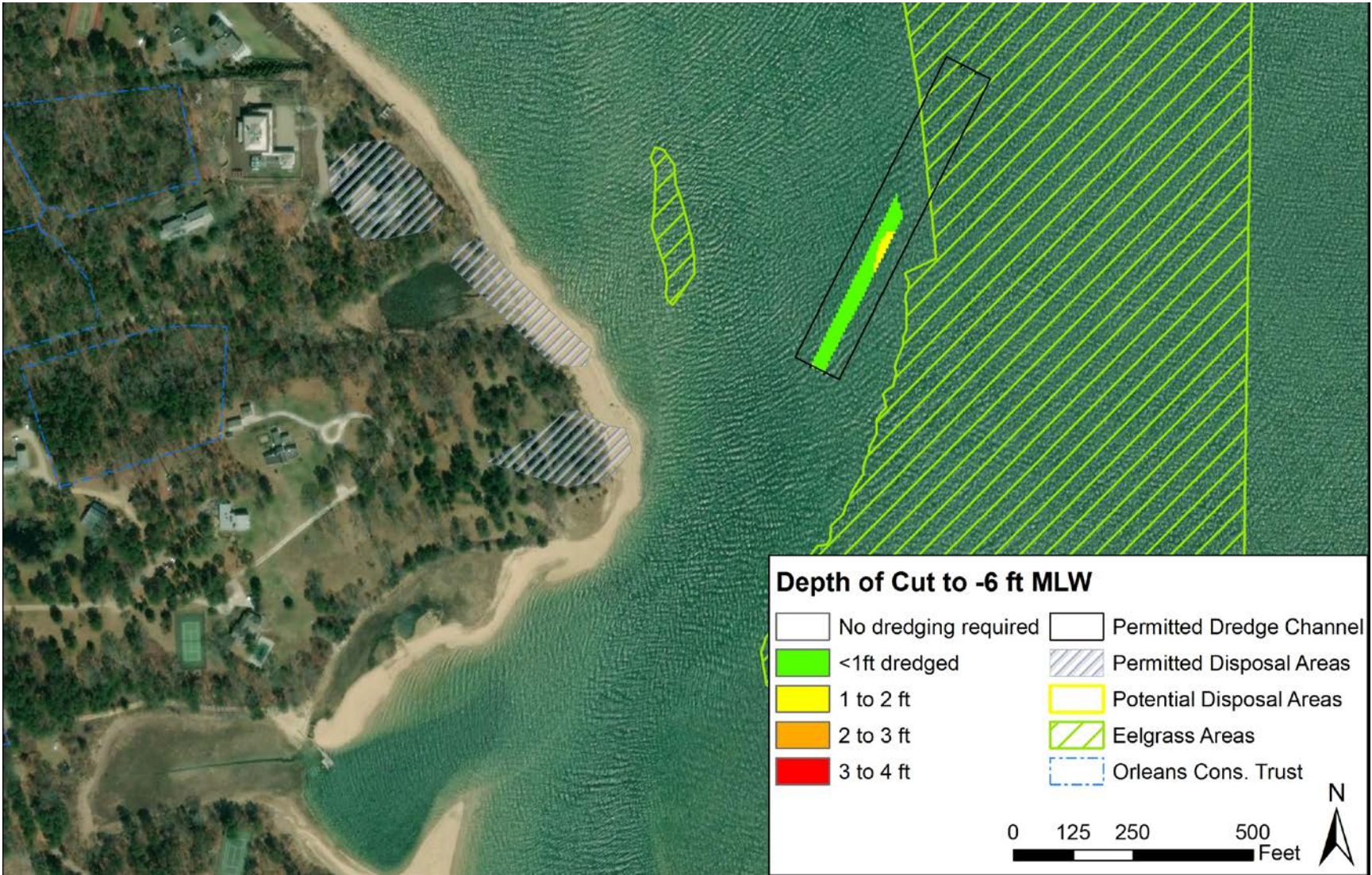
Quanset Harbor



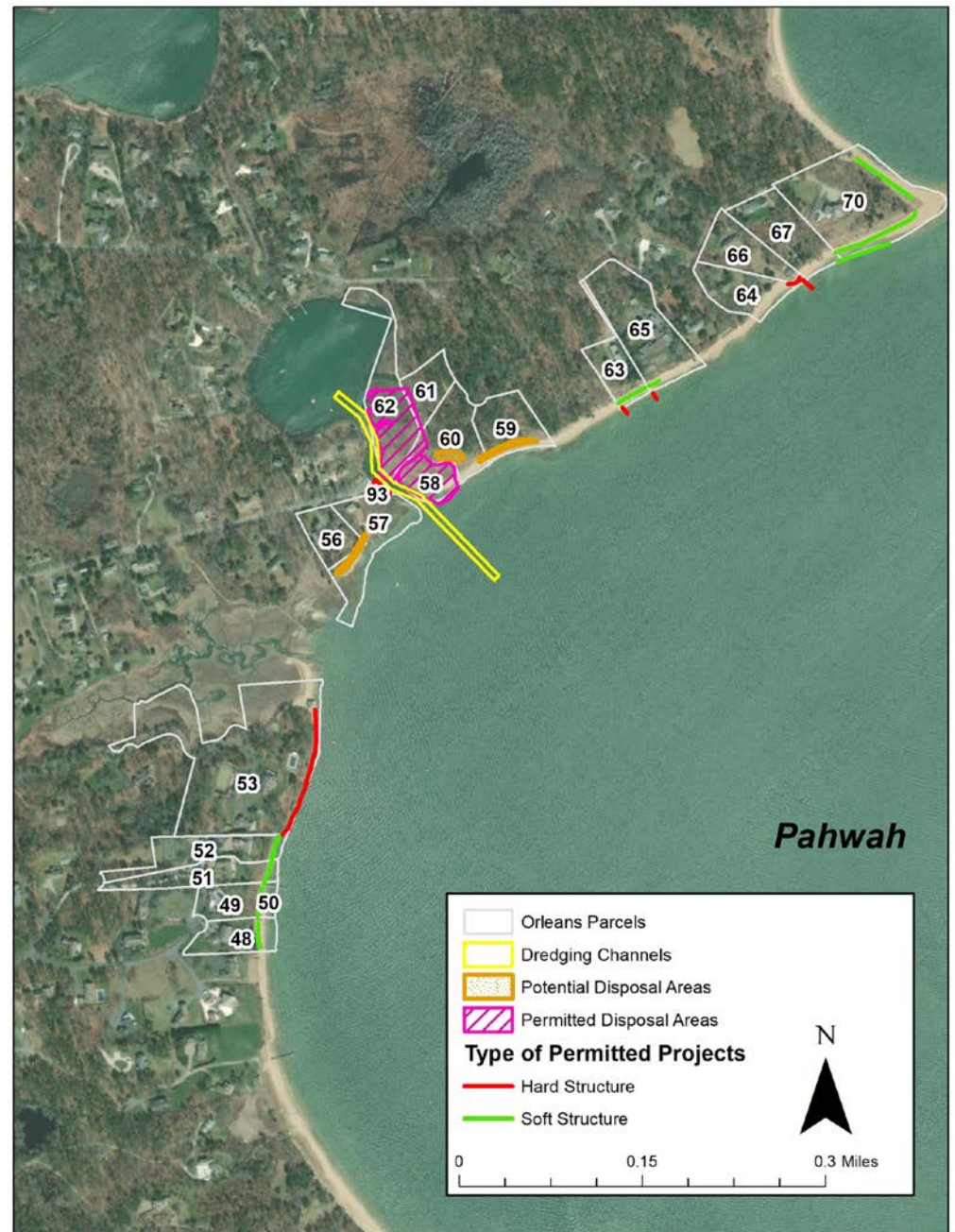


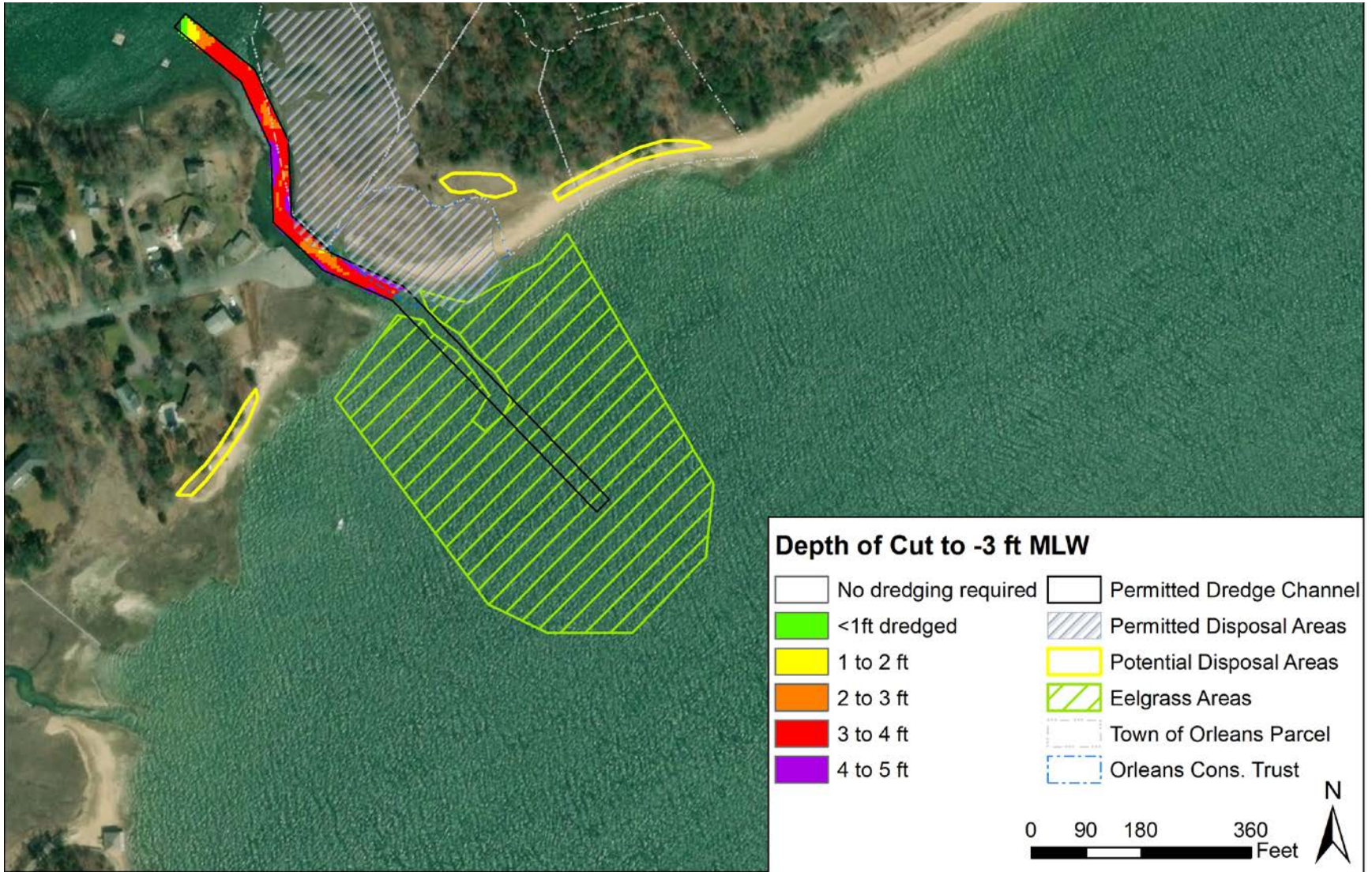
Narrows



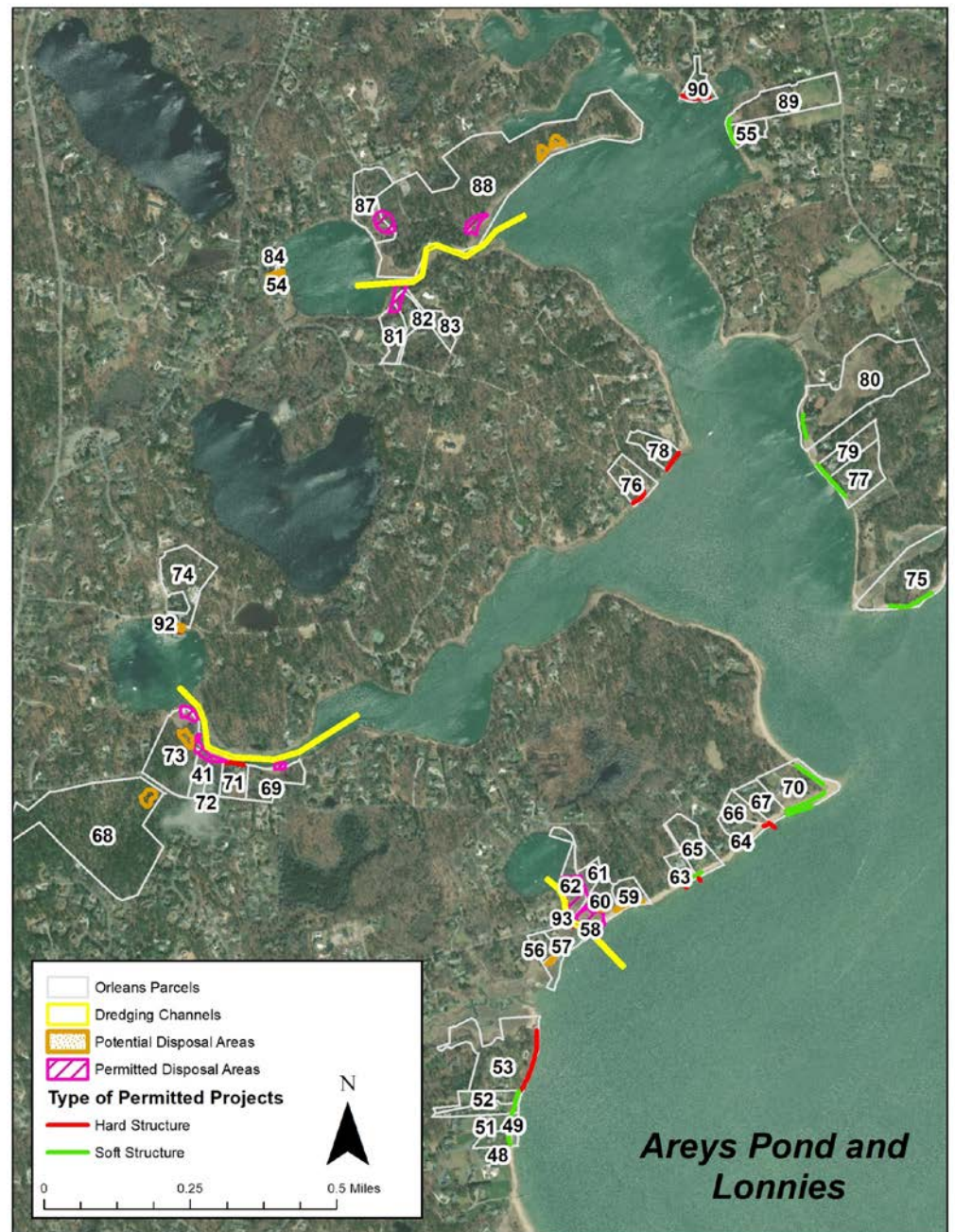


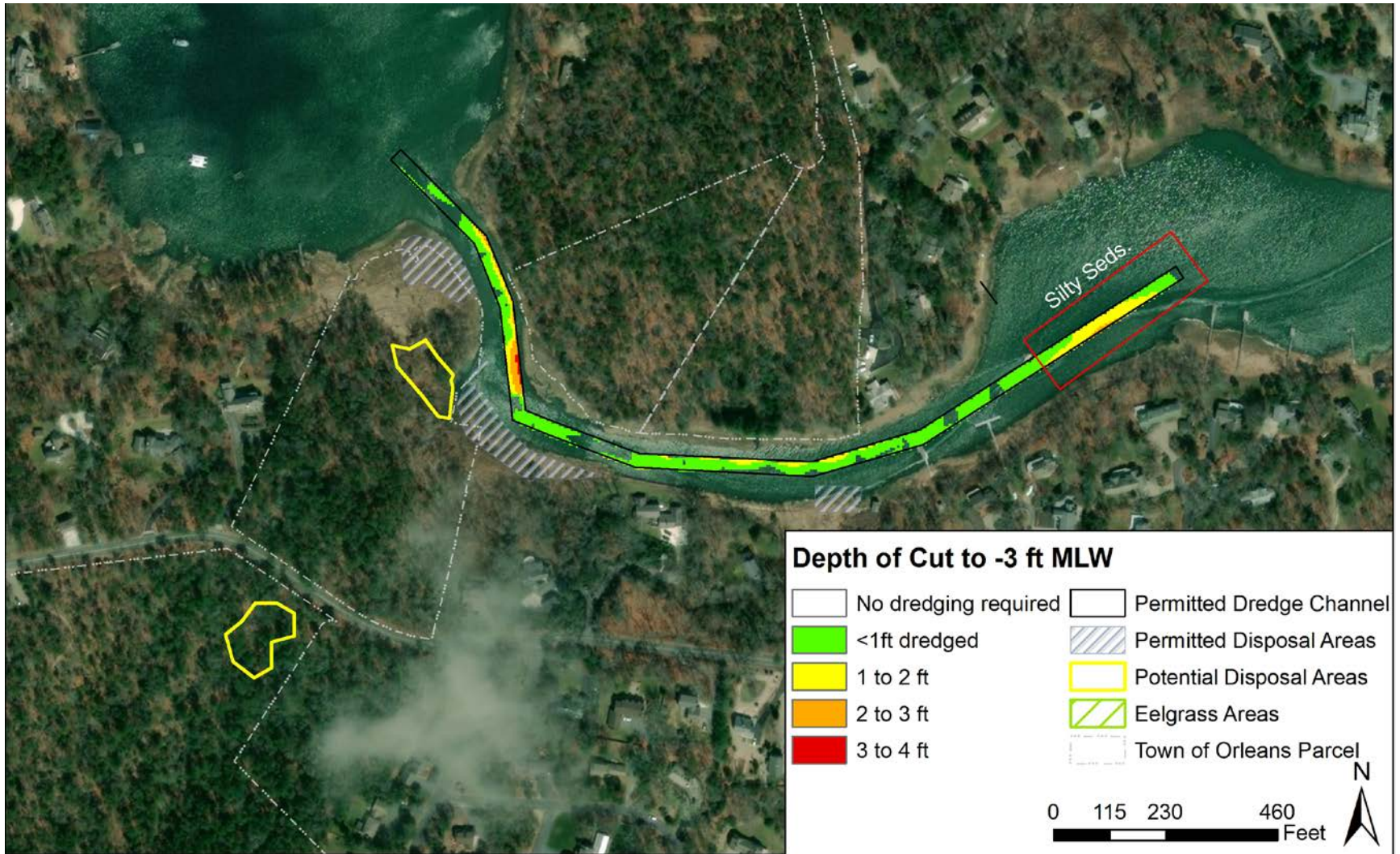
Pah Wah

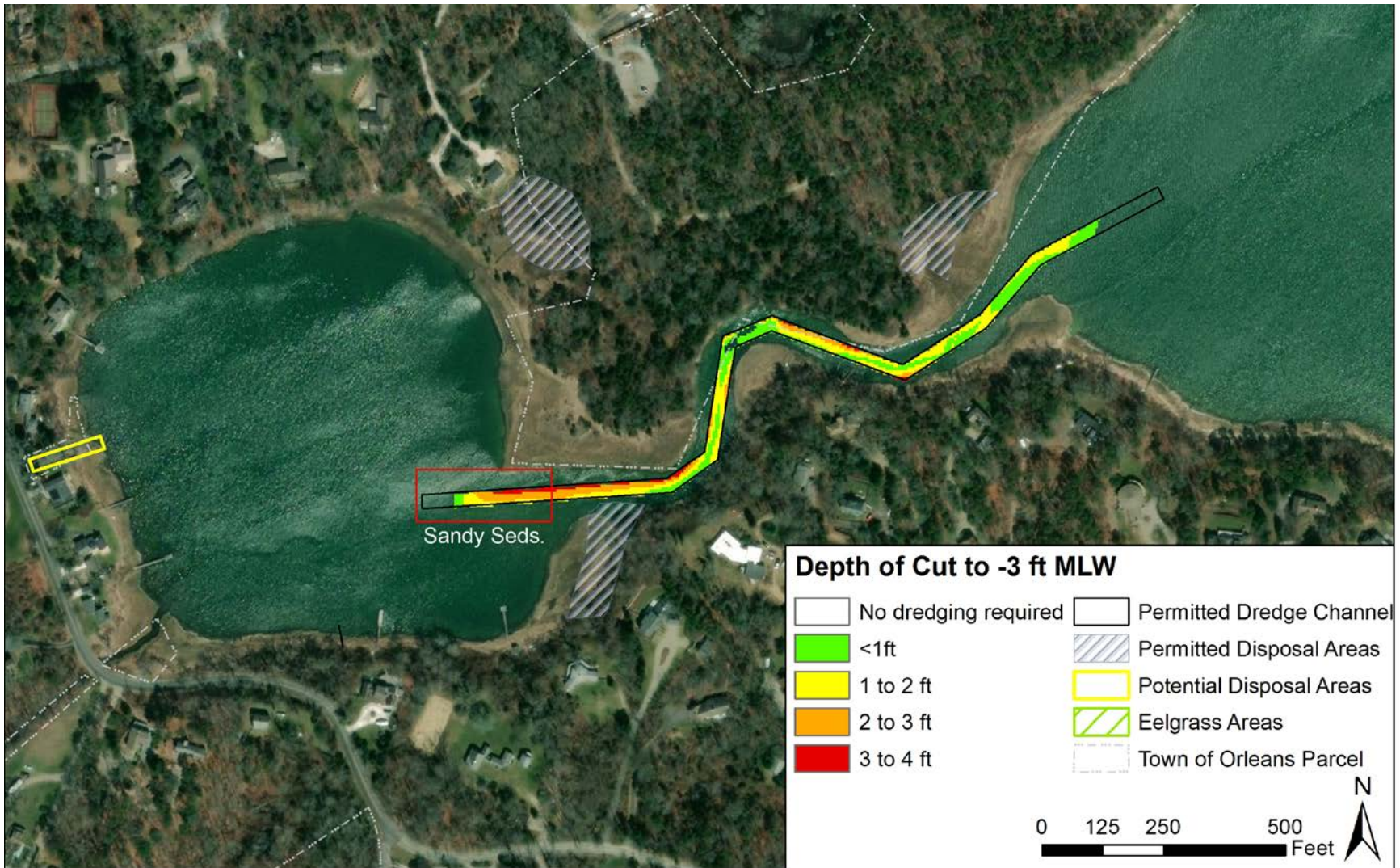




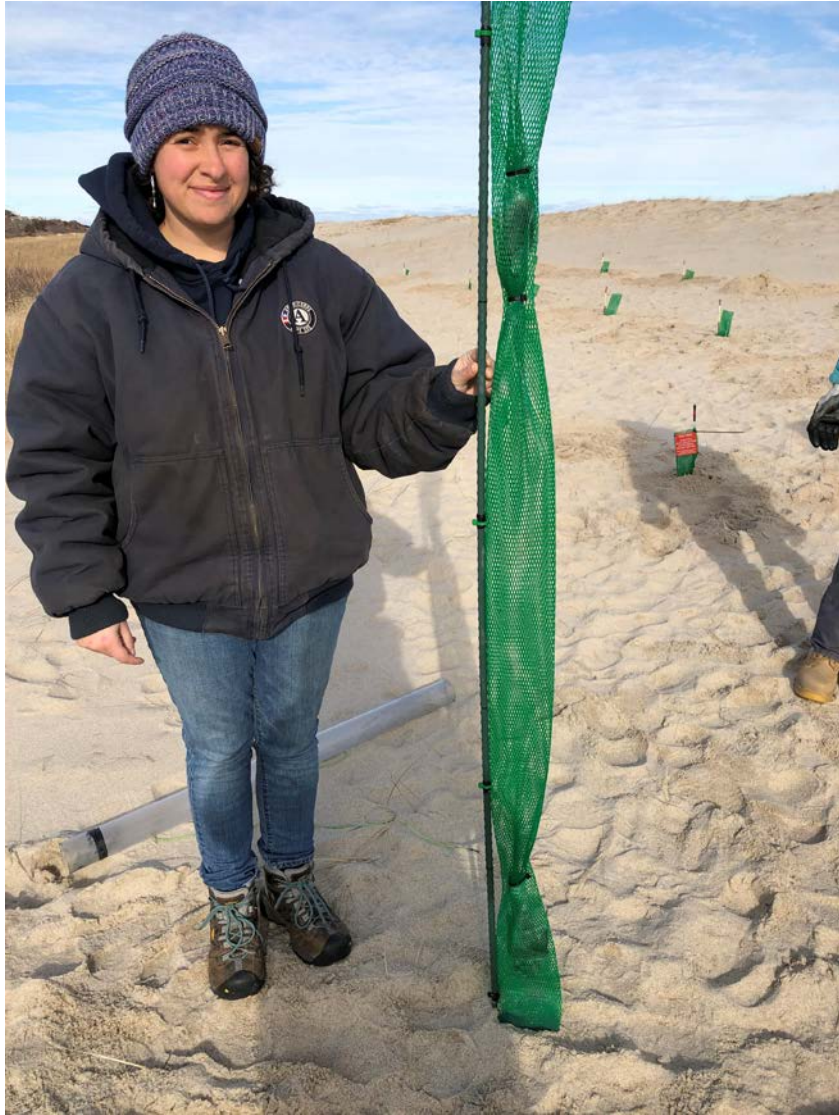
Areys & Lonnies







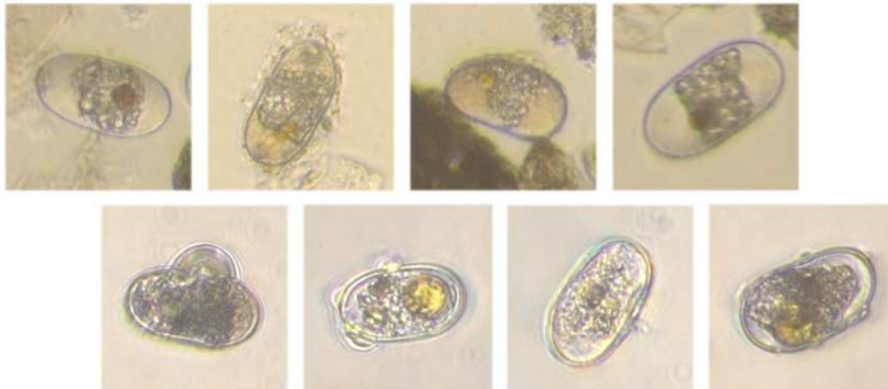
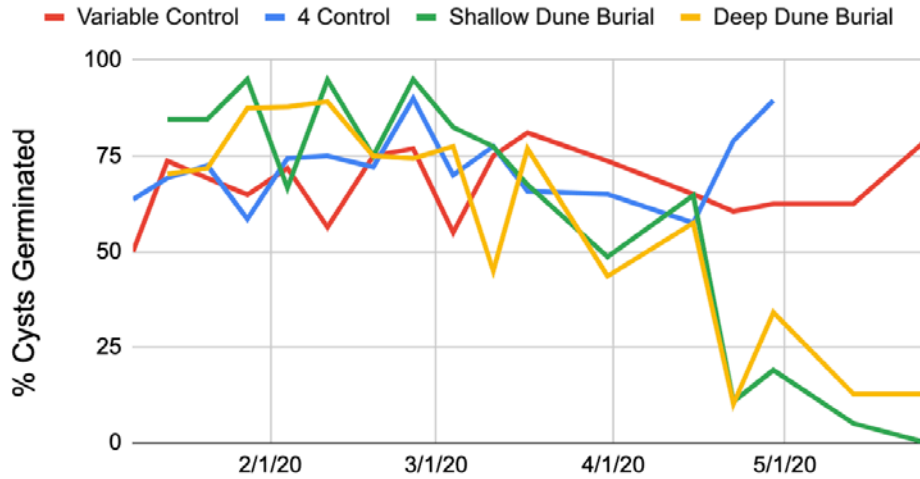
Red Tide Cyst Pilot Project



Methods

- Sediment collected from Nauset Estuary in Dec. 2019 and aliquoted into mesh bags
- Bags buried at shallow and deep depths in Nauset dunes
- Bags collected weekly and brought to WHOI laboratory
- Temperature measured in dunes for entire experiment
- Control sediments in lab in anoxic conditions, one at 4 deg. C and another adjusted to mimic field temperatures
- Samples weighed and dried to determine % moisture
- Salinity measured in samples by centrifuging sediment from liquid
- Sediments were sieved to isolate cysts; cysts were checked for germination after two weeks
- Autofluorescence was scored at time of collection
- Total cyst concentrations were determined using primulin stain
- Imagery was used to document changes in cyst morphology over time

Preliminary Results

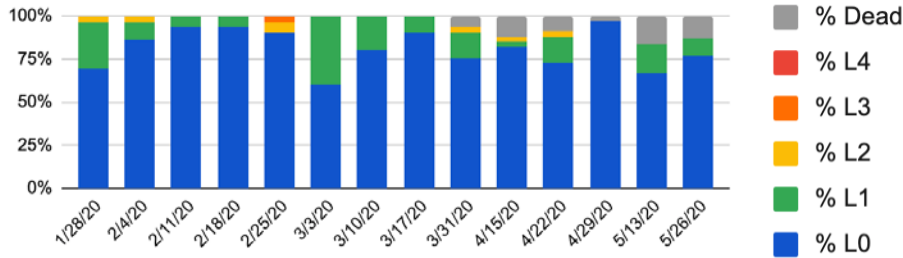


- Top Row: Healthy cysts, imaged 2/25
- Bottom Row: Dead/dying cysts imaged 5/26

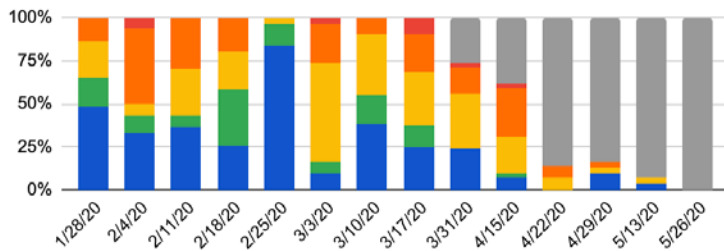
- Cysts remained viable throughout winter months
- At times displayed more successful germination than laboratory controls in anoxic conditions
- Cyst mortality rates increased to 70% in spring (week 15)
- Cyst mortality rates were 100% at shallow treatment in mid May (0% germination, 100% dead cysts)

Preliminary Results

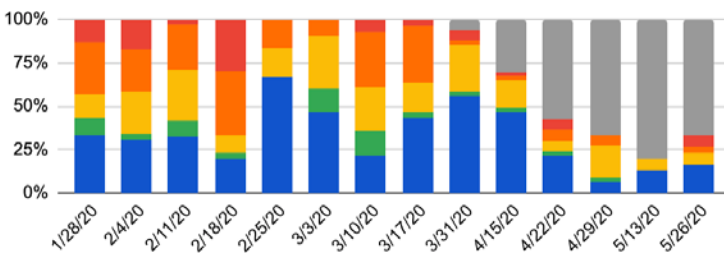
Variable Control



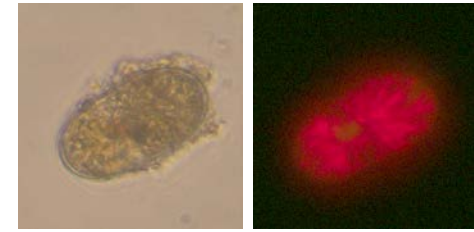
Shallow Treatment



Deep Treatment



- Proportional cyst fluorescence data from the variable control, shallow, and deep treatments.

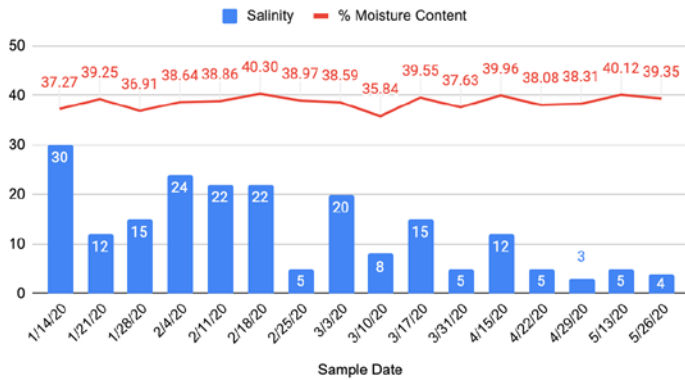


L4 Autofluorescent Cyst

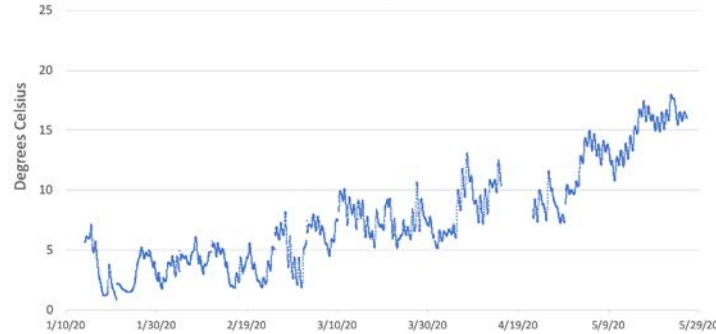
- Prior to germination cysts synthesize chlorophyll which leads to emission of red autofluorescence
- Germination was determined by checking for autofluorescence and gradings on a scale of 0 to 4
- Dune samples displayed high levels of autofluorescence throughout the study – indicating cysts were preparing to germinate

Preliminary Results

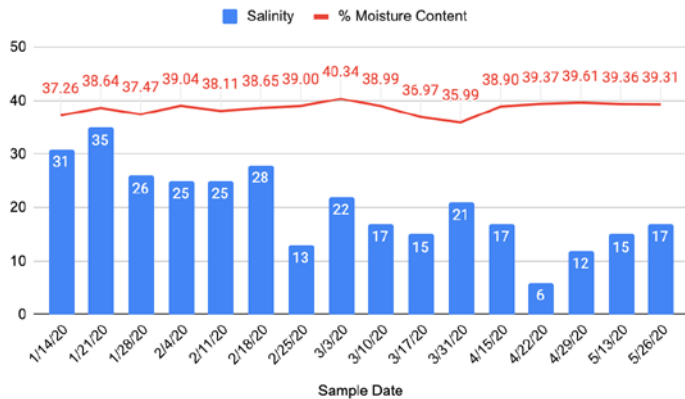
Shallow Treatment



Surface Temperature



Deep Treatment



Bottom Temperature



- Warm winter; freezing conditions not measured in dunes which explains why germination was high throughout winter

- Extended spring rainy season caused salinity levels to drop resulting in cyst mortality

Mill Pond Dredging & Red Tide Cyst

- Highest cyst concentrations in Nauset Estuary are in bottom sediments of Mill Pond, Town Cove and Salt Pond
- Cysts germinate into the water column & grow as vegetative cells into a bloom
- Hydrodynamic model used to evaluate impacts of dredging entire project with spur channel into Mill Pond
- Model included sediment transport component to represent how cysts associated with sediment are transported via currents
- Estuary is flood dominant – shorter duration and faster current velocities than on ebbing tide
- Net sediment transport is in the flood direction to terminal ponds
- Dredging causes increase in tide range and current velocities, with enhanced sediment transport/cysts into terminal ponds, such as Mill Pond
- Dredging also causes enhanced flushing of terminal ponds, which reduces settling/accumulation rates
- No adverse impacts on cyst distributions with Mill Pond dredging