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Coastal Federation
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Lake Mattamuskeet Watershed Restoration Plan

May 8, 2018 Public Meeting

Agenda Overview

7:00 p.m.	Welcome
7:05 p.m.	Update on Plan Development: Erin Fleckenstein
7:10 p.m.	State of the Lake and Proposed Strategies for Restoration: Linda D'Anna and Michael Flynn
7:55 p.m.	Review Matrix of Actions
	-Determining feasibility of strategies
	-July 10 Draft Priority Actions
	-Sept 18 Draft Plan
8:15 p.m.	Question and Answer
8:30 p.m.	Adjourn

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Developing a Watershed Restoration Plan

What is a watershed restoration plan?

A voluntary plan for a specific waterbody

Identifies pollutants and causes of impairment

Provides the framework and guidance to restore an impaired waterbody and outlines future action

Recommends management strategies devised by all stakeholders

Adaptive plan that can be updated over time

Once approved, it can be used to secure grant funds for implementation

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Key Steps in Developing a Watershed Restoration Plan

Assemble Planning Team

Engage stakeholders and the public in the plan development

Determine Water Quality and Quantity Conditions and Impairments

- Summarize research on the current status and trends of the lake water quality
- Capture oral and written history of changes to or improvements in hydrology around the lake

Complete Watershed Characterization

Establish Plan Goals, Objectives and Action Items

Identify Stormwater Reduction or Water Management Techniques

Analyze impact of solutions

Develop Management Plan including priorities and next steps

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Major Progress to Date

Assemble Planning Team

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Stakeholder Team

Daniel Brinn- Hyde Drainage

Pete Campbell- U.S. Fish and Wildlife Service

Michael "Slim" Cahoon- Farming Community

Doug Howell- N.C. Wildlife Resources Commission

Art Keeney- Residential Community

Bill Rich- Hyde County Manager

Ben Simmons- Farming Community/Fairfield Drainage

Pat Simmons- Hospitality Industry

J.W. Spencer- Hyde County Soil and Water Board

James "Booboo" Topping- Residential Community

Joey Ben Williams- Impoundments

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Work with Stakeholders and the Public

Four Public Meetings

Ten Stakeholder Meetings

Webpage for updates and comments:

nccoast.org/lakemattamuskeet

Press Releases

Email update after Public Meetings

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Draft Plan Goals

Goal 1: Protect the way of life in Hyde County:

Maintain existing land uses and industries in the watershed (residential, farming, fishing and tourism) while supporting the lake's natural resources (waterfowl and wildlife).

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Draft Plan Goals

Goal 2: Active Management of Lake Water Level:

Improve the ability to control lake levels to prevent flooding of residential, business and farm properties as well as to grow more submerged and emergent vegetation as waterfowl habitat in and around the lake.

Draft Plan Goals

Goal 3: Restore water quality:

Reduce nutrients, sediments and phytoplankton blooms to improve water quality and clarity, promoting the growth of submerged aquatic grasses and removing the lake from the state's impaired water listing.

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Next Steps of Plan Development

Assemble Planning Team

Engage stakeholders and the public in the plan development

Establish Plan Goals, Objectives and Action Items

Determine Water Quality and Quantity Conditions and Impairments

- Summarize research on the current status and trends of the lake water quality
- Capture oral and written history of changes to or improvements in hydrology around the lake

Complete Watershed Characterization

Identify Stormwater Reduction or Water Management Techniques

Analyze impact of solutions

Develop Management Plan including priorities and next steps

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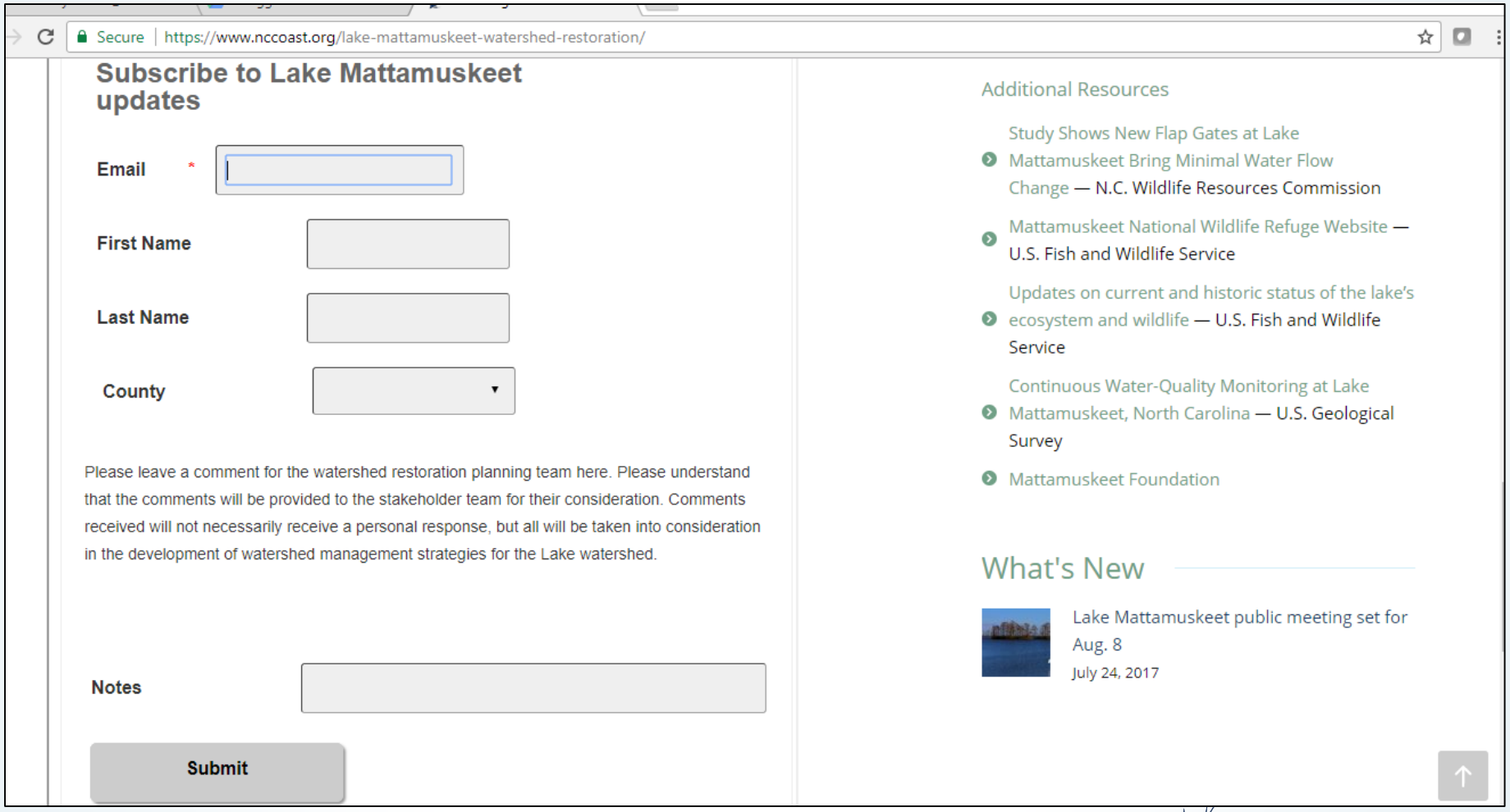
Comments Collected Online



Sign-up for emails and press releases; Submit Comments

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Lake Mattamuskeet Watershed Restoration Plan

Public Meeting

May 8, 2018

Overview

1. Current state of the lake and watershed
2. Desired state of the lake and watershed
3. Address the goals of the Watershed Restoration Plan

Goal 1: Protect the Way of Life in Hyde County

Protect the way of life in Hyde County: Maintain existing uses and industries in the watershed (farming, fishing, and tourism) while supporting the lake's natural resources (waterfowl and wildlife).

Goal 2: Active Management of Lake Water Level

Reduce flooding: Improve the ability to control lake levels to prevent flooding of residential, business and farm properties as well as to grow more submerged and emergent vegetation as waterfowl habitat in an around the lake.

Goal 3: Restore Water Quality

Restore water quality: Reduce nutrients, sediments and phytoplankton blooms to improve water quality and clarity, promoting the growth of submerged aquatic grasses and removing the lake from the NC 303(d)list of impaired waters.

Current State of the Lake and Watershed

1. No active management of lake level other than tide gates
    - Flooding of residential property, septic system failures, & inadequate drainage of croplands
2. Turbid and hypereutrophic water (excessive nutrient levels)
    - Frequent phytoplankton & cyanobacteria blooms
3. SAV coverage is absent along lakebed
4. Minimal emergent vegetation
5. Abundance of common carp
6. Listed on NC 303(d) list of impaired waters
    - Chl-*a* (40 µg/l, AL, NC)
    - pH (8.5, AL, SW)

Desired State of the Lake and Watershed

1. Active management of lake level in addition to tide gates
    - Less frequent flooding of residential property
    - Fewer septic system failures & adequate drainage of croplands
2. Clear and mesotrophic water (moderate nutrient levels)
    - Fewer phytoplankton & cyanobacteria blooms
3. Increased SAV abundance along lakebed
4. Increased emergent vegetation
5. Reduced common carp populations
6. Increased game fish and blue crab populations
7. Removal from the NC 303(d) list of impaired waters
    - Chl-*a* and pH within federal and state guidelines

Overview of Interview Process

1. Purpose and intent
2. Methods
3. Findings related to Watershed Restoration Plan goals
    - Protect the Way of Life in Hyde County
    - Reduce flooding
    - Restore water quality

Goal 1: Protect the Way of Life in Hyde County

Interview Process

- Interviewees discussed how the lake matters to Hyde County

"This is heaven on earth. The lake has made it that, there's no getting around it. The lake is why the people are still here that are here...the lake is what has kept a few of these communities alive one way or the other, either with hunting or fishing or birdwatching."

Goal 1: Protect the Way of Life in Hyde County

Interview Process

- Interviewees discussed how the lake matters to Hyde County and how it is important for:
    - Economy
    - Ecology
    - Recreation
    - Local Identity

Goal 1: Protect the Way of Life in Hyde County

Monitoring & Research

- Documentation of septic system failure
    - Organization: Hyde County Health Department
- Land cover/use change analysis
    - Organization: USGS
- CropScape assessment
    - Organization: USDA NASS
- Analysis of soil samples
    - Organization: NRCS, NC Cooperative Extension, Crop Management Companies
- Waterfowl population surveys
    - Organization: USFWS and NCWRC
- Fish stock assessments
    - Organization: NCWRC

Hot Spot Flooding Regions Surrounding Lake Mattamuskeet

Residential

Farming

Hot Spot Flooding Regions surrounding Lake Mattamuskeet were broken down into two categories, Residential and Farming. These regions exist in lower elevation or depressional regions surrounding the lake.

Residential areas represent portions of those communitites surrounding Lake Mattamuskeet which experience regular flooding during storms, strong winds, or severe weather events.

Farming areas represent regions of farmland which regularly experience flooding during storms or sever weather events.

Miles

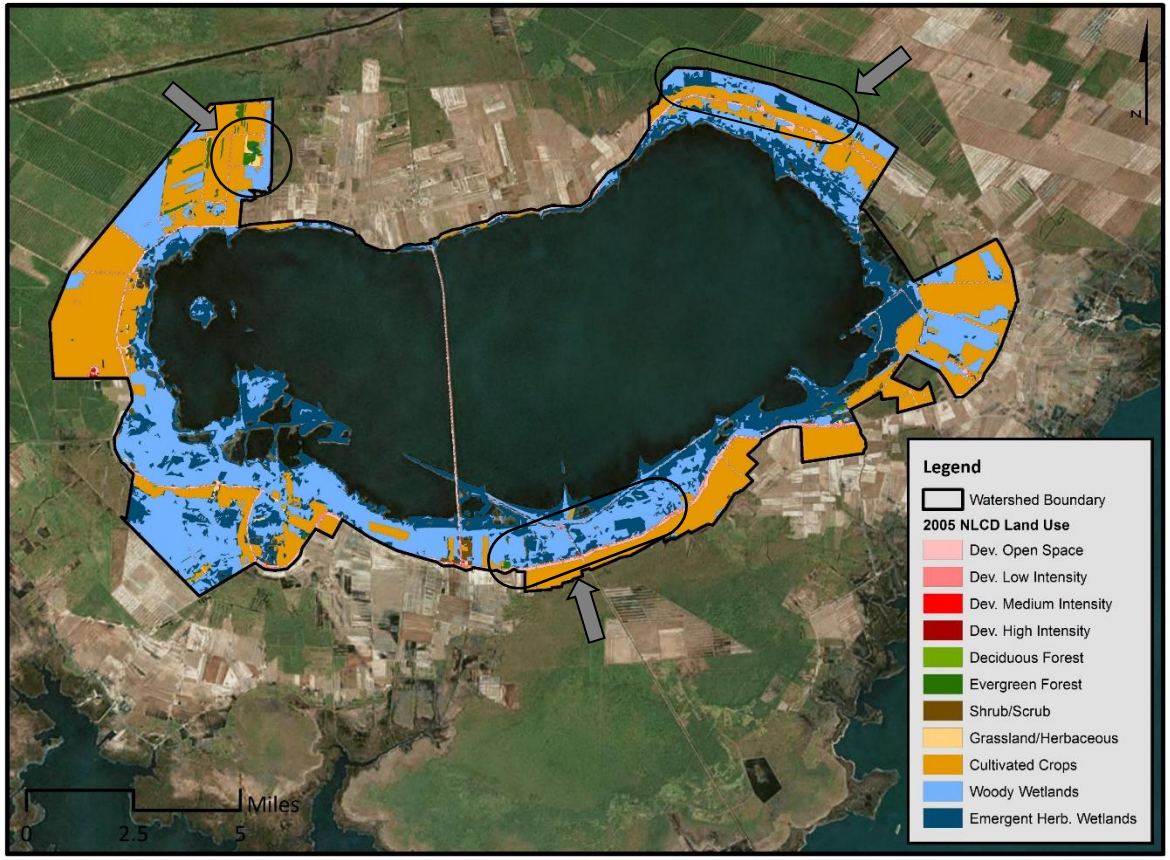
0 1 2 4

Tracking Changes in Land Use

Lake Mattamuskeet Watershed Land Use: 2001-2006-2011

NLCD Land Use Class	2001 (Ac)	2006 (Ac)	2011 (Ac)
Developed	1,569	1,569	1,569.8
Forest	279.8	↓ 246.4	250.5
Shrubland	222.2	222.2	↓ 195.8
Herbaceous	34.2	↑ 67.6	↑ 89.1
Planted/Cultivated	10,110.0	10,110.8	10,106.1
Wetlands	17,267	↑ 17,330	↓ 15,010

Lake Mattamuskeet Watershed Land Use: 2011



Top Three Land Uses:

1. Woody Wetlands
2. Cultivated Crops
3. Developed Open Space

Summary: Minor changes in land use over the last 15 years. No significant changes in developed land or agricultural lands

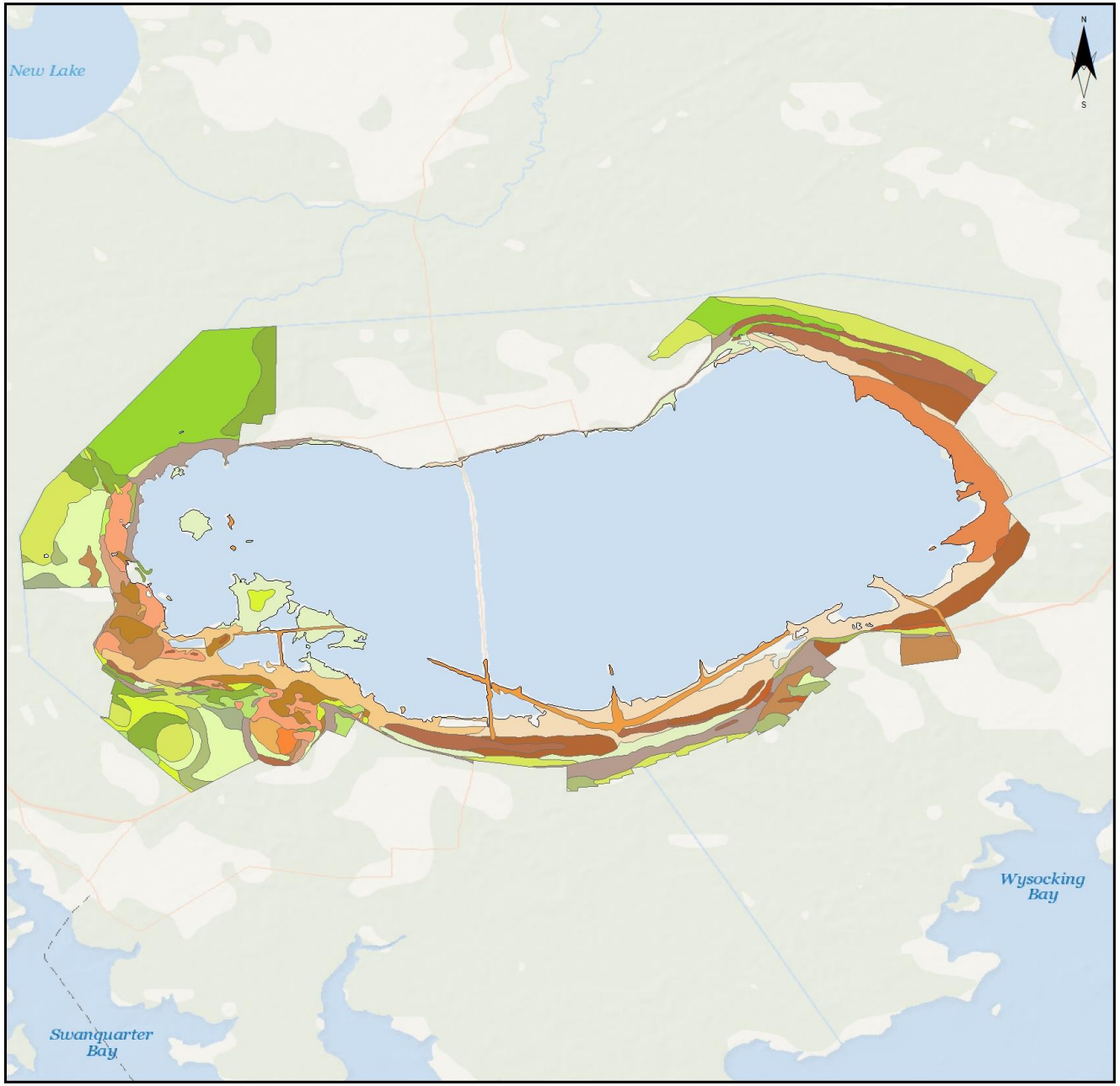
Next Step: Analysis 2016 data set when available; Identify any data for pre-2001 land use.

Composition of Soils within the Lake Mattamuskeet Watershed

Brown Shades- Mineral

Green Shades- Organic

The map to the right represents a classification of the soil series present within the Lake Mattamuskeet Watershed. Soil series were classified as either mineral or organic dependent upon their parent material and percentage of mineral or organic matter content.



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CropScape Assessment

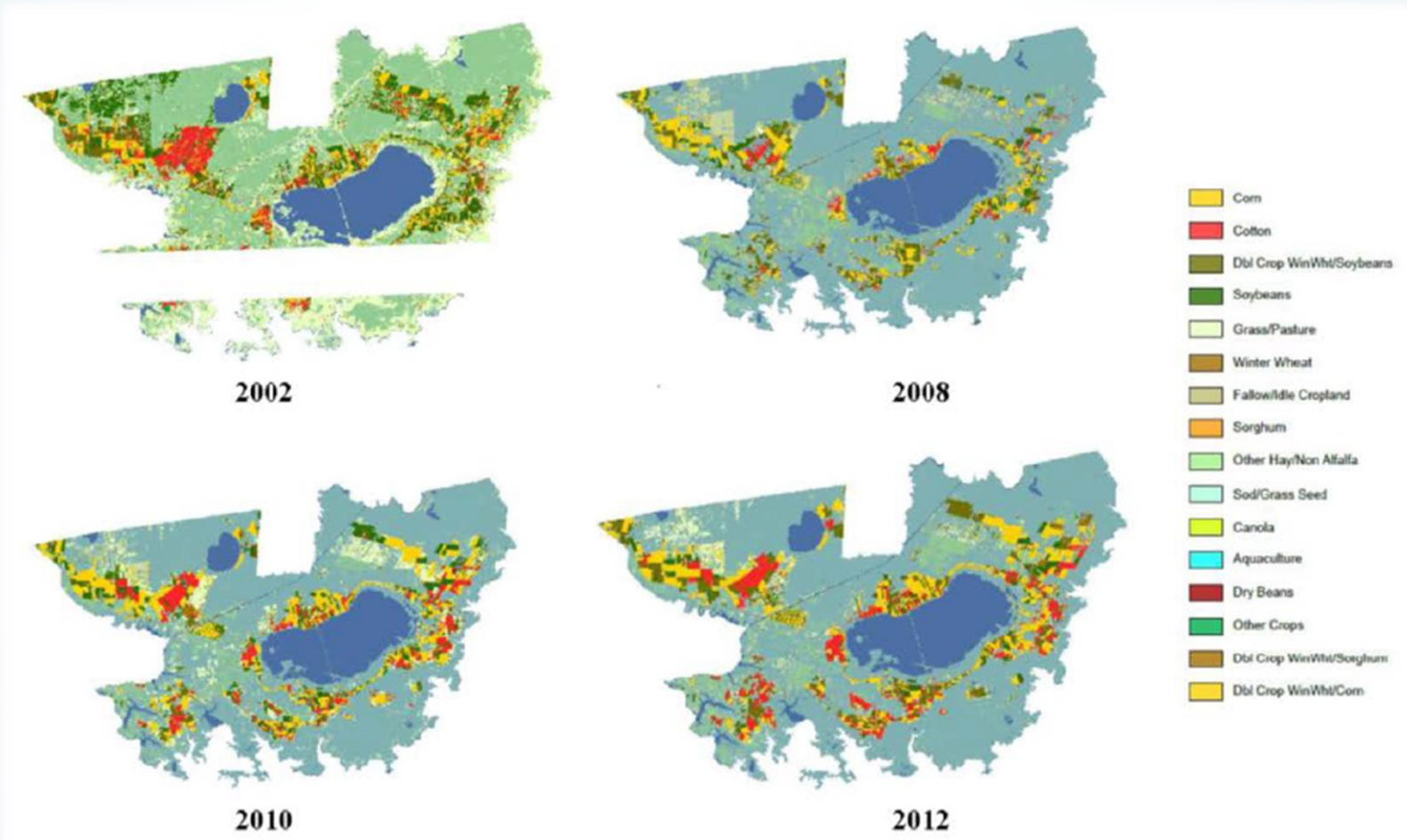
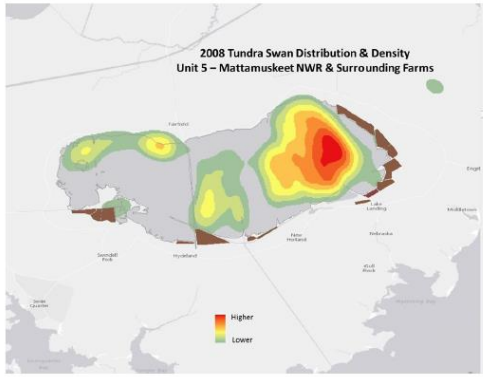
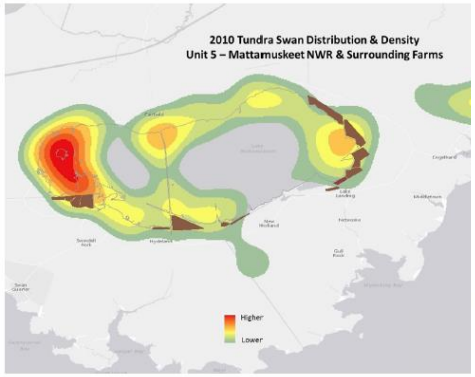
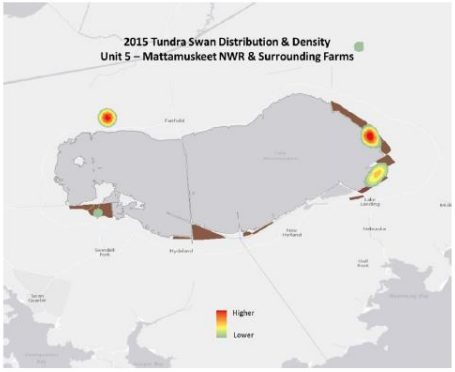


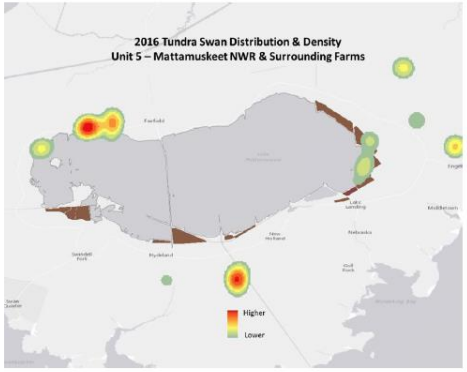
Figure from Powell et al. 2017

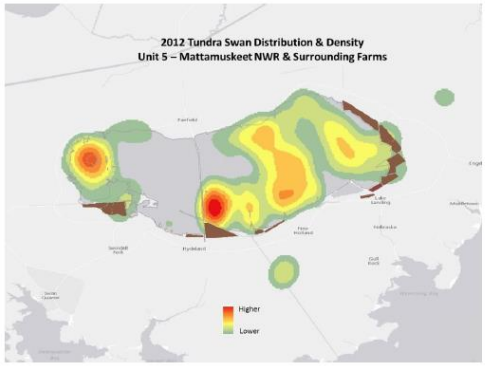
Annual Mid-Winter Waterfowl Survey

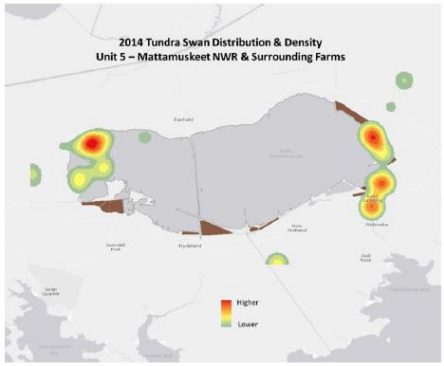


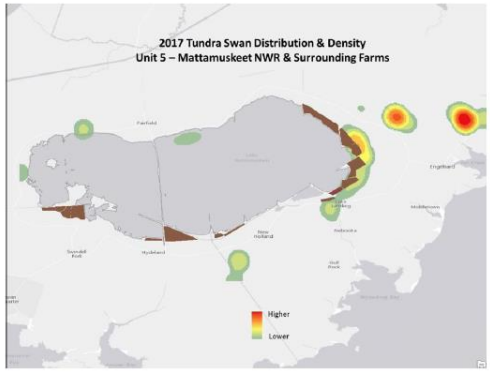












Lake Mattamuskeet Watershed Impoundment Development

Year Developed

- <1984
- 1900's
- Unknown

Historic aerial imagery and google earth timescales were utilized to track the development of waterfowl impoundments within Hyde County over the years.

Most impoundments were developed during the late '80s and early to mid '90s during the height of the CPR program which promoted the conversion of low producing cropland into waterfowl impoundments.

Miles

0 0.75 1.5 3

Hyde County Shellfish Growing Areas

Lake M. Canals

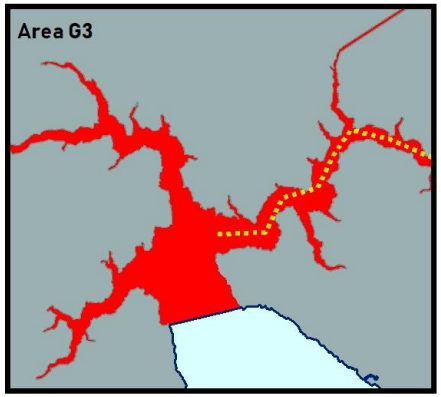
Shellfish Growing Areas

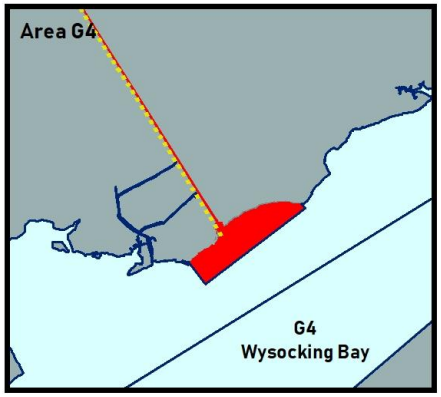
- CSHA- Approved
- CSHA - Prohibited
- Other Areas

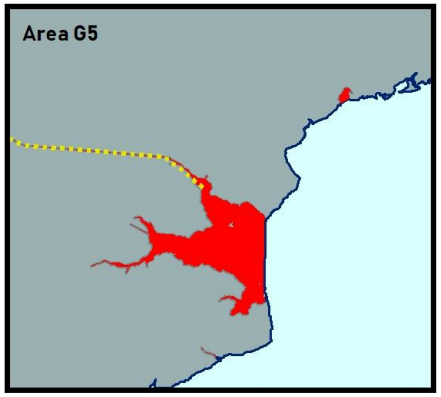
Shellfish Growing Areas of interest surrounding Lake Mattamuskeet include G3, G4 and G5. These regions were designated in Feb. 2004 and each region includes portions which are classified as CSHA Prohibited. These regions are not designated for shellfishing under any circumstances.

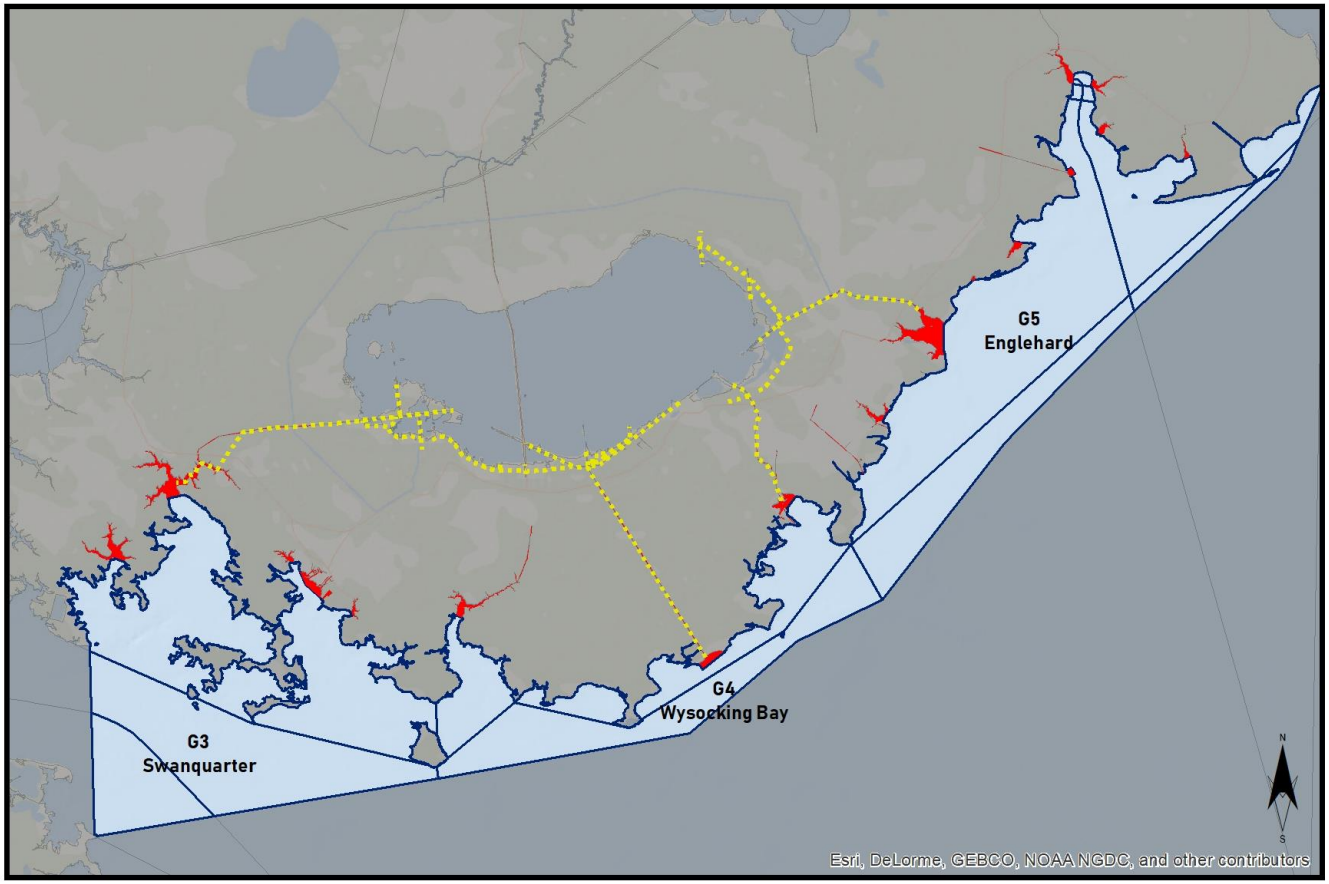
The inset maps display the portion of each growing area where a canal leading from the lake meets the ocean.

Miles
0 2 4 8









Goal 1: Protect the Way of Life in Hyde County

Management Actions to Consider

- Institute active lake level management
- Upgrade/repair septic systems or connect to centralized sewer
- Preserve the agricultural industry
    - Continue to follow nutrient management plans or alter based on recommendations
    - Continue to follow or alter herbicide/pesticide application guidelines based on recommendations
    - Practice no till or strip till where appropriate
    - Preserve space for growth of filter strips along edges of drainage ditches
    - Construct sediment basins/settling ponds
    - Alter water management of croplands (i.e. pump automation)
    - Perform maintenance dredging on drainage canals and ditches
    - Consider converting to organic farming practices

Goal 1: Protect the Way of Life in Hyde County

Management Actions to Consider

- Preserve waterfowl hunting heritage
  - Alter impoundment water management (i.e. stage drawdowns, pump automation)
  - Preserve space for growth of filter strips along edges
  - Construct sediment basins/ settling ponds
  - Convert impoundments from corn feedstock to MSM units

- Preserve recreational fishing heritage
  - Review and update fishing and crabbing regulations as necessary
  - Manage tide gates for anadromous/ catadromous fish and larval blue crab passage
  - Stock fish/ zooplankton

Goal 2: Active Management of Lake Water Level

Interview Process

- Interviewees described how:
  - Lake level depends on weather cycles
  - Recent flooding was worse than what they remembered in the past

"But it stood in the yards the last few years the worst I have seen it since I was a boy. It affects everything we do."

Goal 2: Active Management of Lake Water Level

Interview Process

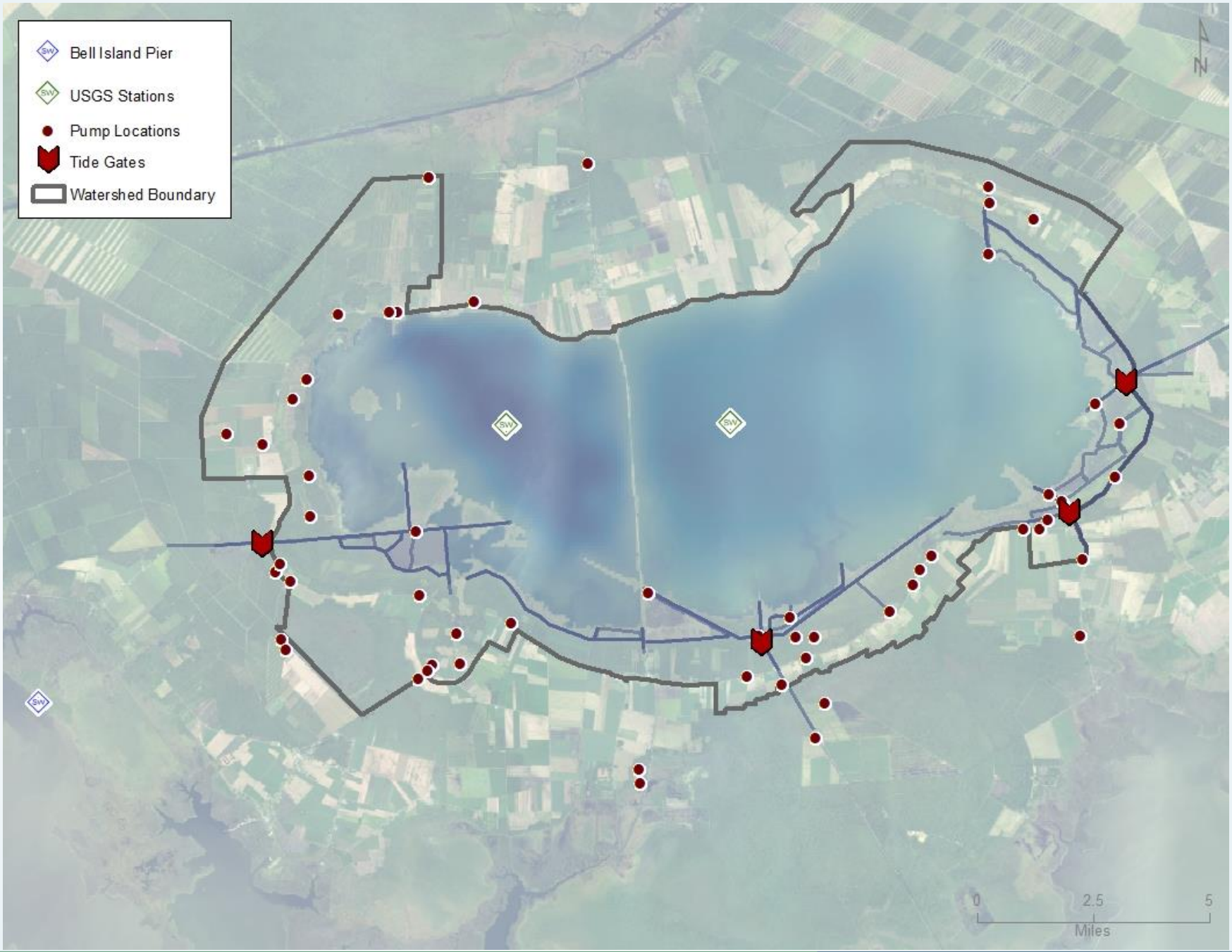
- Interviewees described how:
  - Emergent vegetation zone has changed
  - Higher water in the lake provides boating access
  - Drainage is gravity-fed
    - Gate function
    - Canals are filled in with sediment
    - Tides are running higher

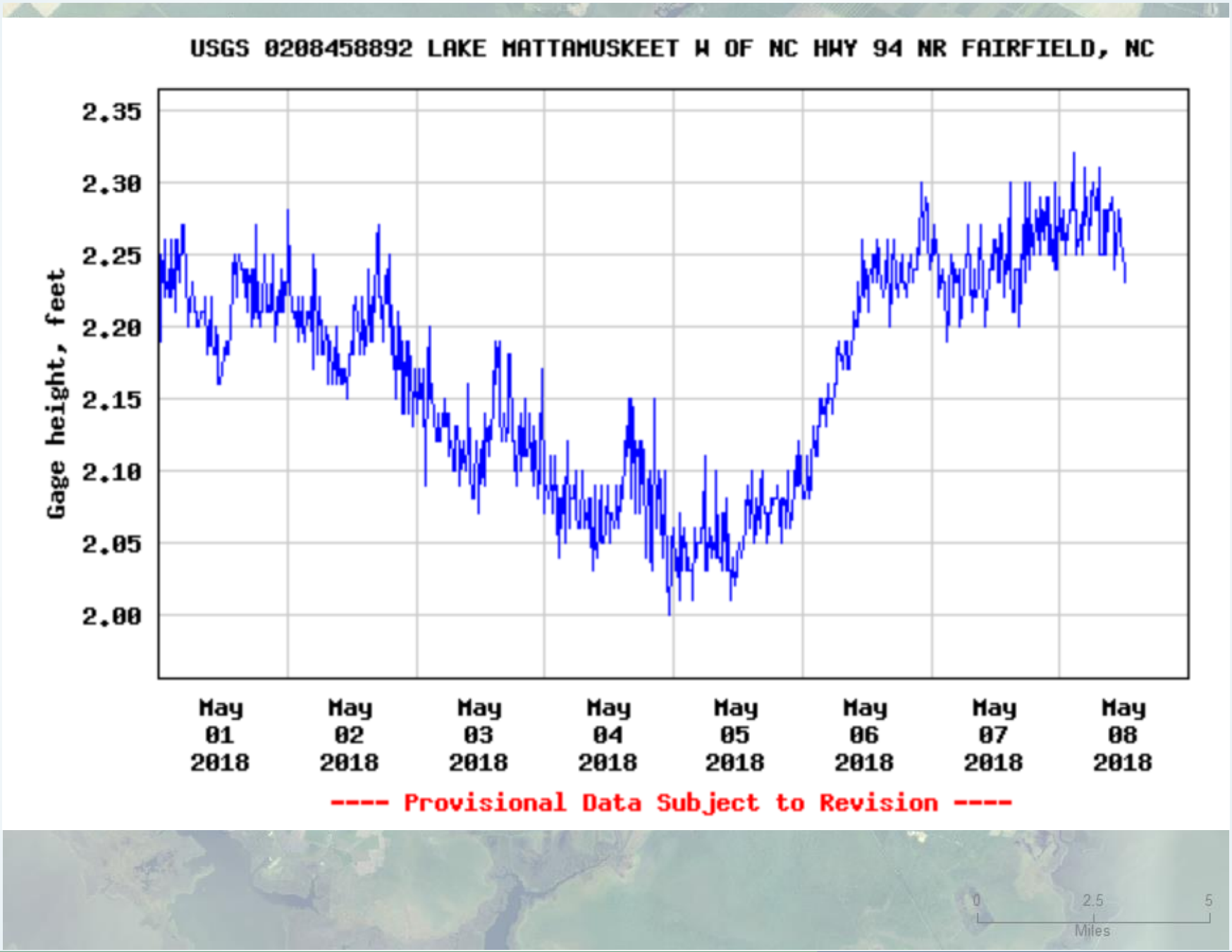
"*What water level is sufficient, huh? You ask 100 people, you'll get 100 different answers*"

Goal 2: Active Management of Lake Water Level

Monitoring & Research

- Real-time hydrologic data
  - USGS monitoring stations
  - Bell Island Pier station
- Weekly lake level and canal flow rate monitoring program
  - Organizer: USFWS staff- informed the development of the water budget and stage-volume relationship for the lake
- Modeling the impact of sedimentation and SLR on the outflow canals
  - Organizer: Dr. Etheridge, ECU
- Lake Level Monitoring Project
  - Organizer: Dr. Pavelsky, UNC
- Sea Level Rise Projections
  - Organizer: NOAA, NC CRC Science Panel


Bell Island Pier
USGS Stations
Pump Locations
Tide Gates
Watershed Boundary
N
0
2.5
5
Miles


USGS 0208458892 LAKE MATTAMUSKEET W OF NC HWY 94 NR FAIRFIELD, NC
Gage height, feet
2.35
2.30
2.25
2.20
2.15
2.10
2.05
2.00
May 01 2018
May 02 2018
May 03 2018
May 04 2018
May 05 2018
May 06 2018
May 07 2018
May 08 2018
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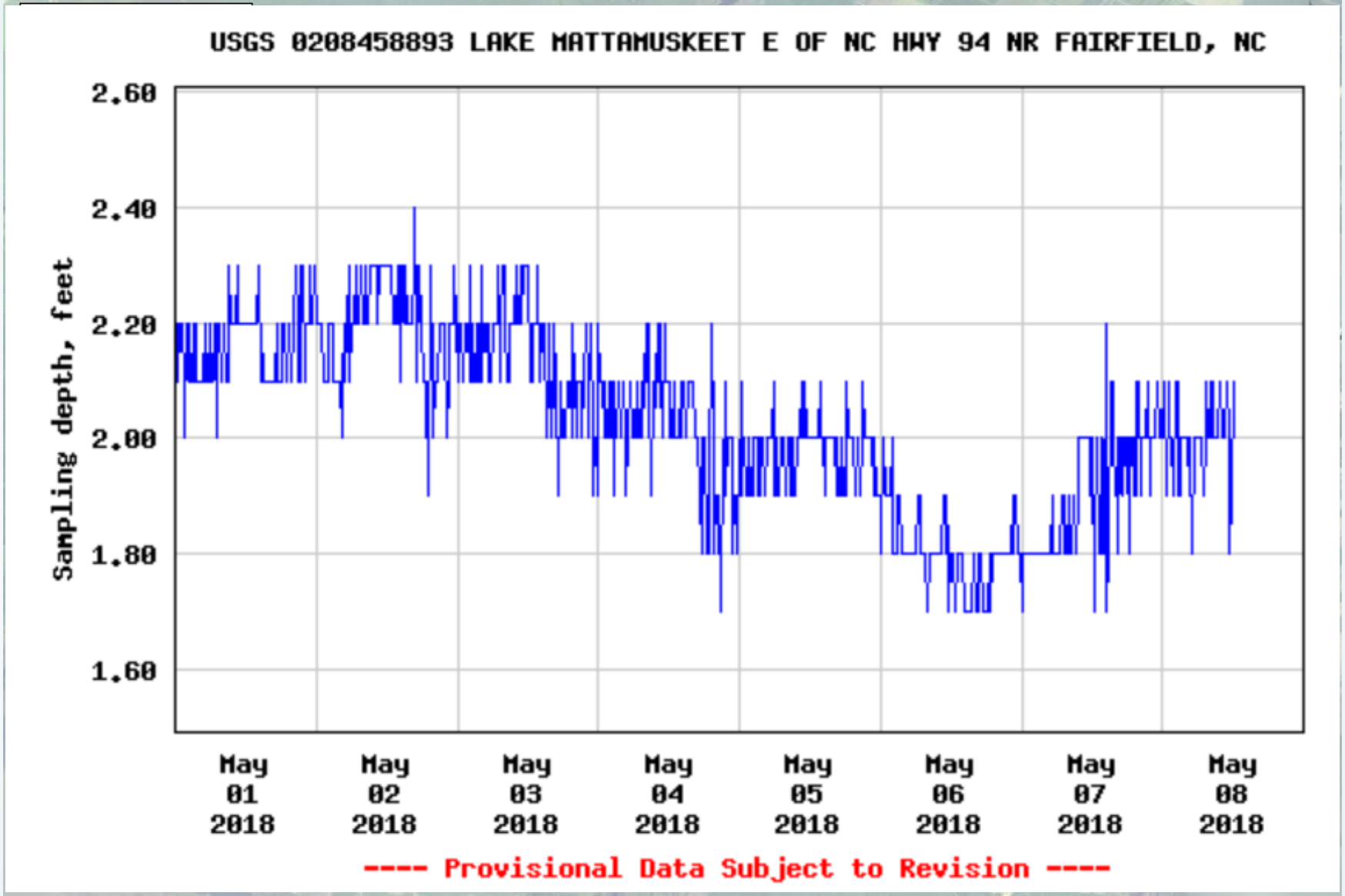
0
2.5
5
Miles


USGS 0208458893 LAKE MATTAMUSKEET E OF NC HWY 94 NR FAIRFIELD, NC
Sampling depth, feet
2.60
2.40
2.20
2.00
1.80
1.60
May 01 2018
May 02 2018
May 03 2018
May 04 2018
May 05 2018
May 06 2018
May 07 2018
May 08 2018
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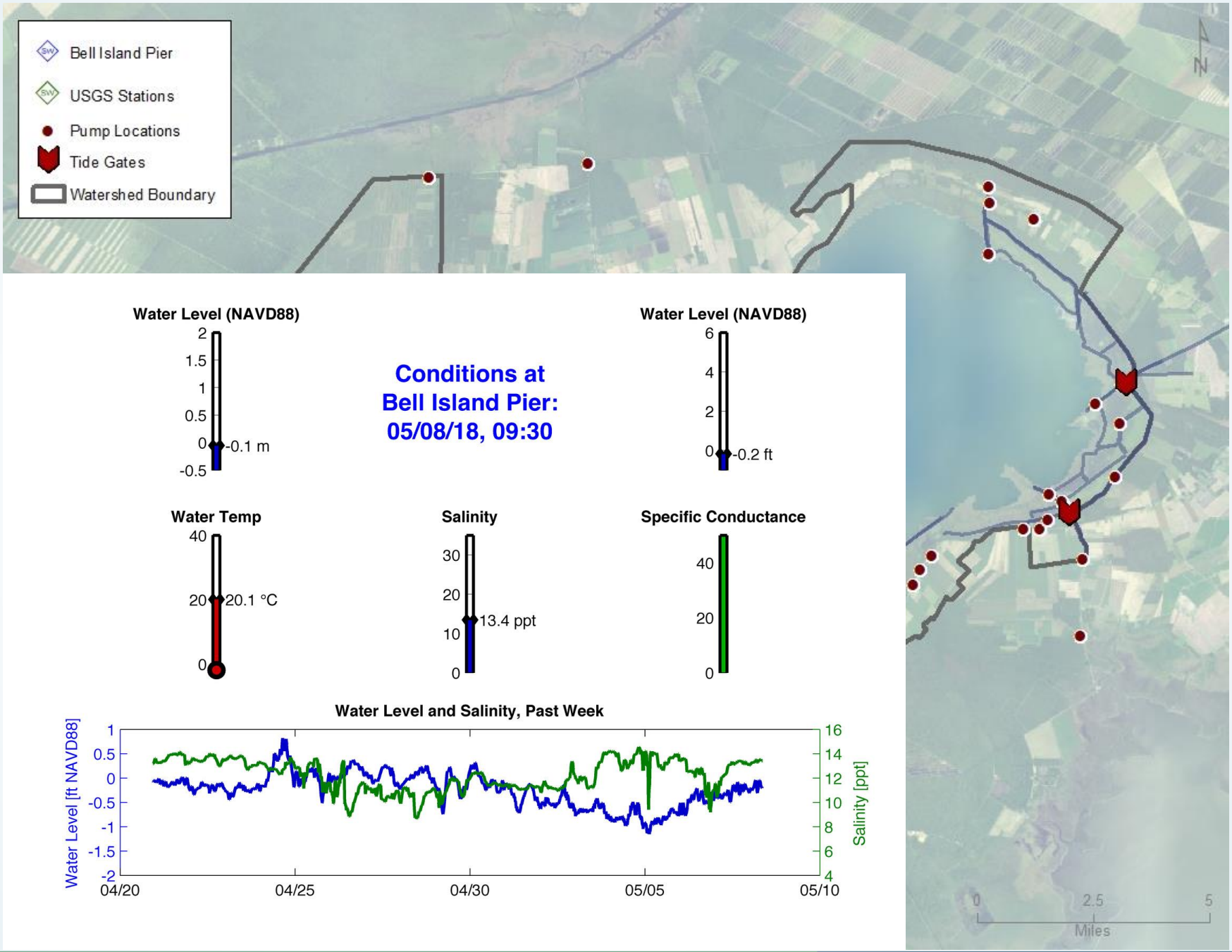

Bell Island Pier
USGS Stations
Pump Locations
Tide Gates
Watershed Boundary
N
Water Level (NAVD88)
2
1.5
1
0.5
0
-0.5
-0.1 m
Conditions at
Bell Island Pier:
05/08/18, 09:30
Water Level (NAVD88)
6
4
2
0
-0.2 ft
Water Temp
40
20
0
20.1 °C
Salinity
30
20
10
0
13.4 ppt
Specific Conductance
40
20
0
Water Level and Salinity, Past Week
Water Level [ft NAVD88]
1
0.5
0
-0.5
-1
-1.5
-2
Salinity [ppt]
16
14
12
10
8
6
4
04/20
04/25
04/30
05/05
05/10
0
2.5
5
Miles

Goal 2: Active Management of Lake Water Level

Management Actions to Consider

- Continue monitoring and research efforts
- Clean and snag canals where appropriate
- Keep tide gates free of debris
- Replace flap gates with side gates where appropriate
- Perform maintenance dredging of internal lake canals and outlets, if advisable
  - Consider beneficial use of dredge material to construct emergent vegetation zones or maintain earthen dikes
- Perform temporary drawdowns to increase storage capacity
  - Consider use of pumps to manage lake level and water diversion
- Conduct localized hydrological studies
- Consider excavating an additional outlet canal
- Re-delineate existing service districts and drainage associations
- Establish a drainage district for the watershed

Goal 3: Restore Water Quality

Interview Process

"The only view of the lake is to go across on 94. What I see there, it looks fine. Looks healthy to me….I've never been involved or had any issue with the quality of the water in the lake. It's never been a concern to me. Or been something you hear in the community."

Goal 3: Restore Water Quality

Interview Process

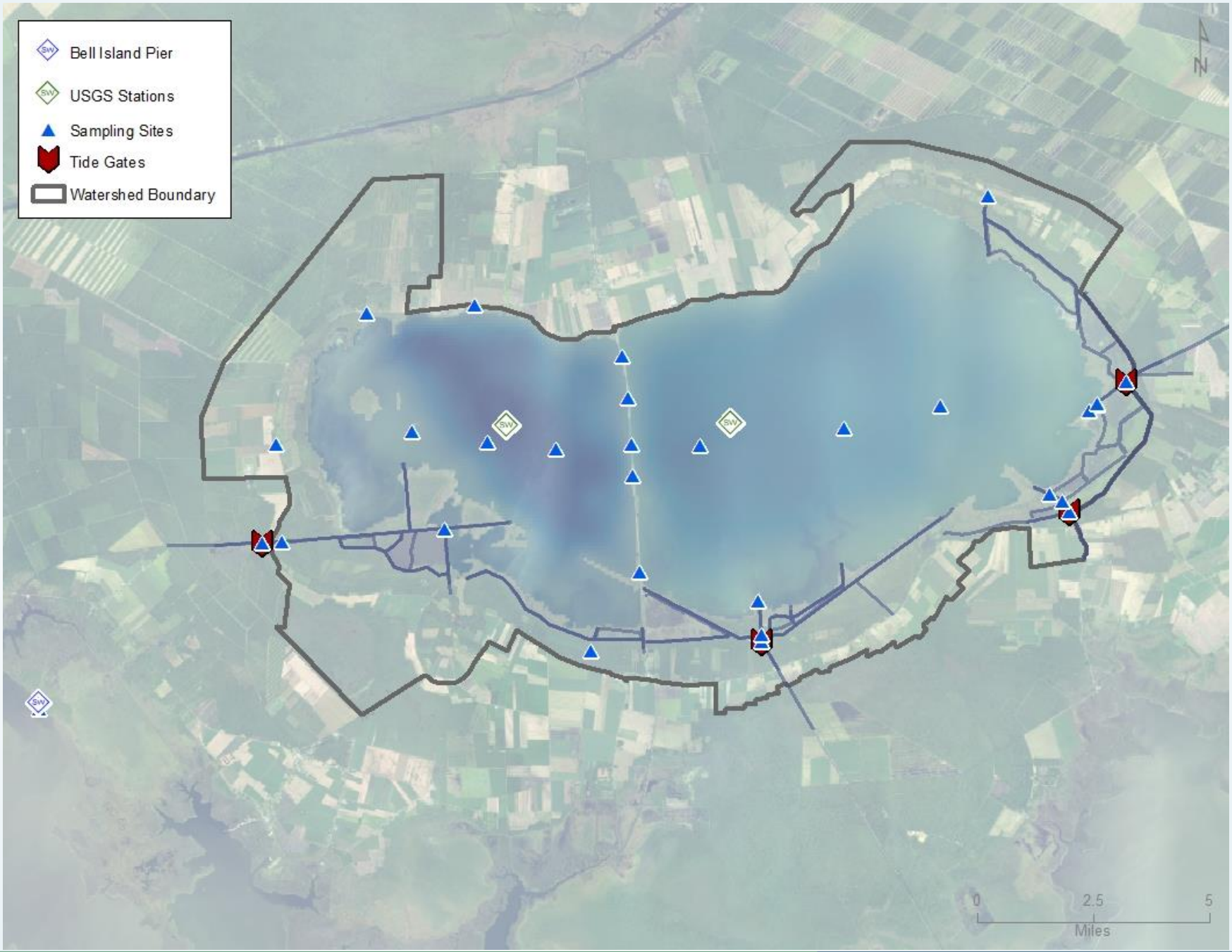
- Interviewees discussed possible changes in land use and practices in the watershed and wondered how they may be contributing to water quality issues:
    - Increase in waterfowl impoundments near lake
    - More acreage draining to the lake
    - Usage of agricultural chemicals

- Other changed that interviewees noted:
    - Deeper water in the lake
    - Restricted flushing of the lake

Goal 3: Restore Water Quality

Monitoring & Research

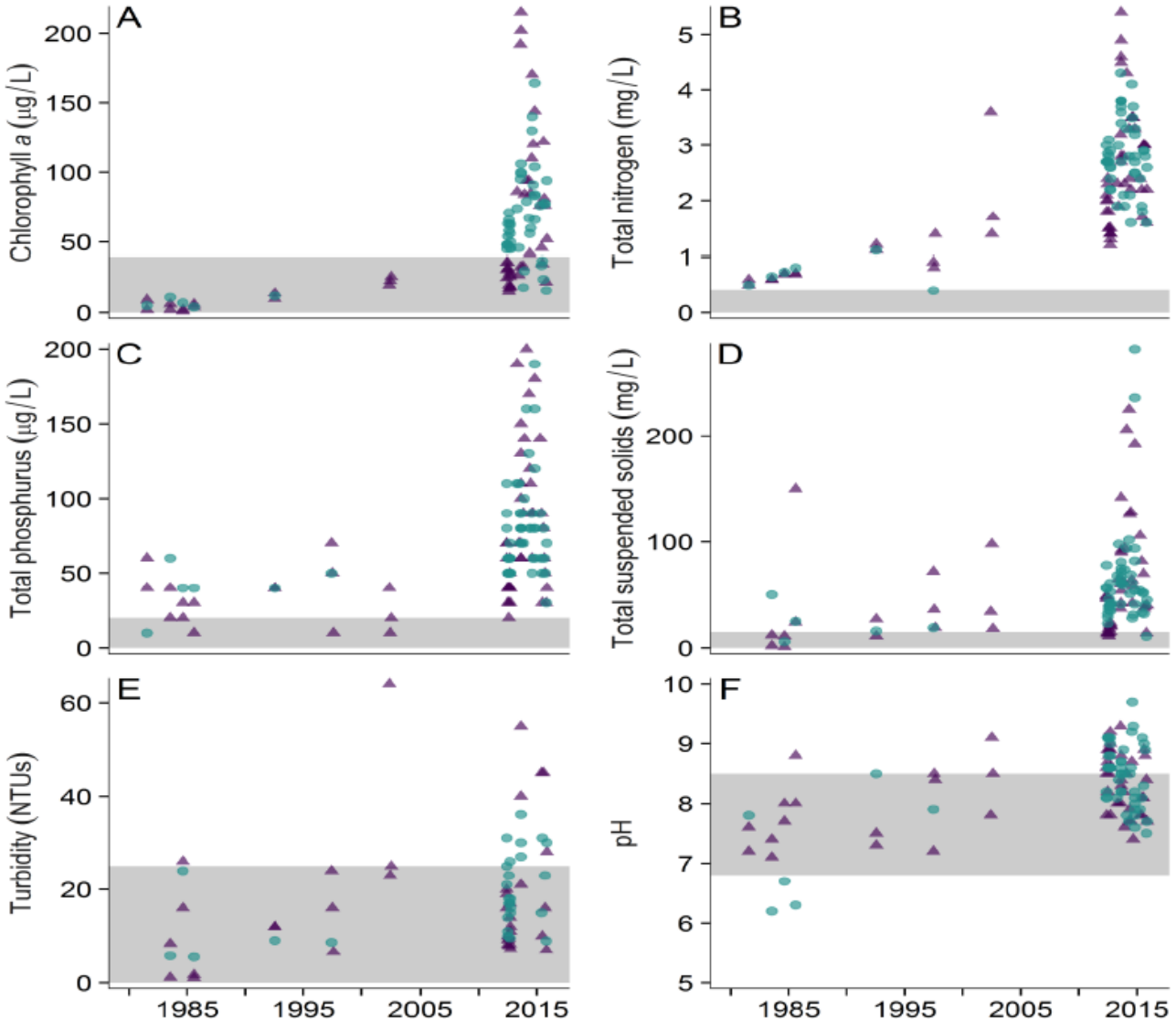
- Continuous water quality monitoring of pH, DO, turbidity, temperature, and salinity in lake and weekly monitoring in canals
    - Organizer: USFWS & USGS
- Monthly monitoring of nutrients, suspended sediment, and chl-*a*
    - Organizer: USFWS & NCDWR
- Phytoplankton and cyanotoxin community assessments
    - Organizer: USFWS
- Nutrient bioassays and sediment nutrient flux analysis
    - Organizer: Dr. Piehler, UNC
- Impact of waterfowl impoundments
    - Organizer: Dr. Etheridge, ECU


Bell Island Pier
USGS Stations
Sampling Sites
Tide Gates
Watershed Boundary
N
0
2.5
5
Miles

Water Quality Monitoring Results

West Basin

East Basin

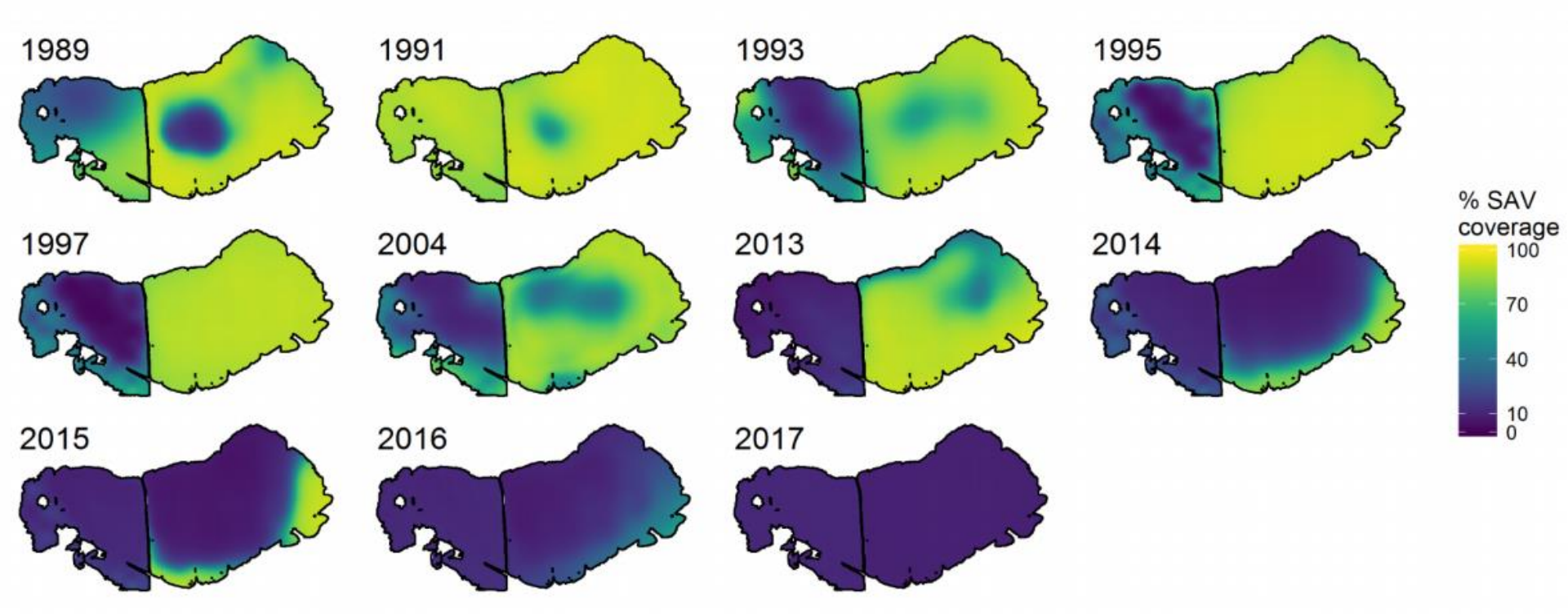


Goal 3: Restore Water Quality

Monitoring & Research

- Annual SAV coverage survey
    - Organizer: USFWS staff
- SAV planting experiment
    - Organizer: Dr. Piehler, UNC
- Assessing the risks of agricultural herbicides
    - Organizer: Anna Alicea and Dr. Greg Cope, NCSU; Celeste Journey, USGS
- Carp biomass removal feasibility study
    - Organizer: April Lamb, Dr. Fischer, and Dr. Layman, NCSU
- Modeling nutrient dynamics in Lake Mattamuskeet
    - Organizer: Dr. Obenour and Dr. Del Giudice, NCSU

Annual SAV Survey: 1989 - 2017



Goal 3: Restore Water Quality

Management Actions to Consider

- Continue monitoring and research efforts
- Preserve space for growth of filter strips along edges of drainage ditches
- Construct woodchip bioreactors
- Construct sediment basins/settling ponds
- Sheet flow water over wetlands
- Perform temporary drawdowns to facilitate sediment deposition
- Perform temporary drawdowns to re-establish emergent zones
  - Plant emergent marsh grasses
- Plant SAV
- Alter herbicide applications on croplands if advisable

Goal 3: Restore Water Quality

Management Actions to Consider

- Alter impoundment water management (i.e. stage drawdowns, pump automation)
- Convert impoundments from corn feedstock to MSM units
- Perform common carp biomass removal
  - Mechanical
  - Chemical
- Stock fish/zooplankton
- Consider coagulation and flocculation treatment system

What's Next?

- Identify additional BMPs/ Actions
- Determine feasibility
- Identify funding source/ implementation agent
- Rank BMPs/ Actions
  - Priority
  - Timeframe
  - Duration
  - Cost
  - Funding source (anticipated availability of cost)
  - Implementation agent
  - Regulatory requirements