Pennsylvania’s Continuous Physiochemical Assessment Method
Data Collection

- PVC chute on rock outcrop in middle of Susquehanna River

- Suspended off bottom in high deposition environment

- Few long-term continuous sites
- No telemetry

- Unique deployments
- Middle channel measurements
Lots of Sites
QA/QC Requirements

- Regular fouling and calibration checks
- Discrete readings with independent meter
- Corrections and removal of “bad” data
- Cross-section transects to ensure data are representative.
Uses of Continuous Data

- Characterize background/historic conditions
- Cause and effect studies
- Assessments using established ALU and PWS criteria
- Eutrophication cause determination
Uses: Eutrophication Cause Determination

Graph showing dissolved oxygen levels over time for Eutrofied Stream and Reference Stream.
§93.7(a), Table 3

- pH: 6.0 - 9.0 units
- Dissolved Oxygen: minimum 5.0 mg/L

Model-derived parameters

- Examples: osmotic pressure (ALU), TDS (PWS)
- Account for uncertainty in model
§96.3(c): “[criteria] shall be achieved in all surface waters at least 99% of the time”

Discrete samples

- Sample represents 1 day
- 4 samples = violation (4 days / 365 days = 1.1%)
99% Rule

- Criteria are protective of all aquatic life, not just macros.
- Macros are not always the most sensitive organisms.

Applying 99% rule over one year has greatest consistency with biology.

<table>
<thead>
<tr>
<th>Macros</th>
<th>Year</th>
<th># of Days</th>
<th>Monthly</th>
<th>Weekly</th>
<th>Daily</th>
</tr>
</thead>
</table>

[Table content]

[Graph content]
Count Exceedances

pH Units

Date

99% with CIM

\[ %Y = 100 \left[ \frac{n \cdot i}{k} \right] \]

<table>
<thead>
<tr>
<th>Interval</th>
<th># Readings &gt; 1% of Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 min</td>
<td>351</td>
</tr>
<tr>
<td>30 min</td>
<td>176</td>
</tr>
<tr>
<td>60 min</td>
<td>88</td>
</tr>
</tbody>
</table>
Critical Periods

- Open canopy vs closed
- Pre- vs post-leaf emergence
- Solubility of oxygen
- Moderates conditions
- Scour of photosynthetic organisms
Annual Variation

Summer Discharge of Susquehanna River at Harrisburg 2013-16

Source: USGS Station 01570500

2013 2014 2015 2016

Discharge (CFS)

June July August September October

2018
## Model-Derived Parameters

<table>
<thead>
<tr>
<th>Specific Conductance</th>
<th>Temperature</th>
<th>Turbidity</th>
<th>Streamflow</th>
<th>Julian-day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actinomycetes</td>
<td>Dissolved phosphorus</td>
<td>Dissolved solids</td>
<td>Sulfate</td>
<td></td>
</tr>
<tr>
<td>Alkalinity</td>
<td>Enterococci bacteria</td>
<td>Fluoride</td>
<td>Suspended sediment</td>
<td></td>
</tr>
<tr>
<td>Atrazine</td>
<td>Fecal coliform bacteria</td>
<td>Hardness</td>
<td>Total nitrogen</td>
<td></td>
</tr>
<tr>
<td>Bicarbonate</td>
<td>Fluoride</td>
<td>Magnesium</td>
<td>Total organic carbon</td>
<td></td>
</tr>
<tr>
<td>Boron</td>
<td>Hardness</td>
<td>Sodium</td>
<td>Total organic N + NH3</td>
<td></td>
</tr>
<tr>
<td>Calcium</td>
<td>Magnesium</td>
<td>Total phosphorus</td>
<td>Total phosphorus</td>
<td></td>
</tr>
<tr>
<td>Chloride</td>
<td>Particulate phosphorus</td>
<td>Sodium</td>
<td>Total suspended solids</td>
<td></td>
</tr>
<tr>
<td>Dissolved nitrate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dissolved nitrate + nitrite</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dissolved orthophosphorus</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
Model-Derived Parameters

- EPA supported
- USGS guidelines
- Discrete samples
  - Over-top of sonde
  - Cover range of values
- Site specific

Probability of Exceedance $\geq 90\%$
Delineating Spatial Extent

- pH Criterion
- Continuous pH
- Discrete

Date

8.90 9.00 9.10 9.20 9.30 9.40 9.50


pH Units
Delineating Spatial Extent – Non-Mixed Rivers
Method Summary

1. Collect CIM data
2. QA procedures (corrections, transects, etc.)
3. Assessment decision
   • Count exceedances of criterion
   • Convert to percentage of a year
   • Not attaining if > 1% of a year
4. Determine spatial extent through discrete data
5. Characterize conditions for reference in future surveys or reassessments
Questions or Comments

Bureau of Clean Water
Division of Water Quality

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Finalized continuous data available at:
https://www.depgreenport.state.pa.us/Data/

Protocols and methods can be found in Pennsylvania’s Monitoring and Assessment books at:
https://www.dep.pa.gov/Business/Water/CleanWater/WaterQuality/