Introduction to Numeric Nutrient Criteria

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Overview

• Background on Numeric Nutrient Criteria Development

• Review of State Support Through N-STEPS

• Discussion on Similarities in Numeric Criteria Values to Date
Nutrient Pollution Destabilizes Ecosystems

- Two main pathways by which nutrients affect water quality

**Competition**
- Increased $\text{N/P}$ → Species Shifts → Nuisance/Harmful Algae/Plants → Toxins → Aesthetics → Taste and Odor → Drinking
- Nuisance/Harmful Taxa Are Poor Competitors

**Productivity**
- Increased $\text{N/P}$ → Increased Productivity → Increased Organic Matter → Increased Respiration → Decreased Oxygen → Physical Habitat → Behavior → Survival → Swimming
- Nutrients Stimulate Organic Matter Production
Nutrient Pollution Impacts Water Quality

Gulf of Mexico dead zone in July 2017
At 8,776 square miles, the 2017 dead zone in the Gulf of Mexico was the largest ever measured (Courtesy of N. Rabalais, LSU/LUMCON)
### Nutrient Pollution Impacts Designated Use Support

#### Region 8
**Causes of Impairment in Assessed Lakes, Reservoirs, and Ponds**

<table>
<thead>
<tr>
<th>Cause of Impairment Group</th>
<th>Acres Threatened or Impaired</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>858,446</td>
</tr>
<tr>
<td>Metals (other than Mercury)</td>
<td>369,197</td>
</tr>
<tr>
<td>Nutrients</td>
<td>241,964</td>
</tr>
<tr>
<td>pH/Acidity/Alkaline Conditions</td>
<td>181,538</td>
</tr>
<tr>
<td>Algal Growth</td>
<td>156,412</td>
</tr>
<tr>
<td>Polychlorinated Biphenyls (PCBs)</td>
<td>152,160</td>
</tr>
<tr>
<td>Salinity/Total Dissolved Solids/Chlorides/Sulfates</td>
<td>109,511</td>
</tr>
<tr>
<td>Organic Enrichment/Oxygen Depletion</td>
<td>75,249</td>
</tr>
<tr>
<td>Flow Alteration(s)</td>
<td>51,859</td>
</tr>
</tbody>
</table>

U.S. EPA ATTAINS accessed on November 8, 2018

473,625 acres listed under 303(d)
Nutrient Criteria Are Important to Protect and Restore Uses

- WQS requirement (40 CFR 131)
  - Designated Use
  - Criteria
  - Antidegradation

- Criteria must:
  - Protect sensitive designated uses
  - Be based on a sound scientific rationale

State Regulations: Narrative Criteria

"Plant nutrients from other than natural causes shall not be present in concentrations which will produce undesirable aquatic life or result in a dominance of nuisance species in surface waters of the state."

- State of New Mexico Standards for Interstate and Intrastate Surface Waters (Subsection E of 20.6.4.13 NMAC)

"Taste- and odor-producing materials. Materials which will impart undesirable tastes or undesirable odors to the receiving water may not be discharged or caused to be discharged into surface waters of the state in concentrations that impair a beneficial use."

- Administrative Rules of South Dakota, Surface Water Quality Standards (74:51:01:08)
Numeric Nutrient Criteria Will Help

- Narratives were proving insufficient to protect designated uses
- Needed a more efficient and effective way for CWA water quality management purposes
- Encourage development of numeric nutrient criteria

EPA Strategy and Technical Support


Technical support documents (pursuant to 33 USC 1314, CWA Section 304)

- Nutrient criteria = nitrogen, phosphorus, chlorophyll-a, and water clarity
- Recommended criteria for most lakes/reservoirs, rivers/streams (2000-1)
- Stressor-response approaches (2010)
Numeric Nutrient Criteria Approach

Identify the management goal

WQ pollutant target (numeric criteria)

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management Goal</td>
<td>Narrative criteria or statement reflective of protecting a designated use</td>
</tr>
<tr>
<td>Assessment Endpoint</td>
<td>Ecological entity and its attributes to be protected to support designated use</td>
</tr>
<tr>
<td>Measure</td>
<td>Measurable attributes of an assessment endpoint</td>
</tr>
<tr>
<td>Water Quality Target</td>
<td>Numeric value that indicates attainment of the management goal</td>
</tr>
</tbody>
</table>
Numeric Nutrient Criteria Approach

- Develop conceptual models
- Compile Data
- Conduct Analyses
  - Classification
  - Stressor-Response Modeling
  - Reference Condition
  - Mechanistic Models
- Implement
Coming soon!
New National Criteria Recommendations for Lakes/Reservoirs

• Stressor-response relationships are used to link chl \( a \) concentration to attainment of each of three designated uses (aquatic life, recreation, and drinking water source).

• When multiple use designations apply to a lake, states and tribes can calculate and compare candidate criteria for each applicable use to inform their risk management decisions (40 CFR 131.11(a)).

• Criteria development tools are based on stressor-response models and combine state and national data to derive state-specific values that reflect local conditions.

• Tools provide flexibility for each state to incorporate their own risk management decisions in deriving final criteria.
N-STEPS Assistance is Available to States and Tribes

• Since 2005, EPA has provided technical support to States and Tribes to help them use their data to derive criteria through N-STEPS (Nutrient Scientific Technical Exchange Partnership and Support).

• States and Tribes can request N-Steps Technical Support through their EPA regional nutrient coordinator, or through our website.

NSTEPS: WA Stream Diatom Models
N-Steps Technical Assistance for Numeric Nutrient Criteria Projects

- NSTEPS State Partnership Projects
- 42 States + 4 tribes/territories
- All steps in derivation process
  - From Data Exploration to Peer Review
Numeric Nutrient Criteria Approach

- States have greatly expanded on this

Montana Small Stream Dosing Experiments

Montana Large River Mechanistic Modeling
What sort of Values are States Using?

• State Adopted Criteria

• Published Research
Results: Adopted TP Criteria Across the US

- 90 percent of Total Phosphorus (mg/L) values:
  - Lakes: 0.02 to 0.100
  - Streams: 0.02 to 0.100
  - Estuaries: 0.015 to 0.05
90 percent of Total Nitrogen (mg/L) values:
- Lakes: 0.20 to 1.20
- Streams: 0.20 to 1.25
- Estuaries: 0.20 to 0.90
Results: Published Studies in Streams

- Across the United States
- For Streams: 90% of values where impacts occur very by less than a factor of 10

**Total Nitrogen**: 0.20 to 1.1 mg/L

**Total Phosphorus**: 0.01 to 0.10 mg/L
Why aren’t the Ranges Larger?

- Phosphorus and nitrogen are naturally rare but every cell needs them

- Tight competition means quick shifts with enrichment

- Limitation means quick organic matter increases with enrichment

- Excess production destabilizes ecosystems and the services we rely on
Take Home Messages

- Numeric nutrient criteria are important for the protection and restoration of designated uses of water bodies.

- There are a variety of ways to derive numeric thresholds and most states are actively pursuing them.

- Through N-STEPs, EPA is providing much needed technical support for these state efforts.

- The range of resulting numeric values are relatively narrow for sound scientific reasons.
Learn More About Technical Support Opportunities
Via N-STEPS and More

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