Tidal Marsh Restoration Design At Prime Hook National Wildlife Refuge In Delaware

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Coastal Delaware National Wildlife Refuge Complex
Partners & Contributors

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Overview of Presentation

• History of wetland management and current management challenges at Prime Hook NWR
• Brief review of the findings of our hydrodynamic modeling effort
• Explanation of how modeling results and other work guide our marsh restoration
• Steps and current status of restoration
• Brief description of proposed monitoring efforts
Located on the western shore of the Delaware Bay, in southern DE
Established in 1963
10,132 acres, primarily wetlands
Refuge divided into management units: Unit I through Unit IV, north to south, primarily divided by roads
History of Prime Hook’s Marshes

- Historically, wetlands almost entirely salt marsh

- Numerous impacts and alterations ... Ditching, draining, mosquito management, grazing and haying, trapping, hunting

- In the 1980’s, the two central units - Unit II and Unit III - were converted to freshwater impoundments through the installation of new water control structures
  - Combat *Phragmites* and provide waterfowl habitat
  - Largest freshwater impoundments east of the Mississippi
  - Dunes on DE Bay coast were supplemented at that time

History of Prime Hook’s Marshes

Impoundment management

- Unit II (~1500 acres) and Unit III (~2500 acres) = freshwater impoundments
- Tidal water was restricted by water control structures at north and south
- Culverts between Unit II and Unit III
The end result was – IT WORKED
History of Prime Hook’s Marshes

Shoreline overwashes & breaches

- **2006 – Hurricane Ernesto**
  - In Unit I only
  - Rejuvenated the Unit I salt marsh
  - Decision not to repair, natural salt marsh

- **2008 – Mother’s Day Storm**
  - Moderate overwash in Unit II
  - Repaired in October 2008
  - 2009 freshwater vegetation management successful

- **2009 – October/November Nor’Easters**
  - Two breaches formed in Unit II
  - Reconsidered wetland management

- **2012 – Hurricane Sandy**
  - Two new large breaches
  - Total breached area nearly tripled
Area of Dune Breaches
2011

Unit I starting to close

2010 was a quiet storm year, until Irene in 2011

Post-Sandy

New breaches 4 total now

2013 aerial imagery courtesy of Atkins Global
Prime Hook NWR Comprehensive Conservation Planning (CCP) Process

- CCPs guide refuge management for 15 years
- Prepared through the NEPA process, evaluating the impacts of several alternatives and seeking public input
- Final Decision = Salt & Brackish Marsh Restoration
- Also considered “No Action” & “Return to Impoundments”
Steps taken to help with marsh restoration planning

- Extensive data collection with DNREC, through cooperative agreement (elevations, water levels, salinity, etc)
- Two workshops with agency and academic partners
- Many informal conversations
- Breach repair analysis
- **Hydrodynamic modeling our most important tool**
Hydrodynamic Modeling

• Worked with Atkins Global to develop hydrodynamic model for wetland complex
  – Circulation, flushing/residence time, salinity
  – Delft3D
  – Delaware Bay from Trenton, NJ to Atlantic Ocean

• Built a Robust Model of Existing Conditions
  – 2+ years of local water level and salinity data
  – Additional elevation and flow data
  – Calibrated very well against normal tide as well as Sandy conditions
Hydrodynamic Modeling

• Model used to evaluate potential restoration / management scenarios
  – Alterations to roads, water control structures
  – Alterations to breaches
    all open, all closed, only one open
  – Alteration of hydrology through adding channels

• Hydrology Alteration scenarios
  – Focused model runs on all breaches closed, WCS and eastern Fowler Beach Rd removed
  – Main conveyance channel to improve circulation
  – Secondary branching tidal channels added
Hydrodynamic Modeling

Prime Hook NWR
Proposed
Channel Locations*

*subject to change during design phase

Legend
- Proposed roadway intersections
- Existing & historical channels
- Proposed main channel
- Proposed finger channels / branches

Prime Hook W
-75.252959, 38.852617

Prime Hook E
-75.246049, 38.854713
Hydrodynamic Modeling

**Highlights of Results**

- Closing all breaches + Removal of water control structures + Addition of conveyance channels →

  *Water levels & salinity conducive to salt/brackish marsh*

- From 0 ppt start, system reached average 26 ppt within 3 months

- Salinity well-distributed throughout marsh complex
Hydrodynamic Modeling

Prime Hook NWR Modeling Results
Typical Tidal Cycle

Legend
Max Salinity - Main w/ Branches (ppt)
- 0
- 1 - 2
- 3 - 4
- 5 - 6
- 7 - 8
- 9 - 10
- 11 - 12
- 13 - 14
- 15 - 16
- 17 - 18
- 19 - 20
- 21 - 22
- 23 - 24
- 25 - 26
- 27 - 28
- 29 - 31
Salt Marsh Restoration

▪ GOAL:
Restore a Barrier Beach & Salt Marsh Complex that can withstand future storms and overwashes... that can adapt, repair, migrate, and sustain itself

▪ HOW?
Restore the structure and processes that sustain a functioning salt and brackish marsh
This will not be a short-term endeavor

▪ WHAT FIRST?
Stabilize the shoreline for the near-term (Recovery)
Begin to rebuild ecosystem processes (Resiliency)
Salt Marsh Restoration

Shoreline Stabilization – Sandy Recovery Project

Stabilize the shoreline for the near-term

- Close breaches, restore dune
- About 6000 linear feet of Unit II
- Extend about 300 feet into back barrier marsh
- Create marsh platform behind restored dune
- About 40-60 acres, to be planted with *Spartina* grasses
- Removal of water control structures
Shoreline Stabilization – Sandy Recovery Project

- Working with Army Corps of Engineers
- Design work is underway not yet finalized
- Fall/Winter 2014-15 target timeframe
Salt Marsh Restoration

Marsh Interior Restoration – Sandy Resiliency Project

- *Begin to rebuild ecosystem processes*

- Improve tidal circulation by creating conveyance channel and tidal channel network

- Use material from on-site dredging work to restore lost elevation in some areas of the marsh interior

- Carefully monitor success of Recovery Project planting, sediment availability and transport, accretion, elevation

- Marsh design during 2014, implement in 2015+
Prime Hook NWR
Modeling Results
Typical Tidal Cycle

Legend
Bottom Elevation - Main w/ Branches elevation (ft NAVD88)
- below -2.0

--- Channel centerlines

Land Coverage - Main w/ Branches Type
- Open water (< low water)
  - Tidal flat (between low and mean water)
  - Low marsh > 18 ppt (between mean and high water)
  - Low marsh < 18 ppt (between mean and high water)
  - High marsh (between high water and high + 0.4 ft)
Monitoring our Progress

- Partnerships with the University of Delaware, through a new Cooperative Agreement with DNREC Coastal Programs
- Continued water and marsh elevation monitoring
- Development of sediment budget
- Fish community surveys, acoustic tagging
- Vegetation and bird community monitoring
- Black duck/wintering waterfowl food availability
- Build on existing programs for long-term monitoring:
  - USFWS Salt Marsh Integrity (SMI) Index
  - Saltmarsh Habitat & Avian Research Program (SHARP)
  - Integrated Waterbird Management & Monitoring (IWMM)
Monitoring our Progress

For more on Monitoring: See poster STP-78