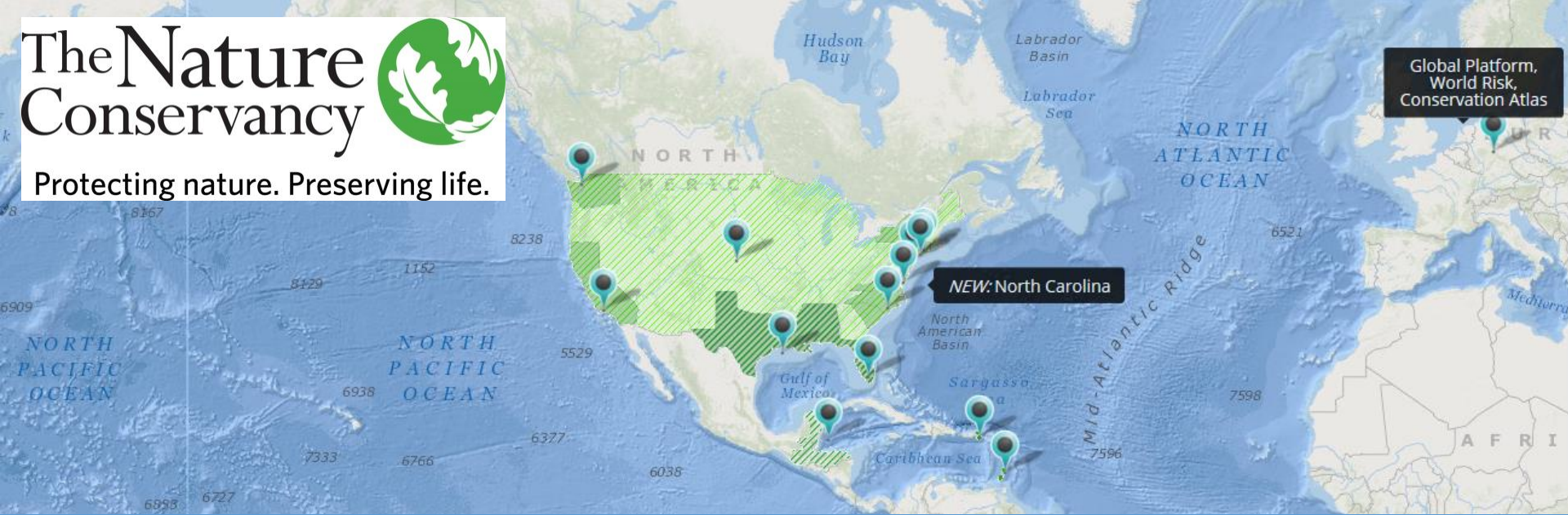# Using Science to Inform Restoration & Conservation Decisions

**Nicole Maher, PhD**
**Senior Coastal Scientist**
**The Nature Conservancy – NY**
**nmaher@tnc.org**

The Nature Conservancy

Protecting nature. Preserving life.

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NEW: North Carolina

Global Platform, World Risk, Conservation Atlas

www.coastalresilience.org

ASSESS RISK

IDENTIFY SOLUTIONS

TAKE ACTION

MEASURE EFFECTIVENESS

# NYC Tidal Marsh Assessment:

# Condition, Vulnerability and Opportunities for Restoration & Advancement

Nicole Maher[1], Stephen Lloyd[1], Lauren Alleman[1], Christopher Haight[2], Marit Larson[2], Rebecca Swadek[2], Ellen K. Hartig[2], and Helen M. Forgione[3]

The Nature Conservancy [1]
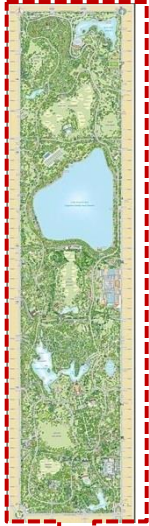NYC Parks - Natural Resources Group [2]
Natural Areas Conservancy [3]

Central Park
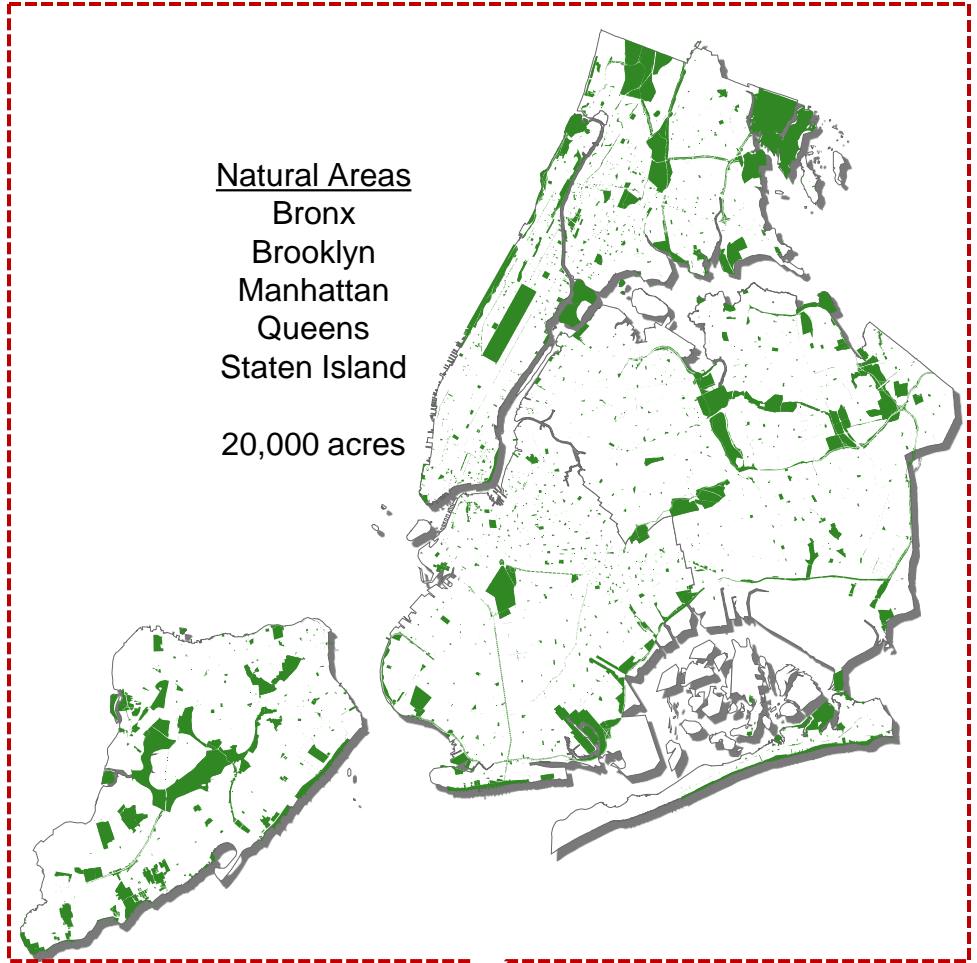Manhattan

840 acres

Prospect Park
Brooklyn

585 acres

Natural Areas
Bronx
Brooklyn
Manhattan
Queens
Staten Island

20,000 acres

**Central Park
Conservancy**

**Prospect
Park
Alliance**

**Natural Areas
Conservancy**

NYC Parks

# MISSION AND GOALS

*The Natural Areas Conservancy exists to restore and conserve the blue and green spaces of New York City in order to enhance the lives of all New Yorkers.*

1. Advance **science-based** regional planning
2. Ensure **healthy forest systems**
3. Promote and improve **coastal resilience**
4. Cultivate **volunteerism and community engagement**

Natural Areas
Conservancy

**Forests & Uplands**: 7000 acres, 53 Parks, 1142 plots

**Freshwater Wetlands**: Over 300 acres, 3 Boroughs, 17 Watersheds, 22 wetlands

**Salt Marshes**: 1500 acres, 25 Marsh Complexes, 4 Boroughs

**Social Assessments**: 9503 acres, 1,600 Interviews

Legend:
- FWW Study Areas
- NACSMA Tidal Wetlands
- Upland Study Areas
- SSA Zones
- Parks
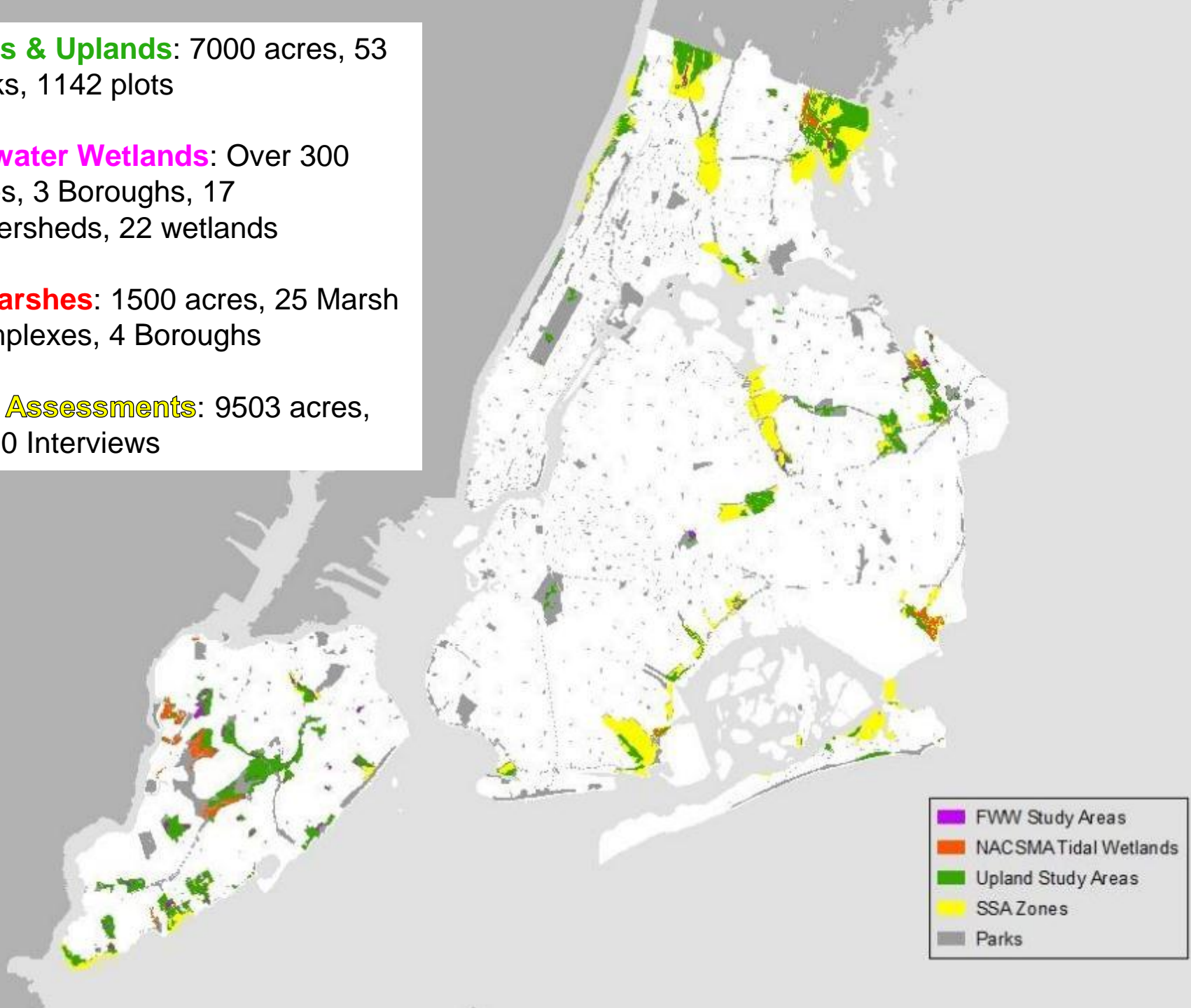
# How can we maximize long-term viability of fringing salt marsh in NYC?

- **Assess condition of largest marshes city-wide**

- **Evaluate vulnerability to sea-level rise (SLR)**
    - Rapid ecological assessment
    - Sea Level Affecting Marshes Model
    - Conditions and vulnerability indices

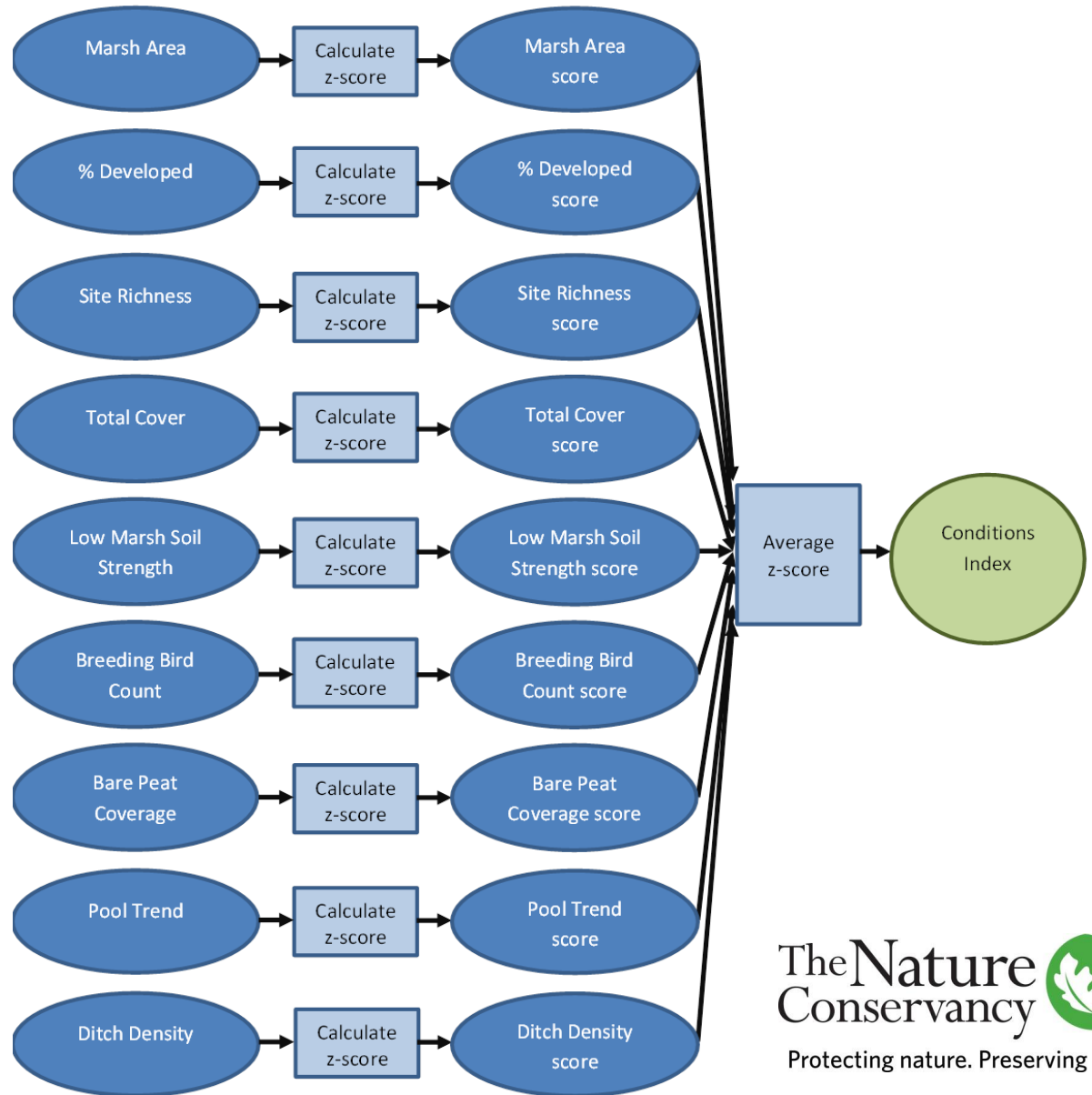- **Identify and prioritize restoration & protection opportunities**



NYC Tidal Marsh Assessment
New York, NY
NYC Parks

- Marsh Study Sites
- NYC Parks Property
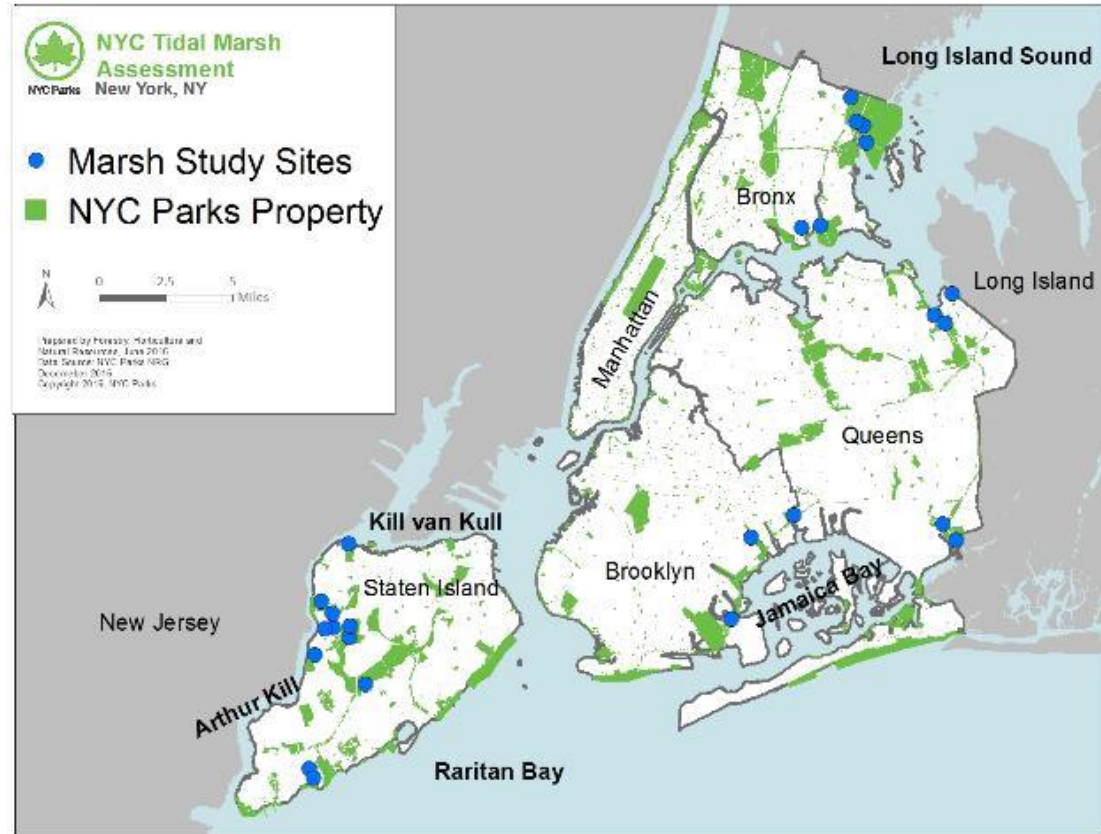
NYC Parks

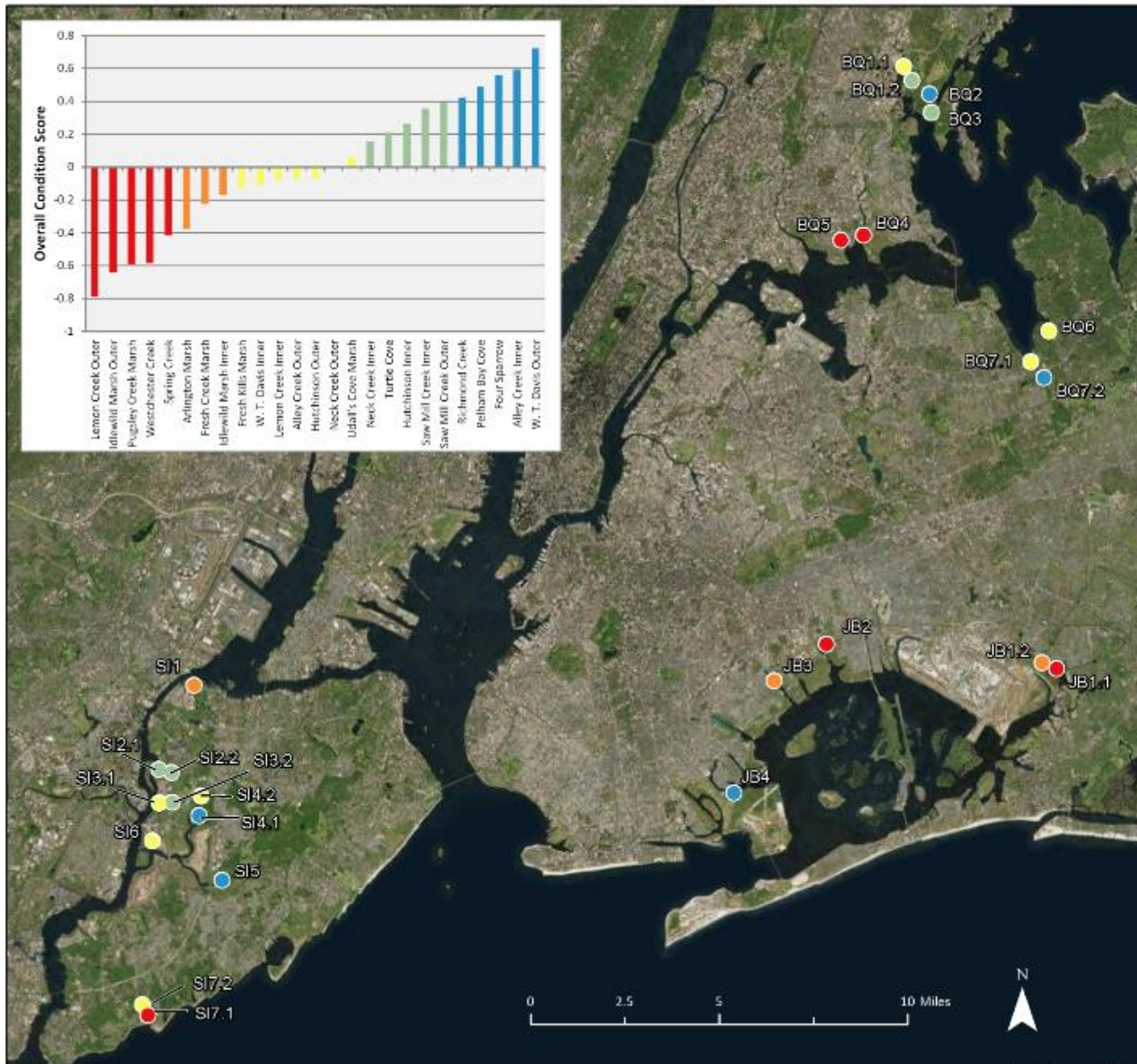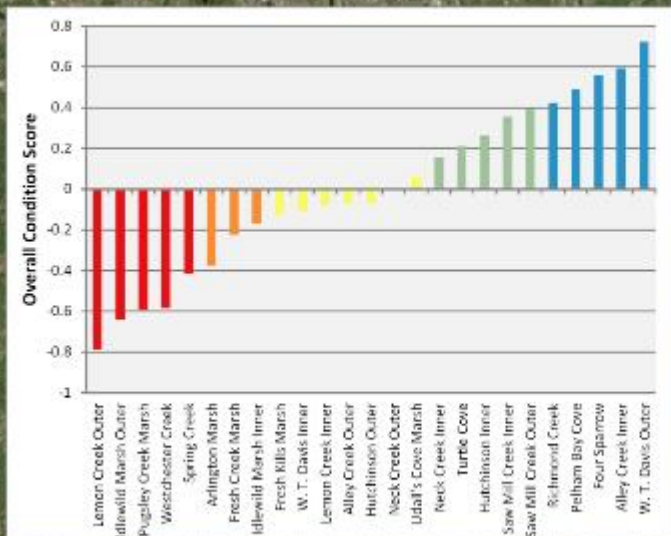# Calculating the Condition Index from a wealth of available data



- Mid-Atlantic Tidal Wetlands Rapid Assessment Method (Mid-TRAM)

- Salt Marsh Ecological assessment (NACSMA)

- Site Specific Intensive Monitoring (SSIM)

- Marsh Loss analysis (1974 - 2012)

- Sea Level Affecting Marshes Model (Warren Pinnacle, NYSERDA)

# Overall Condition Score



Inset chart — Overall Condition Score (bar chart, sites ordered left to right):
Lemon Creek Outer, Idlewild Marsh Outer, Pugsley Creek Marsh, Westchester Creek, Spring Creek, Arlington Marsh, Fresh Creek Marsh, Idlewild Marsh Inner, Fresh Kills Marsh, W. T. Davis Inner, Lemon Creek Inner, Alley Creek Outer, Hutchinson Outer, Neck Creek Outer, Udall's Cove Marsh, Neck Creek Inner, Turtle Cove, Hutchinson Inner, Saw Mill Creek Inner, Saw Mill Creek Outer, Richmond Creek, Pelham Bay Cove, Four Sparrow, Alley Creek Inner, W. T. Davis Outer

| ID | Complex Name | Score |
|------|----------------------|-------|
| BQ1.1 | Hutchinson Outer | -0.07 |
| BQ1.2 | Hutchinson Inner | 0.27 |
| BQ2 | Pelham Bay Cove | 0.49 |
| BQ3 | Turtle Cove | 0.21 |
| BQ4 | Westchester Creek | -0.58 |
| BQ5 | Pugsley Creek Marsh | -0.59 |
| BQ6 | Udall's Cove Marsh | 0.06 |
| BQ7.1 | Alley Creek Outer | -0.07 |
| BQ7.2 | Alley Creek Inner | 0.59 |
| JB1.1 | Idlewild Marsh Outer | -0.64 |
| JB1.2 | Idlewild Marsh Inner | -0.17 |
| JB2 | Spring Creek | -0.42 |
| JB3 | Fresh Creek Marsh | -0.22 |
| JB4 | Four Sparrow | 0.56 |
| SI1 | Arlington Marsh | -0.38 |
| SI2.1 | Saw Mill Creek Outer | 0.40 |
| SI2.2 | Saw Mill Creek Inner | 0.36 |
| SI3.1 | Neck Creek Outer | 0.01 |
| SI3.2 | Neck Creek Inner | 0.16 |
| SI4.1 | W. T. Davis Outer | 0.72 |
| SI4.2 | W. T. Davis Inner | -0.11 |
| SI5 | Richmond Creek | 0.42 |
| SI6 | Fresh Kills Marsh | -0.13 |
| SI7.1 | Lemon Creek Outer | -0.79 |
| SI7.2 | Lemon Creek Inner | -0.08 |

## Map Key

- Higher Condition (blue)
- (green)
- (yellow)
- (orange)
- Lower Condition (red)

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# Calculating the Vulnerability Index from a wealth of available data
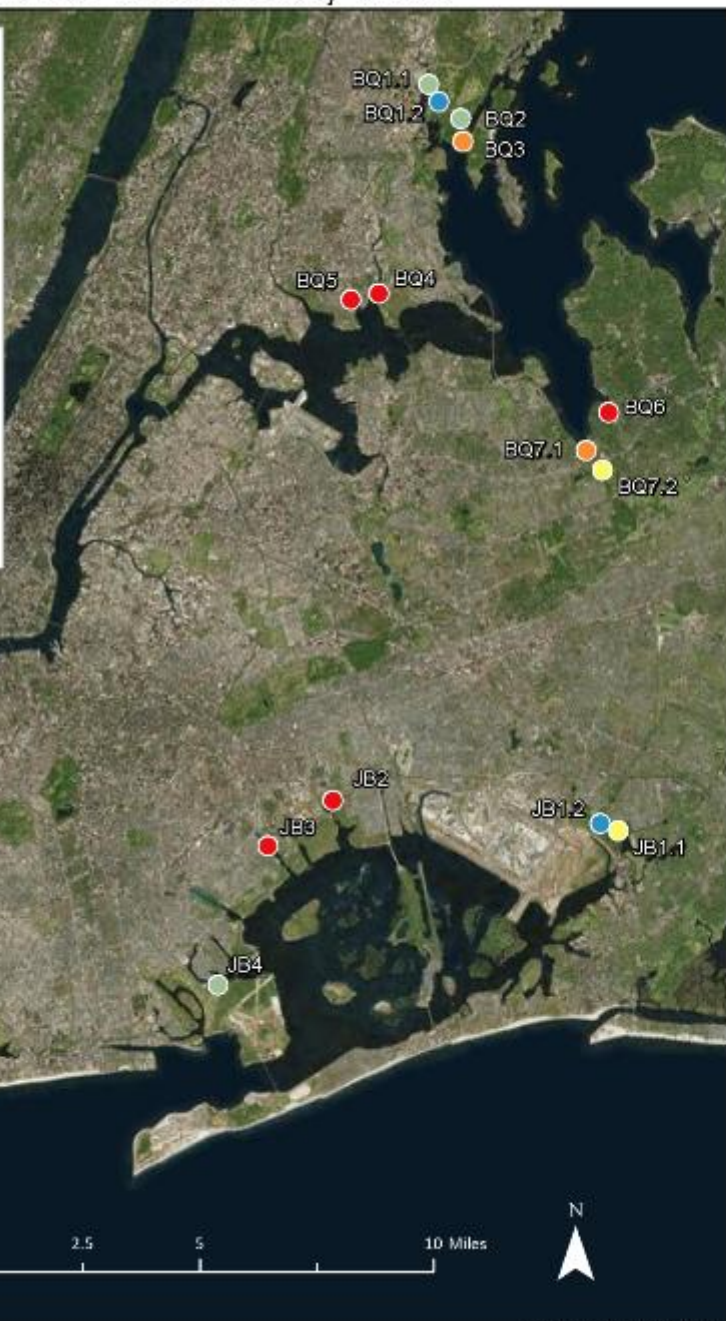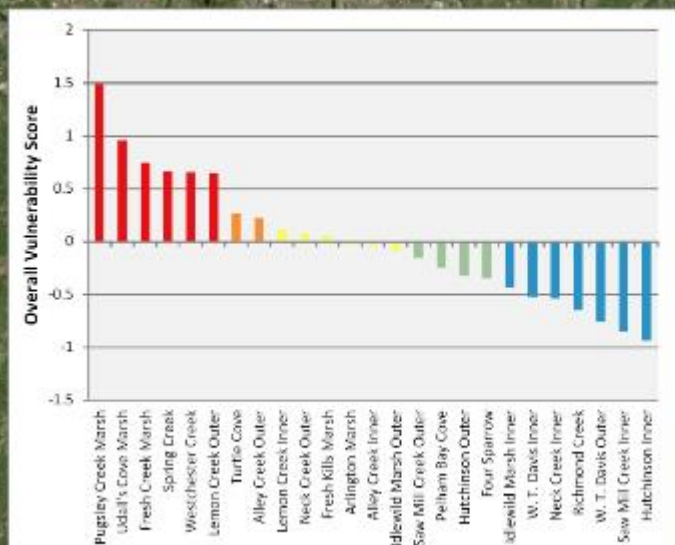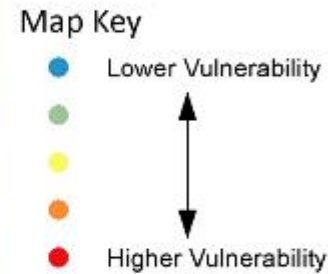


- Mid-Atlantic Tidal Wetlands Rapid Assessment Method (Mid-TRAM)

- Salt Marsh Ecological assessment (NACSMA)

- Site Specific Intensive Monitoring (SSIM)

- Marsh Loss analysis (1974 - 2012)

- Sea Level Affecting Marshes Model (Warren Pinnacle, NYSERDA)
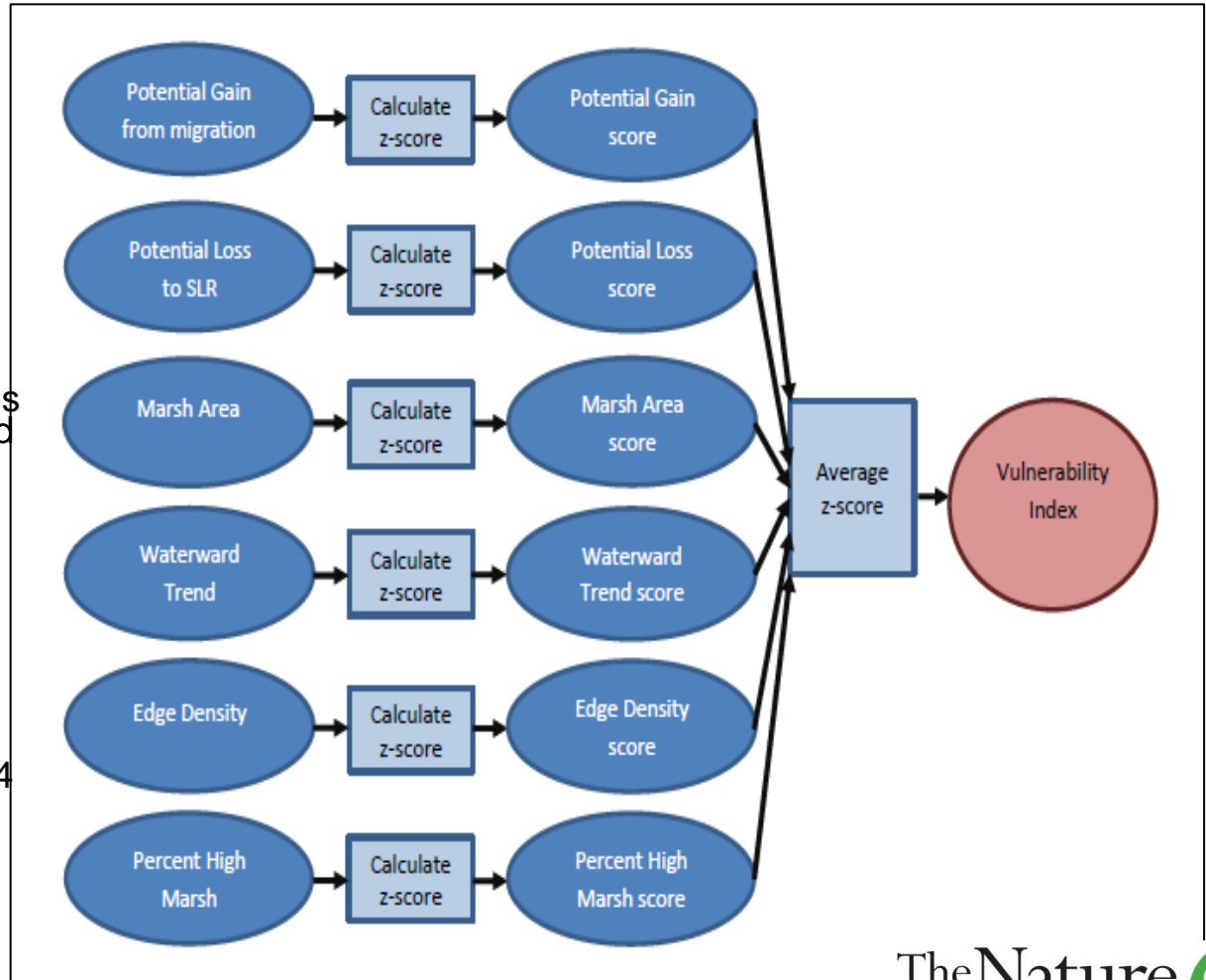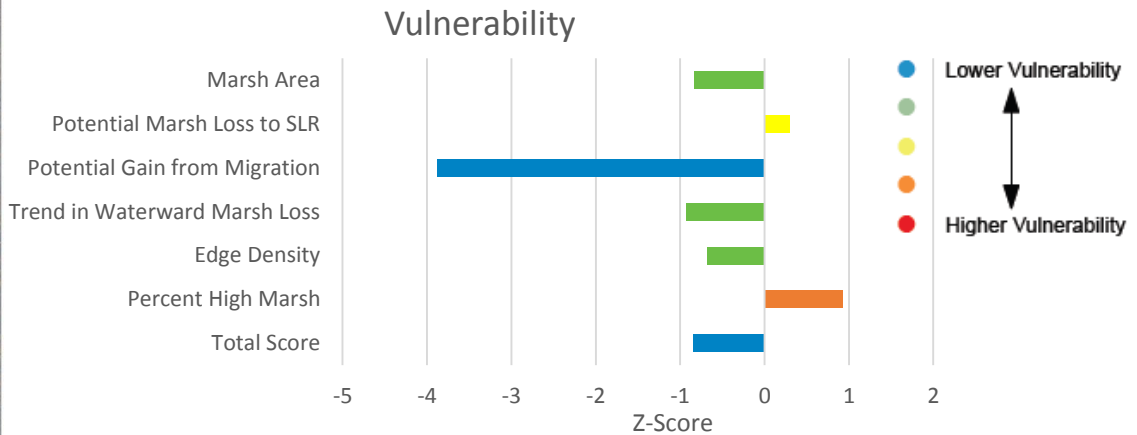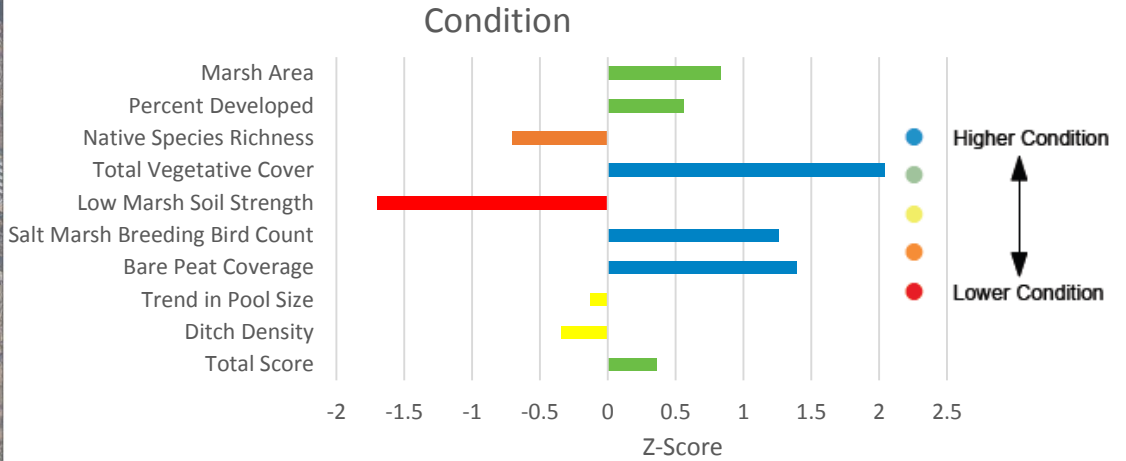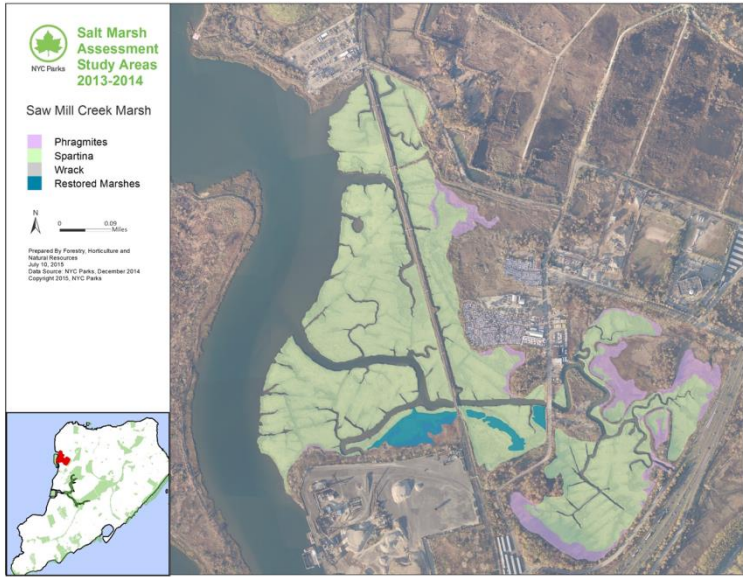
# Overall Vulnerability Score



| ID | Complex Name | Score |
|------|--------------------|-------|
| BQ1.1 | Hutchinson Outer | -0.33 |
| BQ1.2 | Hutchinson Inner | -0.93 |
| BQ2 | Pelham Bay Cove | -0.25 |
| BQ3 | Turtle Cove | 0.27 |
| BQ4 | Westchester Creek | 0.65 |
| BQ5 | Pugsley Creek Marsh | 1.49 |
| BQ6 | Udall's Cove Marsh | 0.96 |
| BQ7.1 | Alley Creek Outer | 0.22 |
| BQ7.2 | Alley Creek Inner | -0.04 |
| JB1.1 | Idlewild Marsh Outer | -0.09 |
| JB1.2 | Idlewild Marsh Inner | -0.43 |
| JB2 | Spring Creek | 0.67 |
| JB3 | Fresh Creek Marsh | 0.74 |
| JB4 | Four Sparrow | -0.34 |
| SI1 | Arlington Marsh | -0.03 |
| SI2.1 | Saw Mill Creek Outer | -0.15 |
| SI2.2 | Saw Mill Creek Inner | -0.85 |
| SI3.1 | Neck Creek Outer | 0.07 |
| SI3.2 | Neck Creek Inner | -0.54 |
| SI4.1 | W. T. Davis Outer | -0.76 |
| SI4.2 | W. T. Davis Inner | -0.52 |
| SI5 | Richmond Creek | -0.65 |
| SI6 | Fresh Kills Marsh | 0.06 |
| SI7.1 | Lemon Creek Outer | 0.65 |
| SI7.2 | Lemon Creek Inner | 0.12 |

## Map Key

- 🔵 Lower Vulnerability
- 🟢
- 🟡
- 🟠
- 🔴 Higher Vulnerability

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# Saw Mill Inner (SI2.2) – Saw Mill Creek Marsh, Staten Island

# Marsh Condition vs. Vulnerability



Are these a better long-term investment?

Legend:
- ● Lower Condition / Higher Vulnerability
- ○ Moderate Condition & Vulnerability
- ○ Higher Condition / Lower Vulnerability

W. T. Davis Outer

Alley Creek Inner

Four Sparrow

Pelham Bay Cove

Richmond Creek

Saw Mill Creek Inner    Saw Mill Creek Outer

Hutchinson Inner

Neck Creek Inner

Turtle Cove

Udall's Cove Marsh

Neck Creek Outer

Alley Creek Outer

Hutchinson Outer

W. T. Davis Inner

Lemon Creek Inner

Idlewild Marsh Inner

Fresh Kills Marsh

Fresh Creek Marsh

Arlington Marsh

Spring Creek

Westchester Creek    Pugsley Creek Marsh

Idlewild Marsh Outer

Lemon Creek Outer

Is there anything we can do to save marshes that are highly vulnerable?

Legend:
- ◆ Long Island Sound
- ■ Jamaica Bay
- ▲ Staten Island

# Identification & Prioritization of Restoration Opportunities

- Acquisition/Transfer of adjacent marsh parcels and future Marsh Migration Zones

- Removal of barriers to marsh migration: Flooded Developed

- Elevation of marsh surface to add elevation capital and increase productivity

- Rebuilding of Marsh Edge in places where the marsh has retreated from the 1974 Tidal Wetlands Inventory line

**All lead to increasing the long-term viability & function of NYC saltmarshes in the study area**

Acquisition / Transfer of Parcels with Current or Future Marsh
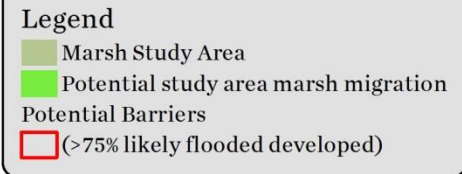
Marsh Advancement by Parcel
*Neck Creek Inner*

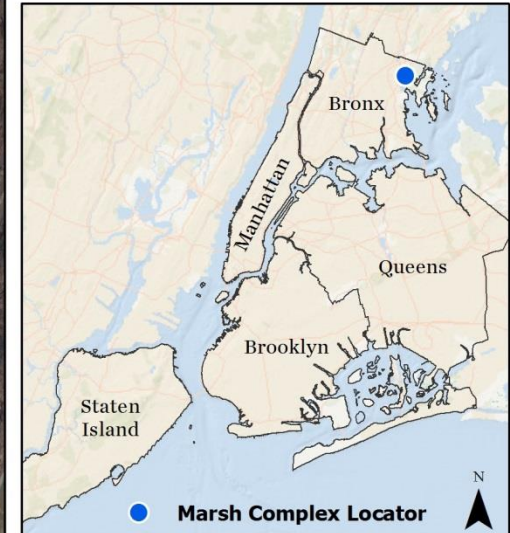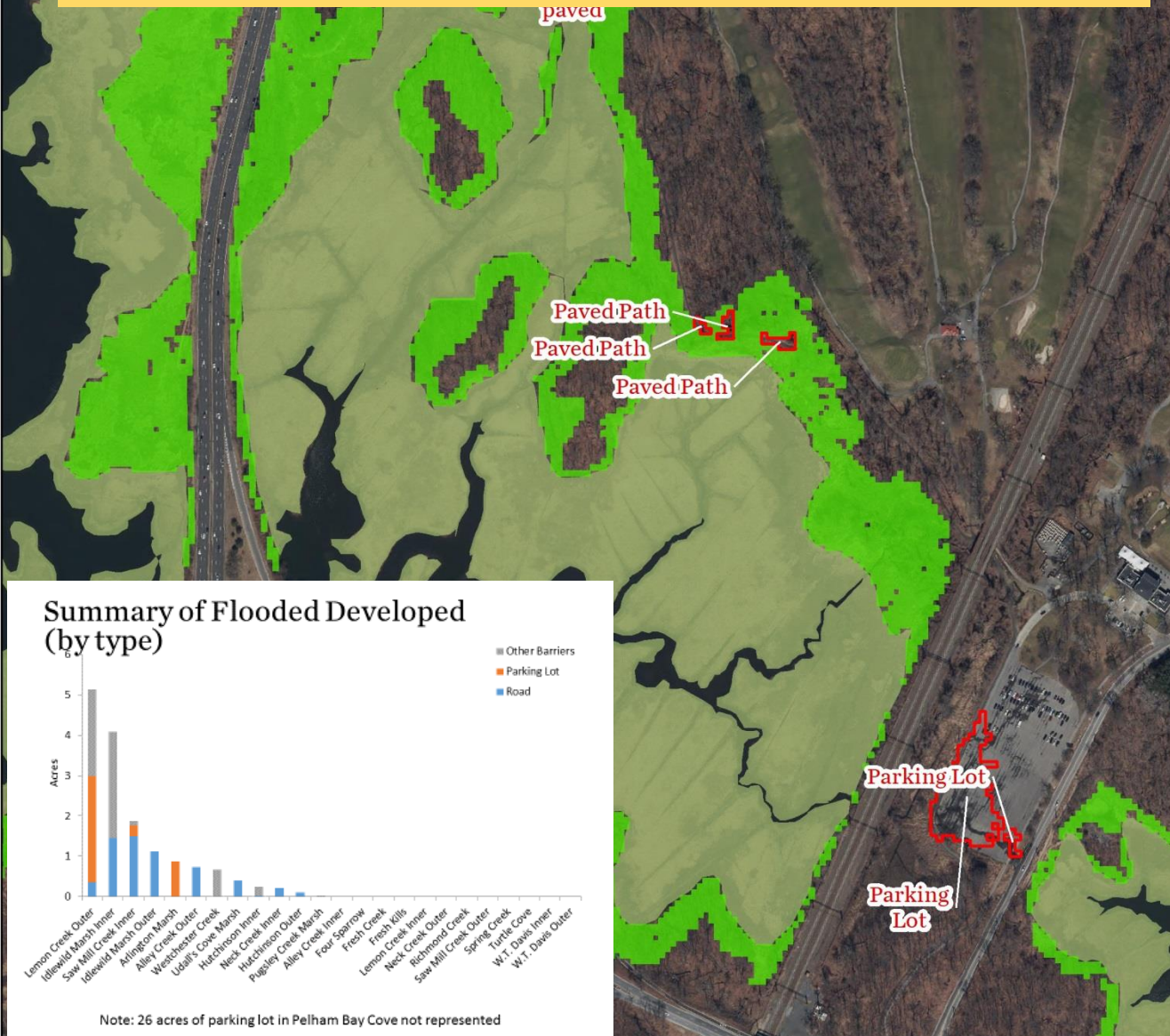Future new marsh acres in Study Area
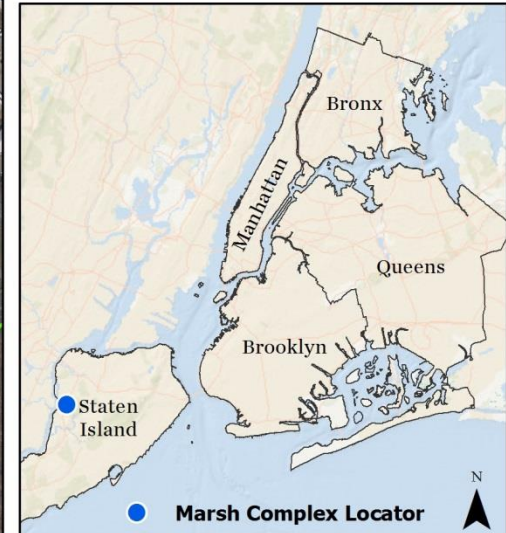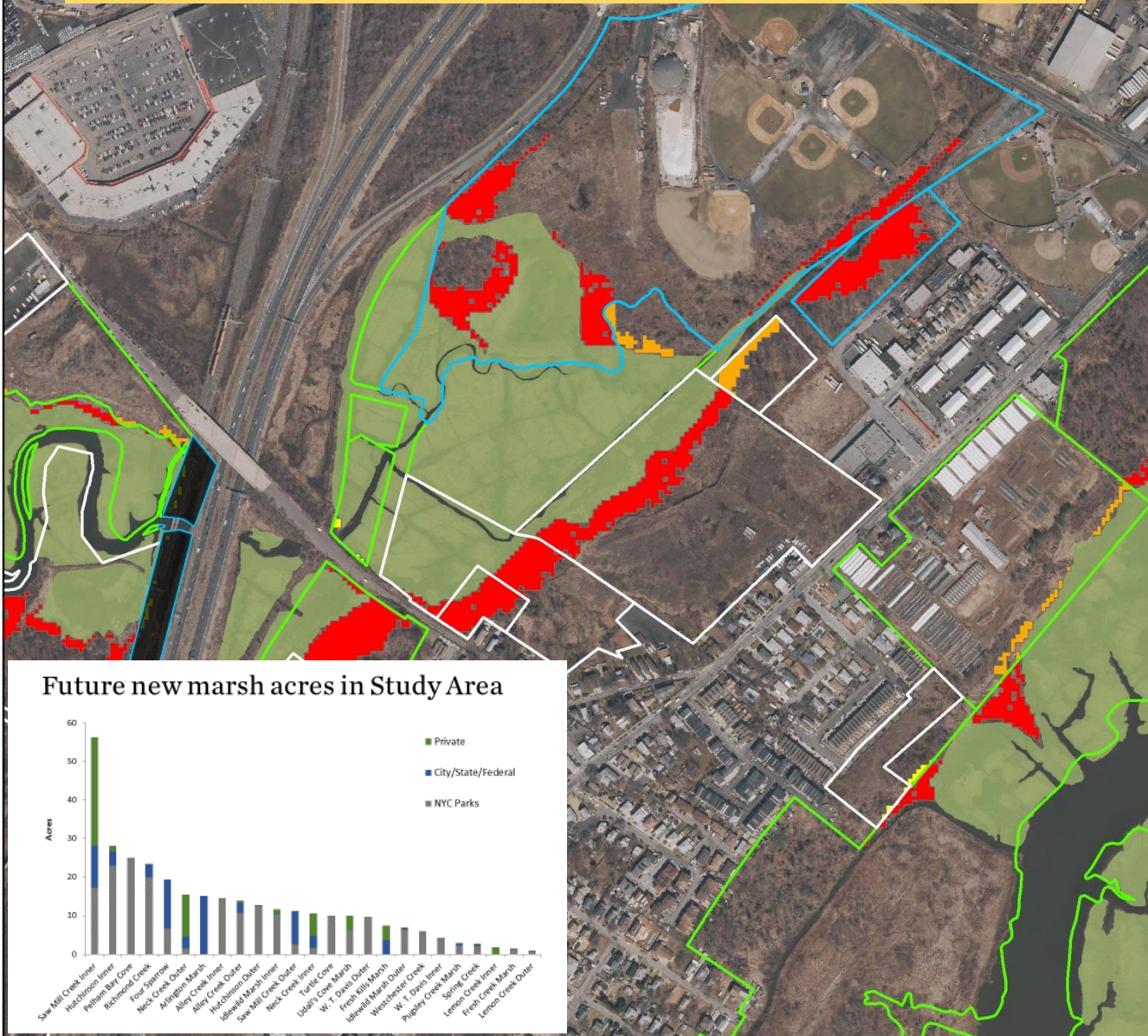
Legend

Marsh Study Area

**Parcel ownership**

City/State/Federal

Parks and Rec

Private

**Potential study area marsh migration by parcel (2085)**

< 0.1 acre

0.1 - 0.5 acre
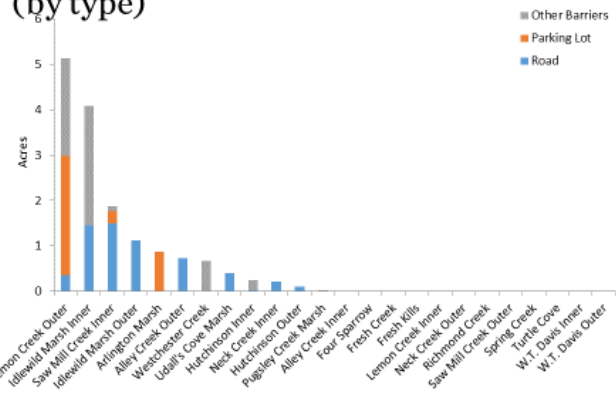
> 0.5 acre

Transportation/planned development

The Nature Conservancy
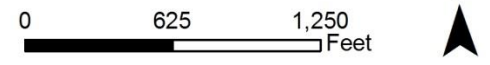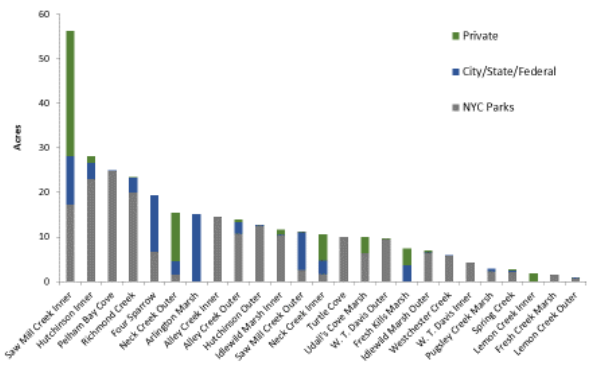
# Restoration of Flooded Developed Barriers to Marsh Migration
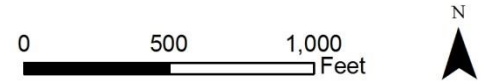
## Marsh Advancement Barriers
### *Hutchinson Inner*

paved

Paved Path
Paved Path
Paved Path

Parking Lot

Parking Lot

**Marsh Complex Locator**

Bronx

Manhattan

Queens

Brooklyn

Staten Island

N

### Legend
Marsh Study Area
Potential study area marsh migration
**Potential Barriers**
(>75% likely flooded developed)

## Summary of Flooded Developed (by type)

Other Barriers
Parking Lot
Road

Acres

Lemon Creek Outer
Idlewild Marsh Inner
Saw Mill Creek Inner
Idlewild Marsh Outer
Arlington Marsh
Alley Creek Outer
Westchester Creek
Uddal's Cove Marsh
Hutchinson Inner
Neck Creek Inner
Hutchinson Outer
Pugsley Creek Marsh
Alley Creek Inner
Four Sparrow
Fresh Kills
Lemon Creek Inner
Neck Creek Outer
Richmond Creek
Saw Mill Creek Outer
Spring Creek
Turtle Cove
W.T. Davis Inner
W.T. Davis Outer

Note: 26 acres of parking lot in Pelham Bay Cove not represented

The Nature Conservancy
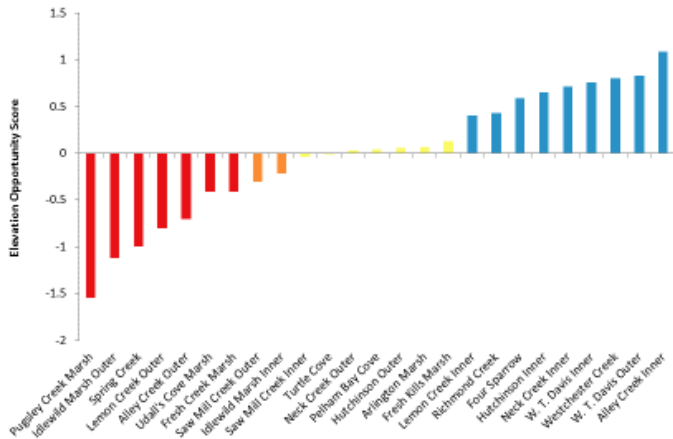
0       500       1,000
Feet

N

Elevation Enhancement
for marshes with low elevation capital
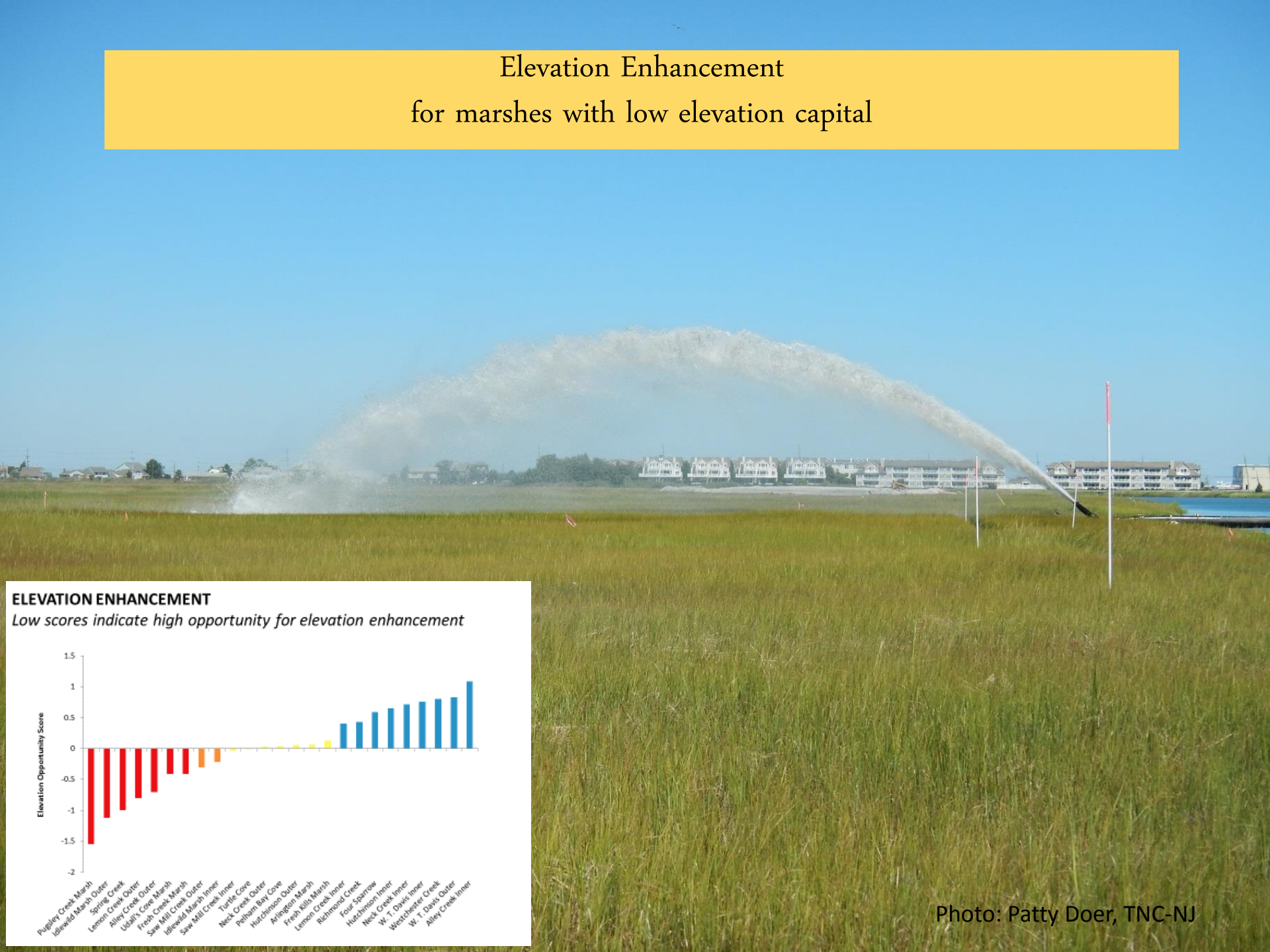
**ELEVATION ENHANCEMENT**
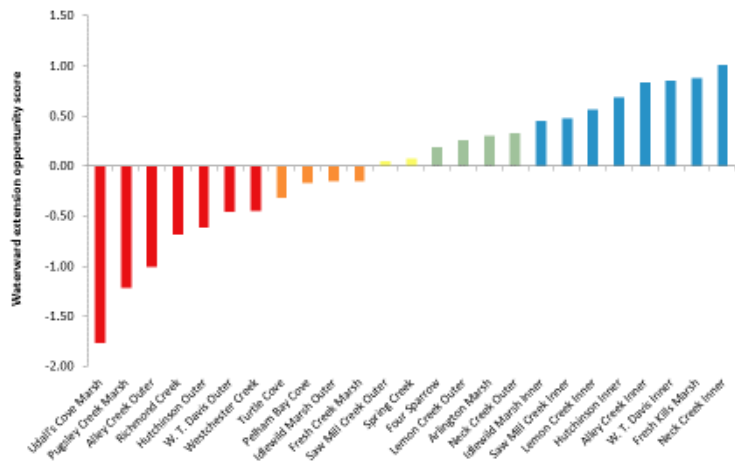*Low scores indicate high opportunity for elevation enhancement*

Photo: Patty Doer, TNC-NJ

# Rebuild Marsh Edge to 1974 Extent
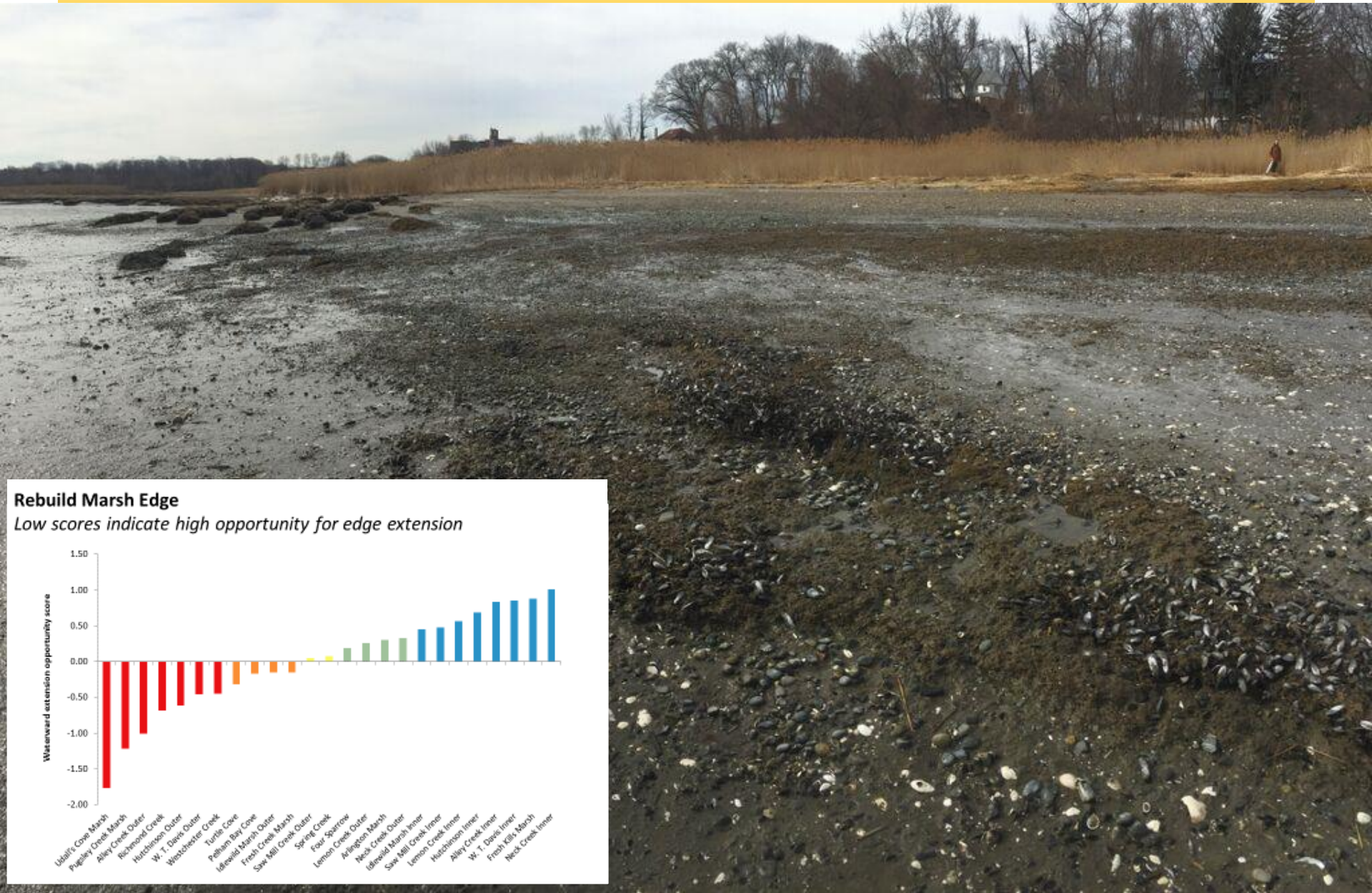
## Rebuild Marsh Edge
*Low scores indicate high opportunity for edge extension*
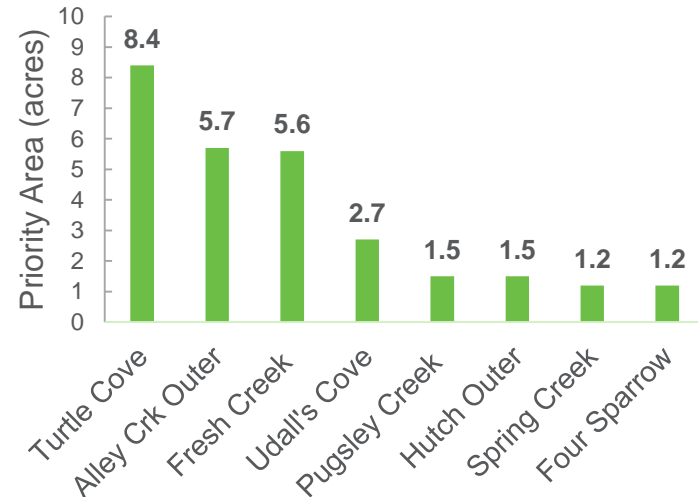
# Watershed Recommendations

**Focus on watershed – specific needs**

**SI - Acquire and transfer parcels**

**JB - Restore elevation**

**LIS - Address edge extension uncertainty**
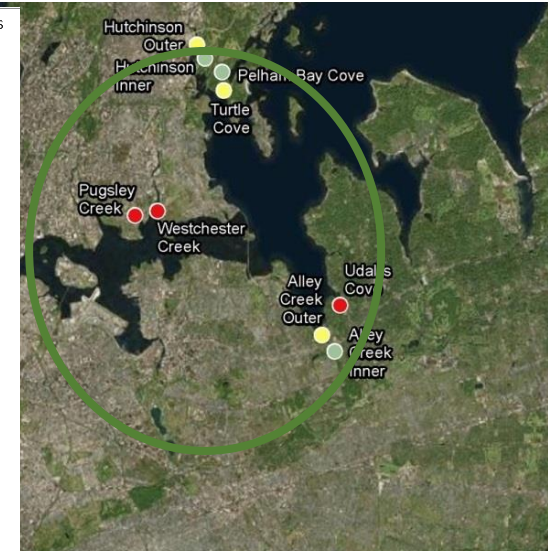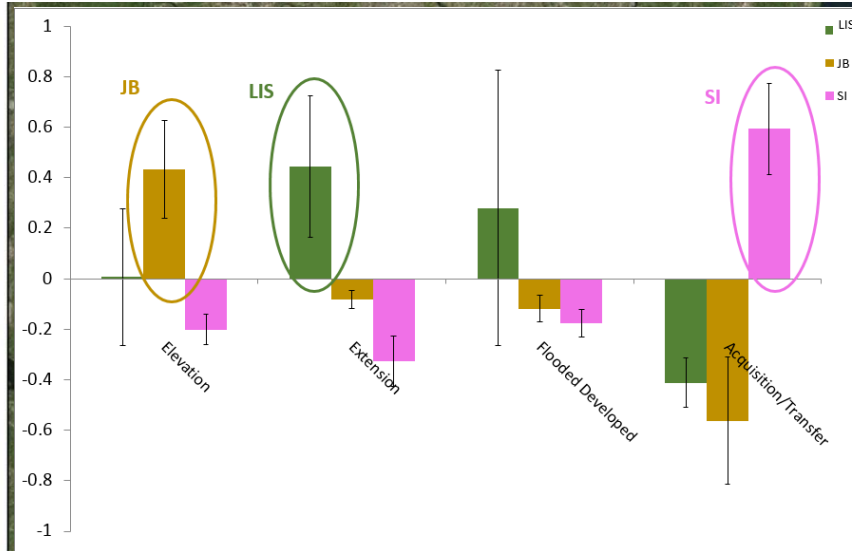
*Strategy for marsh conservation depends on* **articulated goals, landscape context, time horizon,** *and* **socioeconomic factors**

1. **Preserve existing marshes and marsh migration zones so that these systems can persist and function into the future**.

2. **Prioritize high condition / low vulnerability marshes** through best management practices and these 4 conservation strategies as needed.

3. **Pursue opportunities for intermediate condition / high vulnerability marshes** and even some low condition / high vulnerability marshes as indicated by their needs and where other factors (human dimensions, etc.) predominate.

# Recommendations

- Pilot new approaches to wetland protection and restoration:

    ❑ Shoreline protection and waterward restoration

    ❑ Elevation / sand enhancement

- Expand funding and leveraging opportunities

    ❑ Small mitigation project fund

- Protect future marsh migration areas (reduce impervious area in parks, use existing regulations, acquisition, easements)

- Expand assessment approach to include non-Parks properties



Gerritsen Creek, Brooklyn



Soundview Marsh, Bronx

NYC Parks

# Dynamic Marsh Management Tool
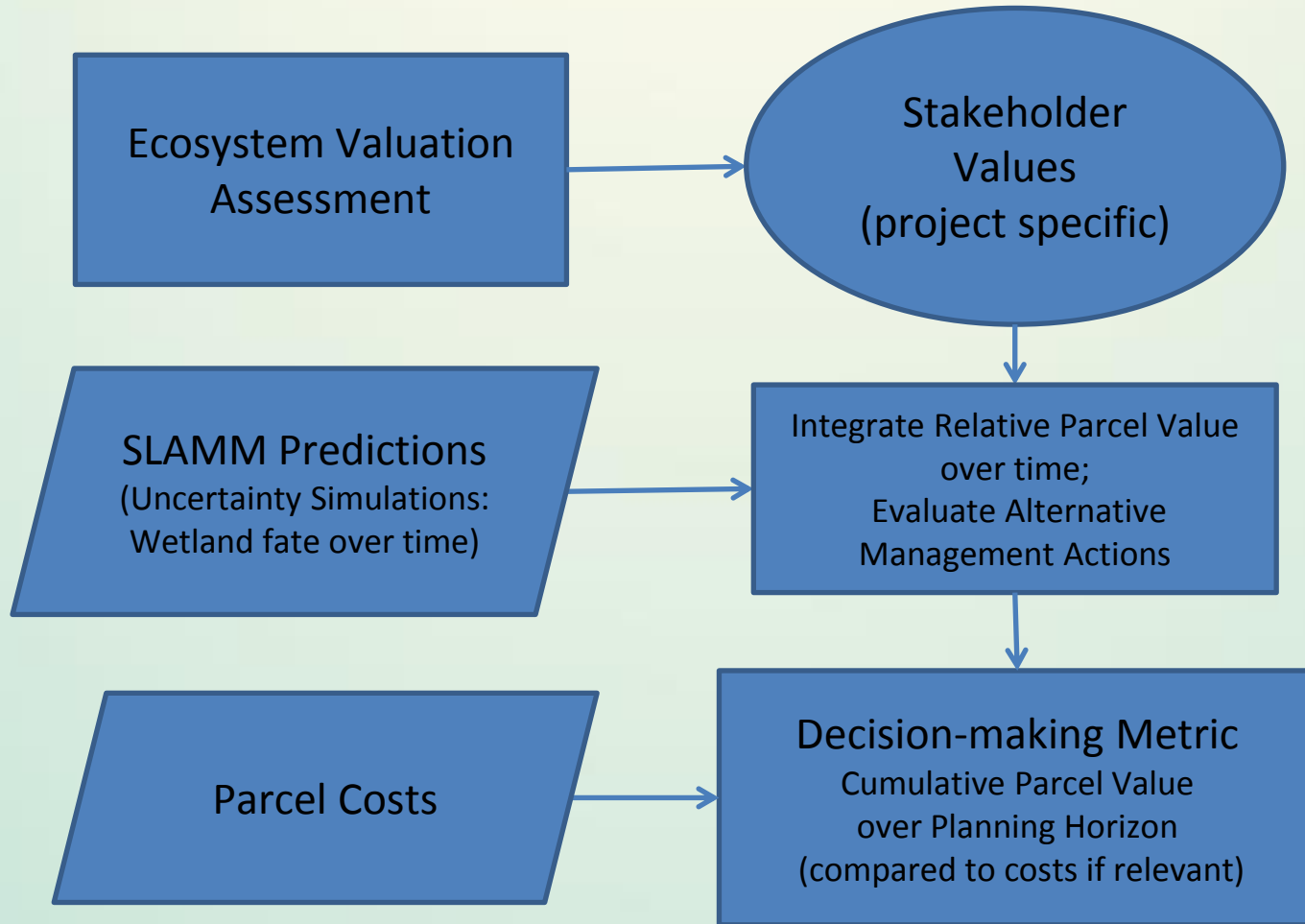
# Tool Demo (Components of Utility)



**Components of Each Site's Utility**

Y-axis: Aggregated Utility from 2016 to 2100 (0 to 1000)

X-axis categories: Udall's Cove, Queens; Pelham Bay Cove; Lemon Creek, Staten Island; Alley Creek, Queens; Idlewild Inner and Outer; W.T. Davis

Legend:
- Marsh Land Recreation
- Undeveloped Dry Land Recreation
- Political/Cultural/Historic value
- Habitat connectivity / Frag
- Flood Protection
- Nekton Habitat
- Natural Areas for Underserved Communities
- Phosphorus Sequestration
- Nitrogen Sequestration
- Carbon Sequestration

Natural Areas Conservancy
NYC Parks

# Apply climate change criteria to prioritize protection of coastal parcels in the Peconic Estuary

**CLIMATE READY ESTUARIES**
**♻EPA**

**Peconic Estuary PROGRAM**

⚓ **ANCHOR QEA**

## Peconic Estuary Climate Ready Assessment Services

The **Nature Conservancy**
Protecting nature. Preserving life.™

# CLPS Parcels With Potential For Tidal Wetland Advancement
## 2050's (Decadal Average) Sea Level Rise Projection

The Nature Conservancy
Protecting nature. Preserving life.

Peconic Estuary Project

**Legend**
- Peconic Estuary Boundary
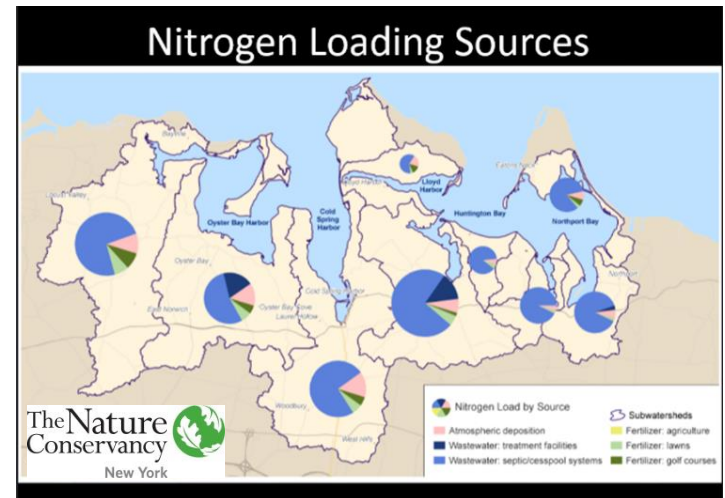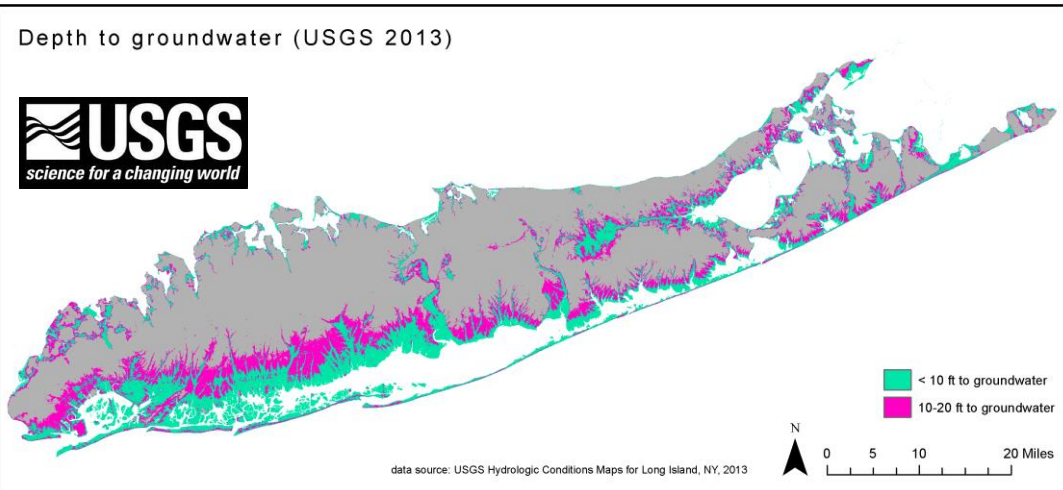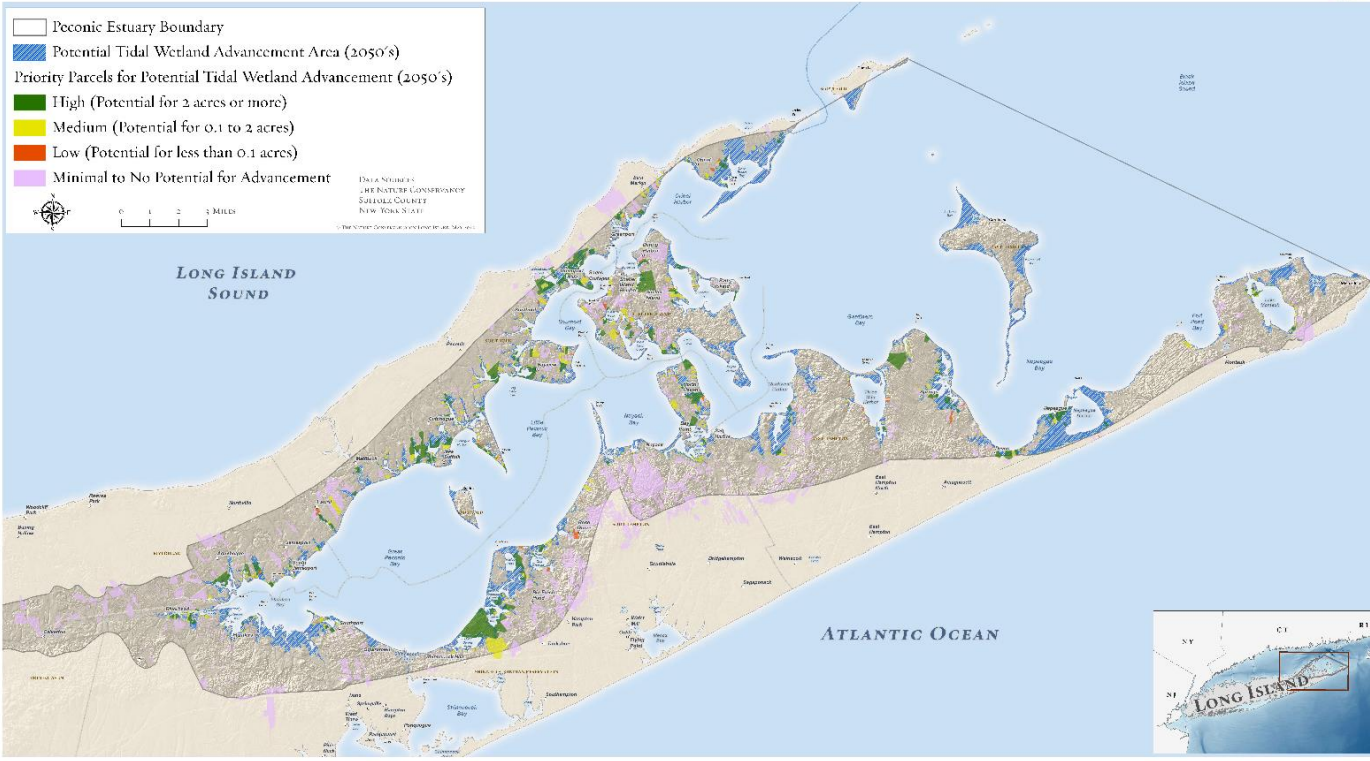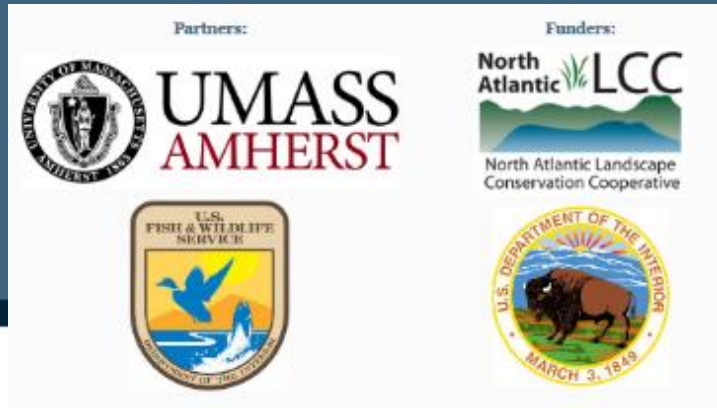- Potential Tidal Wetland Advancement Area (2050's)

**Priority Parcels for Potential Tidal Wetland Advancement (2050's)**
- High (Potential for 2 acres or more)
- Medium (Potential for 0.1 to 2 acres)
- Low (Potential for less than 0.1 acres)
- Minimal to No Potential for Advancement

DATA SOURCES:
THE NATURE CONSERVANCY
SUFFOLK COUNTY
NEW YORK STATE

LONG ISLAND SOUND

ATLANTIC OCEAN

LONG ISLAND

---

# Depth to groundwater (USGS 2013)

USGS
science for a changing world

- < 10 ft to groundwater
- 10-20 ft to groundwater

data source: USGS Hydrologic Conditions Maps for Long Island, NY, 2013

0    5    10                20 Miles

N

---

# Nitrogen Loading Sources

The Nature Conservancy
New York

**Nitrogen Load by Source**
- Atmospheric deposition
- Wastewater: treatment facilities
- Wastewater: septic/cesspool systems

- Subwatersheds
- Fertilizer: agriculture
- Fertilizer: lawns
- Fertilizer: golf courses

# Bridges & Culverts: Stream and Tidal Connectivity

# Culvert Field Assessment: Tidal Marsh Prioritization

Narrow River
Little Bay
Browns Point to Peters Neck Point
East, Mud & Haywater Creeks
SOUTHOLD
SHELTER ISLAND
Mattituck Inlet
Crab Meadow
Nissequogue Upper Sunken Meadow Creek
Wading River Marsh
EAST HAMPTON
Lloyd Harbor
RIVERHEAD
Napeague Harbor
Napeague Meadows
Accabonac Harbor
Northwest Creek
SOUTHAMPTON
Mecox Bay & Beach
West Neck Creek
SMITHTOWN
BROOKHAVEN
HUNTINGTON
Dune Road Marsh & Islands West
ISLIP
BABYLON
Mastic Beach
Carmans River East
Fireplace Neck & Carmans River West
Fire Island National Seashore
Grand Canal & Pickman Wetlands
Heckscher State Park FC Wetland
Captree Island & Seaganus Thatch
Cedar & Nezeras Islands
Gilgo Bch State Park 3-Hemlock Cove to East Bound

## Tidal Marsh Prioritization

### Average Z score

- 🔴 > 0.5 (highest priority)
- 🟠 0.1 to 0.5
- 🟡 -0.1 to 0.1
- 🟢 -0.5 to -0.1
- 🟢 < -0.5 (lowest priority)
- ★ Top 25 Marsh Complexes

0    5    10    20 Miles

N

# Risk Reduction Capacity of Wetlands

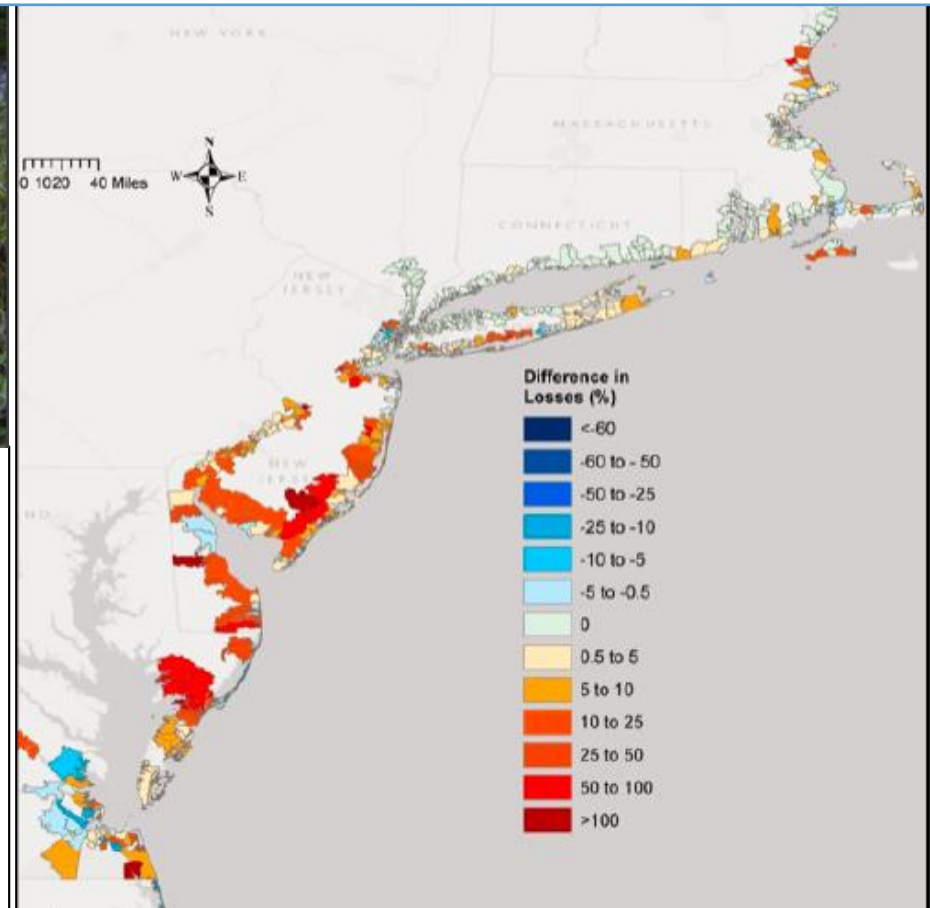www.lloyds.com/coastalresilience

**Corresponding author**

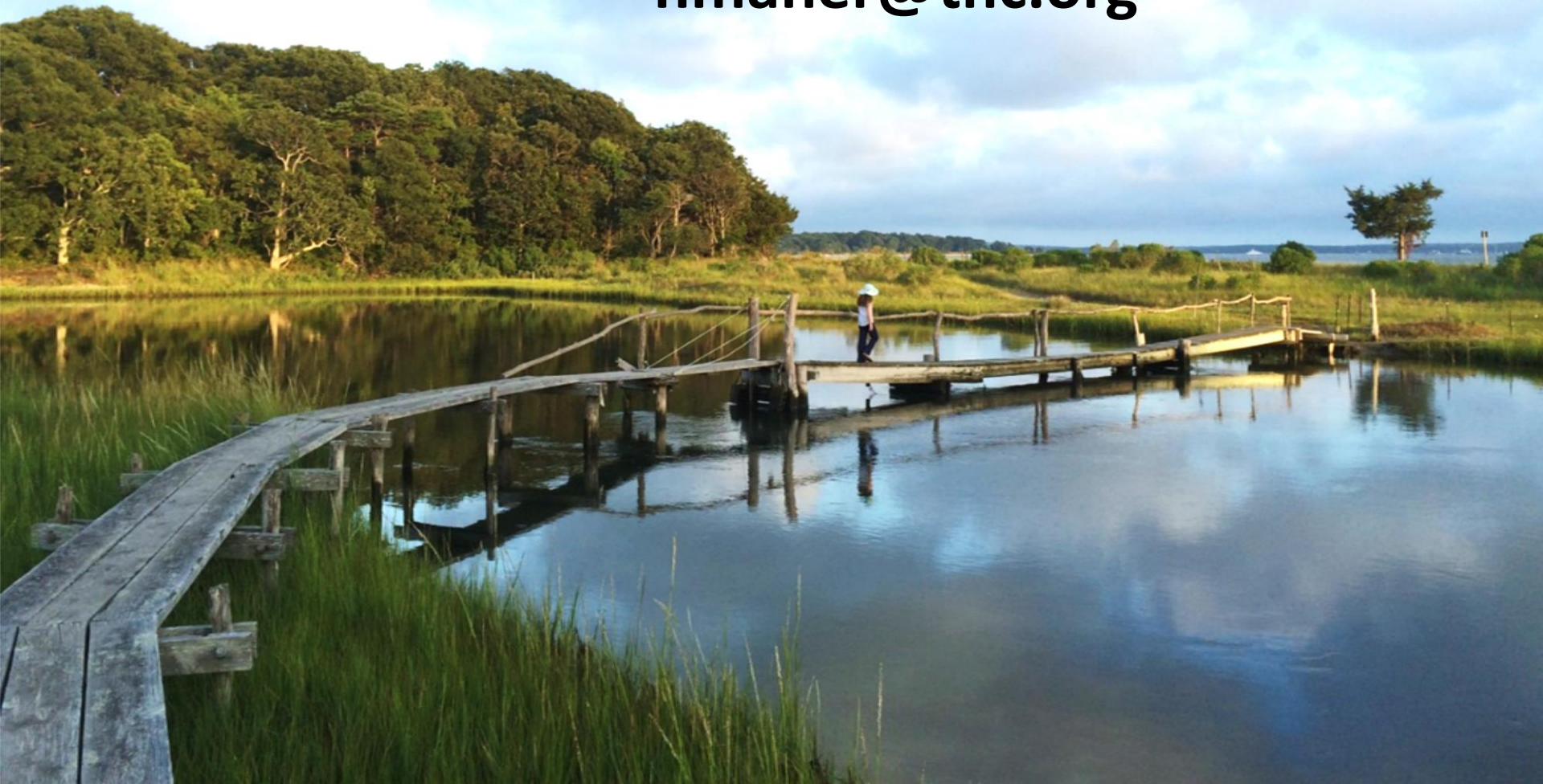Dr. Michael W. Beck, mwbeck@ucsc.edu, mbeck@tnc.org

**COASTAL WETLANDS AND FLOOD DAMAGE REDUCTION**

Using Risk Industry-based Models
to Assess Natural Defenses in the Northeastern USA

October 2016

Nicole Maher, PhD
Senior Coastal Scientist
The Nature Conservancy, NY
nmaher@tnc.org

# New Video Series Focused on Long Island Water Quality



VIEW TRAILER

JIM'S SOLUTION
SW NASSAU COUNTY

WE'RE OYSTER FARMERS
MONTAUK

ANSWERS & SOLUTIONS
HUNTINGTON

GENERATIONS
SHELTER ISLAND

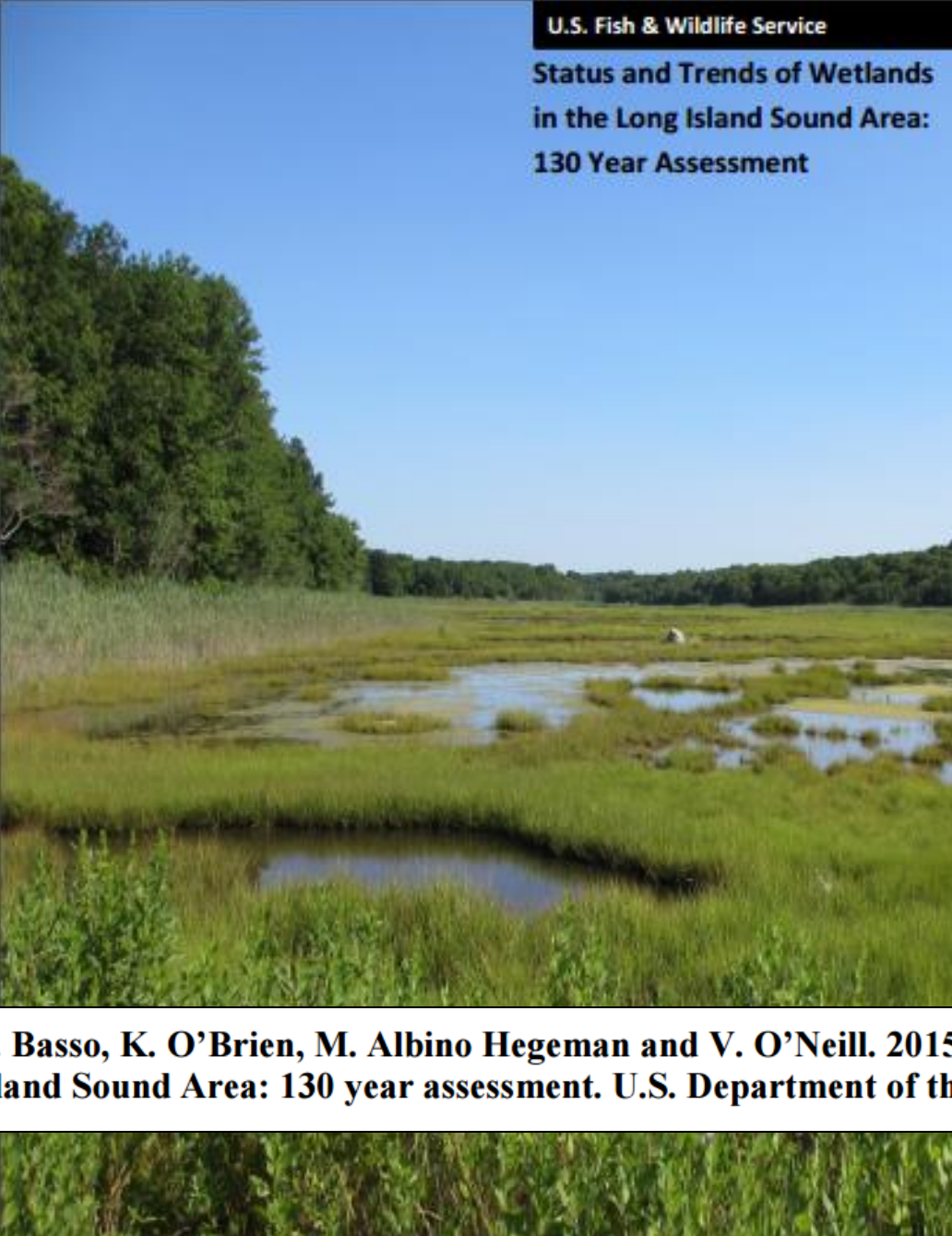ON DISPLAY
BELLPORT

IT'S IMPERATIVE
MASTIC BEACH

SOMETHING LOST
OAKDALE

COLLAPSE OF A LEGACY
NORTH SEA

**Web link is www.nature.org/longislandwater**

U.S. Fish & Wildlife Service

**Status and Trends of Wetlands in the Long Island Sound Area: 130 Year Assessment**

G. Basso, K. O'Brien, M. Albino Hegeman and V. O'Neill. 2015. Status and trends of wetlands in the Long Island Sound Area: 130 year assessment. U.S. Department of the Interior, Fish and Wildlife Service. (36 p.)

# Incremental Benefit of Adaptation Strategies