INTEGRATING N-SPECT WITH THE DEVELOPMENT OF A MANAGEMENT PLAN FOR THE KINGSTON LAKE WATERSHED

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&

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GEOTOOLS
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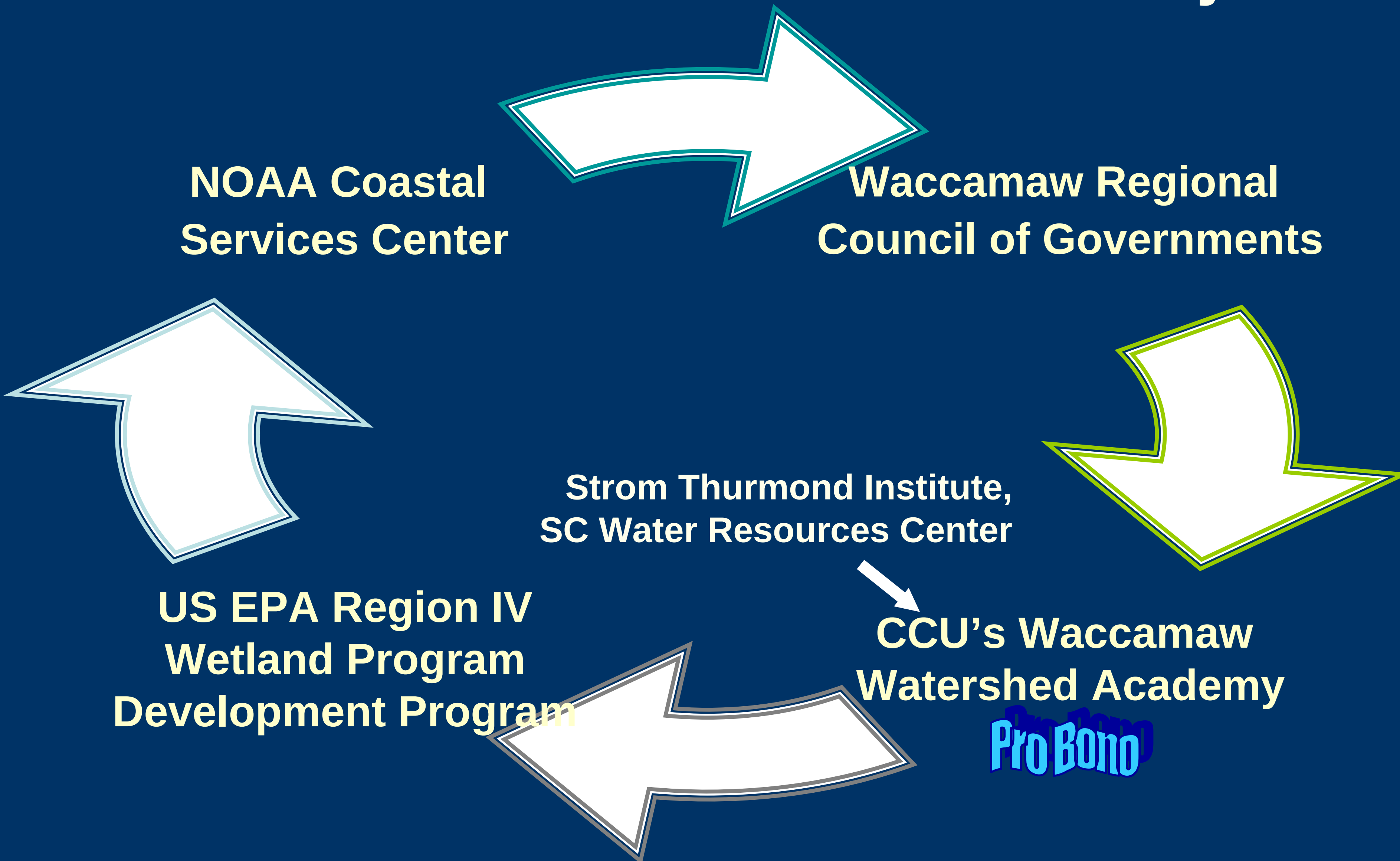
Collaborative Demonstration Project



Overview

- KLW Watershed Planning Project
- N-SPECT
- Project Modeling Scenarios
- Modeling Output
- Role of N-SPECT in public outreach for KLW project
- Future work plan

Waccamaw River

Lake Waccamaw to Atlantic Ocean: 140 mi

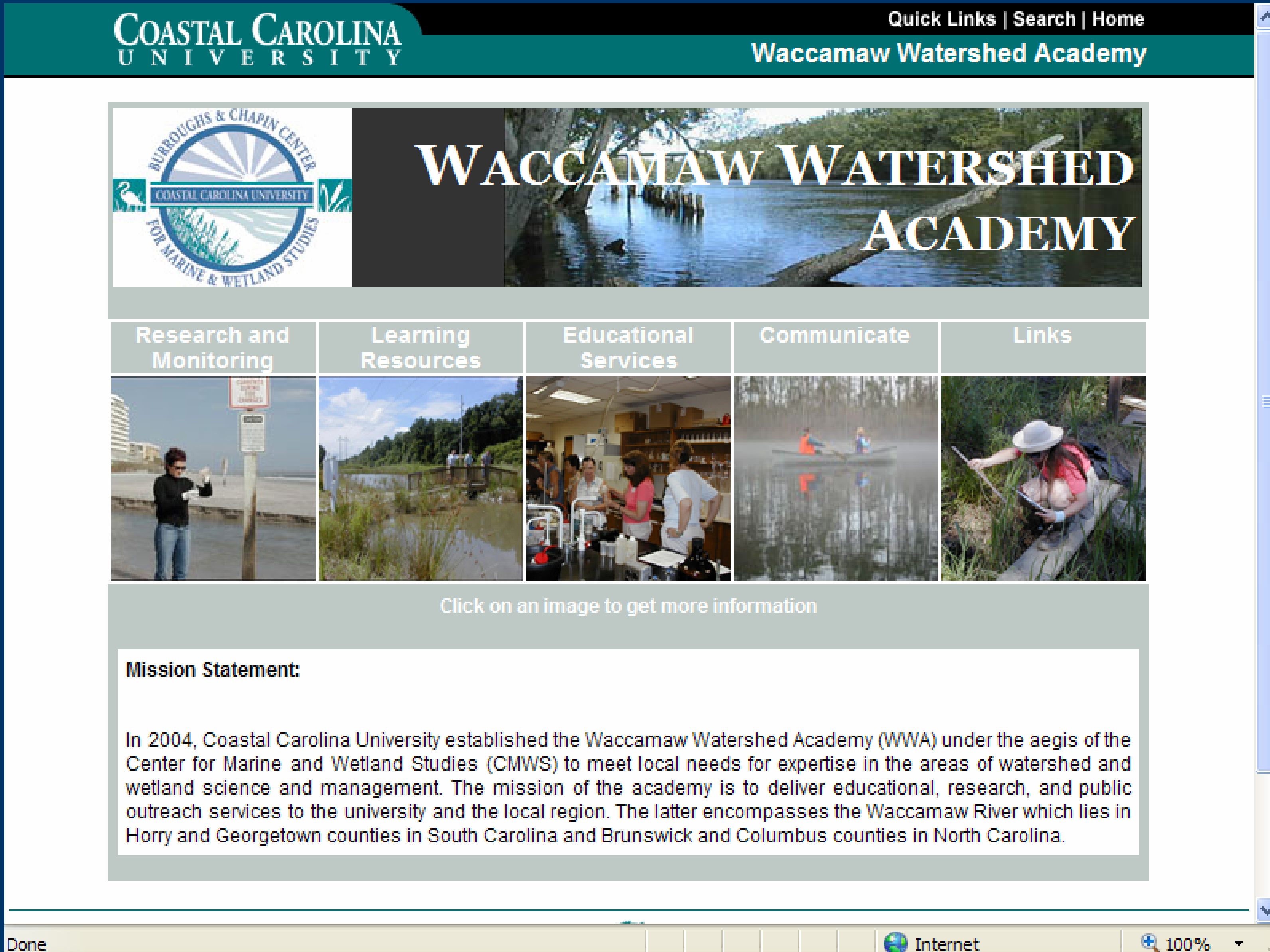
1,243,000 acres drainage

KLW

- 83,446 acres
- 166 stream mi
- 3 subwatersheds
- Two 303(d) listed sites
- Only urban area on River

KLW Project

- Funded by EPA Region IV
- 06/05 to 03/09
- Watershed management plan development
- Builds on prior WQ research by CCU's WWA



www.coastal.edu/wwa

Collaborators

City of Conway
Horry County
Waccamaw Regional Council of Governments
Waccamaw Riverkeeper (Winyah Rivers Foundation)
SC Department of Health & Environmental Control – BOW
SC Department of Health & Environmental Control - OCRM
US Fish and Wildlife Service
Winyah Bay Focus Area Task Force
Natural Resources Conservation Service
Center for Watershed Protection
US Environmental Protection Agency
SC Sea Grant Consortium
North Inlet – Winyah Bay National Estuarine Research Reserve
SC Water Resources Institute
Center for Watershed Protection
Earthworks Group

Why Kingston Lake Watershed and Crabtree Canal?

- Clean up polluted areas & reduce stormwater flooding
  - Two 303(d) listed sites
- Plan for rapid growth
  - Preserve water quality
  - Preserve traditional uses (hunting, fishing, boating)
  - Increase ecotourism
  - Conserve natural areas for wildlife

Nonpoint Source Pollution and Erosion Comparison Tool (N-SPECT)

- Helps coastal managers and local officials predict potential water quality impacts to rivers and streams from nonpoint source pollution and erosion.
- Compares different land-use change scenarios
- Simulates effects of site-specific stormwater BMPs
- Output types
  - Annual accumulated load & concentrations
  - Rain event loads & concentrations
- Pollutants
  - Nutrients & Sediment
  - Zinc & Lead

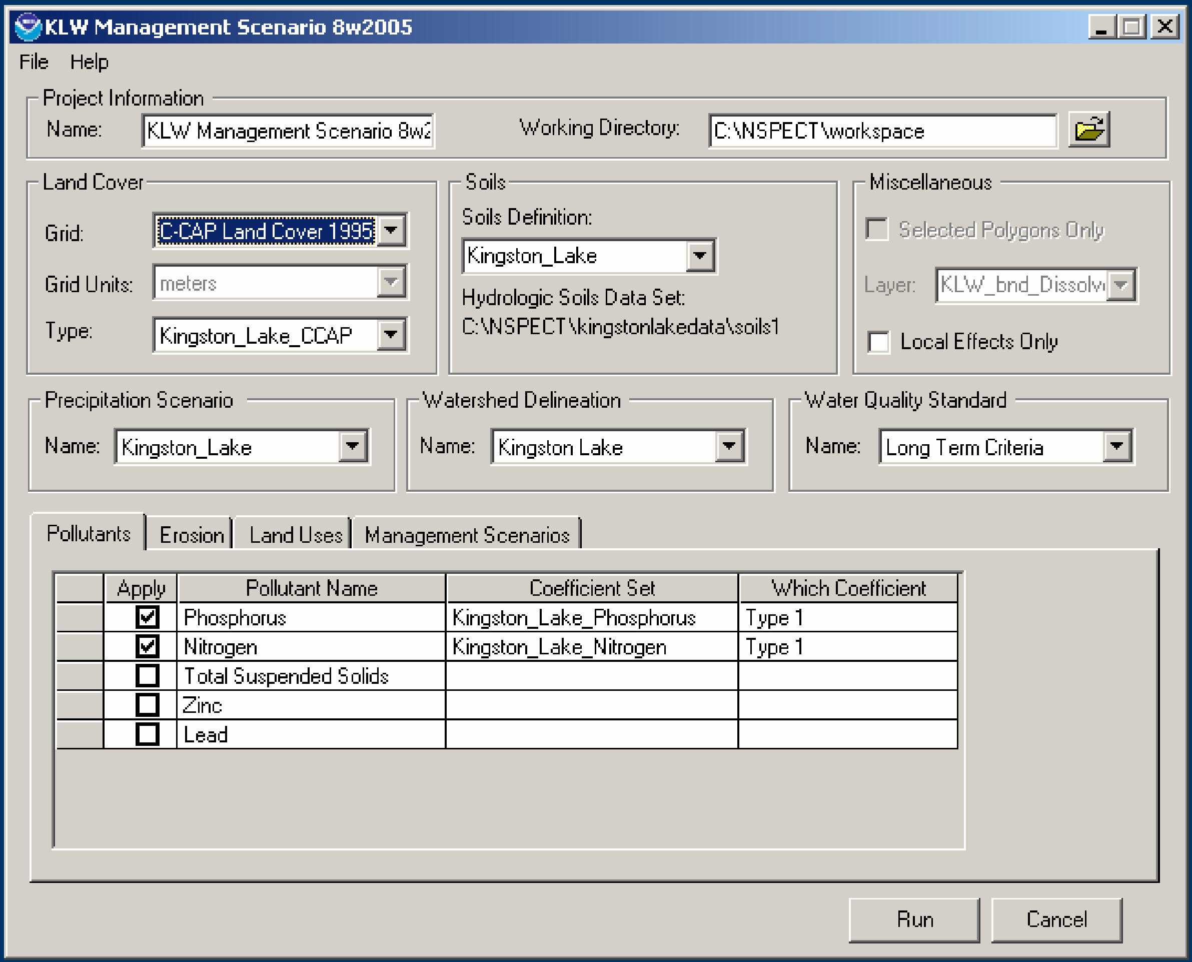
N-SPECT

- Advantages
  - It’s not US EPA’s BASINS
  - User Friendly
  - Low data requirement
  - Low computer complexity
- Limitations
  - It’s not US EPA’s BASINS
  - Not as sophisticated
  - Not necessarily site specific unless you collect a whole lot of data

NOAA Modelers

- Development team
  - Dr. David L. Eslinger, Jamie Carter, Margaret VanderWilt, Bev Wilson, Ed Dempsey, Andrew Meredith
- Major contributors
  - Hawaii Coastal Zone Management Program
  - NOAA Coastal Services Center (CSC)
  - National Ocean Service Pacific Services Center
  - Hawaiian management community

N-SPECT Data Requirements



- Primary
  - Landcover
  - Soils
  - Precipitation
  - Digital Elevation
  - Water Quality Coefficients
  - Water Quality Standards
- Derivative
  - Watershed Delineation
  - Soil Erosivity Factor

Annualized Pollutant Load & Concentration

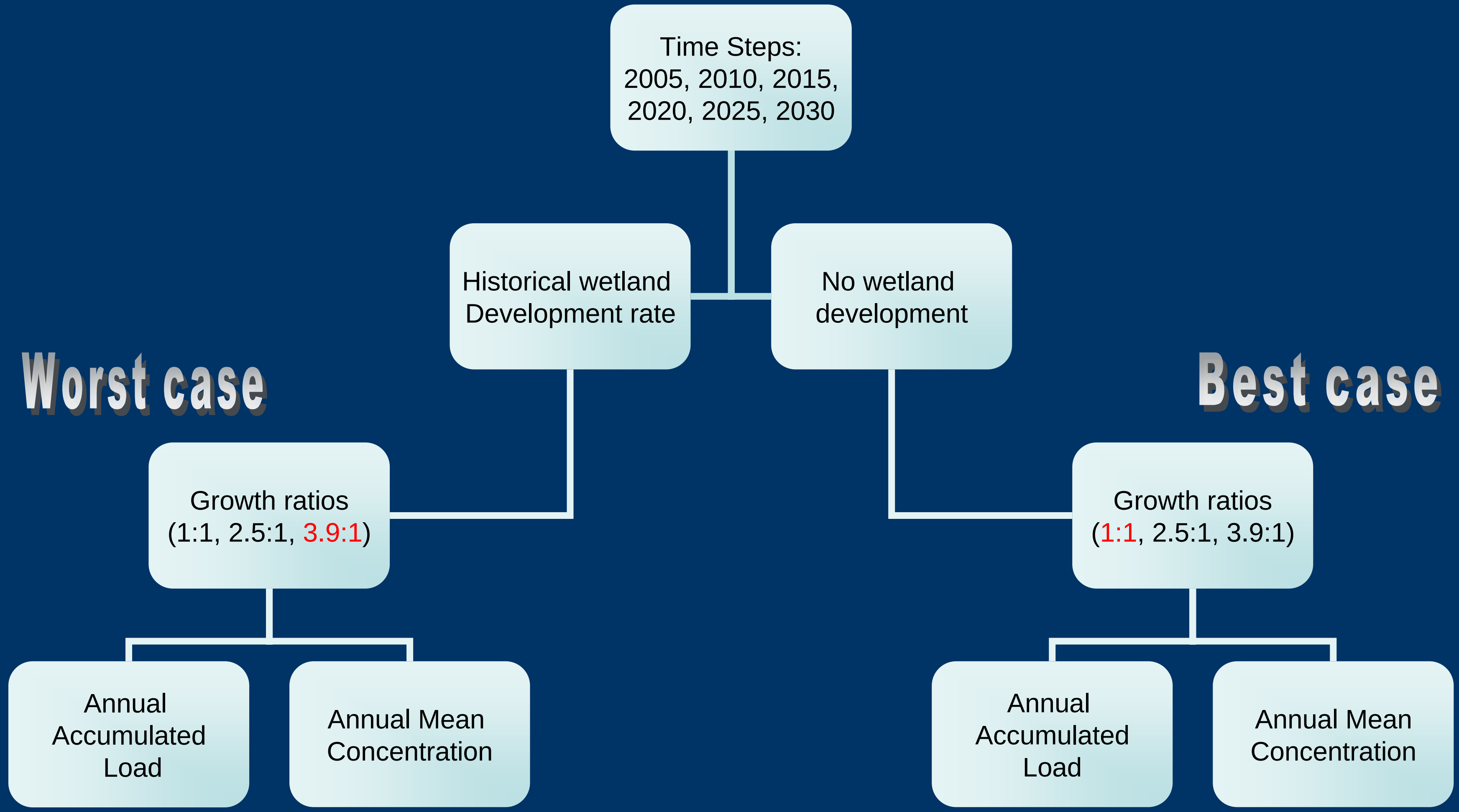
Pollution Concentration Grid	X	Runoff Volume Grid	→	Pollutant Mass Grid
Pollutant Mass Grid	&	Flow direction Grid	→	Accumulated Pollutant Mass Grid
Accumulated Pollutant Mass Grid	/	Accumulated Runoff Grid	→	Pollutant Concentration Grid (Upstream Contribution)
Pollutant Concentration Grid (Upstream Contribution)	+	Pollutant Concentration Grid (Local Contribution)	=	Final Pollutant Concentration Grid

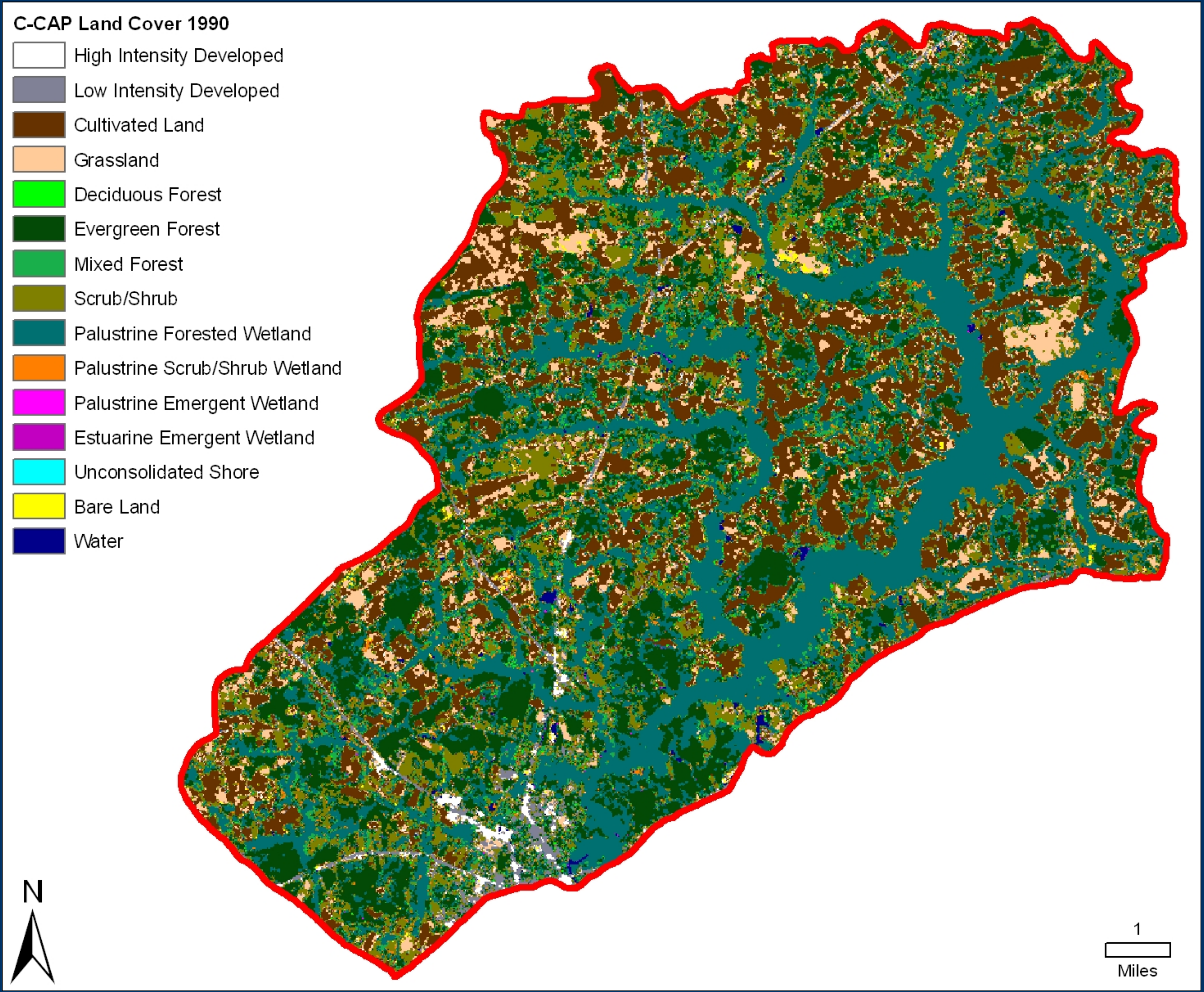
- Doesn't cover first flush issues

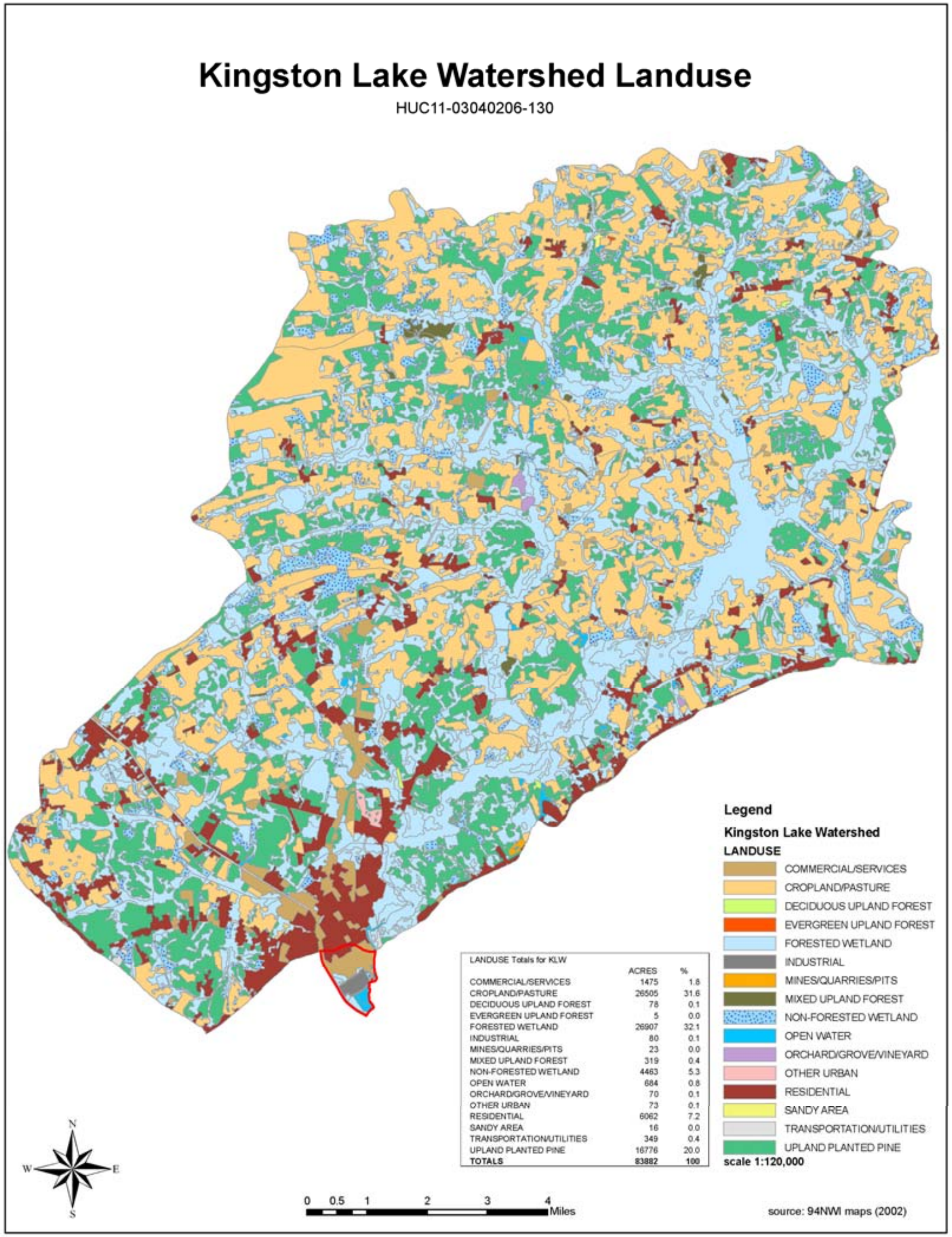
Growth Scenarios

- Historical growth rates projected forward
  - Spatial
  - % areal growth rate : % population growth rate
  - 1:1   (low)
  - 2.5:1 (medium)
  - 3.9:1 (observed for 1992-2001)
- Wetlands Loss rate (8% in 9 yr ☞ 1992-2001)
- Only projects development
  - Doesn't differentiate low from high intensity
  - First iteration, used high intensity pollutant coefficient
- Does not include impacts from proposed I-73

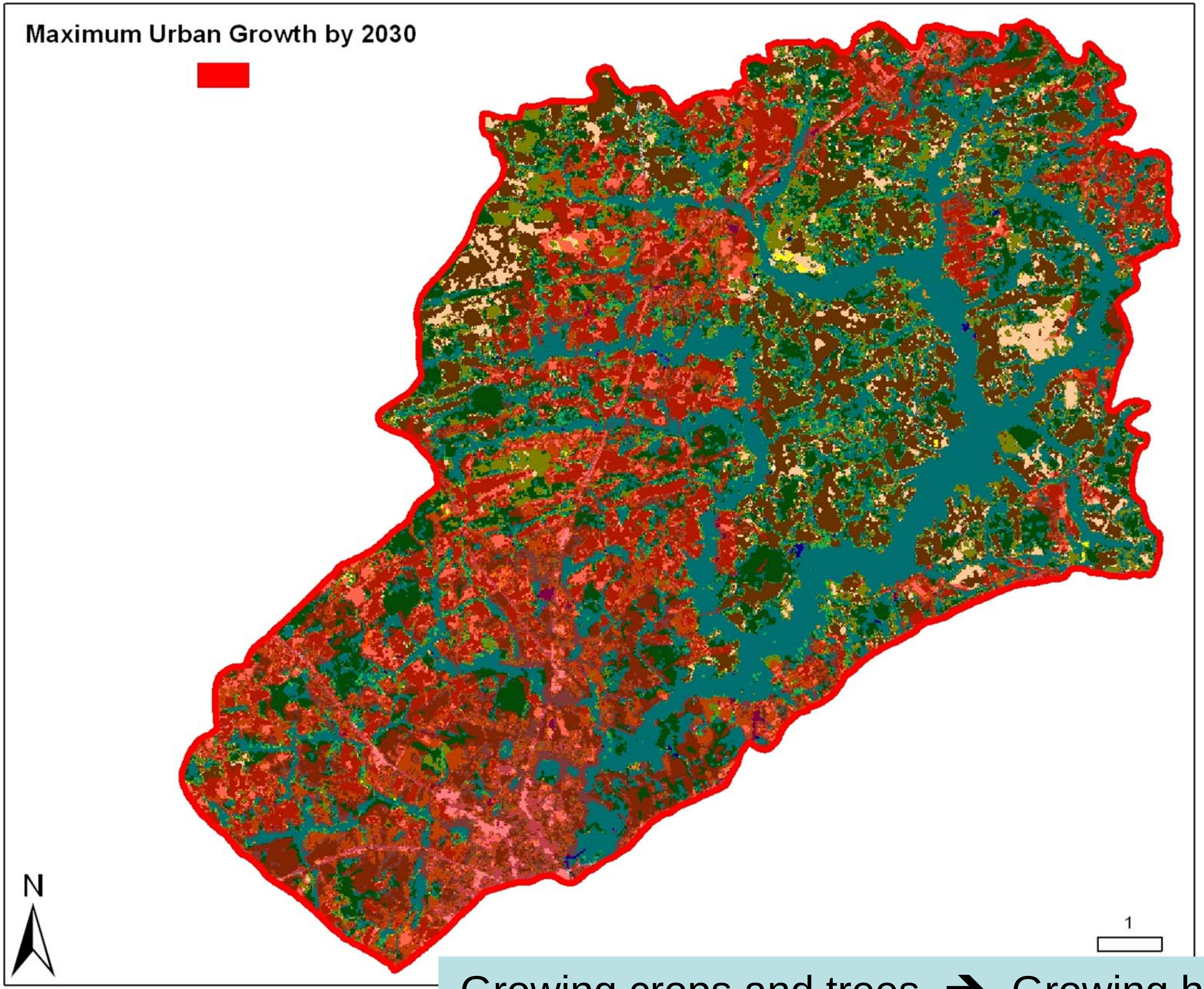
Modeling Scenarios for Predicting Impact of Increased Growth on Phosphorus, Nitrogen & Sediment Loads & Concentrations




C-CAP Land Cover 1990
High Intensity Developed
Low Intensity Developed
Cultivated Land
Grassland
Deciduous Forest
Evergreen Forest
Mixed Forest
Scrub/Shrub
Palustrine Forested Wetland
Palustrine Scrub/Shrub Wetland
Palustrine Emergent Wetland
Estuarine Emergent Wetland
Unconsolidated Shore
Bare Land
Water
N
1
Miles



LANDUSE	%
COMMERCIAL/SERVICES	1.76
CROPLAND/PASTURE	31.60
DECIDUOUS UPLAND FOREST	0.09
EVERGREEN UPLAND FOREST	0.01
FORESTED WETLAND	32.08
INDUSTRIAL	0.10
MINES/QUARRIES/PITS	0.03
MIXED UPLAND FOREST	0.38
NON-FORESTED WETLAND	5.32
OPEN WATER	0.82
ORCHARD/GROVE/VINEYARD	0.08
OTHER URBAN	0.09
RESIDENTIAL	7.23
SANDY AREA	0.02
TRANSPORTATION/UTILITIES	0.42
UPLAND PLANTED PINE	20.00



Growing crops and trees ➔ Growing houses

Pollutant Coefficients by Land Use Type

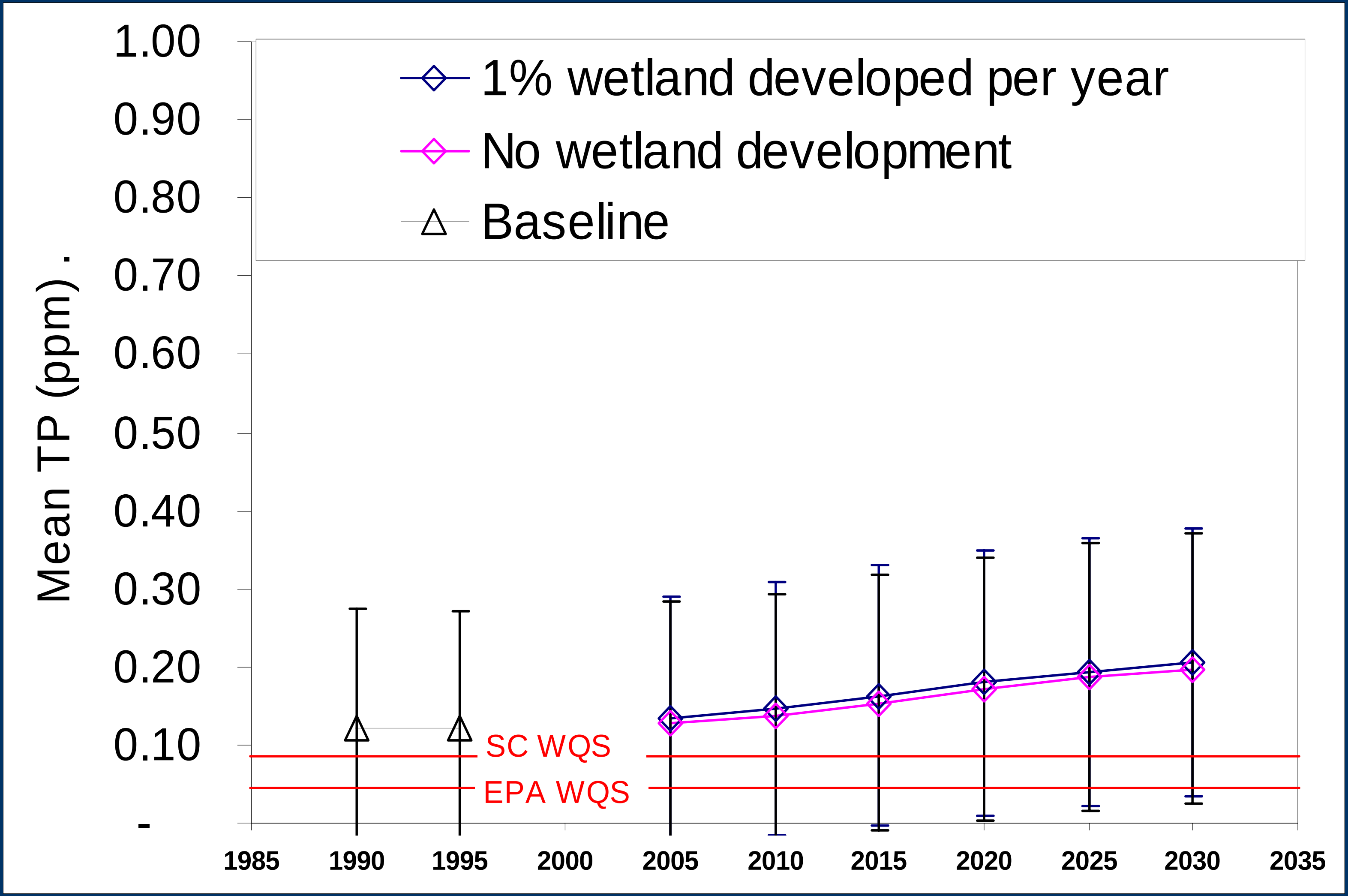
Landcover Type	Nitrogen Coefficient	Phosphorus Coefficient
High Intensity Developed	1.7	0.47
Low Intensity Developed	2.68	0.18
Cultivated Land	2.48	0.42
Grassland	1.25	0.48
Deciduous Forest	1.25	0.05
Evergreen Forest	1.25	0.05
Mixed Forest	1.25	0.05
Scrub/Shrub	1.1	0.05
Palustrine Forested Wetland	1.1	0.2
Palustrine Scrub/Shrub Wetland	1.1	0.2
Palustrine Emergent Wetland	1.1	0.2
Bare Land	0	0
Water	0	0

Not site specific (yet)

Source: N-SPECT Technical Guide, Appendix B

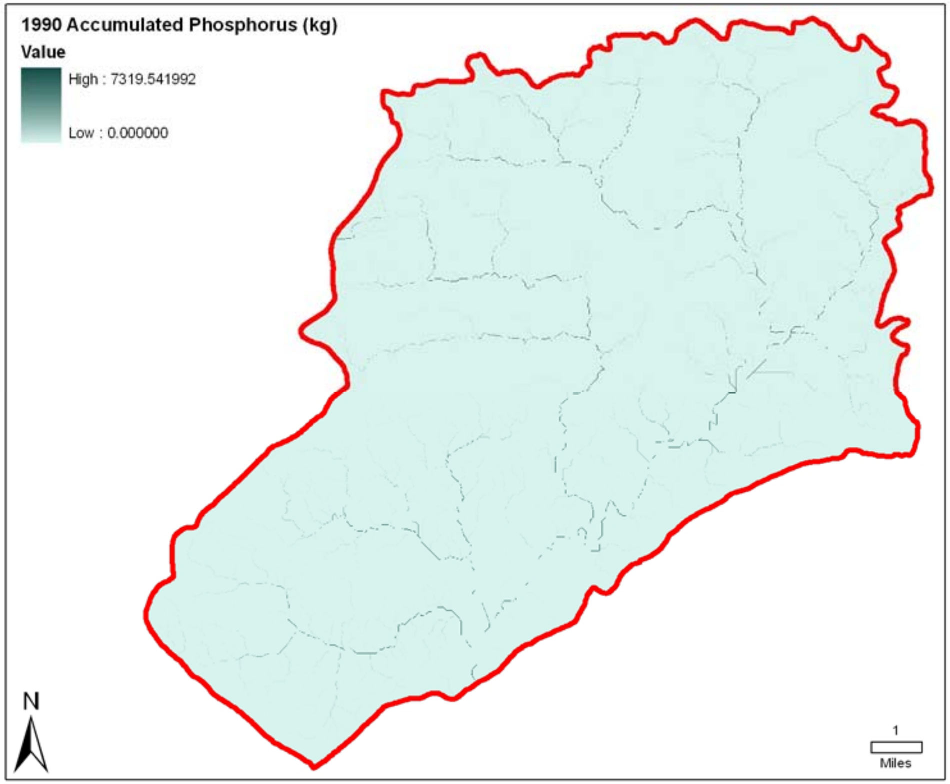
Phosphorus Benchmarks

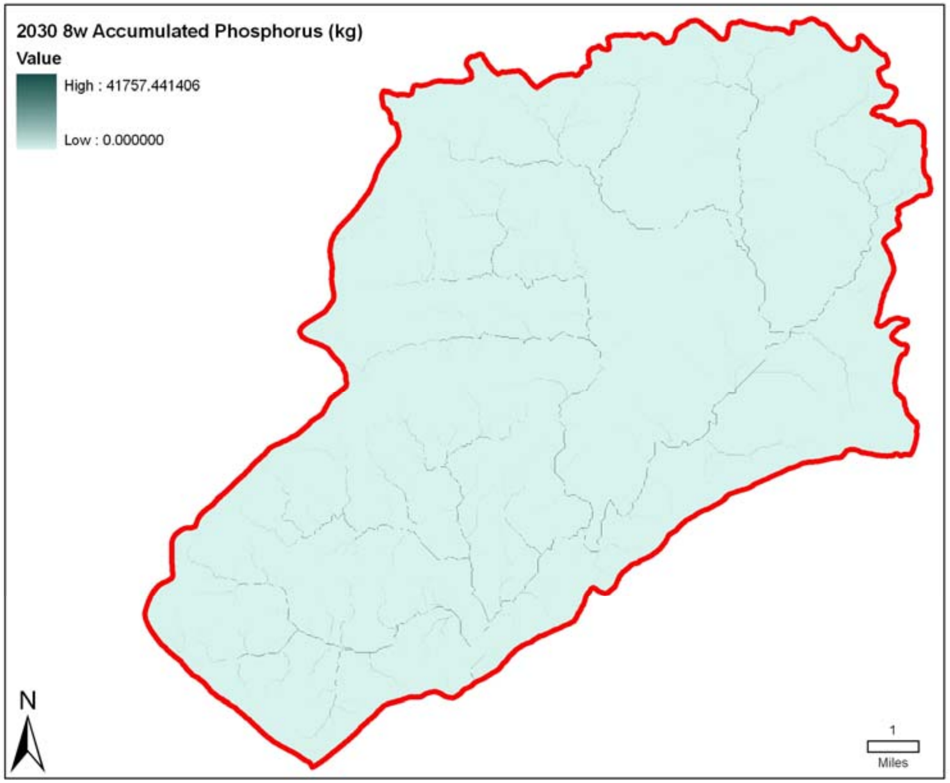
- Water Quality Standards
  - SC State Standards
    - 0.09 ppm P as TP
  - EPA Ambient Water Quality Criteria Recommendations: Rivers and Streams in Nutrient Ecoregion XIV, Level III Ecoregion 63 (2000)
    - 0.05 ppm P as TP
- Observational Data
  - Storet from Crabtree and Kingston Lake as TP
    - 2003: Crabtree Mean 0.04 $\pm$ 0.01 ppm P as TP
    - 2003: Kingston Lake 0.03 $\pm$ 0.01 ppm P as TP
    - 2005: Kingston Lake 0.05 $\pm$ 0.02 ppm P as TP
  - US EPA 319 Project (1999-2001) in KLW
    - Median dry weather: 0.01 $\pm$ 0.02 ppm P-phosphate
    - Median wet weather: 0.28 $\pm$ 0.09 ppm P-phosphate



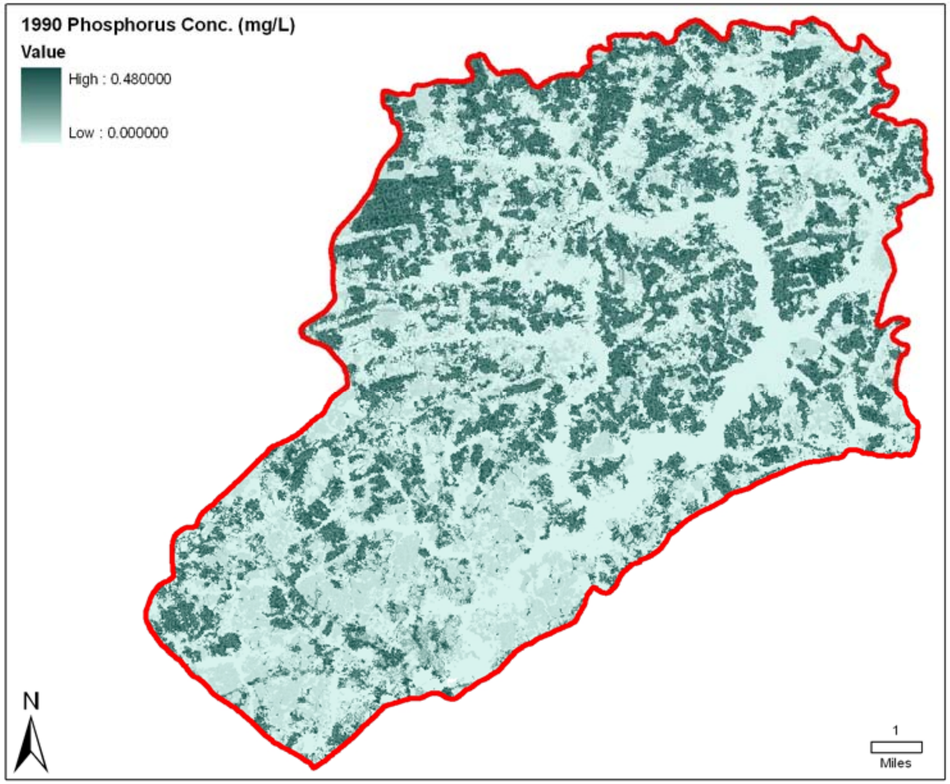
- Model scenarios exceed both State and EPA WQS
- 67% increase from baseline to 2030 (61% nw)
- Large standard deviation due to watershed accumulating effect

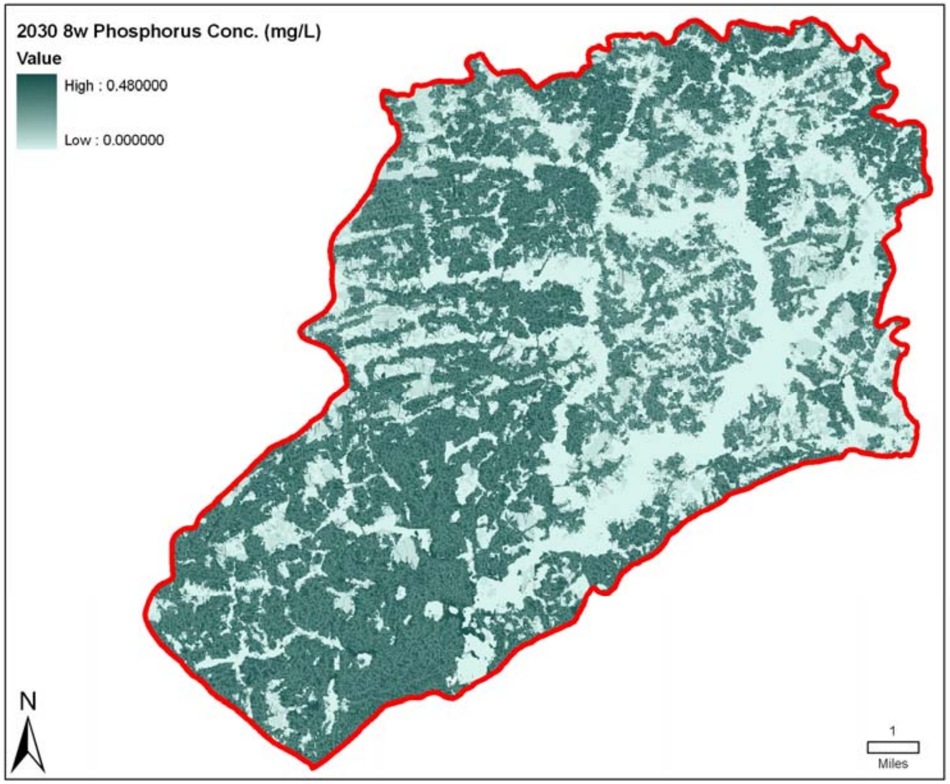
Phosphorus Accumulated Load





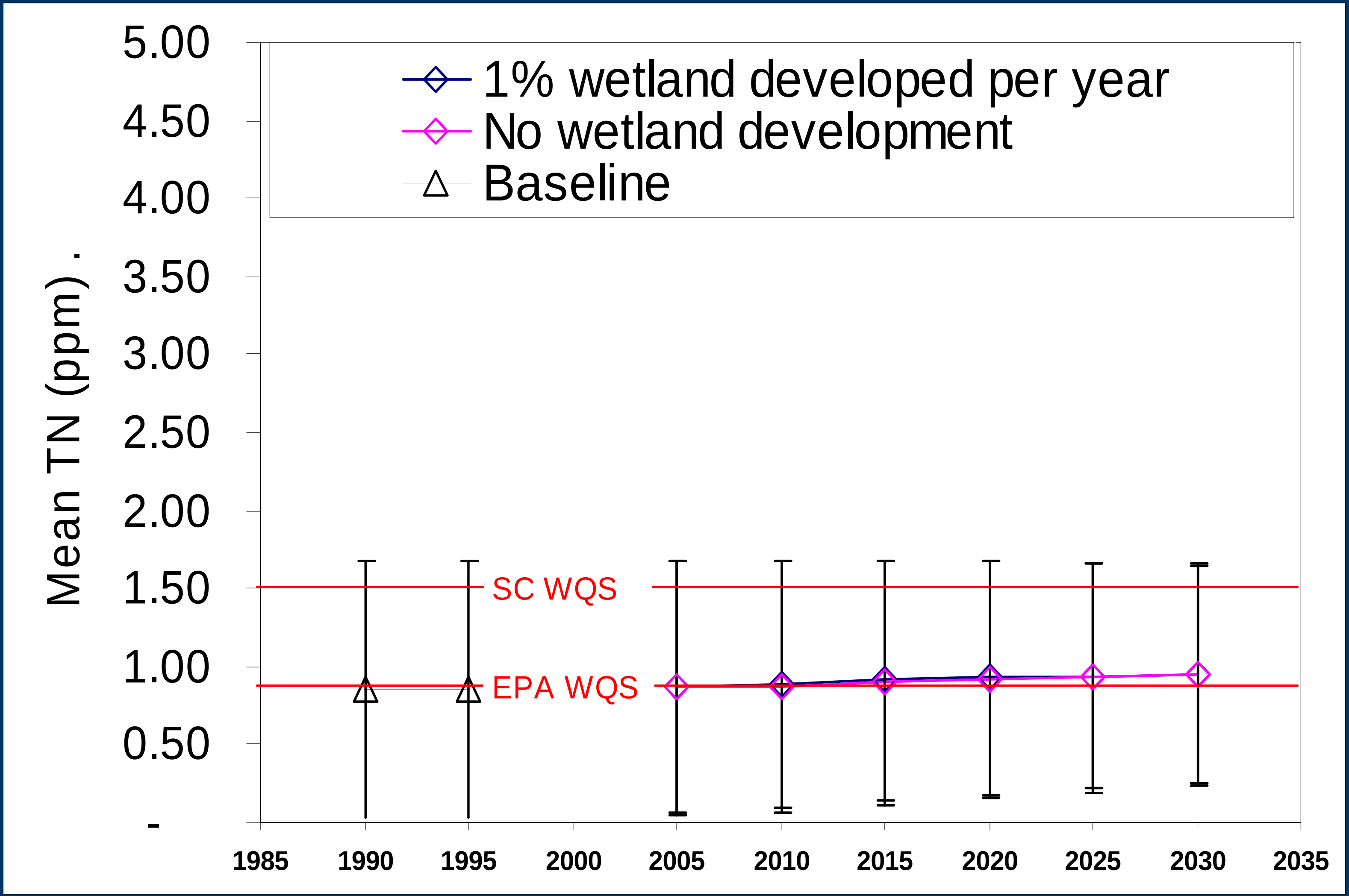
Phosphorus Concentrations





Nitrogen Benchmarks

- Water Quality Standards
  - SC State Standards
    - 1.5 ppm N as TN
  - EPA Ambient Water Quality Criteria Recommendations: Rivers and Streams in Nutrient Ecoregion XIV, Level III Ecoregion 63 (2000)
    - 0.87 ppm N as TN
- Observational Data
  - Storet from Crabtree and Kingston Lake as TN
    - 2003: Crabtree 1.486ppm $\pm$ 0.0933 as TN
    - 2003: Kingston Lake 1.6343ppm $\pm$ 0.5299 as TN
    - 2005: Kingston Lake 1.2783ppm $\pm$ 0.2551 as TN
  - US EPA 319 Project (1999-2001) in KLW
    - Median dry weather (urban): 0.81 $\pm$ 0.40 ppm TDIN
    - Mean wet weather peak (2001): 0.37 $\pm$ 0.25 ppm TDIN

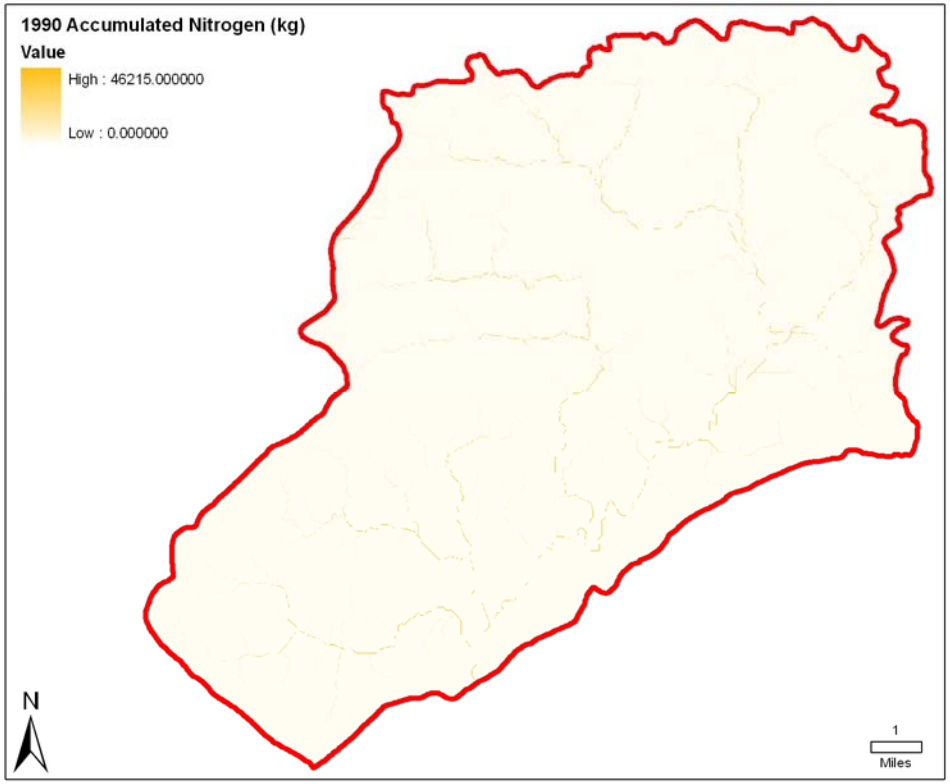


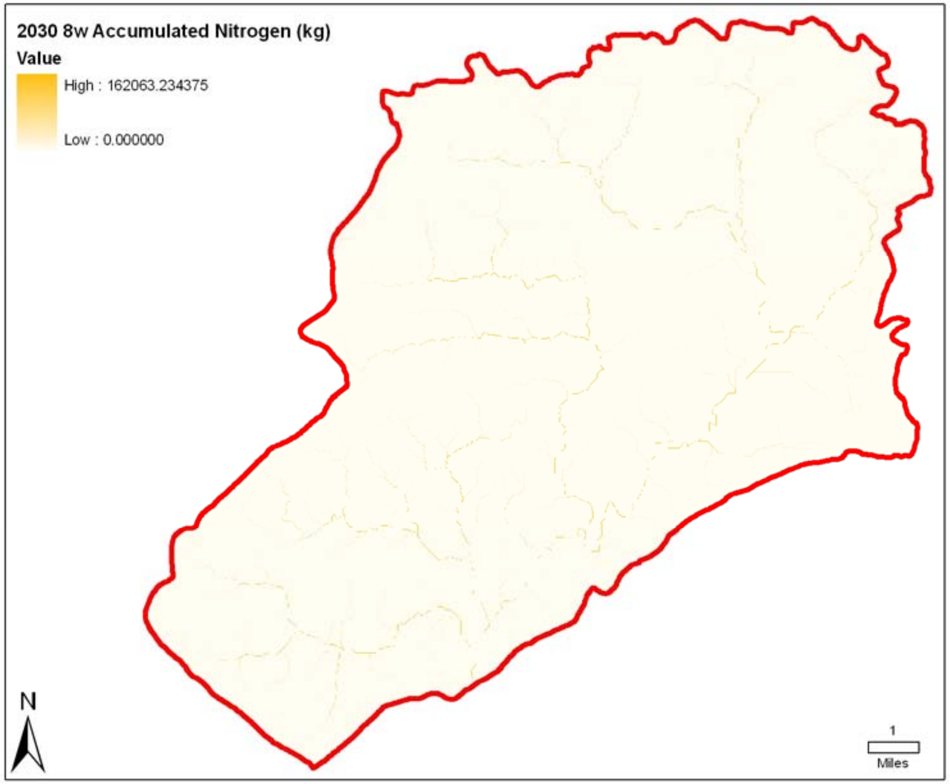
Within State WQS, Exceeds EPA WQS by 2015

12 % increase over time (10.5% nw)

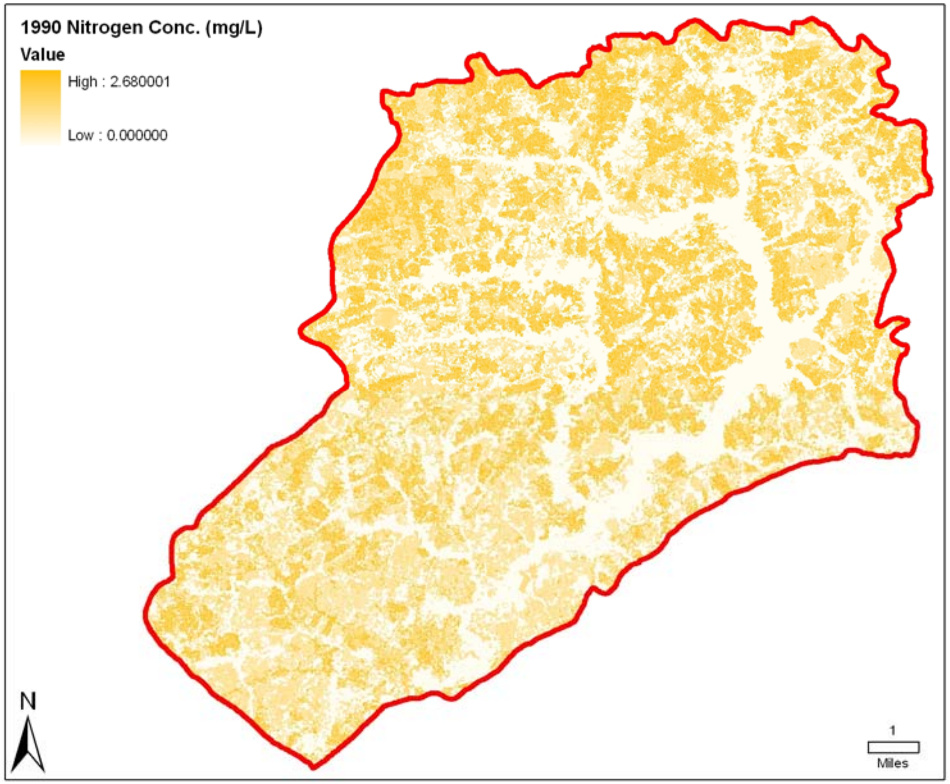
Large standard deviation due to the accumulating effect across the watershed

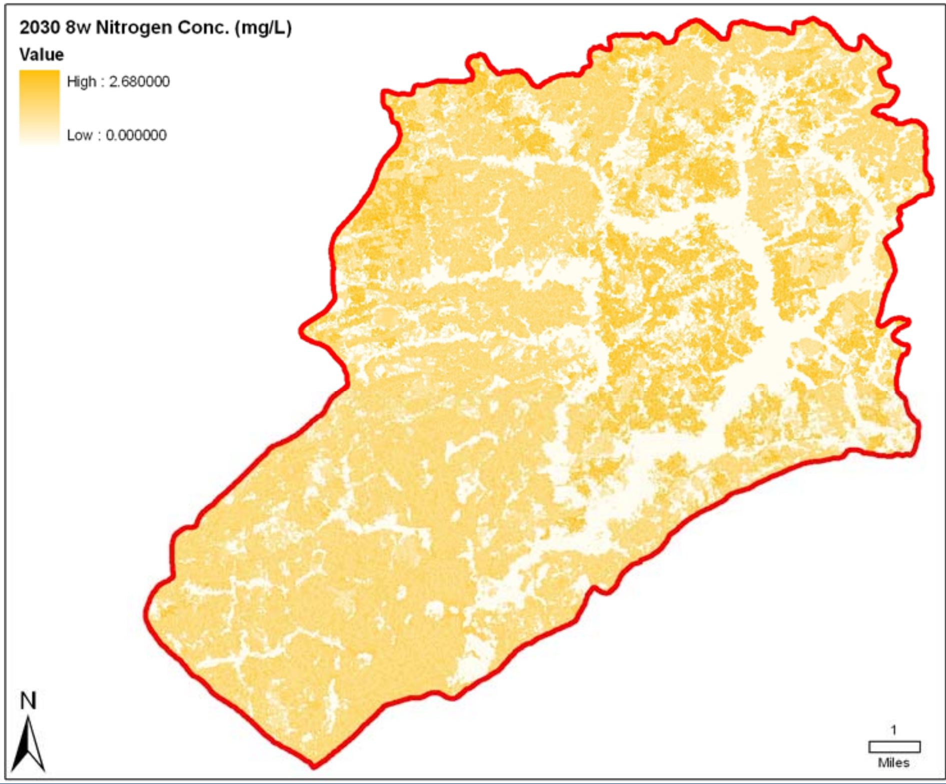
Nitrogen Accumulated Load



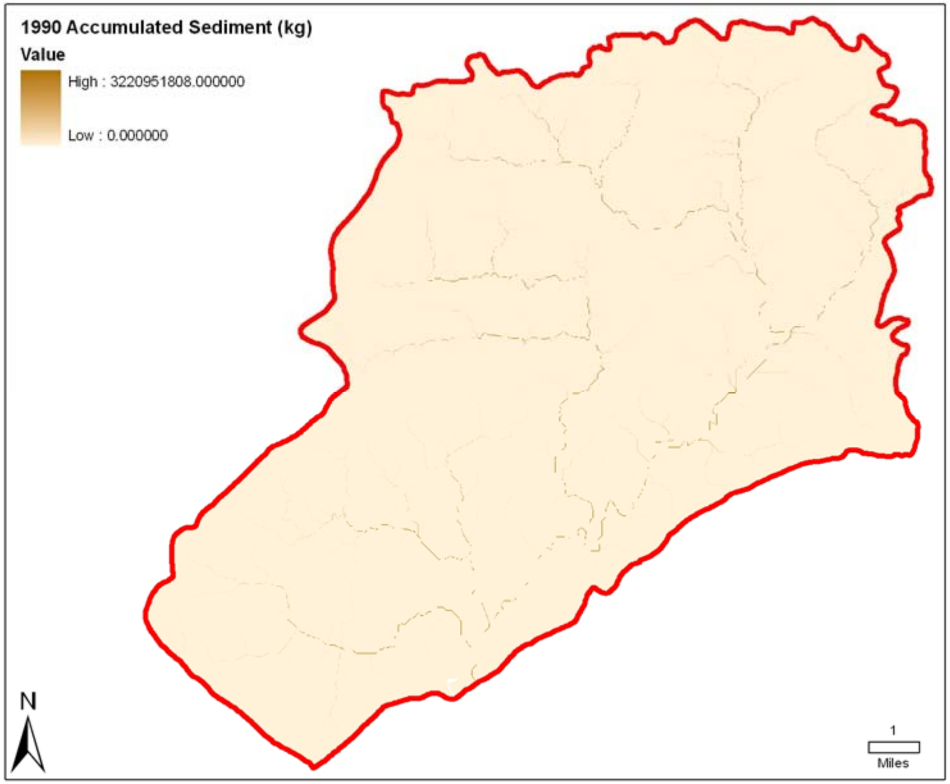


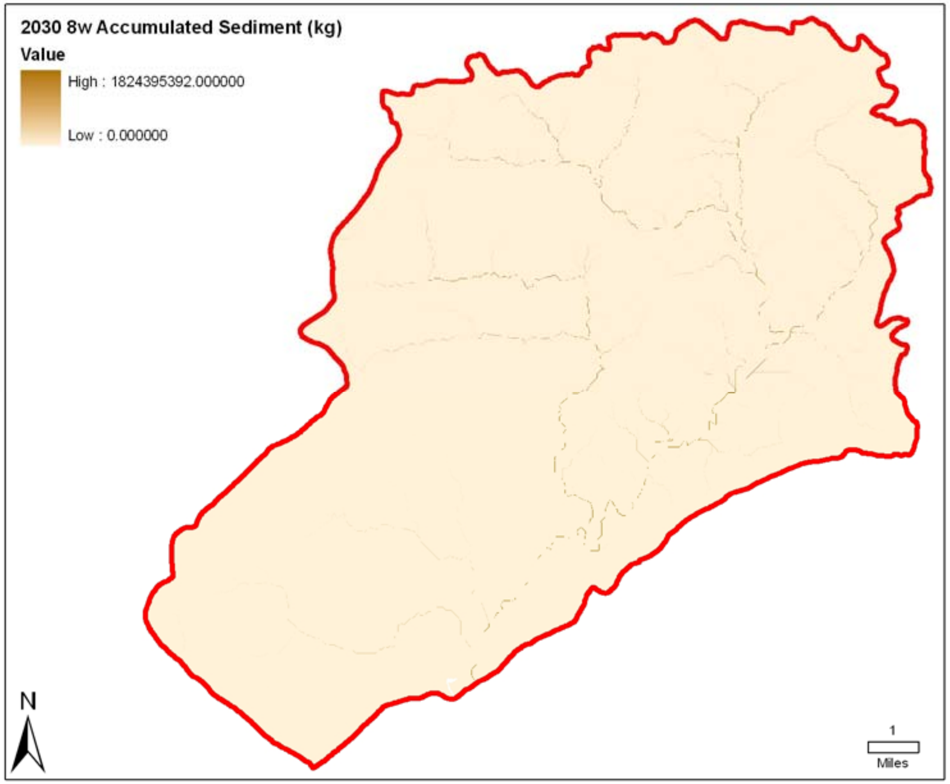
Nitrogen Concentrations



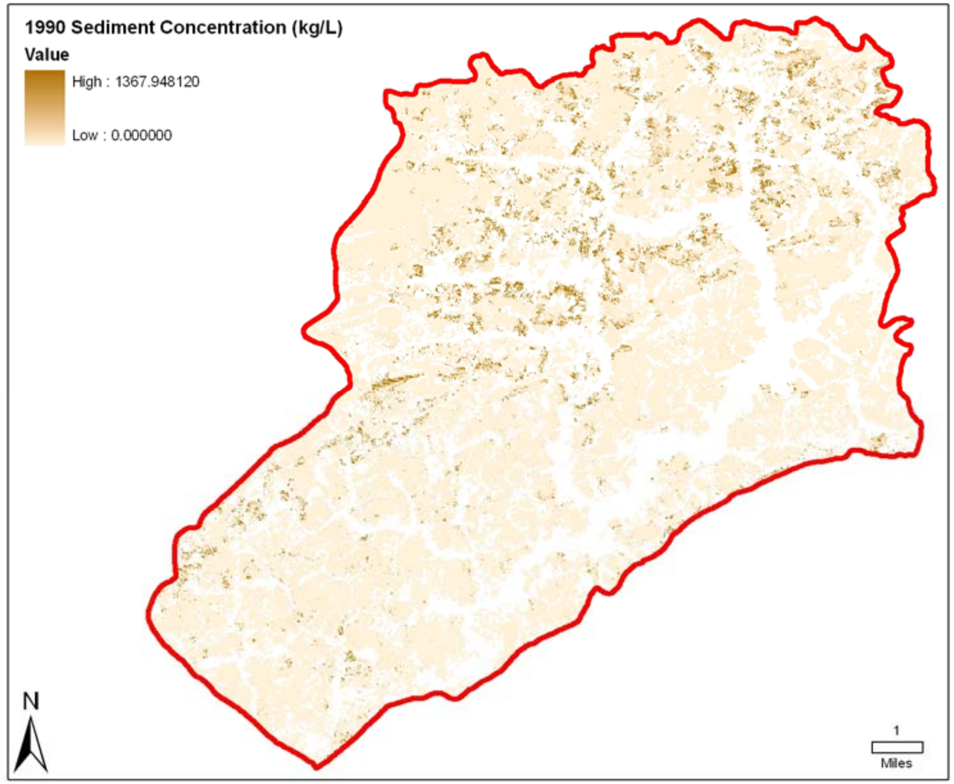


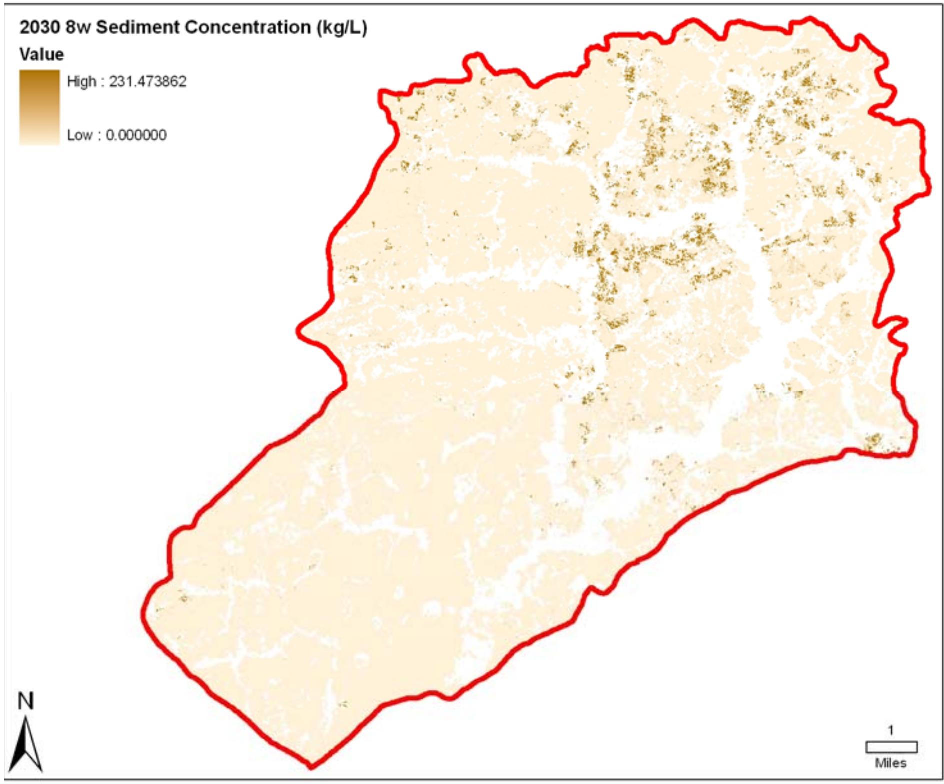
Sediment Accumulated Load





Sediment Concentrations





- Sediment concentration initially increases 7% (1990 to 1995), then decreases by 69% (65% nw)
- As more land is developed less sediment is available to be mobilized
- No longer growing crops & trees instead growing houses

Outreach Plan

- Conceptual tool for community-based land-use planning
- Educational tool for the new NPDES Phase II Program requirements for SMS4's (Conway and Horry County)
  - Coastal Waccamaw Stormwater Education Consortium
  - Nonpoint source education for municipal officials style presentations

Coastal Waccamaw
Stormwater Education Consortium

Future Directions

- Create site-specific pollutant coefficients using water quality data from US EPA 319 Project (1991-2001)
- Partition development into low and high intensity
- Create rain event scenarios with site-specific data
- Create stormwater BMP scenarios
  - Assign special pollutant coefficient and soil curve number to a particular polygon
- Develop datalayer animations
- Develop strategy for using continuous monitoring data from USGS gauging stations established in 2006 & 2007

Acknowledgements

- NOAA Coastal Services Center
- Waccamaw Regional Council of Government
- Environmental Protection Agency
- Clemson University, Strom Thurmond Institute, South Carolina Water Resources Center