Watershed Treatment Model for Urban Watersheds

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Outline

- Background
- Primary Loads
- Secondary Loads
- Current Management Practices
- Future Development
- Future Management Practices
- Limitations/ Challenges
Watershed Treatment Model (WTM)- Need

There is no simple way to track the full range of management options in urban watersheds.
Choice of models

*What is the goal of modeling?*
*What is the parameter of concern/issue?*

Simple

Complex

- Data requirements
- Landscape representation
- Model parameterization
- Algorithms
- Time step (event, daily, snapshot)
- Calibration and validation
WTM Applications

- TMDLs*
- Stormwater Program Assessment
- Stormwater Retrofit Ranking
- Source Water Assessment
- Determine Progress on Load Reductions
Application:

- WTM can help answer the following questions:
  - What are key management decisions to meet target loads?
  - What load reduction can I expect from improved erosion and sediment control or stormwater programs?
  - Does the program effectively reduce the loads associated with new development?
  - Are municipal operations such as street sweeping and catch basin cleaning helping to meet my pollutant reduction goals?
Watershed Treatment Model (WTM)

What it is?

- Simple excel based spreadsheet model
- Full suite of management options
- Examine source partitioning
  - What are the major sources of pollutants?
- Peer into the future
  - Land use change scenarios; and/or
  - Implementation options
What Does the WTM Do?

- Evaluates Nitrogen, Phosphorus, Total Suspended Solids, Bacteria
- Best applied on a small urban watershed scale
- Assesses various management options:
  - Erosion and Sediment Control
  - Stormwater Treatment
  - Riparian buffers
- Assesses the impact of new development on pollutant loads.
Data Requirements

- Land Use/ Impervious Cover
- Programmatic information (e.g., street sweeping frequency, stormwater practice information, ESC program).
- Some infrastructure information, such as length of sewer.
- Model provides default values, but local watershed monitoring can be included
- Should take approximately 2-3 days from start to finish
Parameters

- Default values
- Field data
  - Survey
    - Upland Subwatershed and Site Reconnaissance (USSR, Manual 11)
    - Questionnaire
    - Unified Stream Assessment (USA, Manual 10)
College Gardens
Low Impact Stormwater Management Techniques (LISW)

- Alternatives to structural controls
- Survey
  - USSR*, soil, stream survey
- WTM
  - existing
    - sources
    - Load reduction comparison

* completed
Nuts and Bolts

- Primary Loads
- Secondary Loads
- Management Practices
  - Structural, non-structural, behaviors
- Practice effectiveness
  - “discount” factors
- Future practices
Watershed Treatment Model

**Primary Loads**

- Simple method – Urban areas
  - $\text{load} = f\{\text{rainfall, conc., area}\}$
- Land use>Loading estimates for Ag and Forest
### PRIMARY SOURCES - Land Use

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Area (Acres)</th>
<th>Impervious Cover</th>
<th>TN (mg/l)</th>
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<tbody>
<tr>
<td>Residential</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LDR (&lt;1du/acre)</td>
<td>0</td>
<td>12</td>
<td>2.2</td>
</tr>
<tr>
<td>MDR (1-4 du/acre)</td>
<td>47.68</td>
<td>25</td>
<td>2.2</td>
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<tr>
<td>HDR (&gt;4 du/acre)</td>
<td>23.08</td>
<td>44</td>
<td>2.2</td>
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<tr>
<td>Commercial</td>
<td>36.16</td>
<td>72</td>
<td>2.0</td>
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<tr>
<td>Roadway</td>
<td>18.9</td>
<td>80</td>
<td>3.0</td>
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<tr>
<td>Institutional</td>
<td>4</td>
<td>45</td>
<td>2.5</td>
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<tr>
<td>Open urban space</td>
<td>39.91</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open Water</td>
<td>0.251</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>169.981</strong></td>
<td></td>
<td><strong>42.15465409</strong></td>
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</table>
Secondary Loads

- Active Construction
- SSOs
- CSOs
- Illicit Connections
- Lawn fertilizer

**Total Annual Loads**

<table>
<thead>
<tr>
<th>Source</th>
<th>N Load (lbs/year)</th>
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<tbody>
<tr>
<td>Septic Systems</td>
<td>0</td>
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<tr>
<td>Active Construction</td>
<td>0</td>
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<tr>
<td>SSOs</td>
<td>3</td>
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<tr>
<td>CSOs</td>
<td>0</td>
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<tr>
<td>Illicit Connections</td>
<td>61</td>
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<tr>
<td>Channel Erosion</td>
<td>0</td>
</tr>
<tr>
<td>Lawns (Subsurface Flow)</td>
<td>182</td>
</tr>
<tr>
<td>Hobby Farms/Livestock</td>
<td>0</td>
</tr>
<tr>
<td>Marinas</td>
<td>0.00</td>
</tr>
<tr>
<td>Road Sanding</td>
<td>0</td>
</tr>
<tr>
<td>NPDES Dischargers</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total Secondary Load</strong></td>
<td><strong>246</strong></td>
</tr>
</tbody>
</table>
Management Practices

- Stormwater management
- Street Sweeping
- Erosion and Sediment Control
- Impervious cover disconnection

- Sanitary sewer upgrade
- Illicit discharge disconnection
- Riparian Buffers
Discount Factors

- Ideal load reductions can rarely be achieved
  - Lack of space
  - Imperfect practice application.
  - Inability of programs to be completely effective.

- Discount factors "discount" load reductions to account for less than perfect application of practices.
Example Discount Factors - Stormwater Retrofits

- Treatability
- Capture
- Design
- Maintenance
College Gardens Preliminary Results

- Programmatic
- Existing Load Reduction

Estimated TN Load Reduction

- Street sweeping: 33%
- IC disconnection: 59%
- Wet pond: 7%
- Riparian buffer: 59%
Future Management Practices

- Stormwater management
- Erosion and Sediment Control
- Stormwater retrofits
- Sanitary sewer upgrade
- Illicit discharge disconnection
- Riparian buffers
- Stream restoration/stabilization
- Lawn care
- Pet waste management
- Street sweeping
- Impervious area disconnection
Limitations of the Model

- Few pollutants are currently incorporated
- The model is not predictive, and is intended as a planning tool
- Use of local data
  - Replace model default values
  - Assess many Secondary Sources
- Judgment needs to be applied when assessing discount factors
Lessons Learned

- **Bush River**
  - Harford County, MD
  - 120 sq. miles
  - Rapidly developing
  - Residential

- **Model Results**
  - Significance of lawns
  - Absence of riparian buffers

- **Weems Creek**
  - Annapolis, MD
  - 2 sq. miles
  - Mixed urban, ~29% impervious cover,
    ~50% land area turf

- **Model Results**
  - Stream restoration
  - Channel protection
    - Flow control
Projected TN Load Reduction
Weems Creek

- Overall nitrogen loads could be reduced close to 15%
Projected TSS Load Reduction
Weems Creek

Management Practices
TSS Reduction

- Channel Protection/Stream Restoration
- Stormwater Retrofits
- Riparian Buffers
- Impervious Cover Disconnection
- Marina Pumpouts

• TSS loads could be reduced by 1/3
Lessons Learned

- Stormwater retrofits provided some additional benefit
- Source partitioning
  - Load reduction from non-structural options
- Multi-faceted approach
Manual Builder
Model Ordinances
Slide Shows
Models & Protocols
Fact Sheets
Library Database
About the Center

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Center for Watershed Protection

Founded in 1992, the Center for Watershed Protection works with local, state, and federal governmental agencies, environmental consulting firms, watershed organizations, and the general public to provide objective and scientifically sound information on effective techniques to protect and restore urban watersheds. The Center also acts as a technical resource for local and state governments around the country to develop more effective urban stormwater and watershed protection programs.

The Center for Watershed Protection is a non-membership, nonprofit 501 (c)(3) corporation dedicated to conducting independent research and providing technical support to professionals interested in protecting or restoring their watersheds. Since its inception, the Center has provided technical assistance to local governments in thirty states and the District of Columbia. This close contact enables the Center to understand the unique needs and concerns of local and state governments in this emerging area of environmental practice.

Oversight of the Center is provided by a Board of Directors and a national watershed advisory council, whose members are leaders in the watershed protection arena. The Center for Watershed Protection has also partnered with numerous organizations to accomplish its mission:

- Understand and define the relationship between urban growth and the degradation of watersheds