Flow Monitoring & FRP Indicators

VT DEC
CCRPC MS4 Subcommittee
February 6, 2018
Flow Duration Curve (FDC) Development

- Model calibrated based on hourly data collected for 3 impaired waters and 2 unimpaired waters.
- All impaired and attainment streams modelled using P8 model.
  - 10 years of modelled flow data used to generate initial FDC
- TMDL targets are based on comparison of impaired FDC’s with those of attainment streams
P8

Inputs

• Climatological Data
• Watershed Area
• Percent Impervious
• Pervious Curve Number
• Time of Concentration (Calibration)
• Impervious Coefficient (Calibration)
FDC at High Flow

Percent of Time that Flow is Equaled or Exceeded

Q_{0.3%}
FDC at Low Flow

- Allen Brook
- Bartlett Brook
- Centennial Brook
- Englesby Brook
- Indian Brook
- Morehouse Brook
- Munroe Brook
- Potash Brook
- Sunderland Brook
- Alder Brook
- Allen Brook (Attained)
- Sand Hill Brook
- Youngman Brook
- Little Otter Creek
- Malletts Creek

Normalized Flow (cfs/sq. mi)

Percent of Time that Flow is Equaled or Exceeded

Q_{95%}
Going Forward...

• Interim Flow Metrics
• Implementation Indicators
• Biomonitoring
Flow Metrics

• Attainment and de-listing: ultimately depend on biomonitoring results and the regular 303(d) review and listing process

• Flow regime may be the first to respond to watershed restoration
  o Flow Duration Curves $\rightarrow$ target setting tool & longer term indicator
  o Other flow metrics may prove useful in the interim. Must be:
    • Reflective of urbanization and stormwater degradation/restoration
    • Correlated to biological impacts of urbanization
    • Robust to inter-annual climatic variability
    • Well suited to change-detection
Flow Metrics

Examples of potential metrics:

• Flashiness indices (e.g., Richards-Baker index)
• Fraction of time flows > mean discharge
• Hydrologic ratios (e.g., runoff coefficients)

Interim Metrics working group has been established—DEC, consultants, UVM.
Implementation Indicators

• Measures of FRP implementation
  o # of projects implemented
  o Acres/Percent of impervious managed
  o % flow managed (?)

• Fed by MS4 reporting

• Can be used as an indication of expected change
  o May trigger more frequent biomonitoring
  o Feedback to FRP if other metrics not responding as expected
Biomonitoring

- 2 consecutive “good” results to be considered for delisting
  - Aquatic life standards based on 8 bio-metrics from bug community and fish IBI.
- Streams typically sampled on a 5 year rotational basis (most more often)
  - Can be supplemented with shorter intervals if reason to believe significant changes have occurred.
- Potential for interim metrics from biomonitoring data
Assessment and Delisting

- Ultimate decisions of impairment will rely on Biomonitoring

<table>
<thead>
<tr>
<th>Stream</th>
<th>Rotation</th>
<th>RM (last sample date)</th>
<th>RM (last sample date)</th>
<th>RM (last sample date)</th>
<th>RM (&amp; last sample date)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allen Brook (2.4-5.0)</td>
<td>2020</td>
<td>2.4 (2015)</td>
<td></td>
<td>4.3 (2010)</td>
<td></td>
</tr>
<tr>
<td>Bartlett Brook (0.0-0.7)</td>
<td>2021</td>
<td>0.2 (2012)</td>
<td>0.4 (2009)</td>
<td>0.5 (2009)</td>
<td></td>
</tr>
<tr>
<td>Centennial Brook (0.0-1.2)</td>
<td>2020</td>
<td>0.1 (2005)</td>
<td>0.2 (2014)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Englesby Brook (0.0-1.3)</td>
<td>2021</td>
<td>0.5 (2004)</td>
<td></td>
<td>0.6 (2012)</td>
<td></td>
</tr>
<tr>
<td>Moon Brook (0.0-2.9)</td>
<td>2021</td>
<td>0.1 (2014) - lg</td>
<td>0.3 (2005), 0.4 (2005)</td>
<td>0.9 (2014), 1.1 (2012)</td>
<td>1.5 (2014), 2.5 (2014), 2.8 (2008)</td>
</tr>
<tr>
<td>Munroe Brook (0.0-2.8)</td>
<td>2021</td>
<td>0.3 (2012)</td>
<td>2.8 (2011)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---North Trib (inc)</td>
<td>2021</td>
<td>0.8 (2011)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morehouse Brook (0.0-0.6)</td>
<td>2020</td>
<td>0.3 (2015)</td>
<td>0.6 (2000)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Search by stream name in IWIS

- [https://anrweb.vt.gov/DEC/IWIS/](https://anrweb.vt.gov/DEC/IWIS/)

- click on “Site Search”;

- type in stream name;

- click “Monitoring Site Summary” button at the right of the desired sample site
Locate site by map via the ANR Atlas

- [http://anrmaps.vermont.gov/websites/anra5/](http://anrmaps.vermont.gov/websites/anra5/)

- Turn on layer: Watershed Management, then Water Quality Monitoring

- Click on sample site of interest, then click “Link to Monitoring Site Summary”
## Munroe Brook

In forest above train tracks ~75m. Park in back left lot of AutoMaster car dealership.

Shelburne, VT (44.40661, -73.21998)

Stream Type: Warm Water Medium Gradient

### Macroinvertebrate Community Metrics

Macroinvertebrate Community Assessments are based primarily on eight metrics of the Macroinvertebrate community. These include metrics of abundance, species richness, and indexes of Sensitive to tolerant species ratios. (For More Details)

<table>
<thead>
<tr>
<th>Date</th>
<th>Density</th>
<th>Richness</th>
<th>EPT</th>
<th>PMA-O</th>
<th>B.I.</th>
<th>Oligo.</th>
<th>EPT/EPT+Chiro</th>
<th>PPCS-F</th>
<th>Community Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/8/2004</td>
<td>1880</td>
<td>25.0</td>
<td>9.0</td>
<td>58.0</td>
<td>5.23</td>
<td>1.28</td>
<td>0.90</td>
<td>0.31</td>
<td>Fair</td>
</tr>
<tr>
<td>10/21/2005</td>
<td>5096</td>
<td>39.0</td>
<td>10.0</td>
<td>61.7</td>
<td>6.12</td>
<td>0.63</td>
<td>0.98</td>
<td>0.42</td>
<td>Fair</td>
</tr>
<tr>
<td>10/4/2006</td>
<td>1041</td>
<td>27.0</td>
<td>5.5</td>
<td>58.9</td>
<td>5.96</td>
<td>1.55</td>
<td>0.80</td>
<td>0.72</td>
<td>Poor</td>
</tr>
<tr>
<td>9/30/2009</td>
<td>874</td>
<td>27.0</td>
<td>10.0</td>
<td>64.5</td>
<td>5.23</td>
<td>0.28</td>
<td>0.96</td>
<td>0.47</td>
<td>Fair</td>
</tr>
<tr>
<td>9/22/2011</td>
<td>2124</td>
<td>27.0</td>
<td>12.0</td>
<td>68.3</td>
<td>5.09</td>
<td>0.38</td>
<td>0.97</td>
<td>0.40</td>
<td>Fair</td>
</tr>
<tr>
<td>9/29/2015</td>
<td>3160</td>
<td>25.0</td>
<td>10.0</td>
<td>55.3</td>
<td>5.17</td>
<td>0.00</td>
<td>0.96</td>
<td>0.29</td>
<td>Fair</td>
</tr>
</tbody>
</table>

### Scoring Guideline for a WWMG Stream of Water Quality Class B(2)

<table>
<thead>
<tr>
<th>Density</th>
<th>Richness</th>
<th>EPT</th>
<th>PMA-O</th>
<th>B.I.</th>
<th>Oligo.</th>
<th>EPT/EPT+Chiro</th>
<th>PPCS-F</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 300</td>
<td>≥ 30</td>
<td>≥ 16</td>
<td>≥ 45</td>
<td>≤ 5.4</td>
<td>≤ 12</td>
<td>≥ 0.45</td>
<td>≥ 0.4</td>
<td>Full Support</td>
</tr>
<tr>
<td>≥ 250</td>
<td>≥ 28</td>
<td>≥ 15</td>
<td>≥ 40</td>
<td>≤ 5.65</td>
<td>≤ 14.5</td>
<td>≥ 0.43</td>
<td>≥ 0.35</td>
<td>Indeterminate</td>
</tr>
<tr>
<td>&lt; 250</td>
<td>&lt; 28</td>
<td>&lt; 15</td>
<td>&lt; 40</td>
<td>&gt; 5.65</td>
<td>&gt; 14.5</td>
<td>&lt; 0.43</td>
<td>&lt; 0.35</td>
<td>Non-Support</td>
</tr>
</tbody>
</table>
Delisting protocol

• A minimum of 2 years of biomonitoring data that shows compliance with biocriteria (WQS)
  o Essentially 2 years of “good” or better
  o Years don’t have to be consecutive (i.e. 2018, 2019)
  o Sampling events do
    • (2018 = ”good”, 2020 = “good”) = Compliance
    • (2018 = “good”, 2019 = “fair”, 2020 = “good”) = Still impaired
  o Need to ensure a consistent signal of WQS compliance

• Similar protocol for identifying impairment but in reverse