Elevation Enhancement Restoration: Successes and Improving Adaptive Management Strategy along the Mid-Atlantic Coast

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Consideration

- Why are you attempting to conduct your project?
- No two projects are the same.
- Not all sediment types can be treated with the same methods and have much different issues.
- What are the stressors that are effecting site, and will this work change them?
- Become best friends with your regulators!
- You will be conducting adaptive management. This work does not end at initial project completion.

Adaptive Management (post-Construction)

- Major construction completed now the focused details of the landscape needed to be considered
  - Regrading
  - Vegetation
  - Hydrology
  - Invasive Species

- Major Decisions
  - Wait and See the Natural Response
  - Implement Management prescription

- Why not both…

Workshop on
Saving Saltmarshes from
Sea Level Rise:
A Dialogue About
Thin-Layer Placement

September 17 and 18, 2018

Meeting Outcomes:

• Foster a more open conversation about thin-layer placement and other innovative restoration techniques.
• Improve understanding of coastal marsh vulnerability to sea level rise.
• Improve understanding of thin-layer placement as an adaptation practice and the characteristics of a ‘good’ thin-layer placement project by considering assessment methodologies, success criteria for acceptable thin-layer placement projects, and performance criteria to evaluate their success.
• Identify opportunities to enhance coordination among practitioners and regulators.
• Identify the network of individuals in Federal and state agencies that are engaged with developing and implementing thin-layer projects, both from a regulatory and implementation perspective.
• Identify science and technology gaps regarding marsh vulnerability and restoration strategies (i.e., thin-layer placement).

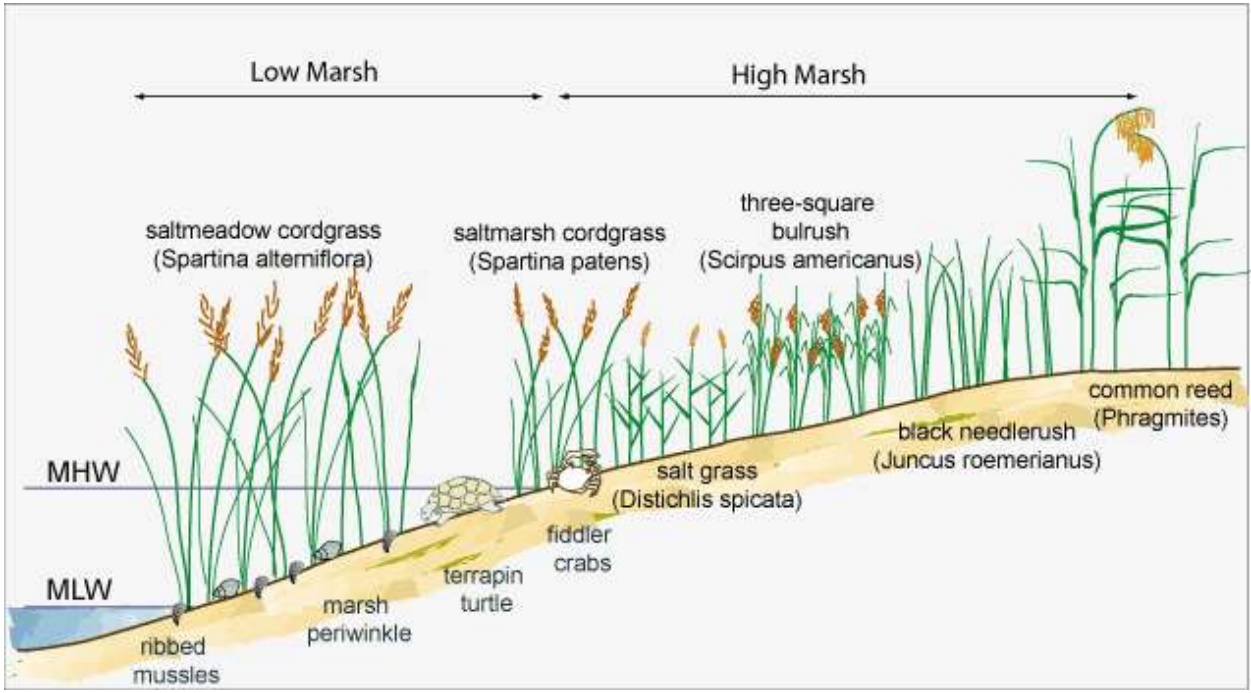
Ongoing Challenges

- Resiliency and Nav. Channel improvements not the same project
  – data collection and design/engineering is very different than traditional dredge material disposal efforts:
    - Building Sea-level rise into the equation becomes problematic – especially in micro-tidal areas
    - Typically there is much more dredge material to be disposed of than is needed for restoration
    - Existing marsh impacts (vegetation and peat/soils)
- Rightly or Wrongly, hydrology is a key piece of a project.
  - It could be main focus or part of adaptive management.
- Assessing Site Need
  - Should not be subjective
  - Biological Target Elevations (ugh)
  - Projects become too focused on methods or overall species driven outcomes
- Permitting:
  - Permitting agencies may have different goals
  - Still a relatively new idea in the permitting world

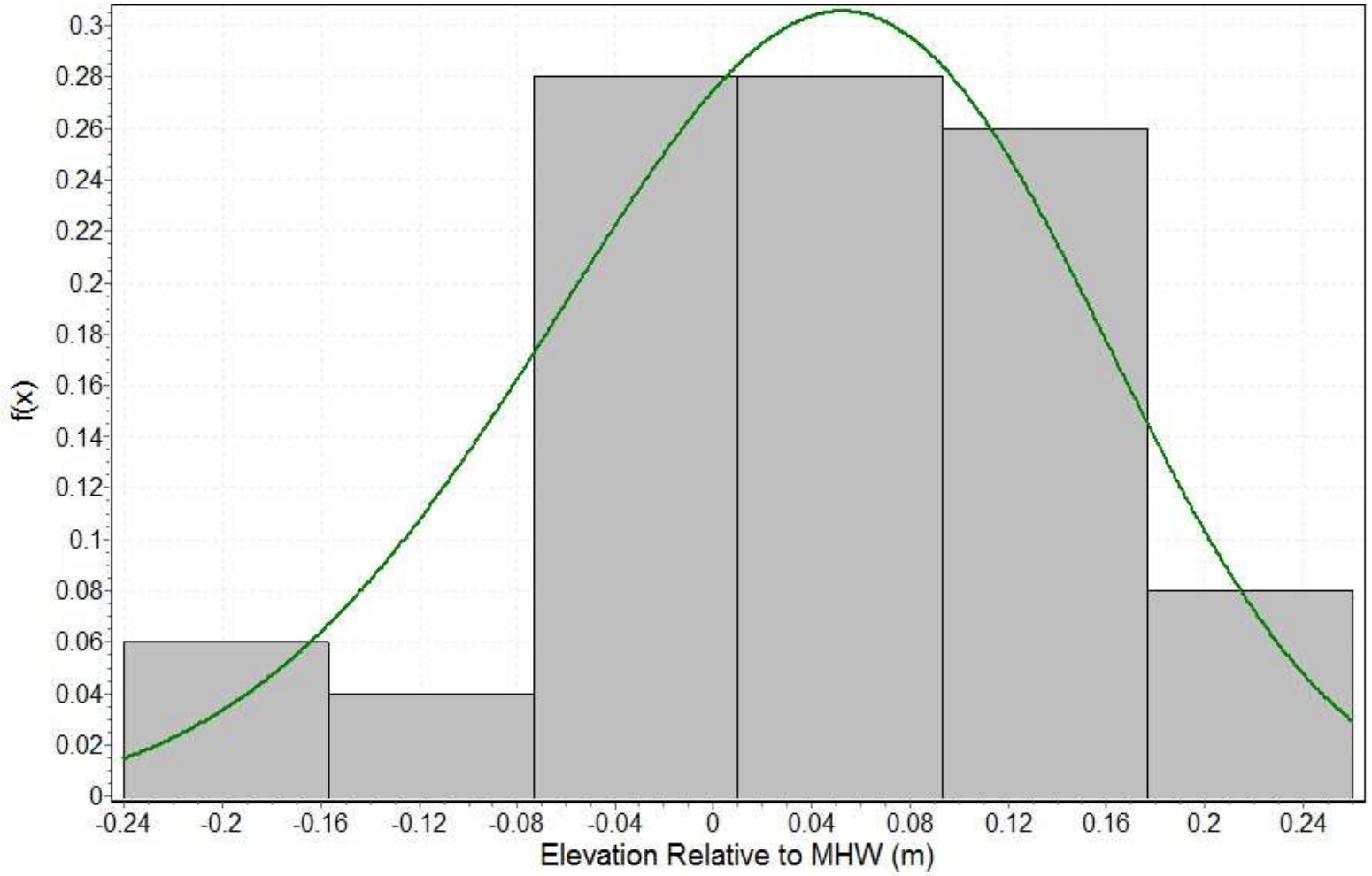
Evaluating site need

- "The Relationship of Smooth Cordgrass (*Spartina alterniflora*) to Tidal Datums: A Review" states that *S. alterniflora* tend to grow in relation to Mean High and Mean Low Water (McKee and Patrick, 1988).

- Elevation of marsh platform within watersheds are dependent upon tidal datums



Total Below-ground Biomass with Respect to Elevation Relative to MHW

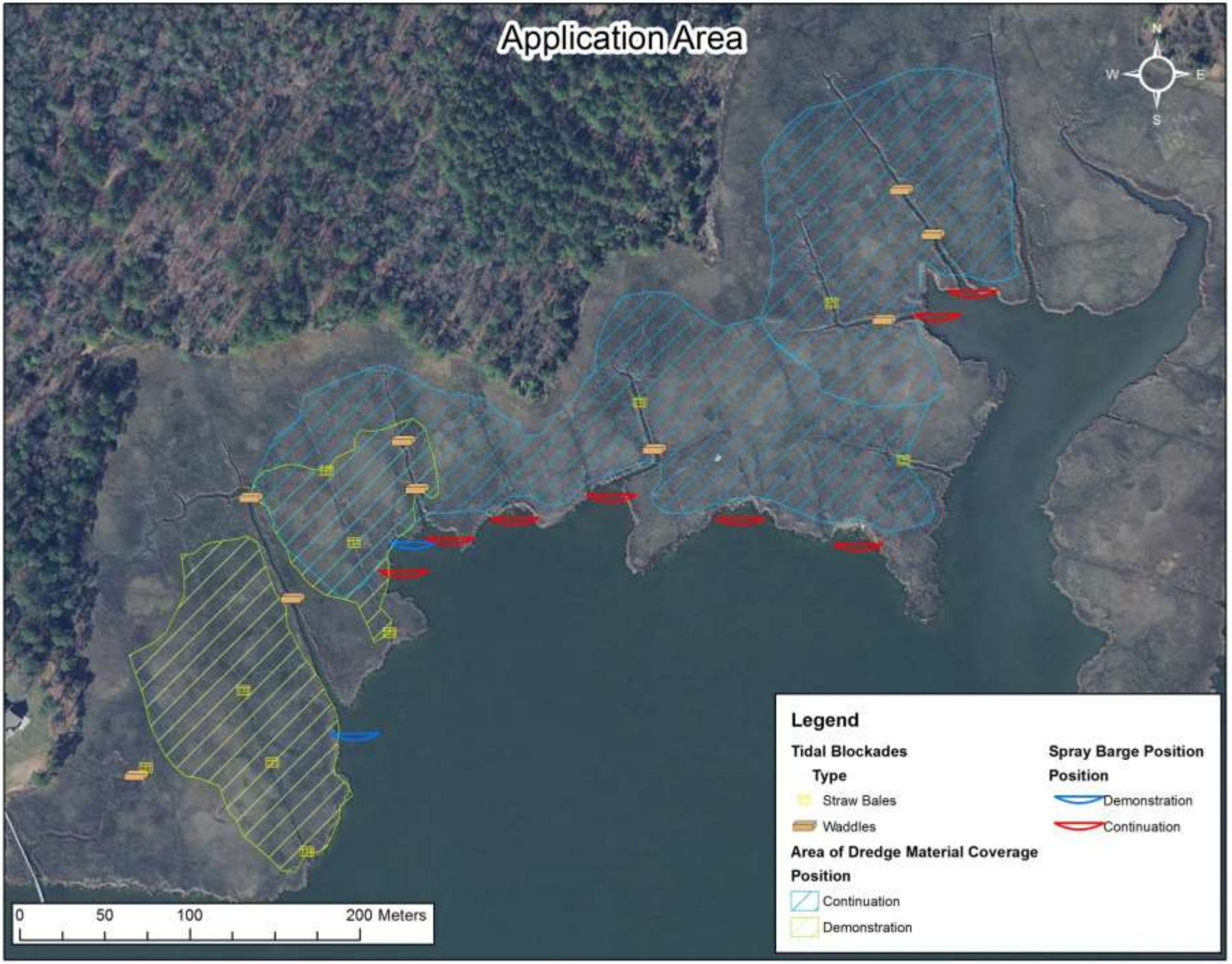


Pepper Creek Beneficial Reuse

- Indian River Bay, Delaware
- Evaluate the use of beneficial dredge material as a method of restoring tidal wetlands.
- Reduce reliance on disposal areas
- Restore Spartina alterniflora marsh
- Promote natural recolonization
- Permitting
  - IP for dredging and NWP 27 for marsh component

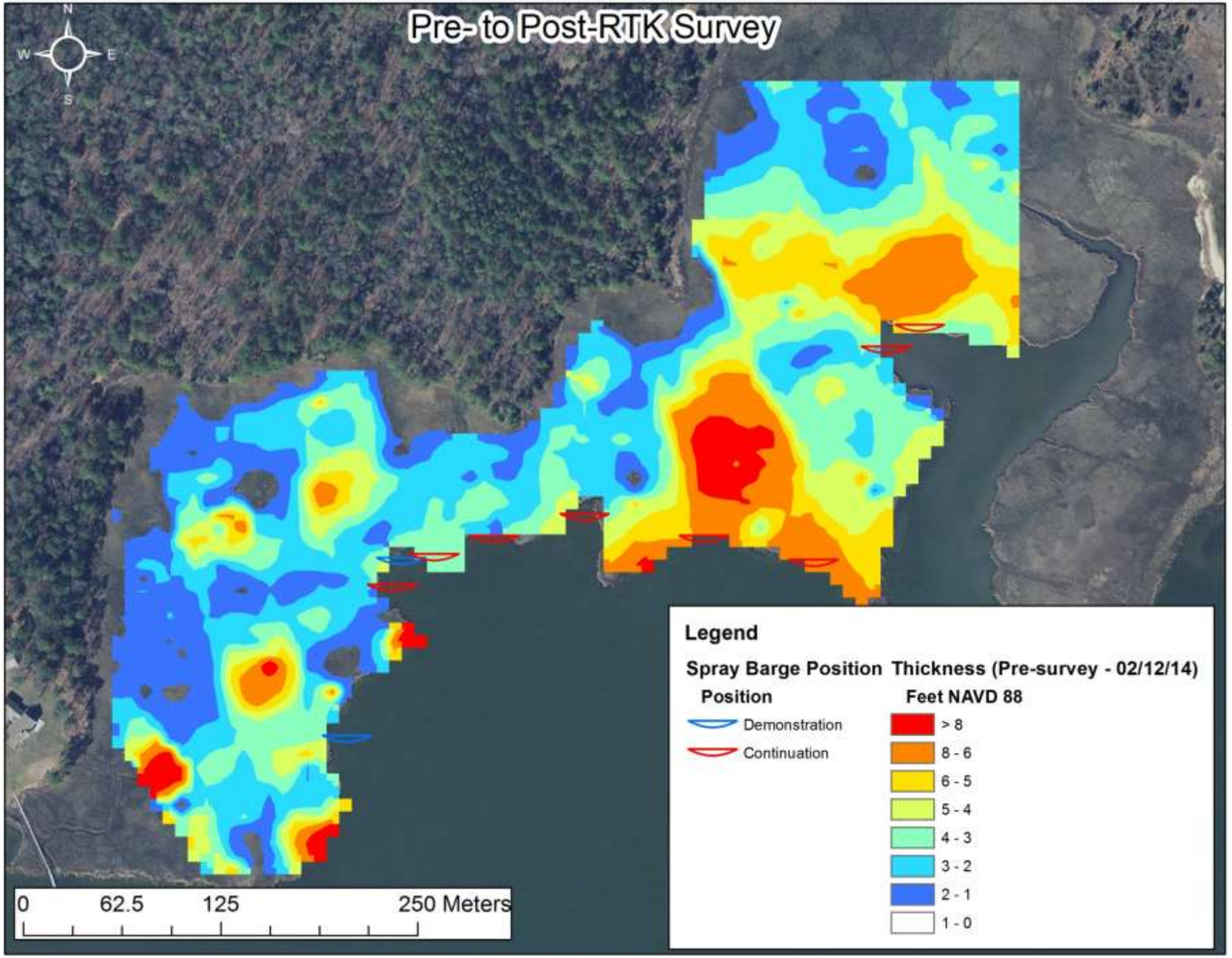
Dredge and spray

February 25- March 25, 2013
September 9-December 21, 2013


Application Area
N
W
E
S
Legend
Tidal Blockades
Type
Straw Bales
Waddles
Area of Dredge Material Coverage
Position
Continuation
Demonstration
Spray Barge Position
Position
Demonstration
Continuation
0
50
100
200 Meters

Direct application areas

Signs of indirect sediment spreading


Pre- to Post-RTK Survey
N
W
E
S
Legend
Spray Barge Position
Position
Demonstration
Continuation
Thickness (Pre-survey - 02/12/14)
Feet NAVD 88
> 8
8 - 6
6 - 5
5 - 4
4 - 3
3 - 2
2 - 1
1 - 0
0
62.5
125
250 Meters

Prime Hook National Wildlife Refuge
Marsh Interior Restoration
Sandy Resiliency Project

- Improve tidal circulation by creating conveyance channel network
  - ~ 21 Miles of channels -
- Use material from on-site dredging work to restore lost elevation in some areas of the marsh interior (thin-layer application)
  - ~600,000 cy: disposal mechanism


STAGING AREA
STAGING AREA
MAIN CHANNEL CONVEYANCE
CHANNEL A
CHANNEL B
UNIT II
FINGER CHANNEL CONVEYANCE
MAIN CHANNEL CONVEYANCE
CHANNEL C
CHANNEL E
CHANNEL F
STAGING AREA
CHANNEL D
FINGER CHANNEL CONVEYANCE
CHANNEL H
CHANNEL G
CHANNEL K
CHANNEL A
CHANNEL I
CHANNEL J
CHANNEL L
MAIN CHANNEL CONVEYANCE
CHANNEL M
CHANNEL N
USFWS HEADQUARTERS
CHANNEL O
CHANNEL I
UNIT III
CHANNEL R
CHANNEL Q
CHANNEL P
DELAWARE BAY
LEGEND:
1 TYPE 1 PRIMARY CONVEYANCE CHANNEL
2 TYPE 2 SECONDARY CONVEYANCE CHANNEL
3 TYPE 3 TERTIARY CONVEYANCE CHANNEL

Discharge on to Shallow Open Water

Berming to Avoid Sediment Inflowing

Remote Spray Barge

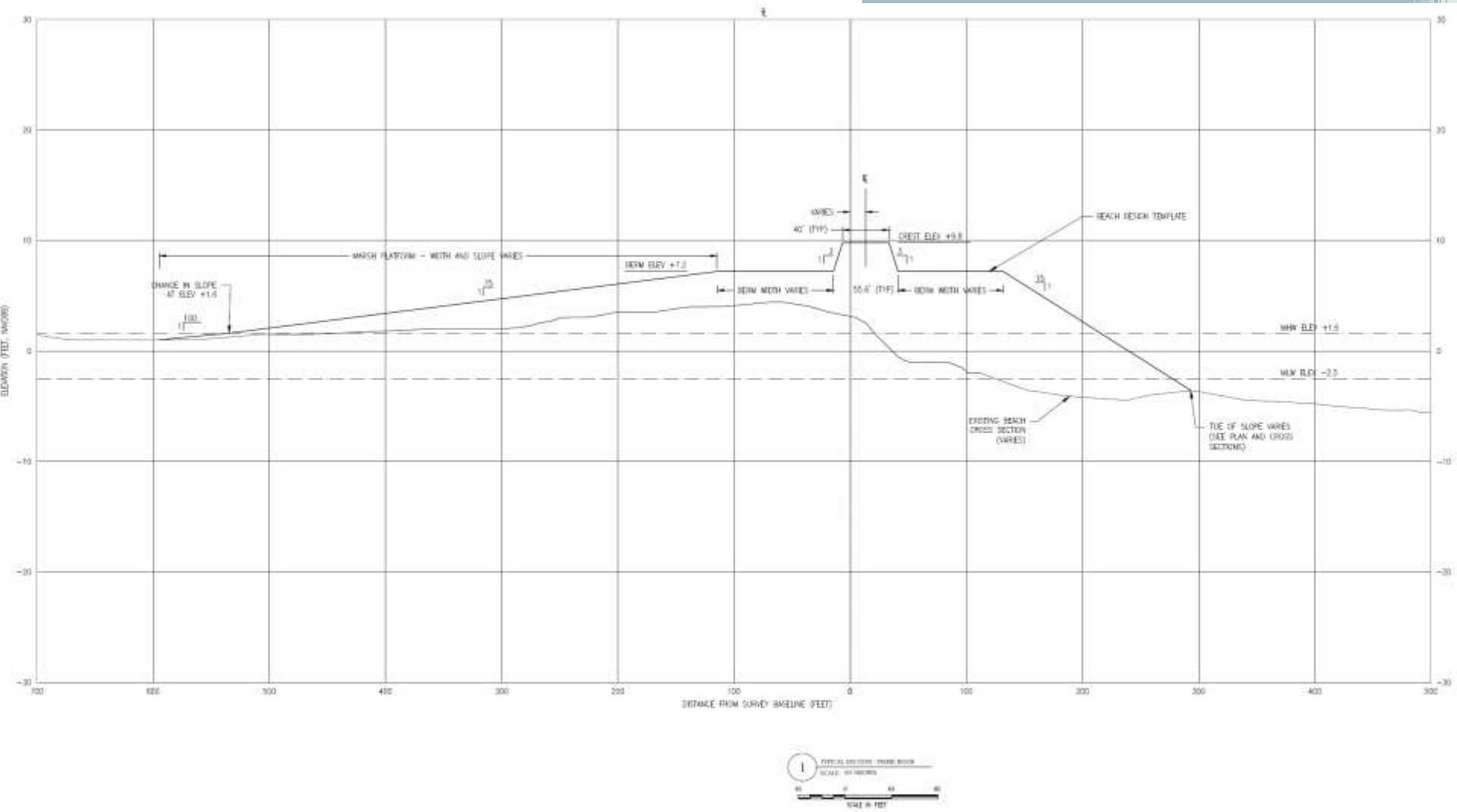
Runnel Construction

Beach, Dune and Back-barrier Restoration
Sandy Recovery Project

- Close breaches, Restore dune
- *1.41* Million cubic yards of sediment
- About 8,900 linear feet

- Create marsh platform behind restored dune
  - 60 total acres
  - Extend about 100 to 600 feet into back barrier marsh

October 2016– Prior to Construction

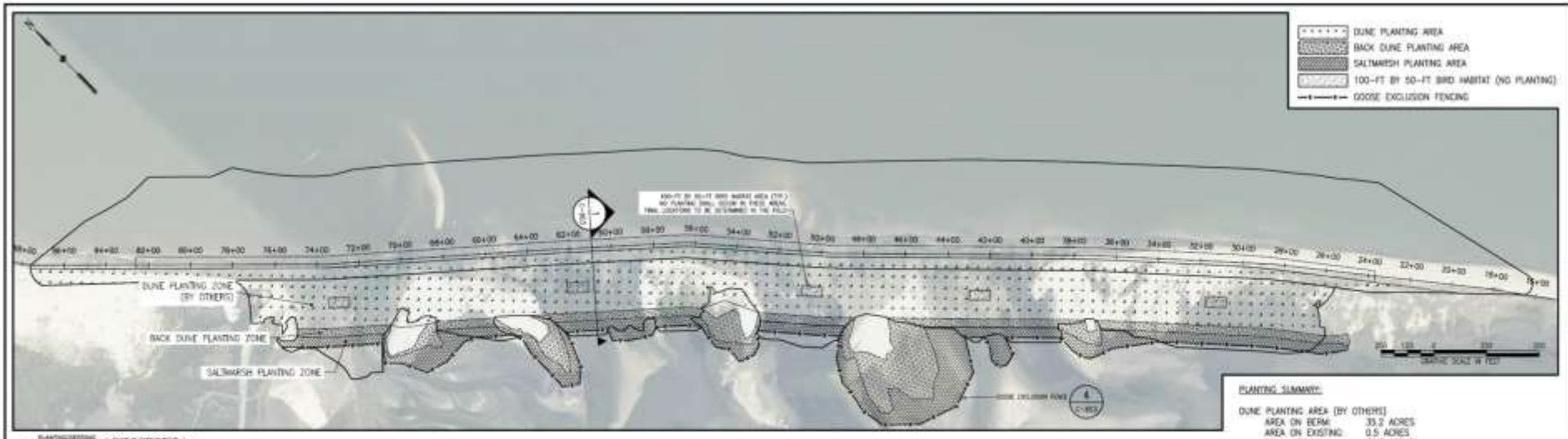


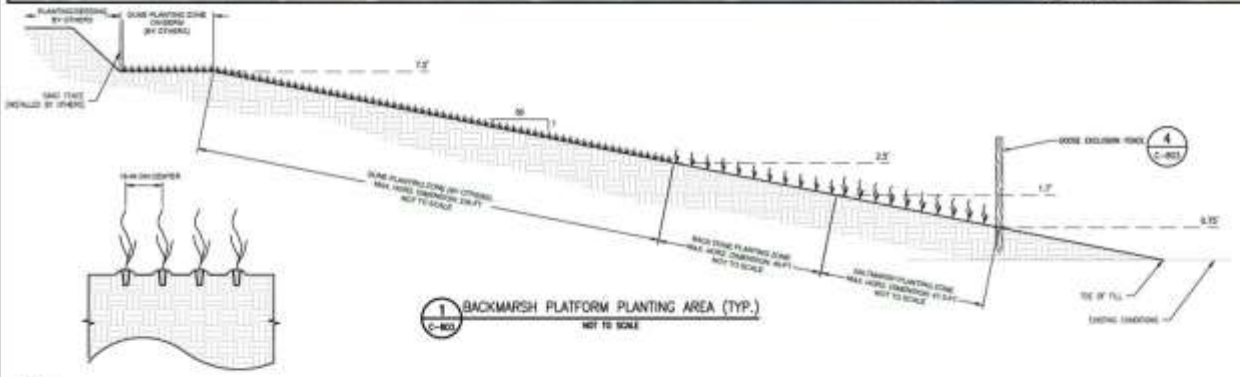
Typical Section

March 2016– Final Project

Planting of Back-barrier

- Building resiliency through stabilization of back-barrier
- Increasing seed stock
  - 40 acres, seeded with *Panicum*
  - 18 acres planted with *Spartina* grasses
    - 255,000 plugs of *patens*
    - 140,000 plugs of *alterniflora*



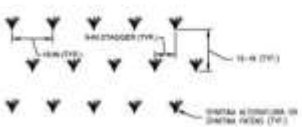


1 BACKMARSH PLATFORM PLANTING AREA (TYP.)
C-803
NOT TO SCALE

NOTES:

1. THIS DETAIL APPLIES TO THE SPARTINA ALTERNIFLORA AND SPARTINA PATENS WITHIN IN THE BACK DUNE AND SALTMARSH PLANTING ZONES.
2. TRANSPLANTS SHALL BE PLANTED IN DUG HOLE SLIGHLY LARGER THAN THE ROOT BALL.
3. THE TOP OF THE ROOT BALL SHALL BE FLUSH OR SLIGHTLY BELOW NORMAL GROUND. ROOT BALLS SHALL NOT BE MORE THAN 2-IN BELOW NORMAL GROUND.
4. PLANTING HOLE SHALL BE CLOSED TIGHTLY AROUND THE PLANT TO PREVENT WIGGLING.
5. PLANTS SHALL REMAIN ERECT AFTER PLANTING.

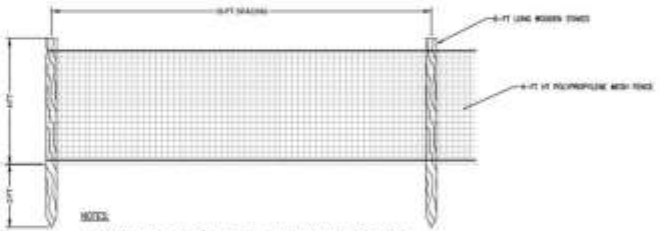
2 BACK DUNE AND SALTMARSH PLANTING DETAIL
C-803
NOT TO SCALE



NOTES:

1. THIS DETAIL APPLIES TO THE SPARTINA ALTERNIFLORA AND SPARTINA PATENS WITHIN IN THE BACK DUNE AND SALTMARSH PLANTING ZONES.

3 BACK DUNE AND SALTMARSH PLANTING SPACING
C-803
NOT TO SCALE



NOTES:

1. GOOSE EXCLUSION FENCE SHALL BE INSTALLED BY CONTRACTOR ON THE WESTERN EDGE OF THE PLANTING AREA.
2. FENCE SHALL BE STAPLED TO THE WOODEN STAKES.
3. POLYPROPOLENE FENCE SHALL BE TENAX CONTROFLEX R OR EQUIVALENT AS APPROVED BY OWNER.

4 GOOSE EXCLUSION FENCE
C-803
NOT TO SCALE

PLANTING SUMMARY:

DUNE PLANTING AREA (BY OTHERS)

AREA ON BERM:	35.2 ACRES
AREA ON EXISTING:	0.5 ACRES
TOTAL AREA:	35.7 ACRES
SPECIES:	PANICUM AMARUM AND PANICUM VIRGATUM
ELEV.:	7.2 TO 2.5-FT NAVD88
EST. QUANTITY:	288-LBS OF PURE LIVE SEED

BACK DUNE PLANTING AREA

AREA ON BERM:	3.4 ACRES
AREA ON EXISTING:	4.4 ACRES
TOTAL AREA:	7.8 ACRES
SPECIES:	SPARTINA PATENS
ELEV:	2.5 TO 1.7-FT NAVD88
EST. QUANTITY:	156,000 PLANTS

SALTMARSH PLANTING AREA

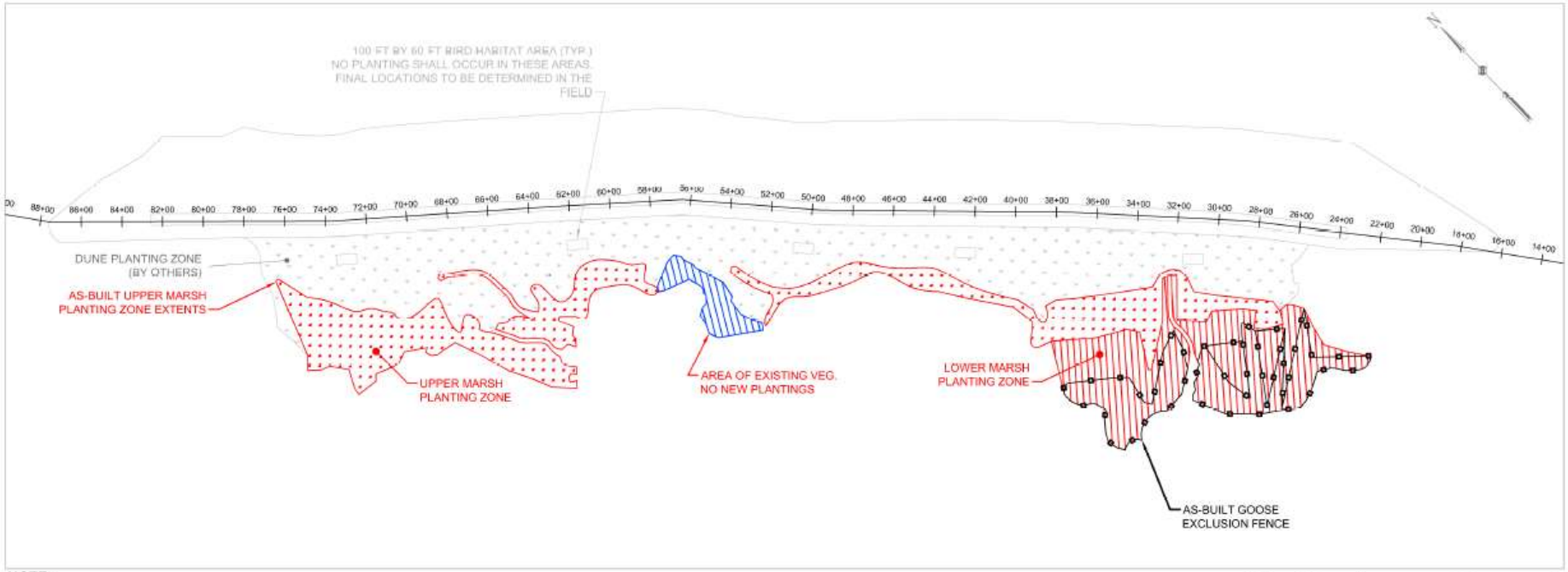
AREA ON BERM:	3.3 ACRES
AREA ON EXISTING:	5.8 ACRES
TOTAL AREA:	9.1 ACRES
SPECIES:	SPARTINA ALTERNIFLORA
ELEV:	1.7 TO 0.75-FT NAVD8
EST. QUANTITY:	184,000 PLANTS

PLANTING NOTES:

1. THE "DUNE PLANTING AREA" IS EXPECTED TO OCCUR AT ELEVATIONS THAT ARE CONSIDERED NON-TIDAL. THE "DUNE PLANTING AREA" ON THE BACKMARSH PLATFORM WILL EXTEND FROM ELEVATION 7.2-FT NAVD88 (TOP OF BERM ELEVATION) TO ELEVATION 2.5-FT NAVD8 (DETERMINED BY USFWS). SWITCHGRASS SHALL BE PLANTED IN THIS AREA WITH A CONVENTIONAL OR NO-TILL DRILL AT DEPTHS OF ¼-IN TO 1-IN AT A RATE OF 8 LBS/ACRE. THE DUNE PLANTING ZONE EXTENDS TO THE EDGE OF THE 40-FT CREST. SEEDING SHALL TAKE PLACE BETWEEN MARCH 1 AND JUNE 30 BY OTHERS.
2. THE "BACK DUNE PLANTING AREA" IS EXPECTED TO OCCUR AT ELEVATIONS THAT ARE CONSIDERED TIDAL AND REGULARLY FLOODED BY TIDAL WATER BUT LESS SO THAN THE "SALTMARSH PLANTING AREA". THE "BACK DUNE PLANTING AREA" ON THE BACKMARSH PLATFORM WILL EXTEND FROM ELEVATION 2.5-FT NAVD88 (DETERMINED BY USFWS) TO 1.7-FT NAVD88 (DETERMINED BY USFWS). SPARTINA PATENS SHALL BE PLANTED ON 18-IN CENTERS IN THE FORM OF 2-IN PLUGS. ADJACENT ROWS OF SPARTINA PATENS SHALL BE OFFSET 9-IN AS SHOWN IN DETAIL 3/C-803. GOOSE EXCLUSION FENCING SHALL BE INSTALLED TO PROTECT THE SPARTINA PATENS AS INDICATED IN DETAIL 4/C-803. SPARTINA PATENS PLATING SHALL TAKE PLACE BETWEEN APRIL 1 AND JUNE 30.
3. THE "SALTMARSH PLANTING AREA" IS EXPECTED TO OCCUR AT ELEVATIONS THAT ARE CONSIDERED TIDAL AND FLOODED BY TIDAL FLOW ON A DAILY BASIS. THE "SALTMARSH PLANTING AREA" ON THE BACKMARSH PLATFORM WILL EXTEND FROM ELEVATION 1.7-FT NAVD88 (DETERMINED BY USFWS) TO ELEVATION 0.75-FT NAVD88 (DETERMINED BY USFWS). SPARTINA ALTERNIFLORA SHALL BE PLANTED ON 18-IN CENTERS IN THE FORM OF 2-IN PLUGS. ADJACENT ROWS OF SPARTINA ALTERNIFLORA SHALL BE OFFSET 9-IN AS SHOWN IN DETAIL 3/C-803. GOOSE EXCLUSION FENCING SHALL BE INSTALLED TO PROTECT THE SPARTINA ALTERNIFLORA AS INDICATED IN DETAIL 4/C-803. SPARTINA ALTERNIFLORA PLATING SHALL TAKE PLACE BETWEEN APRIL 1 AND JUNE 30.

GENERAL NOTES:

1. PLANTING AREAS FROM US ARMY CORPS OF ENGINEERS, PHILADELPHIA DISTRICT, PLANSET TITLED "PRIME HOOK BEACH RESTORATION, PRIME HOOK, DELAWARE, 90% CONCEPTUAL" DATED 24 MAR 2015.
2. PLANTING SHALL BE IN ACCORDANCE WITH APPENDIX F OF THE "STATEMENT OF WORK FOR RESILIENCY PROJECT #15, PRIME HOOK NATIONAL WILDLIFE REFUGE COASTAL TIDAL MARSH, DESIGN/BUILD TIDAL MARSH RESTORATION AT THE PRIME HOOK NATIONAL WILDLIFE REFUGE, MILTON, DELAWARE" DATED 30 OCTOBER 2014.
3. ELEVATION RANGES FOR EACH PLANTING ZONE WAS DETERMINED BY ATKINS FOR USFWS IN A REPORT TITLED "HYDRODYNAMIC MODELING OF PRIME HOOK NATIONAL WILDLIFE REFUGE, FINAL REPORT" DATED 24 JUNE 2014. ALL ELEVATION RANGES WERE ADJUSTED BY USFWS IN AN EMAIL TO EA DATED 27 APRIL 2015 AND 20 MAY 2015.



NOTE:

- DATUM OF THIS SKETCH IS THAT OF THE DELAWARE STATE PLAN GRID NAD 83/91 BASED ON MEASUREMENTS MADE ON MARCH 2016.
- GOOSE FENCE INSTALLED IN THE LOWER MARSH PLANTING ZONE AT THE DIRECTION OF THE USFWS. THE PERIMETER FENCE PROTECTS AGAINST SWIM UP ATTRITION AND MACRO ALGAE, AND FENCE INSTALLED THROUGH THE MIDDLE OF THE AREA BREAKS UP GEESE LANDING ZONES.

500 250 0 500 1000

GRAPHIC SCALE IN FEET

AS-BUILT QUANTITIES	
ITEM	QUANTITY
SPARTINA PATENS	255,000
SPARTINA ALTERNIFLORA	140,000
GOOSE FENCE	6,900 LF

ELEVATION LINES	
LINE TYPE	LENGTH (Ft.)
BACK DUNE PLANTING ZONE	6,900'±
SALT MARSH PLANTING ZONE	9,100'±
TRANSITION LINE	6,410'±

LEGEND

- BACK DUNE PLANTING ZONE
- TRANSITION LINE
- TRANSITION LINE
- GOOSE EXCLUSION FENCE - APPROX. LOCATION
- UPPER MARSH PLANTING ZONE (SPARTINA PATENS)
- LOWER MARSH PLANTING ZONE (SPARTINA ALTERNIFLORA)
- EXISTING VEGETATION - NO PLANTINGS

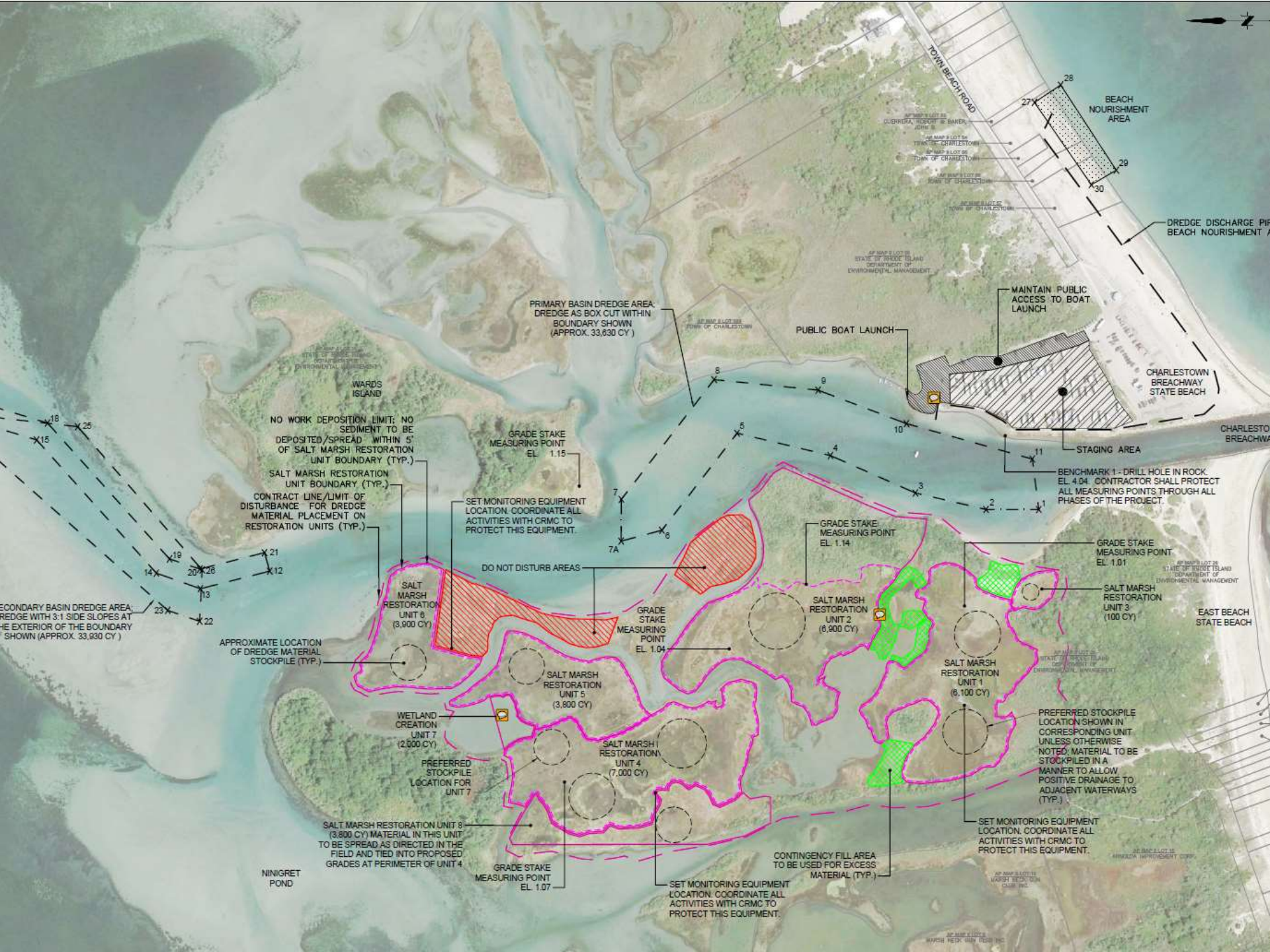
Aerial Seeding

- Used over 10,000 lbs of seed from 17 different species
- 1,000 Acres of exposed mudflat – 2016
- 50 Acres of mudflat - 2017

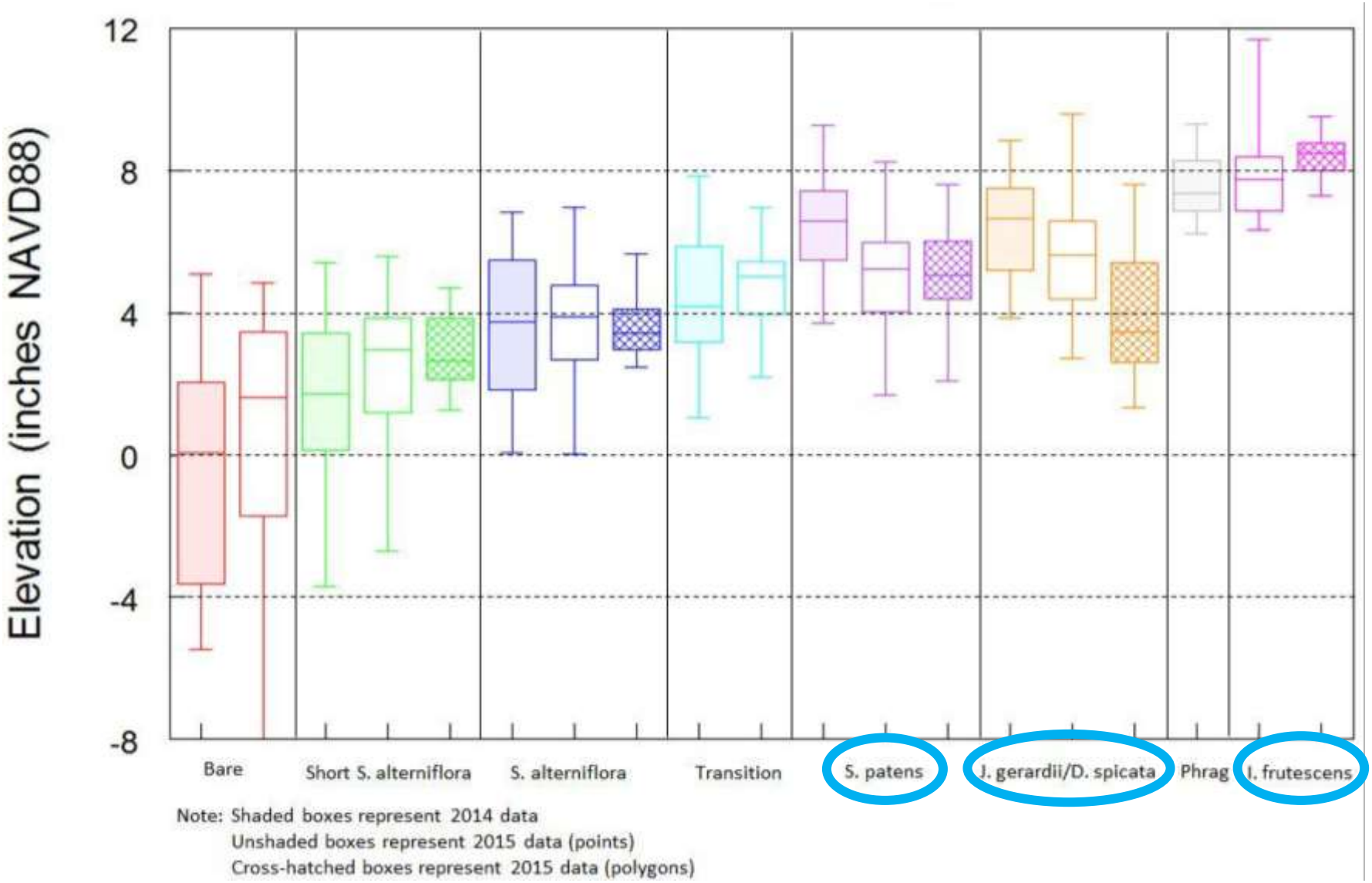
06/2017

Ninigret Salt Marsh Restoration

- Charlestown, Rhode Island
- Creating High Marsh
- Beneficial Reuse – Navigational Channel Dredging (Thick-Layer Deposition)
- Primarily Sand
- Thicker application using bull-dozers


TOWN BEACH ROAD
BEACH NOURISHMENT AREA
28
27
29
30
DREDGE DISCHARGE PIP
BEACH NOURISHMENT A
MAINTAIN PUBLIC ACCESS TO BOAT LAUNCH
PUBLIC BOAT LAUNCH
CHARLESTOWN BREACHWAY STATE BEACH
STAGING AREA
CHARLESTO
BREACHWA
PRIMARY BASIN DREDGE AREA: DREDGE AS BOX CUT WITHIN BOUNDARY SHOWN (APPROX. 33,630 CY)
WARDS ISLAND
NO WORK DEPOSITION LIMIT; NO SEDIMENT TO BE DEPOSITED/SPREAD WITHIN 5' OF SALT MARSH RESTORATION UNIT BOUNDARY (TYP.)
SALT MARSH RESTORATION UNIT BOUNDARY (TYP.)
CONTRACT LINE/LIMIT OF DISTURBANCE FOR DREDGE MATERIAL PLACEMENT ON RESTORATION UNITS (TYP.)
GRADE STAKE MEASURING POINT EL. 1.15
SET MONITORING EQUIPMENT LOCATION. COORDINATE ALL ACTIVITIES WITH CRMC TO PROTECT THIS EQUIPMENT.
BENCHMARK 1 - DRILL HOLE IN ROCK. EL. 4.04. CONTRACTOR SHALL PROTECT ALL MEASURING POINTS THROUGH ALL PHASES OF THE PROJECT.
GRADE STAKE MEASURING POINT EL. 1.14
GRADE STAKE MEASURING POINT EL. 1.01
DO NOT DISTURB AREAS
SALT MARSH RESTORATION UNIT 6 (3,900 CY)
SALT MARSH RESTORATION UNIT 3 (100 CY)
EAST BEACH STATE BEACH
SALT MARSH RESTORATION UNIT 2 (6,900 CY)
GRADE STAKE MEASURING POINT EL. 1.04
APPROXIMATE LOCATION OF DREDGE MATERIAL STOCKPILE (TYP.)
SALT MARSH RESTORATION UNIT 5 (3,800 CY)
SALT MARSH RESTORATION UNIT 1 (6,100 CY)
WETLAND CREATION UNIT 7 (2,000 CY)
SALT MARSH RESTORATION UNIT 4 (7,000 CY)
PREFERRED STOCKPILE LOCATION SHOWN IN CORRESPONDING UNIT UNLESS OTHERWISE NOTED. MATERIAL TO BE STOCKPILED IN A MANNER TO ALLOW POSITIVE DRAINAGE TO ADJACENT WATERWAYS (TYP.)
PREFERRED STOCKPILE LOCATION FOR UNIT 7
SALT MARSH RESTORATION UNIT 8 (3,800 CY) MATERIAL IN THIS UNIT TO BE SPREAD AS DIRECTED IN THE FIELD AND TIED INTO PROPOSED GRADES AT PERIMETER OF UNIT 4
SET MONITORING EQUIPMENT LOCATION. COORDINATE ALL ACTIVITIES WITH CRMC TO PROTECT THIS EQUIPMENT.
NINIGRET POND
GRADE STAKE MEASURING POINT EL. 1.07
CONTINGENCY FILL AREA TO BE USED FOR EXCESS MATERIAL (TYP.)
SET MONITORING EQUIPMENT LOCATION. COORDINATE ALL ACTIVITIES WITH CRMC TO PROTECT THIS EQUIPMENT.
ECONDARY BASIN DREDGE AREA: REDGE WITH 3:1 SIDE SLOPES AT HE EXTERIOR OF THE BOUNDARY SHOWN (APPROX. 33,930 CY)

Vegetation Elevations - Ninigret Salt Marsh



Re-establishing creeks

Chincoteague National Wildlife Refuge

Potential Beneficial Reuse Project

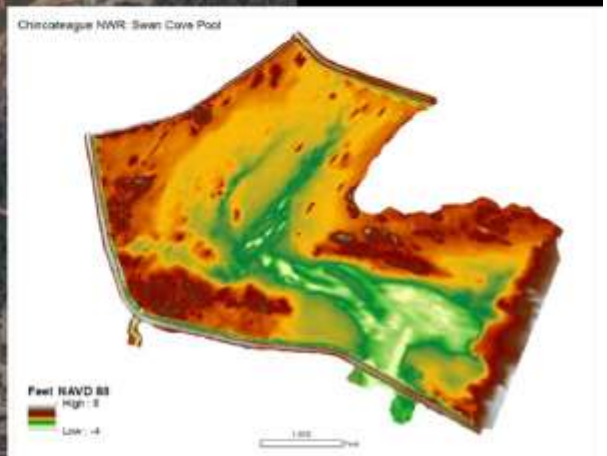
Post Hurricane Sandy– October 31, 2012

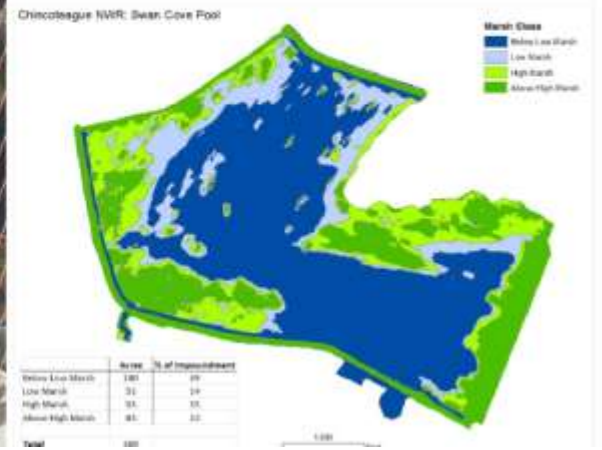
(Patrick J. Hendrickson - Highcamera.com)

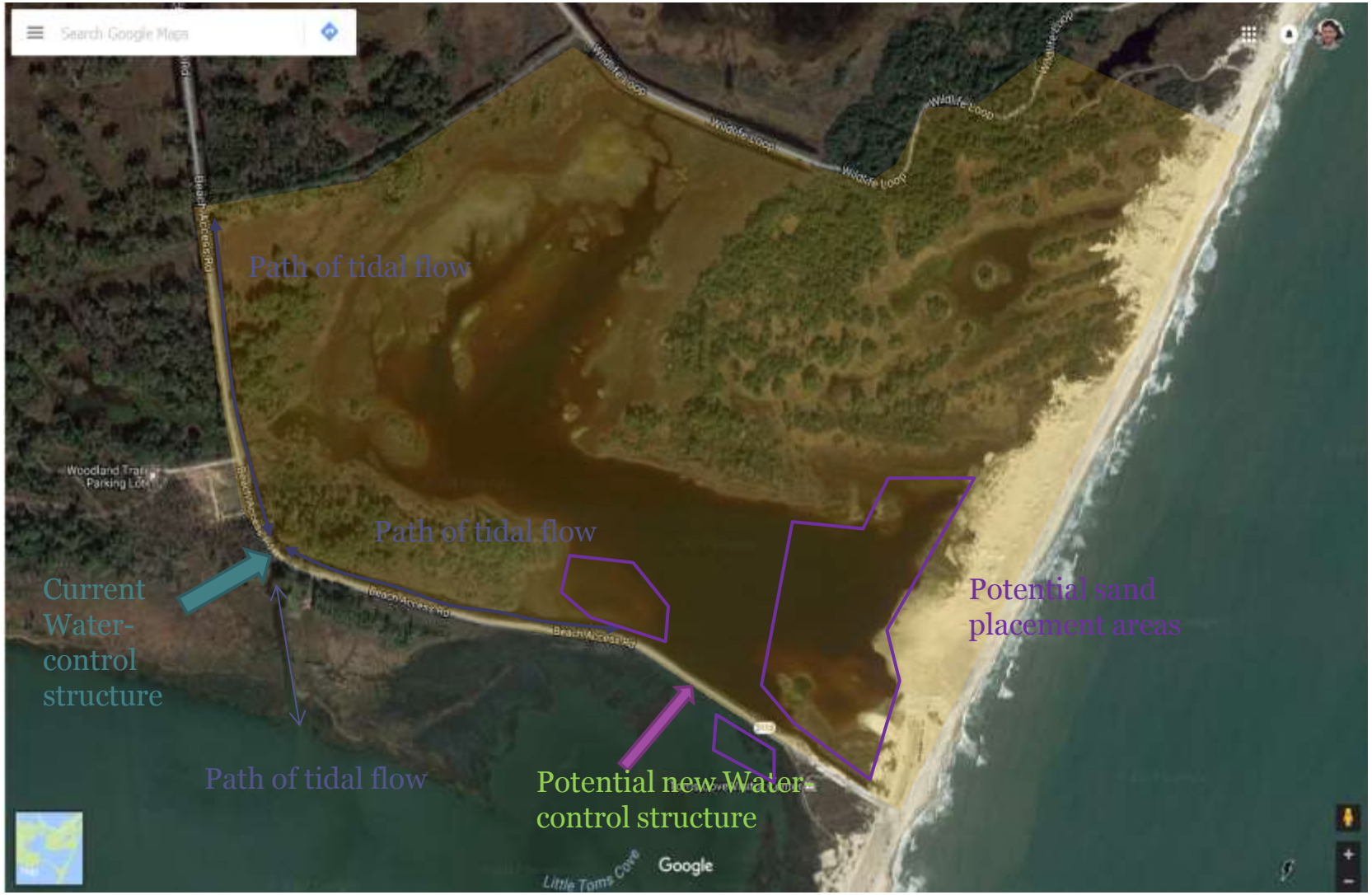
Post Hurricane Sandy – February 6, 2013

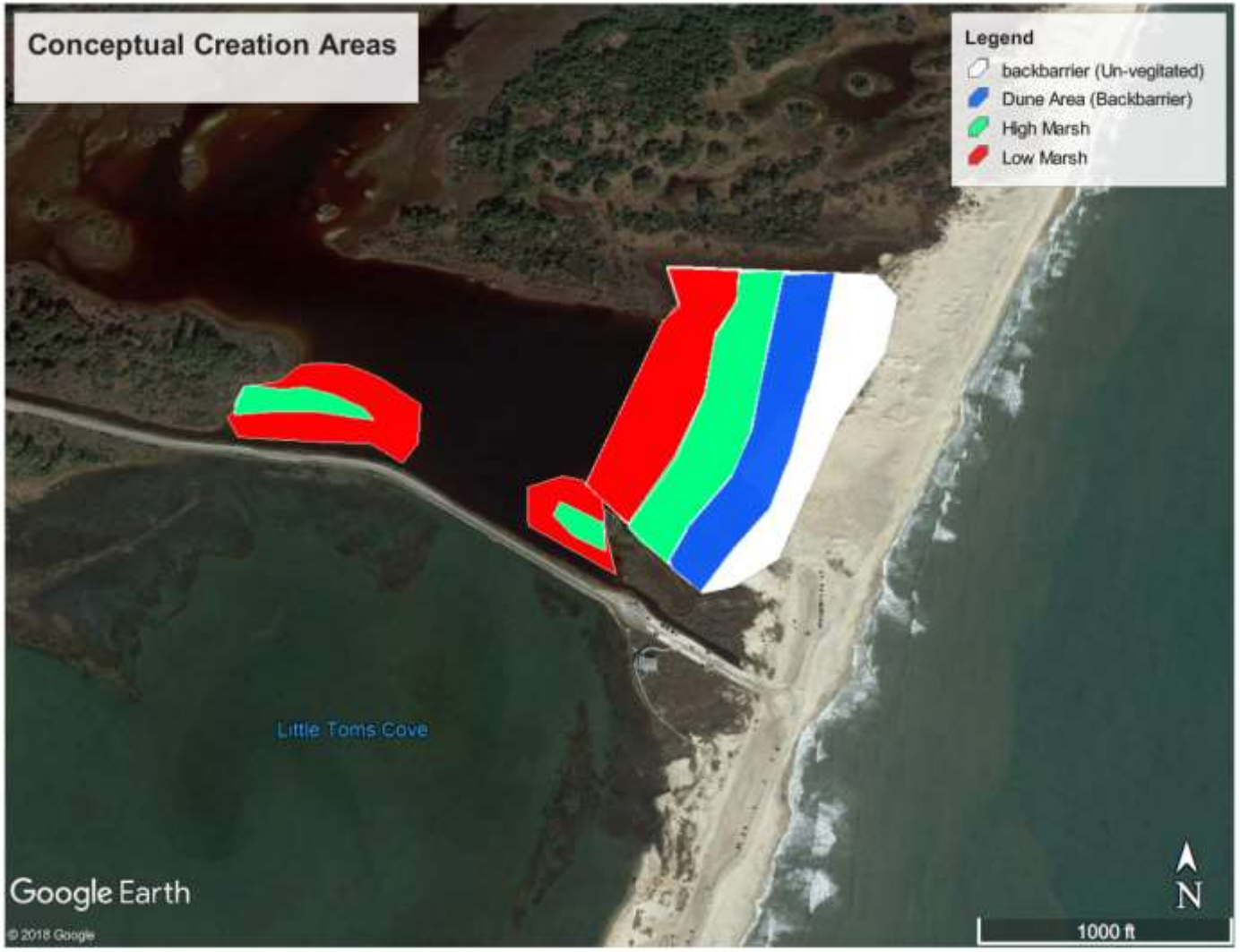
(Patrick J. Hendrickson - Highcamera.com)

Refuge Impoundment Vulnerability Assessment






Search Google Maps
Path of tidal flow
Path of tidal flow
Current Water-control structure
Potential sand placement areas
Path of tidal flow
Potential new Water-control structure
Google


Conceptual Creation Areas
Legend
backbarrier (Un-vegitated)
Dune Area (Backbarrier)
High Marsh
Low Marsh
Little Toms Cove
Google Earth
© 2018 Google
N
1000 ft

Reeds Beach, Cape May NWR

- **2016 Army Corp of Engineers External Partnering Team Award**
- **2016 World Organization of Dredging Associations (WODA)**
  - **Silver Environmental Excellence Award winner in the "Environmental Dredging" category**
- **2017 American Shore and Beach Preservation Association (ASBPA) Best Restored Beach Award**
- **2019 Climate Adaptation Leadership Award for Natural Resources**