CASE STUDIES: SWALE EFFECTIVENESS

BY: MARTY WANIELISTA AND ERIC LIVINGSTON

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Escambia County
ACKNOWLEDGEMENTS

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• The Escambia County LID BMP Manual and the LID BMP Workshops were funded in part by a Section 319 Nonpoint Source Management Program Implementation grant from the U.S. Environmental Protection Agency through an agreement/contract with the Nonpoint Source Management Section of the Florida Department of Environmental Protection.
NOTE !!!: All individual system must be sized prior to being analyzed in conjunction with other systems. Please read instructions in the CATCHMENT AND TREATMENT SUMMARY RESULTS tab for more information.
Available from: www.stormwater.ucf.edu

**What's New**


To be released before Nov of 2016
Model requires the use of Excel 2007 or newer

Disclaimer: These workbooks were created to assist in the analysis of Best Management Practice calculations. All users are responsible for validating the accuracy of the internal calculations. If improvements are noted within this model, please e-mail Marty Wanielista, Ph.D., P.E. at martin.wanielista@ucf.edu with specific information so that revisions can be made.

The authors of this program were Marty Wanielista, Mike Hardin, Haney Harper, Eric Livingston, Christopher Kuzlo, Colin Miller, and Ikiensinma Gogo-Abite. The trial version 8.0 updates of this program were done by Marty Wanielista and Mike Hardin. This is trial version 8.0 of the program, updated on August 1, 2016. Comments are appreciated.
PROBLEM INFORMATION

• Project location is Liberty County
• Single catchment to be examined
  • Area of 1.1 acres
  • Specified removal efficiency of 80%
• A swale is to be used
<table>
<thead>
<tr>
<th>Predevelopment Conditions</th>
<th>Postdevelopment Conditions</th>
<th>Catchment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land use</td>
<td>Land use</td>
<td>Agricultural-pasture</td>
</tr>
<tr>
<td>Curve Number</td>
<td>non-DCIA</td>
<td>Highway</td>
</tr>
<tr>
<td>%DCIA</td>
<td>Curve Number</td>
<td>85</td>
</tr>
<tr>
<td>%DCIA</td>
<td>%DCIA</td>
<td>50</td>
</tr>
<tr>
<td>BMP Area [acre]</td>
<td>BMP Area [acre]</td>
<td>0.1</td>
</tr>
</tbody>
</table>
BMP DESIGN

- Catchment will use 0.1 acre swale
  - Top width = 10 ft
  - Bottom width = 0 ft (so triangular)
  - Length (swale and highway) = 871 ft
  - Highway width = 20 ft
  - Average width of pervious area = 40 ft
  - Swale slope = 0.001
  - Manning’s n = 0.05
  - Soil infiltration rate = 5 in/hr
  - Swale side slope = 5
  - There is no swale block but there is a concentration reduction due to low slope
From the Introduction Page click on the Click Here to Start button to proceed to the General Site Information worksheet.

Select the Reset Input for Stormwater Treatment Analysis button to erase any existing data.

Enter the project name and select the meteorological zone in the General Site Information worksheet.

Indicate the mean annual rainfall amount in the General Site Information worksheet.

Select the Specified Removal Efficiency option from the type of analysis drop down menu in the General Site Information worksheet.

Specify the desired removal efficiency.

The authors of this program were Christopher Kuzlo, Marty Wanielista, Mike Hardin, and Ikiensinma Gogo-Abite.

This is version 5.5 of the program, updated on September 1, 2013. Comments are appreciated.


Mean Annual Rainfall Map

Isopleths of Mean Annual Precipitation in Florida from 1971-2000.


DESIGNATED METEOROLOGICAL REGIONS (ZONES) IN FLORIDA

ZONE MAP

GO TO GENERAL SITE INFORMATION

GO TO STORMWATER HARVESTING SYSTEM

GO TO RAINWATER HARVESTING SYSTEM

MEAN ANNUAL RAINFALL MAP

Isopleths of Mean Annual Precipitation in Florida from 1971-2000.


EXPANDED VIEW - NORTH

EXPANDED VIEW - SOUTH

DESIGNATED METEOROLOGICAL REGIONS (ZONES) IN FLORIDA
• Select the Go To Watershed Characteristics button to proceed to the Watershed Characteristics worksheet.
• Select a catchment configuration from the drop down menu; for diagrams of the different catchment configurations available, click the View Catchment Configuration button to proceed to the Catchment Configuration worksheet.
• Go back to the Watershed Characteristics worksheet by selecting the Go to Watershed Characteristics button.

Select from the 14 different configurations. You need to scroll down and right to see all configurations:

A - Single Catchment
B - 2 Catchment-Series
C - 2 Catchment-Parallel
D - 3 Catchment-Series
E - 3 Catchment-Parallel
F - Mixed-3 Catchment-2 Series-Parallel (A)
G - Mixed-3 Catchment-2 Series-Parallel (B)
H - 4 Catchment-Series
I - Mixed-4 Catchment-Series (A)
J - Mixed-4 Catchment-Series (B)
K - Mixed-4 Catchment-Series (C)
L - 4 Catchment-Parallel
M - Mixed-4 Catchment-2 Series
N - Mixed-4 Catchment-2 Series-Parallel
PROBLEM SOLUTION

From the Watershed Characteristics worksheet:

- Select the single catchment option from the drop-down menu.
- Indicate the pre- and post-development land use, catchment areas, non-DCIA Curve Number and DCIA percentage.

Select the Stormwater Treatment Analysis button to proceed to the Stormwater Treatment Analysis worksheet.
From the Stormwater Treatment Analysis worksheet, select the Swale button to proceed to the Swale worksheet.

Specify the required input in the Swale worksheet.

The example problem specifies additional concentration reduction, so select yes in the cell P6.

Required Treatment Eff (Nitrogen): %
Required Treatment Eff (Phosphorus): %

STORMWATER TREATMENT ANALYSIS:
- Required Treatment Eff (Nitrogen): %
- Required Treatment Eff (Phosphorus): %

NOTE !!!: All individual systems must be sized prior to being analyzed in conjunction with other systems. Please read instructions in the MULTIPLE WATERSHEDS AND TREATMENT SYSTEMS ANALYSIS tab for more information.

STEP 2: Select one of the systems below to analyze efficiency.
- Retention Basin
- Exfiltration
- Trench
- Filtration including Biofiltration
- Permeable Pavement
- Wet Detention
- Stormwater Harvesting
- Greenroof
- Rainwater Harvesting
- Floating Islands with Wet Detention
- Vegetated Natural Buffer
- Vegetated Filter Strip
- Swale
- Rain (Bio) Garden
- Vegetated Area Example tree well
- User Defined BMP

CATCHMENT AND TREATMENT SUMMARY

RESULTS

LINED REUSE POND & UNDERDRAIN INPUT
PROBLEM SOLUTION

- Select the Go to Stormwater Treatment Analysis Button to go to the Stormwater Treatment Analysis worksheet.
- Proceed to the Catchment and Treatment Summary Results worksheet by clicking the Catchment and Treatment Summary Results button.

Required Treatment Eff (Nitrogen): %
Required Treatment Eff (Phosphorus): %

STORMWATER TREATMENT ANALYSIS:
Red Numbers = Input data
Calculated or Carryover
Blue Numbers =

STEP 1:
Specify pre- and post-development watershed characteristics.

NOTE !!!:
All individual system must be sized prior to being analyzed in conjunction with other systems. Please read instructions in the MULTIPLE WATERSHEDS AND TREATMENT SYSTEMS ANALYSIS tab for more information.

STEP 2:
Select one of the systems below to analyze efficiency.

Total Required Treatment Efficiency:

GO TO GENERAL SITE INFORMATION PAGE
RETENTION BASIN
EXFILTRATION
TRENCH
FILTRATION including BIOFILTRATION
PERVIOUS PAVEMENT
WET DETENTION
GO TO WATERSHED CHARACTERISTICS
STORMWATER HARvesting
GREENROOF
RAINWATER HARVESTing
FLOATING ISLANDS WITH WET DETENTION
VEGETATED NATURAL BUFFER
VEGETATED FILTER STRIP
SWALE
RAIN (BIO) GARDEN
VEGETATED AREA
Example tree well
USER DEFINED BMP
CATCHMENT AND TREATMENT SUMMARY RESULTS

1
LINED REUSE POND & UNDERDRAIN INPUT

<table>
<thead>
<tr>
<th>PROJECT TITLE</th>
<th>Example Problem 1</th>
<th>Optional Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMP1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMP2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMP3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catchment Configuration</td>
<td>A - Single Catchment</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Summary Performance</th>
<th>Catchment Nitrogen Pre Load</th>
<th>3.81</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Catchment Phosphorus Pre Load</td>
<td>0.68</td>
</tr>
<tr>
<td></td>
<td>Catchment Nitrogen Post Load</td>
<td>5.41</td>
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<tr>
<td></td>
<td>Catchment Phosphorus Post Load</td>
<td>0.73</td>
</tr>
<tr>
<td></td>
<td>Target Load Reduction (N) %</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>Target Load Reduction (P) %</td>
<td>80</td>
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<tr>
<td></td>
<td>Target Discharge Load, N (kg/yr)</td>
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<tr>
<td></td>
<td>Target Discharge Load, P (kg/yr)</td>
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<tr>
<td></td>
<td>Provided Overall Efficiency, N (%)</td>
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</tr>
<tr>
<td></td>
<td>Provided Overall Efficiency, P (%)</td>
<td>68</td>
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<tr>
<td></td>
<td>Discharged Load, N (kg/yr &amp; lb/yr):</td>
<td>1.44</td>
</tr>
<tr>
<td></td>
<td>Discharged Load, P (kg/yr &amp; lb/yr):</td>
<td>0.23</td>
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<tr>
<td></td>
<td>Load Removed, N (kg/yr &amp; lb/yr):</td>
<td>3.97</td>
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<tr>
<td></td>
<td>Load Removed, P (kg/yr &amp; lb/yr):</td>
<td>0.49</td>
</tr>
</tbody>
</table>
Examination of the Catchments and Treatment Summary Results worksheet shows that the provided overall efficiency does not achieve the required 80%.

To increase the removal efficiency, try modifying the swale, for example, change the shape from triangular to trapezoidal.
SOME OBSERVATIONS

Easy to use model allows you to easily try different designs and evaluate them.

Can evaluate swale designs.

15 BMPs to choose from with the ability to use several different configurations:
- Series
- Parallel
- Combination

Summary sheet allows for quick and easy evaluation of design.
QUESTIONS, REMARKS AND DISCUSSION

THANK YOU!