National Nutrient Standards

- Water Quality Protection
  - Regulatory Initiatives
  - Numeric Nutrient Standards
- Wastewater Treatment Technology
  - Limit of Technology
  - Sustainability
- Nutrient Discharge Permitting
Water Quality Protection

Lake Spokane, WA
Washington Department of Ecology

Fish die in Hood Canal
Deaths blamed on low oxygen in water.

Puget Sound, WA
Seattle Times, 2006
National Water Quality Priorities

**Ben Grumbles, Former EPA Assistant Administrator for Water**

- **Chesapeake Bay**
  - 150,000 New Residents per Year
- **Gulf of Mexico**
  - Large dead zone
  - Importance of Phosphorus
- **Long Island Sound**
  - Below DO in Half of Sound
  - Water quality trading program implemented
- **Puget Sound**
  - Priority No. 1: Better handle on nutrient and bacteria loadings from Septic Systems
EPA’s National Nutrient Strategy

- Ben Grumbles May 25, 2007
  Memorandum to States
  - “Numeric standards reduce States’ time and effort to establish TMDLs and permits to control nutrient levels”

- EPA Assistance to States
  - Assistance in Adopting Numeric Criteria
  - Science-based Criteria for Estuaries, Wetlands, and Large Rivers
  - Communicate the Dangers of Nutrient Pollution and the Merits of Numeric Nutrient Criteria to States, Nutrient Sources, and the General Public
NRDC Petition on Secondary Treatment Standards

- November 27, 2007 NRDC Petition for Rulemaking
  - EPA Has Unreasonably Delayed Publishing Information on Secondary Treatment to Remove Excess Nutrients
  - Nutrient Control is Properly Included within “Secondary Treatment”

NRDC States:
- TP 0.3 mg/l and TN 3 mg/l Currently Attainable
- TP 1 mg/l and TN 8.0 mg/l Attainable Only Using Biological Processes
- EPA Must Assess Whether This Constitutes “Secondary Treatment”
“…we now see additional challenges have arisen in the areas of non point source pollution and in new emerging pollutants of concern.”

“…we need to carefully consider how to ensure that our water, wastewater, and stormwater infrastructure can be financed and managed sustainably.”
Ephraim King, EPA OST predicts we’re coming to perfect storm on nutrients:

- Increasing litigation
- Population growth
- Climate change with less rain and higher nutrient concentrations
- Biofuels to support growth
- Vastly expanded urbanization

EPA Water Program Nutrient Tools

- Narrative standards
- TMDLs
- BMPs
- Economic incentives
- Technology Based standards (treatment technology limits)
- Partnerships
- Numeric Nutrient standards
- How can all of these be put together?
“EPA’s current approach is not working”

**Recommendations**
- Select significant waters of national value
- EPA set numeric nutrient standards
  - Mississippi River and Gulf of Mexico highlighted
- Establish EPA and State accountability
- Establish metrics to gauge progress by States
- EPA regions validate water quality standards action tracking application annually
States and EPA recognize that eutrophication and nutrient overloading are significant environmental problems, not just for aquatic resources but also from a drinking water standpoint. In the past, we have been successful in some areas, but not in others. We agree to meet to develop a strategy to change the way we act to improve ways to reduce or eliminate nutrient releases.

- **Top 5 Most Promising Tools Recommended by Work Groups**
  - Detergent Phosphate Ban
  - Nonpoint Source Regulation
  - Federally Required State WQS Numeric Nutrient Water Quality Criteria
  - Update Secondary Nutrient Treatment Requirements
  - Green Labeling
Numeric Nutrient Standards

Lake Coeur d’Alene, ID

Spokane River, WA

Lake Spokane, WA

Lake Spokane, WA
Evolving Nutrient Limits and Numerical Standards

- **Narrative Standards for Nutrient Enrichment**
  - Nuisance Algae Growth

- **Evolving Numerical Standards for Nutrients**
  - EPA Eco-Region Data

- **EPA's National Numeric Nutrient Criteria for Receiving Waters**
  - Emphasis on Controlling “Nitrogen and Phosphorus Pollution”
**Nutrient Target Setting Challenges**

- **Identifying the Threshold of Harm to Beneficial Uses**
  - Stressor Response, Change Point Analysis
    - Numeric Nutrient Criteria
    - Macroinvertebrate Indices
    - Fisheries
  - Recreation/public Perception
- **Translation of Standards or TMDLs to NPDES Effluent Discharge Permits**

---

**Scientific and Technical Basis for Montana’s Numeric Nutrient Criteria**

- **F 150 mg/m² Chla**
- **D 1,250 mg/m² Chla**

---

**Chart: Algae Density (mg Chla/m²) and Photograph Letter**

- **Percent Ensemble Responses**
  - By-Mail Survey
  - On-Fer River Survey

- **Data Points**
  - A: 40
  - B: 110
  - C: 150
  - D: 200
  - E: 240
  - F: 300
  - G: 400
  - H: 1,280

---

**Legend**

- A: By-Mail Survey
- B: On-Fer River Survey
## Summary of Ecoregion Values for Rivers and Streams

In-stream target concentrations are low in all ecoregions

<table>
<thead>
<tr>
<th>Ecoregion</th>
<th>TN (mg/L)</th>
<th>TP (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I: Willamette and Central Valley</td>
<td>0.66</td>
<td>0.055</td>
</tr>
<tr>
<td>II: Western Forested Mountains</td>
<td>0.12</td>
<td>0.010</td>
</tr>
<tr>
<td>III: Xeric West</td>
<td>0.38</td>
<td>0.022</td>
</tr>
<tr>
<td>IV: Great Plains Grass and Shrublands</td>
<td>0.56</td>
<td>0.023</td>
</tr>
<tr>
<td>V: South Central Cultivated Great Plains</td>
<td>0.88</td>
<td>0.067</td>
</tr>
<tr>
<td>VI: Corn Belt and Northern Great Plains</td>
<td>2.18</td>
<td>0.076</td>
</tr>
<tr>
<td>VII: Mostly Glaciated Dairy Region</td>
<td>0.54</td>
<td>0.033</td>
</tr>
<tr>
<td>VIII: Nutrient-Poor, Largely Glaciated Upper Midwest and Northeast</td>
<td>0.38</td>
<td>0.010</td>
</tr>
<tr>
<td>IX: Southeastern Temperature Forested Plains and Hills</td>
<td>0.69</td>
<td>0.037</td>
</tr>
<tr>
<td>X: Texas-Louisiana Coastal and Mississippi Alluvial Plains</td>
<td>0.57</td>
<td>0.060</td>
</tr>
<tr>
<td>XI: The Central and Eastern Forested Uplands</td>
<td>0.31</td>
<td>0.010</td>
</tr>
<tr>
<td>XII: Southeastern Coastal Plain</td>
<td>0.90</td>
<td>0.040</td>
</tr>
<tr>
<td>XIII: Southern Florida Coastal Plain</td>
<td>1.14</td>
<td>0.015</td>
</tr>
<tr>
<td>XIV: Eastern Coastal Plain</td>
<td>0.71</td>
<td>0.031</td>
</tr>
</tbody>
</table>
## Aggregate Level III Ecoregion – Xeric West III

### Northern and Southern Arizona

<table>
<thead>
<tr>
<th>Nutrient Parameter</th>
<th>Aggregate Nutrient Ecoregion III Reference Conditions</th>
<th>Rivers and Streams in Nutrient Ecogreion III (25th percentile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Phosphorus (mg/L)</td>
<td>0.02188</td>
<td>0.02188</td>
</tr>
<tr>
<td>Total Nitrogen (mg/L)</td>
<td>0.38</td>
<td>0.38</td>
</tr>
<tr>
<td>Chlorophyll a (ug/L)</td>
<td>1.78</td>
<td>1.78</td>
</tr>
<tr>
<td>Turbidity (NTU)</td>
<td>2.34</td>
<td>2.34</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nutrient Parameter</th>
<th>Aggregate Nutrient Ecoregion III Reference Conditions</th>
<th>Lakes and Reservoirs in Nutrient Ecogreion III (25th percentile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Phosphorus (mg/L)</td>
<td>0.017</td>
<td>0.017</td>
</tr>
<tr>
<td>Total Nitrogen (mg/L)</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>Chlorophyll a (ug/L)</td>
<td>3.4</td>
<td>3.4</td>
</tr>
<tr>
<td>Turbidity (NTU)</td>
<td>2.7</td>
<td>2.7</td>
</tr>
</tbody>
</table>
Aggregate Level III Ecoregion – Western Forested Mountains II

- Central Arizona

<table>
<thead>
<tr>
<th>Nutrient Parameter</th>
<th>Aggregate Nutrient Ecoregion II (25th percentile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Phosphorus (mg/L)</td>
<td>0.010</td>
</tr>
<tr>
<td>Total Nitrogen (mg/L)</td>
<td>0.12</td>
</tr>
<tr>
<td>Chlorophyll a (ug/L)</td>
<td>1.08</td>
</tr>
<tr>
<td>Turbidity (NTU)</td>
<td>1.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nutrient Parameter</th>
<th>Aggregate Nutrient Ecoregion II Reference Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Phosphorus (mg/L)</td>
<td>0.0088</td>
</tr>
<tr>
<td>Total Nitrogen (mg/L)</td>
<td>0.1</td>
</tr>
<tr>
<td>Chlorophyll a (ug/L)</td>
<td>1.9</td>
</tr>
<tr>
<td>Turbidity (NTU)</td>
<td>4.5</td>
</tr>
</tbody>
</table>
## Status of States & Territories Numeric Nutrient Standards (EPA, 2008)

<table>
<thead>
<tr>
<th>Stage</th>
<th>Number</th>
<th>States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Has approved criteria for all parameters</td>
<td>5</td>
<td>TN, HI, AS, GU, CN</td>
</tr>
<tr>
<td>Has approved criteria for N, P, or Chlorophyll</td>
<td>4</td>
<td>DC, FL, OK*, NV</td>
</tr>
<tr>
<td>Engaged in developing criteria for all parameters and waters</td>
<td>6</td>
<td>MA, ME, VT, KY, MI, WI</td>
</tr>
<tr>
<td>Collecting data for all parameters or waters</td>
<td>34</td>
<td>CT, NH, RI, NJ, NY, PR, DE, MD, PA, VA, AL, FL, GA, MS, NC, SC, IL, IN, MN, OH, AR, LA, OK, NM, TX, IA, KS, MO, NE, CO, MT, UT, AZ, CA</td>
</tr>
<tr>
<td>Just starting criteria process</td>
<td>8</td>
<td>WV, ND, SD, WY, AK, ID, OR, WA</td>
</tr>
</tbody>
</table>

*OK: scenic rivers only, Updated May 14, 2007
Wastewater Treatment Technology

Yakima River, WA

Healdsburg, CA Membrane Bioreactor

Concrete, WA MBR Effluent
### Numeric Nutrient Criteria and Limits of Wastewater Treatment Technology

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Typical Municipal Raw Wastewater, mg/l</th>
<th>Secondary Effluent (No Nutrient Removal), mg/l</th>
<th>Typical Advanced Treatment Nutrient Removal (BNR), mg/l</th>
<th>Enhanced Nutrient Removal (ENR), mg/l</th>
<th>Limits of Treatment Technology, mg/l</th>
<th>Typical In-Stream Nutrient Criteria, mg/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Phosphorus</td>
<td>4 to 8</td>
<td>4 to 6</td>
<td>1</td>
<td>0.25 to 0.50</td>
<td>0.05 to 0.07</td>
<td>0.020 to 0.050</td>
</tr>
<tr>
<td>Total Nitrogen</td>
<td>25 to 35</td>
<td>20 to 30</td>
<td>10</td>
<td>4 to 6</td>
<td>3 to 4</td>
<td>0.3 to 0.600</td>
</tr>
</tbody>
</table>

- **Las Vegas, NV (TP 0.170 mg/l)**
- **Clean Water Services, OR (TP 0.100 mg/l)**
- **Lacy, Olympia, Tumwater Thurston Co (LOTT), WA (TIN 2 mg/l)**
- **Coeur d’Alene, ID (TP 0.050 mg/l)**
Discharger Issues with Numeric Nutrient Standards

- In-Stream Numeric Nutrient Standards Based on Natural Conditions Are Very Low
  - Translation to Discharge Permits
  - Lower Than Treatment Technologies Are Capable of Achieving If Applied “End-of-Pipe”
- Wastewater Utilities Rely on Surface Waters for Effluent Management
- Over-Regulation of Point Sources May Have Unintended Consequences
- Reduction in Point Sources Alone Will Not Protect Water Quality
Nonpoint Sources Dominate Many Watersheds

Phosphorus Loading Summaries for Gulf of Mexico, Chesapeake Bay, and Flathead Lake
Interpretation/Implementation of Numeric Nutrient Standards

- **Will Water Quality Variances be Required?**
  1. Dams or other hydrologic modifications
  2. Natural, ephemeral intermittent low-flow
  3. Natural physical conditions preclude attainment of aquatic life uses
  4. Human-caused conditions or pollutant sources that cannot be remedied or would cause more environmental damage to correct than to leave in place
  5. Substantial and widespread economic and social impact

- **Montana Approach**
  - Senate Bill 95 Temporary Water Quality Standards
    - Economic Hardship
      - Substantial and Widespread
    - Selected 1% Median Household Income
  - Limits of Technology
  - Rulemaking for Numeric Nutrient Standards

- 2% Median Household Income in Kansas
Treatment Costs Escalate Substantially as It Approaches Technology Limits

- Secondary treatment
- Biological nutrient removal (BNR)
- Enhanced nutrient removal (ENR)
- Limit of treatment technology (LOT)
- Reverse osmosis (RO)

Adapted from Jiang et al. 2005
Balance and Sustainability

Yellowstone River, MT

Billings, MT Treatment Plant
Balance and Sustainability to Protect Water Quality

• As Much as We Like Wastewater Treatment...
  – ... Advanced Treatment Increases:
    • Capital and Operating Costs
    • Energy Use
    • Chemical Use
    • Atmospheric Emissions
  – May Not Always Benefit Water Quality
Comparison of Point and Nonpoint Source Nutrient Control Performance

<table>
<thead>
<tr>
<th>Approach</th>
<th>Nutrient Removal Performance</th>
<th>Cost Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point Source</td>
<td>80% to 90%</td>
<td>$0.50 to $50+ $/lb</td>
</tr>
<tr>
<td>Advanced Treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonpoint Source</td>
<td>15% to 80%</td>
<td>$0.50 to $300+ $/lb</td>
</tr>
<tr>
<td>Best Management Practices¹</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹Conservation Tillage, Grass Buffers, Detention Basins, Wetlands
# Sustainability Comparison of Point and Nonpoint Source Nutrient Controls

<table>
<thead>
<tr>
<th>Approach</th>
<th>Electrical Power</th>
<th>Chemical Use</th>
<th>Greenhouse Gas</th>
<th>Additional Watershed Enhancements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Point Source</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advanced Treatment</td>
<td>+50% to + 250% over Secondary Treatment</td>
<td>Alum, Ferric, Methanol, other carbon sources</td>
<td>+120% over Secondary Treatment</td>
<td>None</td>
</tr>
<tr>
<td><strong>Nonpoint Source</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Best Management Practices(^1)</td>
<td>None</td>
<td>None</td>
<td>Sequesters Carbon</td>
<td>Enhanced Habitat, Aesthetics, Sediment Reduction</td>
</tr>
</tbody>
</table>

\(^1\)Conservation Tillage, Grass Buffers, Detention Basins, Wetlands
Conditions Required for Potential Water Quality Offsets or Trading

- **“Driver” for Pollutant Reductions**
  - TMDL
  - NPDES Permit
    - Permit Limits Conducive to Trading
- **Sources with Significantly Different Costs for Control**
- **Pollutant Reduction Not So Large That All Sources Must Reduce as Much as Possible**
  - Need a Surplus of Reductions To Trade
- **Willing Stakeholders and Agencies**
- **Loading Analysis**
  - Point Sources Defined
  - Need to Quantify Nonpoint Source Loadings
Sidestream Nutrient Recovery

- **Phosphorus Removal Applications**
  - Anaerobic Digestion
  - Dewatering
- **Struvite (MAP) Reactor**
  - Recycles Nutrients as Fertilizer
  - Reduces Solids Stream Recycle Impact
  - Reduces Chemical Use
  - Potential Greenhouse Gas Credit
    - ~6 to 8 tons CO₂ Equivalent per Ton of Struvite

Clean Water Services of Washington County, OR Durham Plant

Ostara’s Green Crystal Green® Fertilizer Product
Effluent Nutrient Discharge Permitting Issues
Appropriate Discharge Permit Guidance for Nutrients

- Translation water quality criteria to NPDES to permit limits
  - Critical interpretation of water quality issues
  - Pre-formulated permit guidance from EPA and States often focused on toxics
- Appropriate averaging periods
- Variability in low nutrient plant performance

Over-specifying effluent discharge permit limits will not provide significant additional water quality protection
Nutrients Differ From Toxics

**Nutrients**
- No Immediate Impact
  - Aside from Ammonia
- Watershed Scale Impacts
  - Nutrient Enrichment Leads to Aquatic Growth
- Algal Response Over Longer Periods
  - Longer Averaging Period Appropriate for Nutrients
  - Seasonal or Annual Averages Appropriate
- Treatment Technology
  - Variability at Low Levels in the Best Technologies

**Toxics**
- Acute and Chronic Impacts on Aquatic Life
  - Chlorine, Metals, Organics
- Near-field (mixing zone) and Far-field (watershed) Impacts
- Long Term Response
  - Average Limits
- Short Term Response
  - Maximum Limits Required
- Treatment Technology
  - Available Technology to Prevent Excursions
Effluent Requirements Below Limit of Technology

- **Ruidoso, NM**
  - **Total Nitrogen**
    - 1 mg/L 30 Day Average
    - 1.5 mg/L Daily Max
  - **Total Phosphorus**
    - 0.1 mg/L 30 Day Average
    - 0.15 mg/L Daily Max

---

### Table: Effluent Characteristics

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Store Code</th>
<th>30-Day Avg</th>
<th>7-Day Avg</th>
<th>Daily Max</th>
<th>Measurement Frequency</th>
<th>Sample Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD</td>
<td>30910</td>
<td>891</td>
<td>995</td>
<td>10</td>
<td>Continuous</td>
<td>Grub</td>
</tr>
<tr>
<td>Total Suspended Solids</td>
<td>90510</td>
<td>126</td>
<td>67</td>
<td>10</td>
<td>1/Week</td>
<td>6-Hr Composite</td>
</tr>
<tr>
<td>E. coli bacteria (*)</td>
<td>90400</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>1/Week</td>
<td>24-Hr Composite</td>
</tr>
<tr>
<td>Yeast (WAD)* (7)</td>
<td>90712</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>1/Week</td>
<td>24-Hr Composite</td>
</tr>
<tr>
<td>Total Nitrogen, T1 &lt; 10°C* (7, 6)*</td>
<td>90680</td>
<td>-153.3</td>
<td>N/A</td>
<td>N/A</td>
<td>Once-2 weeks</td>
<td>24-Hr Composite</td>
</tr>
<tr>
<td>Total Nitrogen, T1 ≥ 20°C (7, 6)*</td>
<td>90680</td>
<td>-140.1</td>
<td>N/A</td>
<td>N/A</td>
<td>Once-2 weeks</td>
<td>24-Hr Composite</td>
</tr>
<tr>
<td>Total Nitrate (5, 7)*</td>
<td>90680</td>
<td>21.1</td>
<td>N/A</td>
<td>N/A</td>
<td>Once-2 weeks</td>
<td>24-Hr Composite</td>
</tr>
<tr>
<td>Total Phosphorus (7)*</td>
<td>90685</td>
<td>0.2</td>
<td>0.1</td>
<td>N/A</td>
<td>Once-2 weeks</td>
<td>24-Hr Composite</td>
</tr>
<tr>
<td>Total TSS (7)*</td>
<td>90686</td>
<td>10.37</td>
<td>10.37</td>
<td>N/A</td>
<td>Once-2 weeks</td>
<td>24-Hr Composite</td>
</tr>
<tr>
<td>MLSS (7)</td>
<td>90687</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Daily</td>
<td>Grub</td>
</tr>
</tbody>
</table>
Phosphorus Requirements Below the Limit of Treatment Technology

- Spokane River D.O.
  - Dissolved Oxygen Total Maximum Daily Load (TMDL)
  - CBOD 4.2 mg/L
  - Ammonia Nitrogen 0.21 mg/L
  - Total Phosphorus 0.036 to 0.042 mg/L
- Best Treatment Technology Capable of TP ~0.050 mg/L

<table>
<thead>
<tr>
<th>Point Source Discharge</th>
<th>2027 Projected Flow Rates (MGD)¹</th>
<th>NH₃</th>
<th>TP</th>
<th>CBOD₅²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mg/L</td>
<td>lbs/day (WLA)</td>
<td>mg/L</td>
<td>lbs/day (WLA)</td>
</tr>
<tr>
<td>Liberty Lake</td>
<td>1.5 variable³</td>
<td>variable³</td>
<td>0.036</td>
<td>0.45</td>
</tr>
<tr>
<td>Kaiser⁴</td>
<td>15.4 0.07</td>
<td>9.0</td>
<td>0.025</td>
<td>3.21</td>
</tr>
<tr>
<td>Inland Empire Paper Company</td>
<td>4.1 0.71</td>
<td>24.29</td>
<td>0.036</td>
<td>1.23</td>
</tr>
<tr>
<td>City of Spokane</td>
<td>50.8 variable³</td>
<td>variable³</td>
<td>0.042</td>
<td>17.81</td>
</tr>
<tr>
<td>Spokane County (new plant)</td>
<td>8 variable³</td>
<td>variable³</td>
<td>0.042</td>
<td>2.80</td>
</tr>
<tr>
<td>Stormwater⁵</td>
<td>2.36 0.05</td>
<td>0.98</td>
<td>0.310</td>
<td>6.1</td>
</tr>
<tr>
<td>CSO</td>
<td>0.12</td>
<td>1.0</td>
<td>0.95</td>
<td>0.95</td>
</tr>
</tbody>
</table>

Revised TMDL Spokane River Wasteload Allocation, Washington Department of Ecology, September 2009

Nonpoint Source Reduction to Off-set
Point Source Loading
Eliminate 15,000 On-site Septic Systems
Water Quality Off-set WAC 173-201A-450
NPDES Permitting Regulations

- 40 CFR 122.45(d) requires that all permit limits be expressed as average monthly limits and average weekly limits for publicly owned treatment works (POTWs) and as both average monthly limits and maximum daily limits for all others, unless “impracticable.”

- Maximum monthly, weekly, and daily limits likely to be exceeded by even the best designed and operated low nutrient treatment facilities.

- Effluent N and P concentration is highly variable for even the best designed and operated low nutrient treatment facilities.

- Individual permit writers in every nutrient limited watershed must interpret these NPDES regulations and the definition of “impracticable” with limited guidance.
Chesapeake Bay Annual Limits

- Annual Permit Limits for Nitrogen and Phosphorus for Permits Designed to Protect Chesapeake Bay
  - “...permit limits expressed as an annual limit are appropriate and that it is reasonable in this case to conclude that it is “impracticable” to express permit effluent limits as daily maximum, weekly average, or monthly average effluent limitations.”
### Variety of Permit Structures Nationally

- **Concentration Only, Mass Only, Both**
  - **Seasonal Limits**
  - **Mean or Median**
  - **Shared Capacity**

<table>
<thead>
<tr>
<th>Location</th>
<th>Total Phosphorus Limits</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean Water Services of Washington County, OR</td>
<td>0.100 mg/l</td>
<td>Monthly Median, May 1 to Oct 31 Watershed Permit</td>
</tr>
<tr>
<td>Las Vegas, Clark County, Henderson, NV</td>
<td>334 lbs/day (130/174/30 lbs/day)</td>
<td>Mar 1 to Oct 31 Cooperative Agreement to Share for Flexibility</td>
</tr>
<tr>
<td>Alexandria, VA</td>
<td>0.18 mg/l and 37 kg/day 0.27 mg/l and 55 kg/day</td>
<td>Monthly Average Weekly Average</td>
</tr>
</tbody>
</table>
Discharge Permits that Make Sense for Nutrients

- **Performance Achieved by a Technology Under Specific Conditions and Expressed in Statistical Terms**
  - Lowest Technology Can Achieve
  - Full Scale Plant Performance

**Diagram:**
- **2005 Durham AWWTP Effluent TP**
- **Log Normal Mean 0.080 mg/l**
- **Daily Effluent Phosphorus Concentration, Clean Water Services, OR Durham Plan, 2005**
- **Probability Scale Plot of Effluent Phosphorus Data Showing 3.84th, 50th, and 95th Percentiles**
Recommendations for Consideration

Puget Sound Mud Monster

Spokane River, WA Treatment Technology Workshop
Wastewater Utilities

**Capabilities**
- Effective Technologies for Nutrient Removal
- Predictable Nutrient Removal Performance
- Continuing Innovation
- Sustainable Designs

**Needs**
- Predictable Future for Facilities Planning
  - 20 Year Capital Improvement Programs
- Balanced Regulatory Framework
- Practical Consideration of Limit of Treatment Technology
- NPDES Compliance Schedules Spanning Multiple 5-Year Cycles
WESTCAS 2009 Fall Conference

National Nutrient Standards

David L. Clark
HDR Engineering
dclark@hdrinc.com

October 29, 2009
Regulatory Challenges

• **Unfortunately…**
  – Current Regulations Present Challenges in Practice
    • Disproportionate Regulation of Point Sources
    • No Specific Process to Balance Broader Considerations
• **Clean Water Act**

• **Good News!**
  – No Prohibition on Sustainable Design
  – Convergence of Technologies
  – Watershed Opportunities
    • Locally Balanced Decisions
    • Voluntary Nonpoint Source Reduction
Draft Aggregations of Level III Ecoregions for the National Nutrient Strategy
Aggregate Level III Ecoregion -- South Central Cultivated Great Plains V

- **Northeastern Colorado (including Fort Collins, Boulder and Denver)**

<table>
<thead>
<tr>
<th>Nutrient Parameter</th>
<th>Aggregate Nutrient Ecoregion V Reference Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Phosphorus (mg/L)</td>
<td>0.067</td>
</tr>
<tr>
<td>Total Nitrogen (mg/L)</td>
<td>0.88</td>
</tr>
<tr>
<td>Chlorophyll a (ug/L)</td>
<td>3</td>
</tr>
<tr>
<td>Turbidity (FTU)</td>
<td>7.83</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nutrient Parameter</th>
<th>Aggregate Nutrient Ecoregion V Reference Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Phosphorus (mg/L)</td>
<td>0.033</td>
</tr>
<tr>
<td>Total Nitrogen (mg/L)</td>
<td>0.56</td>
</tr>
<tr>
<td>Chlorophyll a (ug/L)</td>
<td>2.3</td>
</tr>
<tr>
<td>Turbidity (FTU)</td>
<td>1.3</td>
</tr>
</tbody>
</table>
Aggregate Level III Ecoregion -- Great Plains Grass and Shrublands IV

- Southeastern Colorado (including Colorado Springs)

<table>
<thead>
<tr>
<th>Nutrient Parameter</th>
<th>Aggregate Nutrient Ecoregion IV Reference Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Phosphorus (mg/L)</td>
<td>0.023</td>
</tr>
<tr>
<td>Total Nitrogen (mg/L)</td>
<td>0.56</td>
</tr>
<tr>
<td>Chlorophyll a (ug/L)</td>
<td>2.4</td>
</tr>
<tr>
<td>Turbidity (FTU)</td>
<td>4.21</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nutrient Parameter</th>
<th>Aggregate Nutrient Ecoregion IV Reference Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Phosphorus (mg/L)</td>
<td>0.020</td>
</tr>
<tr>
<td>Total Nitrogen (mg/L)</td>
<td>0.44</td>
</tr>
<tr>
<td>Chlorophyll a (ug/L)</td>
<td>2</td>
</tr>
<tr>
<td>Turbidity (FTU)</td>
<td>2</td>
</tr>
</tbody>
</table>
New USDA Office of Ecosystem Services and Markets

- Conservation and Land Management Environmental Services Board
  - Assess Environmental Benefits
  - Promote Markets for Ecosystem Services
    - Carbon Trading

Secretary of Agriculture, Tom Vilsack, speaks at a Conservation Reserve Enhancement Program (CREP), April 24, 2009
Convergence of Technologies

• Reclaimed Water Reuse
  – Effluent Filtration for Low Phosphorus
  – Standards for Reclaimed Water
  – Recycles Nutrients

• New Options for Effluent Management
  – Appropriate Discharge Permit Structure
    • Avoid Disincentives

• Microconstituents, EDCs, PPCPs
  – Existing Treatment Technologies Effective on Many Compounds
  – Not All Processes Equal!
  – Activated Sludge
    • Potential for large removals
      – Enhanced by Longer SRT
  – MBR or Membrane filtration
    • Enhanced solids removal

Endocrine Disrupting Compounds and Implications for Wastewater Treatment. WERF 04-WEM-6. 2005

H.R. 2454 American Clean Energy and Security Act of 2009
Passes House

- **Cap and Trade Program**
  - **Greenhouse Gas Reduction**
    - 17% from 2005 levels by 2020
    - 83% by 2050
- **Limiting Emissions from Industry**
  - *Agriculture excluded from the cap*
- **Tighter Standards on New Coal-fired Power Plants**
- **Electric Utilities**
  - 12% from renewable sources
  - 8% energy-efficiency savings
- **Offset Projects**
  - Tree Planting and Forest Protection
- **Rebates and Credits to Low-income Households**
### Table I.3

<table>
<thead>
<tr>
<th>Constituent</th>
<th>City of Las Vegas IWLA</th>
<th>Clark County Sanitation District IWLA</th>
<th>City of Henderson IWLA</th>
<th>( \Sigma \text{WLA} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Phosphorus as P</td>
<td>130 lb/day</td>
<td>174 lb/day</td>
<td>30 lb/day</td>
<td>334 lb/day, Note: This WLA only applies March 1 - October 31; no limit applies the rest of the year.</td>
</tr>
<tr>
<td>Total Ammonia as N</td>
<td>379 lb/day</td>
<td>502 lb/day</td>
<td>89 lb/day</td>
<td>970 lb/day, Note: This WLA only applies April 1 - September 30; no limit applies the rest of the year.</td>
</tr>
</tbody>
</table>

### I.A.2. Waste Load Allocation (WLA)

The Permittee is authorized to discharge the waste loads listed in Table I.3. for Total Phosphorus as P and Total Ammonia as N, to the Las Vegas Wash. The WLA applies to the combined loading from Outfalls 001 and 002. This permit condition constitutes a cooperative agreement between the City of Las Vegas, Clark County Sanitation District, and City of Henderson (hereinafter dischargers) to allow discharge flexibility. Each facility has an Individual Waste Load Allocation (IWLA) and there is a Sum of Waste Load Allocations (\( \Sigma \text{WLA} \)) defined below for the three facilities. Treatment facilities which are used to attain a waste load allocation are not required to be operated when not needed to meet that allocation.

- The Permittee shall be considered in compliance if **either**:
  - The Permittee does not exceed the IWLA listed below or the IWLA in effect due to transfers, **or**
  - The Sum of the Waste Load Allocations (\( \Sigma \text{WLA} \)) listed below is not exceeded.

- **Mass Only**
- **Seasonal**
- **Shared Wasteload Allocation**
Definition of Reasonable Economic Hardship Thresholds

- **Federal Reference Points**
  - “Substantial”
  - “Widespread”

- **EPA Recommendations**
  - “Substantial”
    - “Municipal Preliminary Screener”
      - Mean Total Pollution Control Cost per Household/Median Household Income
    - MPS < 1% Cost Bearable
    - MPS 1% to 2% Midrange Impact
    - MPS > 2% Unreasonable Cost
  - “Widespread”
### Municipal Preliminary Screener 1% to 2% Midrange Impact

#### Example Threshold for Economic Hardship @ 2% of Median Household Income
- **Little Comfort That “Substantial” and “Widespread” Economic Thresholds Reflect Expectations for Reasonable Wastewater Rates**

<table>
<thead>
<tr>
<th>City</th>
<th>Monthly Rate, $/Mo</th>
<th>Median 2004 Household Income, $/Yr</th>
<th>2% Median Income, $/Mo</th>
<th>Increase Over Existing Rates, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Branson</td>
<td>$17.20</td>
<td>$31,919</td>
<td>$53</td>
<td>209%</td>
</tr>
<tr>
<td>Independence</td>
<td>$22.30</td>
<td>$42,351</td>
<td>$71</td>
<td>217%</td>
</tr>
<tr>
<td>Jefferson</td>
<td>$17.82</td>
<td>$47,715</td>
<td>$80</td>
<td>346%</td>
</tr>
<tr>
<td>Ozark</td>
<td>$31.22</td>
<td>$43,231</td>
<td>$72</td>
<td>131%</td>
</tr>
<tr>
<td>Springfield</td>
<td>$14.57</td>
<td>$36,887</td>
<td>$61</td>
<td>322%</td>
</tr>
</tbody>
</table>