Using Science to Convince 18 Million People to Go (and Stay) on a Pollution Diet

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September 25, 2015
How Too Much Nutrient Pollution Impacts the Chesapeake Bay Ecosystems

Balanced Nutrient Diet

Too Much Nutrients

“Stratification”

“Dead Zone”

Loss of shallow bottom habitat

Loss of deep bottom habitat

Nitrogen + Phosphorus
Low to no dissolved oxygen in the Bay and tidal rivers every summer
Refined Designated Uses for the Bay and Tidal Tributary Waters

A. Cross Section of Chesapeake Bay or Tidal Tributary

- Shallow-Water Bay Grass Use
- Deep-Water Seasonal Fish and Shellfish Use
- Deep-Channel Seasonal Refuge Use
- Open-Water Fish and Shellfish Use

B. Oblique View of the “Chesapeake Bay” and its Tidal Tributaries

- Shallow-Water Bay Grass Use
- Deep-Water Seasonal Fish and Shellfish Use
- Deep-Channel Seasonal Refuge Use
- Open-Water Habitat
- Migratory Fish Spawning and Nursery Use

Source: U.S. EPA 2003
Local “Zoning” for Bay and Tidal River Fish, Crab and Grasses Habitats

Bay Grasses Habitat

Rockfish, Bluefish Menhaden Habitat

Oyster, Crab, Croaker and Spot Habitat

Summertime Crab Food Habitat

Shad, Herring, Perch and Rockfish Spawning Habitat
Migratory Fish Spawning and Nursery Use

Supports early life stages of fish inhabiting the upper reaches of tidal waters and the upper mainstem used as spawning and nursery grounds by striped bass, shad, perch and other fish February - May.
## Bay Dissolved Oxygen Criteria

Minimum Amount of Oxygen (mg/L) Needed to Survive by Species

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<td>Deep Channel</td>
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Shallow-Water Bay Grass Use

Water Clarity/SAV Criteria

Two Percent Light Parameters for Evaluating Ambient Conditions. Illustration of the relationship of the two percent light parameters and the water quality conditions influencing both of them.
Scientific Basis for Decisions was Documented by the Partners
These Chesapeake Bay-specific water quality criteria were derived through the collaborative efforts, collective knowledge and applied expertise of the following four Chesapeake Bay criteria and standards coordinator teams.

**Water Quality Standards Coordinators Team**

Richard Batiuk, U.S. EPA Chesapeake Bay Program Office; Claire Buchanan, Interstate Commission on the Potomac River Basin; Arthur Butt, Virginia Department of Environmental Quality; Denise Britburg, Academy of Natural Sciences; Thomas Cronin, U.S. Geological Survey; Mirta Dias, NOAA Institute of Marine and Environmental Studies; Stephen Disalvo, U.S. EPA Office of Water; John Finger, University of Maryland Horn Point Laboratory; David Fritts, University of Virginia; Robert Haas, Virginia Department of Environmental Quality; Bruce Mahler, University of Maryland; Richard Batiuk, U.S. EPA Chesapeake Bay Program Office; Joe Madison, Maryland Department of the Environment; Thomas Gardner, U.S. EPA Office of Water (Criteria); and Erik Winchester, U.S. EPA Chesapeake Bay Program Office.

Without the efforts of the authors of the first and second Chesapeake Bay underwater bay grass technical syntheses, the Bay-specific water clarity criteria could not have been developed: Mike Altaboni, Anne Arundel Community College; Rick Bartleson, University of Maryland Horn Point Laboratory; Richard Batiuk, U.S. EPA Chesapeake Bay Program Office; Peter Bergstrom, U.S. Fish and Wildlife Service; Steve Biber, Maryland Department of the Environment; Richard Carter, U.S. Geological Survey; William Dennison, University of Maryland Center for Environmental Studies; Charles Gallegos, Smithsonian Environmental Research Center; Will Hunley, Hampton Roads Sanitation District; Michael Kemp, University of Maryland Horn Point Laboratory; Evamarie Koch, University of Maryland Horn Point Laboratory; Stan Kollar, Harford Community College; Jurate Landwehr, U.S. Geological Survey; Ken Moore, Virginia Institute of Marine Science; Laura Murray, University of Maryland Horn Point Laboratory; David M. Mylander, Maryland Department of Natural Resources; Robert Orth, Virginia Institute of Marine Science; Nancy Rybicki, U.S. Geological Survey; Lori Staver, University of Maryland; Court Stevenson, University of Maryland Horn Point Laboratory; Mirtha Teichberg, Woods Hole Oceanographic Institution; and David Wilcox, Virginia Institute of Marine Science.

**Water Quality Criteria Team**

Richard Batiuk, U.S. EPA Chesapeake Bay Program Office; Richard Batiuk, U.S. EPA Chesapeake Bay Program Office; Denise Britburg, Academy of Natural Sciences; Arthur Butt, Virginia Department of Environmental Quality; Thomas Cronin, U.S. Geological Survey; Ifeyinwa Davis, U.S. EPA Office of Water; Robert Diaz, Virginia Institute of Marine Science; Frederick Hoffman, Virginia Department of Environmental Quality; Steve Jordan, Maryland Department of Natural Resources; James Keating, U.S. EPA Office of Water; Marcia Olson, NOAA Chesapeake Bay Office; James Plett, Hampton Roads Sanitation District; David Secor, University of Maryland Chesapeake Biological Laboratory; Glen Thursby, U.S. EPA Office of Research and Development; and Erik Winchester, U.S. EPA Office of Research and Development.

Scientists from across the country, well recognized for their work in the area of low dissolved oxygen effects on individual species up to ecosystem trophic dynamics, contributed their time, expertise, publications and preliminary data and findings to support the derivation of Chesapeake Bay-specific criteria: Steve Brandt, NOAA Great Lakes Environmental Research Laboratory; Walter Boynton, University of Maryland Chesapeake Biological Laboratory; Ed Chesney, Louisiana Universities Marine Consortium; Larry Crowder, Duke University Marine Laboratory; Peter dePur, Virginia Commonwealth University; Ed Houde, University of Maryland Chesapeake Biological Laboratory; Julie Keister, Oregon State University; Nancy Marcus, Florida State University; John Miller, North Carolina State University; Ken Paynter, University of Maryland; Sherry Poucher, SAIC; Nancy Rabalais, Louisiana Universities Marine Consortium; Jim Rice, North Carolina State University; Mike Roman, University of Maryland Horn Point Laboratory; Linda Schaffner, Virginia Institute of Marine Science; Dave Simpson, Connecticut Department of Environmental Protection; and Tim Target, University of Delaware.

**Chlorophyll a Criteria Team**

Richard Batiuk, U.S. EPA Chesapeake Bay Program Office; Claire Buchanan, Interstate Commission on the Potomac River Basin; Arthur Butt, Virginia Department of Environmental Quality; Ifeyinwa Davis, U.S. EPA Office of Water; Tom Fisher, University of Maryland Horn Point Laboratory; David Fritts, U.S. EPA Office of Water; Larry Haas, Virginia Institute of Marine Science; Larry Harding, University of Maryland Horn Point Laboratory/Maryland Sea Grant; Frederick Hoffman Virginia Department of Environmental Quality; Will Hunley, Hampton Roads Sanitation District; Richard Lacouture, Academy of Natural Sciences; Robert Magnien, Maryland Department of Natural Resources; Harold Marshall, Old Dominion University; Robert Steidel, Hopewell Regional Wastewater Facility; and Peter Tango, Maryland Department of Natural Resources.

Without the efforts of the Chesapeake Bay Phytoplankton Restoration Goals Team forging connections between reference phytoplankton communities and resulting chlorophyll a concentrations would not have been possible: Claire Buchanan, Interstate Commission on the Potomac River Basin; Richard Lacouture, Academy of Natural Sciences; Harold Marshall, Old Dominion University; Stella Sellmer, Academy of Natural Sciences; Jacqueline Johnson, Interstate Commission on the Potomac River Basin/Chesapeake Bay Program Office; Jonathan Champion, Chesapeake Research Consortium/Chesapeake Bay Program Office; Marcia Olson, NOAA Chesapeake Bay Office; Fred Jacobs, AKRF, Inc.; John Seibert, PBS & J, Inc.; and Elgin Perry. 

**Dissolved Oxygen Criteria Team**

Richard Batiuk, U.S. EPA Chesapeake Bay Program Office; Claire Buchanan, Interstate Commission on the Potomac River Basin; Arthur Butt, Virginia Department of Environmental Quality; Ifeyinwa Davis, U.S. EPA Office of Water; Tom Fisher, University of Maryland Horn Point Laboratory; David Fritts, U.S. EPA Office of Water; Larry Haas, Virginia Institute of Marine Science; Larry Harding, University of Maryland Horn Point Laboratory/Maryland Sea Grant; Frederick Hoffman Virginia Department of Environmental Quality; Will Hunley, Hampton Roads Sanitation District; Richard Lacouture, Academy of Natural Sciences; Robert Magnien, Maryland Department of Natural Resources; Harold Marshall, Old Dominion University; Robert Steidel, Hopewell Regional Wastewater Facility; and Peter Tango, Maryland Department of Natural Resources.

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Criteria Assessment
Chesapeake 2000 Agreement

1986-1991

1992-2000

State WQS Adoption/Amendment

Addendum Documents Publication

1999

2000

EPA/States agreement on DO, clarity, chlor as criteria; N, P, S as loads

2001-2003

2004-2010

2008 - Present

- 2010-2015 two federal court cases won
- 2015 Criteria Addendum
- 2016/2017 WQS amendments by states
- 2018 Phase III WIPs
- 2019 Possible Bay TMDL amendments

1999

2000

2001-2003

2004-2010

2008 - Present

- 2010-2015 two federal court cases won
- 2015 Criteria Addendum
- 2016/2017 WQS amendments by states
- 2018 Phase III WIPs
- 2019 Possible Bay TMDL amendments
Nitrogen Loads to the Bay by Source

- Agriculture: 44%
- Wastewater + Combined Sewer Overflow: 18%
- Urban Stormwater: 16%
- Septic: 3%
- Forest + Non-Tidal Water Atmospheric Deposition: 19%
Nitrogen Loads to the Bay by Root Source

- Atmospheric Deposition (including livestock & fertilized soil emissions, mobile+utility +industry, natural sources) 31%
- Manure 15%
- Fertilizer 27%
- Wastewater + Combined Sewer Overflow 18%
- Septic 3%
- Legume Fixation 6%
Dissolved Oxygen Criteria Attainment

Basin-wide load is 185.9 N and 12.5 P (MPY)
Relative Effect of a Pound of Pollution on Bay Water Quality
Major River Basin by Jurisdiction Relative Impact on Bay WQ
Pollution Diet by River

Pollution Diet by State

Note: There is also an Atmospheric Deposition Allocation of 15.70 million pounds/year.
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Extracted from “Appendix Q. Detailed Annual Chesapeake Bay TMDL WLAs and LAs”

Simulated Nitrogen Loads Delivered to Chesapeake Bay by Jurisdiction

*Simulated Nitrogen Loads Delivered to the Bay by Jurisdiction* (million pounds/year)

- **EPA: Atmospheric Deposition to Tidal Water** (to be reduced to 15.2 million lbs/yr under Clean Air Act)
- **EPA: Atmospheric Deposition to Watershed** (to be reduced under Clean Air Act)
- **District of Columbia**
- **Delaware**
- **West Virginia**
- **Virginia**
- **Maryland**
- **Pennsylvania**
- **New York**

*Loads simulated using 5.3.2 version of Watershed Model and wastewater discharge data reported by Bay jurisdictions.*
## Status of Trajectory Towards Achieving 2017 Interim Targets: Nitrogen

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## 2014-2015 EPA Oversight Status

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2 Year Milestones

Pennsylvania Nitrogen

*Loads simulated using 5.3.2 version of Watershed Model and wastewater discharge data reported by Bay jurisdictions.*
2 Year Milestones

Pennsylvania Nitrogen

*Loads simulated using 5.3.2 version of Watershed Model and wastewater discharge data reported by Bay jurisdictions.*
Modeled Nitrogen Loads and Goals
Pennsylvania CB Watershed

Graph showing modeled nitrogen loads from 2009 to 2017 for all sources, agriculture (Ag), urban areas, and WWTPs. The graph indicates a downward trend in nitrogen loads over the years, with a specific note on progress in 2014.
## PA Loads and Goals

### 2009-2014 Trajectory Progress

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<td>0.767</td>
<td>0.696</td>
<td>0.561</td>
<td>0.424</td>
<td>0.071</td>
<td>0.135</td>
</tr>
<tr>
<td>PA</td>
<td>Wastewater+CSO</td>
<td>1.071</td>
<td>0.758</td>
<td>0.966</td>
<td>0.897</td>
<td>0.313</td>
<td>-0.209</td>
</tr>
<tr>
<td>PA</td>
<td>Forest+</td>
<td>0.431</td>
<td>0.421</td>
<td>0.433</td>
<td>0.435</td>
<td>0.010</td>
<td>-0.012</td>
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<tr>
<td>PA</td>
<td>AllSources</td>
<td>4.984</td>
<td>4.438</td>
<td>4.136</td>
<td>3.571</td>
<td>0.546</td>
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</table>

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Source</th>
<th>TSS (M lbs/year)</th>
<th>TSS (M lbs/year)</th>
<th>TSS (M lbs/year)</th>
<th>TSS (M lbs/year)</th>
<th>TSS (M lbs/year)</th>
<th>TSS (M lbs/year)</th>
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</thead>
<tbody>
<tr>
<td>PA</td>
<td>Agriculture</td>
<td>1,677</td>
<td>1,695</td>
<td>1,326</td>
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<td>PA</td>
<td>Urban Runoff</td>
<td>560</td>
<td>519</td>
<td>391</td>
<td>278</td>
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<td>128</td>
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<tr>
<td>PA</td>
<td>Wastewater+CSO</td>
<td>21</td>
<td>25</td>
<td>121</td>
<td>187</td>
<td>-4</td>
<td>-95</td>
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<tr>
<td>PA</td>
<td>Forest+</td>
<td>386</td>
<td>379</td>
<td>388</td>
<td>389</td>
<td>8</td>
<td>-9</td>
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<tr>
<td>PA</td>
<td>AllSources</td>
<td>2,644</td>
<td>2,618</td>
<td>2,225</td>
<td>1,945</td>
<td>26</td>
<td>393</td>
</tr>
</tbody>
</table>

**Legend:**
- Loads meet 2014 trajectory target
- Loads don’t meet 2014 trajectory target
Where are the Planned Nitrogen Load Reductions Coming From?

- **LandRetire 18.2%**
- ForestBuffers 12.9%
- Infiltration 8.5%
- Filter 6.7%
- Other Ag 4.4%
- DairyPrecFeed 1.2%
- PastFence 1.2%
- WetlandRestore 1.8%
- ConPlan 2.4%
- ComCovCrop 2.5%
- GrassBuffers 3.6%
- CarSeqAltCrop 4.9%
- CoverCrop 5.1%
- EnhancedNM 5.6%
- AWMS 5.8%
- ConserveTill 6.9%

Green = agricultural practices
Yellow = urban/suburban stormwater practices
Red = wastewater controls
Pink = septic practices

* Agricultural land retirement takes marginal and highly erosive cropland out of production by planting permanent vegetative cover such as shrubs, grasses, and/or trees.
Introduction

During the 2009 Chesapeake Bay Program Council (CBP) meeting, the 2009-2011 milestones were set at 10% reduction in nitrogen. The Interim Progress Assessment/Fact Sheet - June 2011 document contains information about the progress towards achieving these milestones. The current report is an update on the progress made towards achieving the interim milestones set in 2009.

As of June 2010, the jurisdictions are generally on track to implement pollution control projects necessary to achieve the interim milestones. In particular, those states that are behind are taking steps to catch up, and some progress has been made towards achieving the interim milestones.

### Chesapeake Bay Watershed 2009-2011 Milestones

**Interim Progress Assessment/Fact Sheet - June 2011**

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Status</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>VA, DE</td>
<td>Generally on track.</td>
<td>In some cases, behind on one or two milestones.</td>
</tr>
<tr>
<td>PA, WV</td>
<td>Generally short of schedule.</td>
<td>Holding on some milestones.</td>
</tr>
<tr>
<td>NY</td>
<td>Generally short of schedule.</td>
<td>Some progress, behind on others.</td>
</tr>
<tr>
<td>MD</td>
<td>Generally short of schedule.</td>
<td>More current progress, thus closer to goal.</td>
</tr>
<tr>
<td>DC</td>
<td>Generally short of schedule.</td>
<td></td>
</tr>
</tbody>
</table>

For more, contact Margaret Enloe (410) 267-5740, menloe@cbp.state.md.us.
Significant Point Sources in the Chesapeake Bay Basin

Facility Capacity
(million gallons/day)
- < 2
- 2-10
- 10-25
- 25-50
- > 50
Wastewater TN Load Reduction Progress

TN EOS Load (mil lbs/yr) vs Population Trend in the Chesapeake Bay Watershed

- Industrial
- Municipal
- Population
Using Monitoring Data To Measure Progress and Explain Change

Foundation: Monitoring networks
Long-Term Trend in Flow-Adjusted Total Nitrogen Concentration, 1985-2012

- Not Significant
- Improving, Decrease
- Degrading, Increase

Long-Term Trend in Flow-Adjusted Total Phosphorus Concentration, 1985-2012

- Not Significant
- Improving, Decrease
- Degrading, Increase
Total Nitrogen Delivered to the Bay
Changes in Total Nitrogen Delivered to the Bay Estuary from the 9 RIM Stations

Total reduction in RIM total nitrogen:
1985 to 2014 = 16%
2005 to 2014 = 2%
Long-Term Trends for Surface Total Nitrogen in the Chesapeake Bay: 1999-2013

This map shows 136 sampling stations. Trends were computed by MD and VA state partners using Seasonal Kendall method on the annual data sets. A decrease in Total Nitrogen corresponds to an increase in water clarity.

Data Sources: Chesapeake Bay Program

For more information, visit www.chesapeakebay.net

Disclaimer: www.chesapeakebay.net/termsOfUse.html

Created by HW, 02/23/15
Bay (tidal) Water Quality

29% for 2011-13 period (down slightly from 31% in 2010-12)

- 92 segments of tidal Bay evaluated using:
- 3 pieces of monitoring data for each:
  - Dissolved oxygen
  - Chlorophyll $a$ (algae)
  - Water clarity as measured by underwater grass abundance
Restoration of Mattawoman Creek: Potomac River estuary tributary

- strongly impacted by nutrients from 1970 - mid-1990s
- large and persistent algal blooms, sea grasses rare
- WWTP load reductions stimulated restoration

Photo from Elena Gilroy
Major WWTP load reduction completed

More Algae

Drought Year

Year

Major WWTP load reduction completed

ALGAL BIOMASS DECREASED...WITH SUBSTANTIAL LAG TIME

• No clear response for about 4 years followed by sharp decline in algae

• After 2005 low levels of algae became normal
Water Clarity Increased...also with a Lag Time

- No clear increase for about 8 years followed by sharp increase in clarity
- Water clarity and algae highly correlated shallow Chesapeake Bay systems
• Very low levels of SAV were present prior to nutrient load reductions

• Major expansion of SAV in 2002, a severe drought year
Florida’s Numeric Nutrient Criteria

Background and Implementation

• Doug Durbin, Ph.D. September 2015
Background
Florida NNC – Online Resources

- Background and links to rules, documents, maps, etc:
  - [http://www.dep.state.fl.us/water/wqssp/nutrients/](http://www.dep.state.fl.us/water/wqssp/nutrients/)

- Implementation guidance:
  - [http://www.dep.state.fl.us/water/wqssp/nutrients/docs/NNC_Implementation.pdf](http://www.dep.state.fl.us/water/wqssp/nutrients/docs/NNC_Implementation.pdf)

- Development of Type III SSACs for nutrients:
  - [http://www.dep.state.fl.us/water/wqssp/docs/swqdocs/type_III_ssac.pdf](http://www.dep.state.fl.us/water/wqssp/docs/swqdocs/type_III_ssac.pdf)
Florida NNC – General Timeline

- **2001** - FDEP began technical process
  - Data compilation and review
  - New data collection
  - NNC Technical Advisory Committee
  - Public input and meetings
- **2008** - Law suit filed by Earth Justice to compel EPA to establish NNC for Florida
- **Jan 2009** – EPA issued a Determination Letter stating that NNC were required in FL to implement the CWA
- **Aug 2009** - EPA and Earth Justice signed a consent decree
  - Established specific milestones dates
Florida NNC – General Timeline

- **Nov 2010** – EPA finalized NNC for streams, lakes and springs
  - Used data and work from FDEP
  - Included specific “downstream protection values”
  - Provided for nutrient SSACs
- Many parties filed suit against EPA NNC
  - Judge upheld NNC for lakes and springs, but overturned other parts of the EPA rule
- **Dec 2011** – FDEP adopted NNC for lakes, streams and springs
  - Challenges were filed, but NNC were upheld by FL judge
- **Nov 2012** – EPA approved the FDEP NNC
  - Agreed that FL could continue to use narrative approach for certain waters
- **March 2013** - EPA withdrew its NNC for FL
  - FL to continue NNC establishment for estuaries
- **June 2013** – FDEP estuarine criteria approved by EPA
  - **Statewide NNC fully in place**
Florida NNC – The Regulations

• “For many decades Florida has had a narrative nutrient water quality criterion in place to protect Florida’s waters against nutrient over-enrichment. In 2009, the Department initiated rulemaking and, by 2011, adopted what would be the first set of statewide numeric nutrient standards for Florida’s waters. By 2015, almost all of the remaining waters in Florida have numeric nutrient standards.”

• There are actually four distinct sets of rules:

  • Lakes, Streams and Springs (62-302.531)
  • Estuaries and Coastal Areas (62-302.532)
  • Everglades (62-302.540)
  • Identification of Impaired Waters (62-303)
Florida NNC – What Did They Get?

- What did Florida get?:
  - **Statewide** NNC
  - Flexibility
    - (in some cases)
  - Biological Confirmation
    - (when it's feasible)
  - The **very same** numeric values EPA proposed for lakes, streams and springs
    - But, generally at the “back” of the rule, not the “front”
    - Over-protective?, under-protective?, ambiguous?
Florida NNC – The “Numeric” Parts

Summary of Fresh Water NNC – Lakes & Springs

<table>
<thead>
<tr>
<th>Waterbody Type</th>
<th>Class</th>
<th>TN (mg/L)</th>
<th>TP (mg/L)</th>
<th>Chl-a (ug/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lakes</td>
<td>Colored</td>
<td>1.27 [or up to 2.23]</td>
<td>0.05 [or up to 0.16]*</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Clear, Alkaline</td>
<td>1.05 [or up to 1.91]</td>
<td>0.03 [or up to 0.09]</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Clear, Acid</td>
<td>0.51 [or up to 0.93]</td>
<td>0.01 [or up to 0.03]</td>
<td>6</td>
</tr>
<tr>
<td>Springs</td>
<td>All</td>
<td>0.35**</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

TN and TP criteria can change based on observed Chl a levels

* For lakes in the West Central region, the maximum TP limit is 0.49 mg/L

**Criterion applies to nitrate+nitrite concentrations only
### Summary of Fresh Water NNC – Streams

<table>
<thead>
<tr>
<th>Nutrient Watershed Region</th>
<th>TN (mg/L)</th>
<th>TP (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panhandle West</td>
<td>0.67</td>
<td>0.06</td>
</tr>
<tr>
<td>Panhandle East</td>
<td>1.03</td>
<td>0.18</td>
</tr>
<tr>
<td>North Central</td>
<td>1.87</td>
<td>0.30</td>
</tr>
<tr>
<td>West Central</td>
<td>1.65</td>
<td>0.49</td>
</tr>
<tr>
<td>Peninsula</td>
<td>1.54</td>
<td>0.12</td>
</tr>
</tbody>
</table>
Estuarine NNC

- Numerous water-body-specific numeric criteria
- Some as loadings (tons/million cubic m)
- Others as concentrations (ug/L, mg/L)
- Some as annual mean
- Others as annual geometric mean
- Many are “hold the line” protective criteria
- Many are based on local estuary program data collection and management efforts
- Estuaries are not all alike.
Florida NNC – Biological Aspects of NNC - Streams

**Floral Metrics**
- Annual Geometric Mean Chlorophyll-a
- Linear Vegetation Survey (LVS)
- Rapid Periphyton Survey (RPS)

**Faunal Metrics**
- Stream Condition Index (SCI)

**Nutrient Thresholds**

<table>
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<tr>
<th>Nutrient Watershed Region</th>
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</table>
Florida NNC – Biological Factors

Fresh Water NNC – Streams

Floral Metrics

Nutrient Thresholds

Stream Condition Index

Attains Nutrient Standard

Attains Nutrient Standard
Florida NNC – Biological Factors

**Fresh Water NNC – Streams**

Water Body Must Achieve **All** To Attain Numeric Interpretation of Narrative Nutrient Standard:

- Exotic aquatic vegetation not greater than 25%
- Mean Coefficient of Conservatism score greater than 2.5
- Benthic algae coverage of 6 mm or greater not more than 25%
- Benthic algae species is not nuisance or undesirable (if more than 20% coverage observed)
- Average SCI score greater than 40
- Neither of the two most recent SCI scores less than 35
- Annual geometric mean chlorophyll-a less than 20 ug/L
  - Between 3.2 and 20 ug/L – site specific conditions must indicate nutrients not an issue
  - No increasing trend observed
If the biology of the system is ok, the nutrients must not be causing a problem.
Easy and Straightforward So Far, Right?
Implementation
Implementing NNC

Implementation of
Florida’s Numeric Nutrient Standards

Document Submitted to EPA in Support of the Department of Environmental Protection’s Adopted Nutrient Standards for Streams, Spring Vents, Lakes, and Selected Estuaries

April 2013
PURPOSE OF DOCUMENT

This document describes how numeric nutrient standards in Chapters 62-302 (Water Quality Standards) and 62-303 (Identification of Impaired Surface Waters), Florida Administrative Code (F.A.C.), are implemented by the Department of Environmental Protection (Department). The major topics include the hierarchical approach used to interpret the narrative nutrient criterion (NNC) on a site-specific basis; a summary of the criteria for lakes, spring vents, streams and estuaries; floral measures and the weight of evidence approach in streams; example scenarios for how the criteria will be implemented in the 303(d) assessment process; and a description of how the Water Quality Based Effluent Limitation (WQBEL) process is used to implement the nutrient standards in wastewater permitting. Finally, because of the complexity associated with assessing nutrient enrichment effects in streams, a summary of the weight-of-evidence evaluation involving flora, fauna, and Nutrient Thresholds is provided.
Hierarchical Approach

Nutrient Total Maximum Daily Loads, Site Specific Alternative Criteria, Estuary-specific Criteria, and Water Quality Based Effluent Limitations

→ Stressor-Response Relationships (lakes & springs)

→ Reference stream-based thresholds combined with biological data (flora and fauna)

→ Narrative (wetlands, intermittent streams, South Florida flowing waters)
### Summary of the Criteria

#### Covered on Earlier Slides

<table>
<thead>
<tr>
<th>Waterbody Type</th>
<th>Class</th>
<th>TN (mg/L)</th>
<th>TP (mg/L)</th>
<th>Chl-a (ug/L)</th>
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TN and TP criteria can change based on observed Chl a levels

* For lakes in the West Central region, the maximum TP limit is 0.49 mg/L

**Criterion applies to nitrate+nitrite concentrations only
Application of NNC in 303(d) Process

- Lots of data compilation and analysis for streams and lakes
- Lots of new data collection
  - Especially biological information
  - Generally more than one sampling event needed
  - “Floral measures alone can provide evidence that the nutrient standard is not achieved, leading to the waterbody being placed on the Florida Verified List and Clean Water Act 303(d) list.”
  - **EVEN IF THE WATER BODY IS BELOW THE NUMERIC CRITERIA VALUES**

- Water body can have one of three designations
  - Not Impaired (no TMDL required)
  - Verified Impaired (TMDL is required)
  - Study List (more data needed)
# Application of NNC in 303(d) Process

## Establishing Nutrient Impairment in FL Streams

<table>
<thead>
<tr>
<th>Attains Nutrient Thresholds for Both TN and TP (3 Years of Data)</th>
<th>Nutrient Threshold Attainment Inconclusive for Either TN or TP (&lt;3 Years of Data)</th>
<th>At Least One Nutrient Threshold Not Attained (3 Years of Data)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SCI Attains</strong> (2 Samples)</td>
<td><strong>SCI Inconclusive</strong> (&lt;2 Samples)</td>
<td><strong>SCI Not Attained</strong> (1 or 2 Samples)</td>
</tr>
<tr>
<td><strong>Floral Measures Inconclusive (&lt;2 Sampling Events)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attains .531(2)(c)</td>
<td>Cat. 2</td>
<td>Attains .531(2)(c)</td>
</tr>
<tr>
<td>Cat. 2</td>
<td></td>
<td>Attains .531(2)(c)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Any One Floral Measure Not Attained (2 Sampling Events)</strong></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>.531(2)(c) Not Attained</td>
<td>.531(2)(c) Not Attained</td>
<td>.531(2)(c) Not Attained</td>
</tr>
<tr>
<td>Cat. 5 (Verified &amp; 303(d) List)</td>
<td>Cat. 5 (Verified &amp; 303(d) List)</td>
<td>Cat. 5 (Verified &amp; 303(d) List)</td>
</tr>
</tbody>
</table>
**Establishing Nutrient Impairment in FL Lakes**

- If annual geometric mean of chl a exceeds criterion for the lake type more than one in three years – **Verified Impaired and 303(d) list**

- If annual geometric mean chl a does **not** exceed the value for the lake type, **but** annual mean of either TN or TP exceeds the upper limit for the lake type more than one in three years – **Verified Impaired and 303(d) list**

- **Within any year**, if annual geometric mean of chl a exceeds criterion for that lake type, the TN and TP criteria are set at the lower thresholds – and vice-versa.

- **This means the TN and TP criteria for a lake can change on a year to year basis based on chl a values**
Establishing Nutrient Impairment in FL Springs

- Is NO$_2$+NO$_3$ above 0.35 mg/L – Verified Impaired and 303(d) list
- No phosphorus considerations
- No chlorophyll or other biological considerations
Establishing Nutrient Impairment in FL Estuaries

- Straightforward application of numeric values in the Rule
- Ongoing data collection by FDEP, resource agencies, and local estuary stakeholders in most cases
- Could be confusion over tidal creeks, coastal marshes, etc.
  - Not the same as open waters
WQBEL Process – Wastewater Permits

Renewal of Existing Permits
(nearly all NPDES discharges in FL are to streams)

• For Existing Discharges – Level I WQBEL
  - Rely mostly on existing data
  - “Simple” analysis

Evaluate Floral and Faunal Metrics in Receiving Water
If Achieved – nutrients in discharge must not be a problem
Permit Renewed with current permitted limits
WQBEL Process

New or Expanded Permits

• Level II WQBEL
  • New data usually needed
  • More stringent analysis
  • More expensive
  • More time consuming
  • Likely to require water quality modelling

• Must demonstrate discharge will not cause or contribute to violations of NNC
• Must link nutrient concentrations in discharge to biology in receiving waters
  • Biological metrics

THESE ARE LARGELY UNCHARTED WATERS FOR NNC
“If downstream waters are anticipated to be potentially affected by the discharge of nutrients from an upstream facility, the potential impact must be assessed, regardless of distance.” (FDEP 2013)
Site-Specific Alternative Criteria (SSAC)

Type III SSACs established specifically for NNC

Requires same data collection as biological health demonstration
  > Must show attainment of all biological metrics
  > Can be for segment or watershed

Sets numeric criteria for waterbody or segment
  > Spatially defined by applicant
  > Can provide regulatory certainty

Requires FDEP and EPA approval
  > No defined timeline for approval

Must provide for downstream protection
NNC Implementation
Supplemental Information

Unexpected Consequences of Florida NNC
FL’s NNC Are Intended to Play a Role in:

- FDEP
  - Managing the state 303(d) List
  - Identifying, regulating and restoring “impaired waters”

- NPDES Permit Applicants and Renewals
  - WQBEL Process
    - Domestic Waste
    - Industrial Waste
But Could They Have Influences Elsewhere . . . . ?

- **Federal Permitting**
  - USACE Dredge and Fill (404)
    - Same kinds of projects as State ERP
  - FERC (pipelines, power transmission)
  - NEPA Process
    - Environmental Assessment
    - Environmental Impact Studies
  - EPA oversight of some…
    - Federal permitting
    - State permitting
Influences Elsewhere . . . ?

- **Municipalities with MS4 Permits**
  - Form of NPDES permit
  - Many highly altered water bodies
    - Canals
    - Ditches
    - Impoundments
  - Complex
    - Multiple discharge points
    - Total dependence on storm water as their driver
  - Aging storm water ponds/systems with decades of sequestered nutrients
• **Construction Generic Permit**
  • Form of NPDES permit
  • Administered through FDEP
  • Requires a SWPPP
    • Evaluation of how and where pollutants may be mobilized
    • BMPs to control pollution
  • Historically focused on sediment/erosion
    • What if site abuts a stream or lake impaired for nutrients?
    • What if the impaired water is downstream but could be reached by runoff during construction?
  • Legacy nutrient issues could arise

And Elsewhere . . . . ?
And Elsewhere . . . . ?

- **Florida Environmental Resource Permitting**
  - Land development
    - Residential, commercial, industrial
  - Mining and Reclamation Activities
  - Transportation and other linear projects
  - Channel & marina dredging
  - State Water Quality (401) Certification via ERP

- **Beware of “Impaired Waters” on or near your development site**
  - WMD permitters have begun asking for stronger demonstration of net water quality improvement from development
And Elsewhere . . . . ?

- Agriculture operations – especially conversions
  - Legacy nutrients

- Aquaculture facilities

- Brownfield management or redevelopment
And Elsewhere . . . . ?

- **Local Government Regulation and Initiatives**
  - Local stormwater management policies
  - Fertilizer ordinances and other landscaping regulations
  - Setbacks and buffers from waters and wetlands
  - Septic tank & drainfield ordinances
  - Green Infrastructure Programs
And Still Elsewhere . . . . ?

- **Groundwater Regulation & Management**
  - Drinking water facilities
  - Springs protection and restoration
  - Land application (fertilizer, waste)
  - Septic tank & drainfield regulation or management

- *FDEP has funded a “seepage study” project to quantify nutrients in groundwater entering surface waters. Pilot project is on the Sebastian River associated with agricultural lands, with other projects to follow elsewhere in the state*
Other Places NNC Could Be Felt

• Water Quality (Nutrient) Credit Trading
  • The recent Florida statute needs to be amended to open up more potential trades
  • DEP is in rulemaking on this (pay attention)
• Updated Waters of the US rule (WOTUS)
  • More jurisdictional wetlands - and particularly streams - may mean more places where NNC would apply
  • More likely to affect ERP permitting than NPDES

• “Stakeholders” in basins with nutrient TMDLs and BMAPs may face many challenges not associated with NPDES permits
• Types or frequency of legal actions brought by environmental NGOs may increase because NNC offer new entry points
Thank You
Nutrient Criteria Implementation in NC: Work In Progress

NC Nutrient Criteria Implementation Committee
Sept. 25, 2015

Rich Gannon
NC Division of Water Resources
## NC Nutrient Strategies Scorecard

<table>
<thead>
<tr>
<th>Date</th>
<th>Watershed</th>
<th>Sources</th>
<th>Fully Implemented?</th>
<th>Success?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981</td>
<td>Chowan (1)</td>
<td>Point</td>
<td>Yes ~1984</td>
<td>Yes!</td>
</tr>
<tr>
<td>1991</td>
<td>New (2)</td>
<td>Point</td>
<td>Yes ~1996</td>
<td>Yes!</td>
</tr>
<tr>
<td>1997</td>
<td>Neuse (3)</td>
<td>PS/NPS</td>
<td>Yes - 2003</td>
<td>Not so much</td>
</tr>
<tr>
<td>2000</td>
<td>Tar-Pamlico (4)</td>
<td>PS/NPS</td>
<td>Yes - 2006</td>
<td>“</td>
</tr>
<tr>
<td>2009</td>
<td>Jordan (5)</td>
<td>PS/NPS</td>
<td>No – 2029+</td>
<td>Too soon</td>
</tr>
<tr>
<td>2011</td>
<td>Falls (6)</td>
<td>PS/NPS</td>
<td>No - 2041</td>
<td>“</td>
</tr>
</tbody>
</table>
Big 4 ‘Comprehensive’ Nutrient Strategies
# Strategy Elements and Possible CIC Roles

<table>
<thead>
<tr>
<th>Element Type</th>
<th>Possible Element</th>
<th>SAC Role?</th>
<th>CIC/Stakeholder Input?</th>
</tr>
</thead>
<tbody>
<tr>
<td>What</td>
<td>[N], [P]</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>What</td>
<td>Response: [chl a] &lt; 40? [Phyto types]?</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>When</td>
<td>Seasonal?</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Where</td>
<td>Spatial?</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>How much</td>
<td>% N vs. P lb/yr</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Who</td>
<td>Which sources</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>By When</td>
<td>Over what timespan</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

See handout
Neuse and Tar-Pamlico – What Sources?

First ‘comprehensive’ nutrient regulations in NC

- Wastewater discharges
- Urban stormwater
- Agriculture
- Riparian areas protection
- Fertilizer management
Sources Regulated under Big 4?

Neuse, Tar rules:
- Wastewater
- Agriculture
- New development stormwater (w/offsets)

Jordan, Falls rules **add**:
- New D **all parties**
- Existing development stormwater
- Trading

Jordan, Falls Target-Setting
Lake Model N/P Reduction Response Curves

Falls Lake

Jordan Lake – Upper New Hope

(average growing season frequency of excursions)

Percent of Chlorophyll $a$
Excursions
(Observations $> 40 \mu g/l$)

- 40.0
- 30.0
- 25.0
- 20.0
- 15.0
- 12.0
- 10.0
- 8.0
- 6.0

Falls Lake

Existing Condition

P reduction

N reduction

Fraction of Existing Total N Load

Fraction of Existing Total P Load

N Reduction (%)
Common Features of Major Nutrient Strategies

• Collaborative development
• Waterbody-specific goals
• ‘All’ significant sources
  – Fair, reasonable, ∝ reductions
  – Load accounting
• Options, offsets, trading
• Increasingly complex, longer horizons
Challenges for Complex Strategies:
NPS Accounting (science), Resources

- All NPS: Estimating *instream* loads & reductions
- New Development – hydrology
- Trading: useful structure
- Existing Development – bigger toolbox
- Agriculture
  - To-stream N accounting – loads, reductions
  - Quantitative phosphorus accounting
  - Pasture nutrient science
- Regulator resources – state, local
- Biology – Piedmont reservoirs …
Information

DWR Nutrient Strategies
http://portal.ncdenr.org/web/wq/ns

Nutrient Offset
http://portal.ncdenr.org/web/wq/ps/nps/nutrientoffsetintro

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Others john.Huisman@ncdenr.gov  807-6436
Rich.gannon@ncdenr.gov  919-807-6440
Falls Lake Impairment, Reduction Goals

<table>
<thead>
<tr>
<th>Station ID</th>
<th>% over 40 ug/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELL10</td>
<td>84.0%</td>
</tr>
<tr>
<td>LC01</td>
<td>21.1%</td>
</tr>
<tr>
<td>LLC01</td>
<td>39.0%</td>
</tr>
<tr>
<td>NEU010</td>
<td>53.0%</td>
</tr>
<tr>
<td>NEU013B</td>
<td>53.0%</td>
</tr>
<tr>
<td>NEU0171B</td>
<td>25.0%</td>
</tr>
<tr>
<td>NEU018E</td>
<td>16.0%</td>
</tr>
<tr>
<td>NEU019C</td>
<td>4.0%</td>
</tr>
<tr>
<td>NEU019E</td>
<td>16.0%</td>
</tr>
<tr>
<td>NEU019L</td>
<td>12.0%</td>
</tr>
<tr>
<td>NEU019P</td>
<td>9.9%</td>
</tr>
<tr>
<td>NEU020D</td>
<td>9.9%</td>
</tr>
</tbody>
</table>

Upper Lake 40%/77%

Lower Lake “CAC”, ~20%/40%
Chowan Watershed Management Options with Projected Population and Land Use Changes
Challenge: Up/Down Cost/Benefit Perceptions

Haw Subwatershed

Upper New Hope Subwatershed

Lower New Hope Subwatershed
Jordan Lake Nutrient Goals

Upper New Hope Arm
35% N
5% P

Lower New Hope Arm
0% N
0% P

Haw Arm
8% N
5% P

Goals are relative to a baseline period ending 2001
Progress on ED Measures

• Programmatic
  – Improved street sweep
  – Malfunctioning septic
  – Urban canopy increase
  – Fertilizer controls

• Wastewater/Pumped
  – Discharging sand filter
  – Algal turf scrubber

• Ecosystem
  – Stream restoration
  – Buffer credit revisions

• Stormwater
  – Pond retrofits
    • Floating wetlands
    • Littoral sand filter
    • Upflow filter
  – Regen. St’water Conveyance
  – Divert impervious
  – Soil amendment
  – Infiltration devices

• Agriculture
  – Cropland conversion
  – (Buffered) exclusion
## Point Source Requirements

<table>
<thead>
<tr>
<th>Waterbody</th>
<th>Estimated Nitrogen Concentrations</th>
<th>Estimated Phosphorus Concentrations</th>
<th>Facilities Affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tar Pamlico Estuary</td>
<td>Group Cap (2010) 6.85 mg/l</td>
<td>Group Cap (2010) 0.92 mg/l</td>
<td>15 WWTPs</td>
</tr>
<tr>
<td>Neuse River Estuary</td>
<td>Mass limits Equivalent to 3.75 to 5.5 mg/l</td>
<td>Equivalent to 2.0 mg/l</td>
<td>18 &gt; 0.5mgd</td>
</tr>
<tr>
<td>Jordan Lake</td>
<td>Equivalent to:</td>
<td>Equivalent to:</td>
<td></td>
</tr>
<tr>
<td>▪ Upper New Hope</td>
<td>▪ 5.35 mg/l</td>
<td>▪ 0.23 mg/l</td>
<td>▪ 4 WWTPs &gt; 0.1 mgd</td>
</tr>
<tr>
<td>▪ Lower New Hope</td>
<td>▪ 3.0 mg/l</td>
<td>▪ 0.37 mg/l</td>
<td>▪ 1 WWTP &gt; 0.1 mgd</td>
</tr>
<tr>
<td>▪ Haw River</td>
<td>▪ 5.39 mg/l</td>
<td>▪ 0.66 mg/l</td>
<td>▪ 10 WWTPs &gt; 0.1 mgd</td>
</tr>
<tr>
<td>Falls Lake Watershed</td>
<td>▪ 3.0 - 3.6 mg/l</td>
<td>▪ 0.33 - 0.46 mg/l</td>
<td>3 Major &gt; 0.1 mgd</td>
</tr>
<tr>
<td>▪ Stage 1</td>
<td>▪ 1.13 mg/l</td>
<td>▪ 0.06 mg/l</td>
<td></td>
</tr>
<tr>
<td>▪ Stage 2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Chowan Sets Stage for Subsequent Strategies

- 1978 – adopted chlorophyll a standard
- 1979 – NSW classification; Chowan 1st
- 1980’s – Chowan strategy
  - Point source: reduced to background
  - Launched NC Ag Cost Share Program
- 1988 – phosphate detergent ban
Coastal New River Strategy

• “Nutrient Sensitive” 1991
• Point source improvements
• By 2001:
  - Reduced frequency, duration of blooms
  - Mainstem “fully supporting”