EVALUATION OF VOLUME IN TWO BIOSWALE

Judy Horwathich US Geological Survey
• Wisconsin Department of Transportation
• Wisconsin Department of Natural Resources
• Support Changes to State Technical Standard Bioretention 1004
• Measure Flow and Concentration from Highway VV, WI
• Measure Flow and Concentration from Bioswale Treating Highway VV
• Calibrate and Validate Biofilter Routine in WinSLAMMs (Source Loading and Management Model for Windows)
TODAY’S PRESENTATION

• Changes in Bioretention Technical Standard 1004
• Sites’ Description
• Measured Data
• WinSLAMM Modeling
Engineered Soil Mix Composition
• 50% Sand/ 50% Compost
• 85-75% Sand/ 15-25% Compost

Engineered Soil Thickness
• 3 feet
• 2 feet
BIOSWALE DESIGN

- Linear Bioretention
- Follow Bioretention Design
- Located Along Roadways
- Runoff Enters Through Several Curb Cuts
- Filter Pollutants Through Engineered Soil
- Infiltrate to Native Soil and/or Storm Sewer
Study Site

Two Engineered Mixes:

1. State Standard - 75% Sand 25% Compost
2. Growth Layer - 18” of Sand Top 6” Compost
MONITORING

Inlet Flows
- Two Curb Cuts Monitored at Each Site
- Extrapolate to Entire Watershed

Outlet Flows
- Drain Tile at Each Site
HIGHWAY SITE DESCRIPTION

- Newly Constructed 4-Lane Highway
- 2-Lane Divided Highway into East & West Bound Lanes
- 2 Inner Lanes Slope Towards Median
- Curb-Cuts Drain Highway Runoff into Median (~ 70-ft)
## Surface Areas

<table>
<thead>
<tr>
<th>Sites</th>
<th>Number of Curb Cuts</th>
<th>Highway Surface Area (ft^2)</th>
<th>Bioswale Surface Area (ft^2)</th>
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</thead>
<tbody>
<tr>
<td>East</td>
<td>10</td>
<td>9,540</td>
<td>2,225</td>
</tr>
<tr>
<td>West</td>
<td>6</td>
<td>5,920</td>
<td>1,225</td>
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</table>
MEASURED HIGHWAY VOLUMES FROM TWO CURB CUTS

- Medians Identical
- Means within 5 percent
Percent Volume Reduction:
East 97
West 92
CALIBRATE AND VALIDATE BIOFILTER ROUTINE IN WinSLAMM

- Simulate Highway Runoff
- Simulate Bioretention
- Transfer Project Results to WisDOT Future Projects
WinSLAMM PARAMETER FILE

- Wisconsin Files
- Based on Measured Data
- Calibrated for Flow and Concentration
- Validated for Numerous Sites
WinSLAMMM INTERFACE

- Characterize Stormwater By Source Areas and Landuses
- Source Area and Regional Management Practices
WinSLAMM SMALL STORM HYDROLOGY

- Runoff Coefficient ($R_v$) Curves for at Least 14 Source Area
- Conducts a Continuous Water Mass Balance for Every Event
ASSESS BIOSWALE IN WinSLAMM

Model Steps
1. Create Rainfall File Using Measured Values
2. Assess Runoff Inlet Event Volumes—Measured vs Modeled
3. Assess Biofilter Event Volumes—Measured vs Modeled
EVALUATION OF WinSLAMM

Create Rainfall File Using Measured Values
INLET VOLUME COMPARISON – MEASURED VS. MODELED USING DEFAULT HIGH-TRAFFIC URBAN RV

For Both Sites WinSLAMM is Over-Estimating Event Volumes ~50 percent
DEVELOP A NEW RUNOFF COEFFICIENT (R_v)

Split Dataset
- West Site Calibration
- East Site Validation

Calibration
- Determine New R_v using Rainfall
- Extend R_v to Larger Events not Measured

![Graph showing runoff coefficient vs rainfall with equation y = 0.0455ln(x) + 0.6179]
INLET VOLUME COMPARISON OF MEASURED TO MODELED HWY-VV Rv

Percent Error
West 1
East 7
• Modeling Biofilters
OUTLET VOLUME COMPARISON OF MEASURED TO MODELED

West Modeled Outlet (Inf 0.5)

Percent Reduction | Measured | Modeled |
--- | --- | --- |
West | 92 | 91 |

Number of Event With Volume

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<tr>
<th>West</th>
<th>Measured</th>
<th>Modeled</th>
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<td>18</td>
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</table>

Percent Reduction | Measured | Modeled |
--- | --- | --- |
West | 97 | 95 |

Number of Event With Volume

<table>
<thead>
<tr>
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<th>Measured</th>
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</thead>
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<tr>
<td>West</td>
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## VOLUME COMPARISON
### MEASURED VS MODELED

<table>
<thead>
<tr>
<th></th>
<th>Measured (cf)</th>
<th>Modeled (cf)</th>
<th>Percent Difference</th>
<th>Infiltration Rate (in/hr)</th>
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<tbody>
<tr>
<td><strong>West</strong></td>
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<td></td>
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<tr>
<td>Inlet</td>
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<table>
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<tr>
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CONCLUSION

• Bioswales Very Effective Along Highways
• WinSLAMM Modeled Results Match Measure Data
• WisDOT Achieving Reduction Goals