Pinellas County Stormwater Management Manual Training Workshop

BMPTRAINS MODEL:
EXAMPLE APPLICATION AND NAVIGATION OF THE MODEL

BY: MARTY WANIELISTA, 2017
PURPOSE:

- Understand the basis of removal for 15 Stormwater Best Management Practices within BMPTRAINS.
- Define input data required for the BMPTRAINS program.
- Use BMPTRAINS for the selection of stormwater best management practices.
WHY INTRODUCE LID METHODS?

- LID do not require additional land making use very cost effective when land costs are considered.
- Additional options in the tool box to meet a need to reduce nutrients.
- Some developments use LID as standard practice. Thus credit should be available and applied to ERP and TMDL programs.
- Options to reduce cost.
- Acceptable to local, FDOT, WMD and DEP as options to meet ERP requirements and TMDL levels.
- The standard structural BMPs, wet detention and retention sometimes can not meet ERP requirements or TMDL reductions.
- In re-development, TMDLs may not be met even with a reduction in impervious area or the addition of regional wet detention ponds.
SOME CONSIDERATIONS IN THE CHOICE OF A MODEL TO EVALUATE DESIGNS

- Uses Florida Rainfall conditions.
- Uses Florida soils and physical land use conditions.
- Uses event mean concentration data from Florida based studies.
- Incorporates removal effectiveness for many structural BMPs and LIDs.
- Evaluates the effectiveness of BMPs in series and parallel.
- Peer reviewed by professionals and “passed” administrative hearings.
- Be available in the open literature (no cost to purchase).
- Acceptable to the practicing professionals.
- Acceptable to the local, regional (WMD) and DEP regulatory professionals.
- BMPTRAINS provides all of the above.
BMPTRAINS: an EXCEL and VB based model for sizing BMPs and estimating annual removal effectiveness.

It's acronym is derived from the analysis of stormwater BMPs in series, but can also evaluate parallel and series treatment.

The model is used to evaluate Best Management Practice Treatment options for Removal on an Annual basis by those Interested in Nutrients in Stormwater.

Available from: www.stormwater.ucf.edu

Credit and thanks for the programming and technical skills of: Dr. Mike Hardin, Dr. Harvey Harper, Dr. Ikiensinma Gogo-Abite, Eric Livingston, and Chris Kuzlo
BMPTRAINS MODEL:
INTRODUCTION TO AND NAVIGATION OF THE MODEL

BY: MARTY WANIELISTA
NAVIGATING the BMPTRAINS Model

ENABLE the macros

INTRODUCTION PAGE

Model requires the use of Excel 2007 or newer

1) There is a users manual to help navigate this program and it is available at www.stormwater.ucf.edu

2) This spreadsheet is best viewed at 1280 BY 1080 PIXELS screen resolution. If the maximum resolution of your computer screen is lower than 1280 BY 1080 PIXELS you can adjust the view in the Excel VIEW menu by zooming out to value smaller than 100 PERCENT.

3) This spreadsheet has incorporated ERROR MESSAGE WINDOWS. Your analysis is not valid unless ALL ERROR MESSAGE WINDOWS are clear.

4) PRINTING INSTRUCTIONS: Many options. One is to print the page to MICROSOFT OFFICE DOCUMENT IMAGE WRITER (typically the default) or ADOBE PDF, save the page as an image document, then print the document you saved.

5) Click on the button located on the top of this window titled CLICK HERE TO START to begin the analysis.

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.
**INTRODUCTION PAGE**

Model requires the use of Excel 2007 or newer.

1) There is a users manual to help navigate this program and it is available at www.stormwater.ucf.edu

2) This spreadsheet is best viewed at 1280 BY 1080 PIXELS screen resolution. If the maximum resolution of your computer screen is lower than 1280 BY 1080 PIXELS you can adjust the view in the Excel VIEW menu by zooming out to value smaller than 100 PERCENT.

3) This spreadsheet has incorporated ERROR MESSAGE WINDOWS. Your analysis is not valid unless ALL ERROR MESSAGE WINDOWS are clear.

4) PRINTING INSTRUCTIONS: Many options. One is to print the page to MICROSOFT OFFICE DOCUMENT IMAGE WRITER (typically the default) or ADOBE PDF, save the page as an image document, then print the document you saved.

5) Click on the button located on the top of this window titled **CLICK HERE TO START** to begin the analysis.

---

**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 Christopher Kudlo, Marty Wanielista, Mike Hardin, and Ikiensimma Gogo-Abite. The Stormwater Management Academy is responsible for the content of this program.

---

This program is compiled from stormwater management publications and deliberations during a two year review of the stormwater rule in the State of Florida. Input from the members of the Florida Department of Environmental Protection Stormwater Review Technical Advisory Committee and the staff and consultants from the State Water Management Districts is appreciated.

The State Department of Transportation provided guidance and resources to compile this program. The Stormwater Management Academy is responsible for the content of this program.

---

Version: 8.5 | Date: February 27, 2017 | SMADA ONLINE
NAVGATING the BMPTRAINS Model

INTRODUCTION PAGE

Model requires the use of Excel 2007 or newer.

1) There is a users manual to help navigate this program and it is available at www.stormwater.ucf.edu

2) This spreadsheet is best viewed at 1280 BY 1080 PIXELS screen resolution. If the maximum resolution of your computer screen is lower than 1280 BY 1080 PIXELS you can adjust the view in the Excel VIEW menu by zooming out to value smaller than 100 PERCENT.

3) This spreadsheet has incorporated ERROR MESSAGE WINDOWS. Your analysis is not valid unless ALL ERROR MESSAGE WINDOWS are clear.

4) PRINTING INSTRUCTIONS: Many options. One is to print the page to MICROSOFT OFFICE DOCUMENT IMAGE WRITER (typically the default) or ADOBE PDF, save the page as an image document, then print the document you saved.

5) Click on the button located on the top of this window titled CLICK HERE TO START to begin the analysis.

HELP AND BACKGROUND

This program is compiled from stormwater management publications and deliberations during a two year review of the stormwater rule in the State of Florida.

Input from the members of the Florida Department of Environmental Protection Stormwater Review Technical Advisory Committee and the staff and consultants from the State Water Management Districts is appreciated.

The State Department of Transportation provided guidance and resources to compile this program. The Stormwater Management Academy is responsible for the content of this program.

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.
INTRODUCTION PAGE

Model requires the use of Excel 2007 or newer

1) There is a users manual to help navigate this program and it is available at www.stormwater.ucf.edu

2) This spreadsheet is best viewed at 1280 BY 1080 PIXELS screen resolution. If the maximum resolution of your computer screen is lower than 1280 BY 1080 PIXELS you can adjust the view in the Excel VIEW menu by zooming out to value smaller than 100 PERCENT.

3) This spreadsheet has incorporated ERROR MESSAGE WINDOWS. Your analysis is not valid unless ALL ERROR MESSAGE WINDOWS are clear.

4) PRINTING INSTRUCTIONS: Many options. One is to print the page to MICROSOFT OFFICE DOCUMENT IMAGE WRITER (typically the default) or ADOBE PDF, save the page as an image document, then print the document you saved.

5) Click on the button located on the top of this window titled CLICK HERE TO START to begin the analysis.

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.
GENERAL SITE INFORMATION

Select the appropriate Meteorological Zone, input the appropriate Mean Annual Rainfall amount and select the type of analysis:

- Meteorological Zone (Please use zone map):
- Mean Annual Rainfall (Please use rainfall map):
- Type of analysis:
  - Treatment efficiency (N, P) (leave empty if net improvement or BMP analysis is used):

There is a user's manual for the BMPTRAINS model. It can be downloaded from www.stormwater.ucf.edu. The results from the example problems shown in the manual however may not reflect current model results due to ongoing updates of the model.

RESET INPUT FOR STORMWATER TREATMENT ANALYSIS

STORMWATER TREATMENT ANALYSIS

Systems available for analysis:
- Retention Basin with option for calculating effluent concentration
- Wet Detention
- Exfiltration Trench
- Pervious Pavement
- Stormwater Harvesting
- Underdrain Biofiltration
- Greenroof
- Rainwater Harvesting
- Floating Island with Wet Detention
- Vegetated Natural Buffer
- Vegetated Filter Strip
- Swale
- Rain Garden
- Lined reuse pond
- User Defined BMP

METHODOLOGY FOR CALCULATING REQUIRED TREATMENT EFFICIENCY

METHODOLOGY FOR RETENTION SYSTEMS

METHODOLOGY FOR WET DETENTION SYSTEMS

METHODOLOGY FOR GREENROOF SYSTEMS

METHODOLOGY FOR WATER HARVESTING SYSTEMS
RAINFALL AND TYPE OF EFFECTIVENESS ANALYSIS

STEP 1: Select the appropriate Meteorological Zone, input the appropriate Mean Annual Rainfall amount and select the type of analysis

Meteorological Zone (Please use zone map):

Mean Annual Rainfall (Please use rainfall map):

Type of analysis:

Treatment efficiency (N, P) (leave empty if net improvement or BMP analysis is used):

BMP, Net Efficiency 10% less than pre

Annual Effectiveness

Buttons For

View Zone Maps

View Mean Annual Rainfall Map
Rainfall distributions are regionally different.
GENERAL SITE INFORMATION

<table>
<thead>
<tr>
<th>GENERAL SITE INFORMATION: V 8.5</th>
<th>GO TO INTRODUCTION PAGE</th>
<th>3/26/2017</th>
<th>Input data</th>
</tr>
</thead>
<tbody>
<tr>
<td>General site information:</td>
<td>Name of project</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mixed use</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Select the appropriate Meteorological Zone, input the appropriate Mean Annual Rainfall amount and select the type of analysis.

Meteorological Zone (Please use zone map):
- CLICK ON CELL BELOW TO SELECT
  - Zone 4

Mean Annual Rainfall (Please use rainfall map): 51.00 inches

Type of analysis:
- CLICK ON CELL BELOW TO SELECT
  - Specified removal efficiency
  - 55% 80%

Select the STORMWATER TREATMENT ANALYSIS Button below to begin analyzing the effectiveness of Best Management Practices.

There is a user's manual for the BMPTRAINS model. It can be downloaded from www.stormwater.ucf.edu. The results from the example problems shown in the manual however may not reflect current model results due to ongoing updates of the model.

STORMWATER TREATMENT ANALYSIS

Systems available for analysis:
- Retention Basin with option for calculating effluent concentration
- Wet Detention
- Exfiltration Trench
- Pervious Pavement
- Stormwater Harvesting
- Biofiltration
- Greenroof
- Rainwater Harvesting
- Managed Aquatic Plants Detention
- Vegetated Natural Buffer
- Vegetated Filter Strip
- Swale
- Rain Garden
- Tree Well
- Lined reuse pond
- User Defined BMP

RESET INPUT FOR STORMWATER TREATMENT ANALYSIS

GO TO WATERSHED CHARACTERISTICS

METHODOLOGY FOR CALCULATING REQUIRED TREATMENT EFFICIENCY

METHODOLOGY FOR RETENTION SYSTEMS

METHODOLOGY FOR WET DETENTION SYSTEMS

METHODOLOGY FOR GREENROOF SYSTEMS

METHODOLOGY FOR WATER HARVESTING SYSTEMS
WATERSHEDS
CATCHMENT INPUTS

**WATERSHED CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Delay [hrs]</th>
<th>max delay = 15 hrs.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Pre-development land use:</th>
<th>with default EMCs</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Post-development land use:</th>
<th>with default EMCs</th>
</tr>
</thead>
</table>

**CATCHMENT NO.1 NAME:**

For comingling, the off-site catchment must be upstream. The delay is only for retention BMPs and must be used in hours as measured by the time of concentration at a one inch/hour rain.

**GO TO STORMWATER TREATMENT ANALYSIS**

**VIEW AVERAGE ANNUAL RUNOFF "C" Factor**

**VIEW EMC & FLUCCS**

**GO TO GIS LANDUSE DATA**

**TWO NEW HELP BUTTONS**
WATERSHEDS
CATCHMENT CONFIGURATIONS

<table>
<thead>
<tr>
<th>SERIES</th>
<th>PARALLEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 → 2 → 3</td>
<td>1 → 2 → 3 → 4</td>
</tr>
</tbody>
</table>

Up to 3 BMPs in each catchment and in series

14 configurations
### Watersheds Catchment Inputs

**Watershed Characteristics V 8.5**

**Select Catchment Configuration**

<table>
<thead>
<tr>
<th>Delay [hrs]</th>
<th>CATCHMENT NO.1 NAME:</th>
<th>pinellas shores</th>
</tr>
</thead>
<tbody>
<tr>
<td>max delay = 15 hrs.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Pre-development land use:**
- with default EMCs

**Post-development land use:**
- with default EMCs

#### For comingling, the off-site catchment must be upstream. The delay is only for retention BMPs and must be used in hours as measured by the time of concentration at a one inch/hour rain.

#### Input Data in Grey Field
- Estimated BMP Area (No loading from this area)

#### And For Each Worksheet in Blue Color
- Total pre-development catchment area: 12.000 AC
- Total post-development catchment area: 12.000 AC
- Pre-development Non DCIA CN:
  - Single-Family: 60.00
  - Multi-Family: 60.00
- Pre-development DCIA percentage:
  - Single-Family: 24.00%
  - Multi-Family: 70.00%
- Post-development Non DCIA CN:
  - Single-Family: 60.00
  - Multi-Family: 60.00
- Post-development DCIA percentage:
  - Single-Family: 70.00%
  - Multi-Family: 70.00%

**Average Annual Precipitation**

- Average annual precipitation:
  - Pre-development: 12.000 AC
  - Post-development: 12.000 AC
  - Pre-development: 60.00
  - Post-development: 60.00

**Go to Stormwater Treatment Analysis**

**View Average Annual Runoff "C" Factor**

**View EMC & FLUCCS**

**Go to GIS Landuse Data**

#### 3/27/2017
## FLUCCS Codes and Model Land Uses

<table>
<thead>
<tr>
<th>Code</th>
<th>Land Use</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>2210</td>
<td>Citrus groves</td>
<td>Refining the Indian River Lagoon TMDL- Tech Memo Report</td>
</tr>
<tr>
<td>2220</td>
<td>Fruit Orchards</td>
<td>Assessment and Evaluation of Model Input Parameters</td>
</tr>
<tr>
<td>1400</td>
<td>Commercial and Services</td>
<td>Prepared by ERD, July 2013</td>
</tr>
<tr>
<td>1410</td>
<td>Retail Sales and Services</td>
<td>FLUCCS code reference: FDOT</td>
</tr>
<tr>
<td>3212</td>
<td>Dry Prairie</td>
<td>* Can also use the general undeveloped rangeland.</td>
</tr>
<tr>
<td>3220</td>
<td>Coastal Strand</td>
<td>NOTE: Pre-application meeting frequent discussion</td>
</tr>
<tr>
<td>3300</td>
<td>Mixed Rangeland</td>
<td></td>
</tr>
<tr>
<td>1300</td>
<td>Residential, High-Density</td>
<td></td>
</tr>
<tr>
<td>1310</td>
<td>Fixed Single Family Units</td>
<td></td>
</tr>
<tr>
<td>1330</td>
<td>Residential, High-Density; Multiple</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dwelling Units, Low Rise &lt;Two stories or less&gt;</td>
<td></td>
</tr>
</tbody>
</table>
## Loading Data (IN RED)

### Formwater Treatment Analysis

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Blue Numbers =</th>
<th>Input data</th>
<th>Red Numbers =</th>
<th>Calculated</th>
</tr>
</thead>
<tbody>
<tr>
<td>A - Single Catchment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMINGLING</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MULTI LAND USE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Overwrite Default Concentrations Using:

<table>
<thead>
<tr>
<th></th>
<th>Pre:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>EMC(N)</td>
<td>mg/L</td>
<td></td>
</tr>
<tr>
<td>EMC(P)</td>
<td>mg/L</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Post:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mg/L</td>
<td></td>
</tr>
</tbody>
</table>

### Use Default Concentrations

- **Average annual pre runoff volume:** 11.638 ac-ft/year
- **Average annual post runoff volume (note no BMP area):** 28.114 ac-ft/year
- **Pre-development Annual Mass Loading - Nitrogen:** 29.711 kg/year
- **Pre-development Annual Mass Loading - Phosphorus:** 4.693 kg/year
- **Post-development Annual Mass Loading - Nitrogen:** 80.438 kg/year
- **Post-development Annual Mass Loading - Phosphorus:** 18.029 kg/year
STREAM GAGING DATA

• Actual Data from a stream nearby UCF, gage operated by USGS.
• Average Streamflow = 1.926 CFS/SQ MI/yr = 26.19 inches streamflow/yr
  • Conversion factor is 13.6 inches on the watershed = 1 CFS/SQ MI.
• Hydrograph separation is 50% runoff or 13.1 inches runoff per year
• Stream is located in meteorological zone 2 with annual rain of 50 inches
• Annual “C” factor is 13.1/50 = 0.262
## Zone 2

Mean Annual Runoff Coefficients (C Values) as a Function of DCIA Percentage and Non-DCIA Curve Number (CN)

<table>
<thead>
<tr>
<th>NDCIA</th>
<th>0</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
<th>45</th>
<th>50</th>
<th>55</th>
<th>60</th>
<th>65</th>
<th>70</th>
<th>75</th>
<th>80</th>
<th>85</th>
<th>90</th>
<th>95</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>0.002</td>
<td>0.043</td>
<td>0.083</td>
<td>0.123</td>
<td>0.164</td>
<td>0.204</td>
<td>0.244</td>
<td>0.285</td>
<td>0.325</td>
<td>0.366</td>
<td>0.406</td>
<td>0.446</td>
<td>0.487</td>
<td>0.527</td>
<td>0.567</td>
<td>0.608</td>
<td>0.648</td>
<td>0.688</td>
<td>0.729</td>
<td>0.769</td>
<td>0.809</td>
</tr>
<tr>
<td>35</td>
<td>0.004</td>
<td>0.044</td>
<td>0.085</td>
<td>0.125</td>
<td>0.165</td>
<td>0.205</td>
<td>0.246</td>
<td>0.286</td>
<td>0.326</td>
<td>0.366</td>
<td>0.407</td>
<td>0.447</td>
<td>0.487</td>
<td>0.528</td>
<td>0.568</td>
<td>0.608</td>
<td>0.648</td>
<td>0.688</td>
<td>0.729</td>
<td>0.769</td>
<td>0.809</td>
</tr>
<tr>
<td>40</td>
<td>0.007</td>
<td>0.047</td>
<td>0.087</td>
<td>0.127</td>
<td>0.167</td>
<td>0.207</td>
<td>0.248</td>
<td>0.288</td>
<td>0.328</td>
<td>0.368</td>
<td>0.408</td>
<td>0.448</td>
<td>0.488</td>
<td>0.528</td>
<td>0.569</td>
<td>0.609</td>
<td>0.649</td>
<td>0.689</td>
<td>0.729</td>
<td>0.769</td>
<td>0.809</td>
</tr>
<tr>
<td>45</td>
<td>0.010</td>
<td>0.050</td>
<td>0.090</td>
<td>0.130</td>
<td>0.170</td>
<td>0.210</td>
<td>0.250</td>
<td>0.290</td>
<td>0.330</td>
<td>0.370</td>
<td>0.410</td>
<td>0.450</td>
<td>0.490</td>
<td>0.530</td>
<td>0.570</td>
<td>0.610</td>
<td>0.650</td>
<td>0.690</td>
<td>0.729</td>
<td>0.769</td>
<td>0.809</td>
</tr>
<tr>
<td>50</td>
<td>0.015</td>
<td>0.055</td>
<td>0.095</td>
<td>0.134</td>
<td>0.174</td>
<td>0.214</td>
<td>0.254</td>
<td>0.293</td>
<td>0.333</td>
<td>0.373</td>
<td>0.412</td>
<td>0.452</td>
<td>0.492</td>
<td>0.531</td>
<td>0.571</td>
<td>0.611</td>
<td>0.651</td>
<td>0.690</td>
<td>0.730</td>
<td>0.770</td>
<td>0.809</td>
</tr>
<tr>
<td>55</td>
<td>0.022</td>
<td>0.061</td>
<td>0.101</td>
<td>0.140</td>
<td>0.179</td>
<td>0.219</td>
<td>0.258</td>
<td>0.298</td>
<td>0.337</td>
<td>0.376</td>
<td>0.416</td>
<td>0.455</td>
<td>0.494</td>
<td>0.534</td>
<td>0.573</td>
<td>0.613</td>
<td>0.652</td>
<td>0.691</td>
<td>0.731</td>
<td>0.770</td>
<td>0.809</td>
</tr>
<tr>
<td>60</td>
<td>0.030</td>
<td>0.069</td>
<td>0.108</td>
<td>0.147</td>
<td>0.186</td>
<td>0.225</td>
<td>0.264</td>
<td>0.303</td>
<td>0.342</td>
<td>0.381</td>
<td>0.420</td>
<td>0.459</td>
<td>0.498</td>
<td>0.537</td>
<td>0.576</td>
<td>0.615</td>
<td>0.654</td>
<td>0.693</td>
<td>0.731</td>
<td>0.770</td>
<td>0.809</td>
</tr>
<tr>
<td>65</td>
<td>0.042</td>
<td>0.080</td>
<td>0.119</td>
<td>0.157</td>
<td>0.195</td>
<td>0.234</td>
<td>0.272</td>
<td>0.311</td>
<td>0.349</td>
<td>0.387</td>
<td>0.426</td>
<td>0.464</td>
<td>0.502</td>
<td>0.541</td>
<td>0.579</td>
<td>0.618</td>
<td>0.656</td>
<td>0.694</td>
<td>0.733</td>
<td>0.771</td>
<td>0.809</td>
</tr>
<tr>
<td>70</td>
<td>0.057</td>
<td>0.095</td>
<td>0.133</td>
<td>0.170</td>
<td>0.208</td>
<td>0.245</td>
<td>0.283</td>
<td>0.321</td>
<td>0.358</td>
<td>0.396</td>
<td>0.433</td>
<td>0.471</td>
<td>0.509</td>
<td>0.546</td>
<td>0.584</td>
<td>0.621</td>
<td>0.659</td>
<td>0.697</td>
<td>0.734</td>
<td>0.772</td>
<td>0.809</td>
</tr>
<tr>
<td>75</td>
<td>0.079</td>
<td>0.116</td>
<td>0.152</td>
<td>0.189</td>
<td>0.225</td>
<td>0.262</td>
<td>0.298</td>
<td>0.335</td>
<td>0.371</td>
<td>0.408</td>
<td>0.444</td>
<td>0.481</td>
<td>0.517</td>
<td>0.554</td>
<td>0.590</td>
<td>0.627</td>
<td>0.663</td>
<td>0.700</td>
<td>0.736</td>
<td>0.773</td>
<td>0.809</td>
</tr>
<tr>
<td>80</td>
<td>0.111</td>
<td>0.146</td>
<td>0.181</td>
<td>0.216</td>
<td>0.251</td>
<td>0.285</td>
<td>0.326</td>
<td>0.355</td>
<td>0.390</td>
<td>0.425</td>
<td>0.460</td>
<td>0.495</td>
<td>0.530</td>
<td>0.565</td>
<td>0.600</td>
<td>0.635</td>
<td>0.670</td>
<td>0.705</td>
<td>0.740</td>
<td>0.774</td>
<td>0.809</td>
</tr>
<tr>
<td>85</td>
<td>0.160</td>
<td>0.192</td>
<td>0.225</td>
<td>0.257</td>
<td>0.290</td>
<td>0.329</td>
<td>0.358</td>
<td>0.387</td>
<td>0.420</td>
<td>0.452</td>
<td>0.485</td>
<td>0.517</td>
<td>0.550</td>
<td>0.582</td>
<td>0.614</td>
<td>0.647</td>
<td>0.679</td>
<td>0.712</td>
<td>0.744</td>
<td>0.777</td>
<td>0.809</td>
</tr>
<tr>
<td>90</td>
<td>0.242</td>
<td>0.270</td>
<td>0.299</td>
<td>0.327</td>
<td>0.355</td>
<td>0.384</td>
<td>0.412</td>
<td>0.440</td>
<td>0.469</td>
<td>0.497</td>
<td>0.526</td>
<td>0.554</td>
<td>0.582</td>
<td>0.611</td>
<td>0.639</td>
<td>0.667</td>
<td>0.696</td>
<td>0.724</td>
<td>0.753</td>
<td>0.781</td>
<td>0.809</td>
</tr>
<tr>
<td>95</td>
<td>0.404</td>
<td>0.424</td>
<td>0.444</td>
<td>0.464</td>
<td>0.485</td>
<td>0.506</td>
<td>0.525</td>
<td>0.546</td>
<td>0.566</td>
<td>0.586</td>
<td>0.606</td>
<td>0.627</td>
<td>0.647</td>
<td>0.667</td>
<td>0.688</td>
<td>0.708</td>
<td>0.728</td>
<td>0.749</td>
<td>0.769</td>
<td>0.789</td>
<td>0.809</td>
</tr>
<tr>
<td>98</td>
<td>0.595</td>
<td>0.605</td>
<td>0.616</td>
<td>0.627</td>
<td>0.638</td>
<td>0.648</td>
<td>0.659</td>
<td>0.670</td>
<td>0.680</td>
<td>0.691</td>
<td>0.702</td>
<td>0.713</td>
<td>0.723</td>
<td>0.734</td>
<td>0.745</td>
<td>0.756</td>
<td>0.766</td>
<td>0.777</td>
<td>0.788</td>
<td>0.799</td>
<td>0.809</td>
</tr>
</tbody>
</table>

NOTE: Pre-application meeting frequent discussion
### WATERSHEDS
#### CATCHMENT INPUTS

<table>
<thead>
<tr>
<th>WATERSHED CHARACTERISTICS V 8.0</th>
<th>GO TO STORMWATER TREATMENT ANALYSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SELECT CATCHMENT CONFIGURATION</td>
<td>CLICK ON CELL BELOW TO SELECT CONFIGURATION</td>
</tr>
<tr>
<td>8/28/2016</td>
<td>CLICK ON CELL BELOW TO SELECT CONFIGURATION</td>
</tr>
<tr>
<td>GO TO CATCHMENT CONFIGURATION</td>
<td>VIEW AVERAGE ANNUAL RUNOFF &quot;C&quot; Factor</td>
</tr>
<tr>
<td>CLICK ON CELL BELOW TO SELECT</td>
<td>VIEW EMC &amp; FLUCCS</td>
</tr>
<tr>
<td>CATCHMENT NO.1 NAME: Gulf Coast #1</td>
<td>GO TO GIS LANDUSE DATA</td>
</tr>
<tr>
<td>Delay [hrs]</td>
<td>USE DEFAULT CONCENTRATIONS</td>
</tr>
<tr>
<td>CATCHMENT NO.1 NAME: Gulf Coast #1</td>
<td>OVERWRITE DEFAULT CONCENTRATIONS USING:</td>
</tr>
<tr>
<td>Pre-development land use:</td>
<td>PRE:</td>
</tr>
<tr>
<td>with default EMCs</td>
<td>E{MC(N)}: mg/L</td>
</tr>
<tr>
<td>Post-development land use:</td>
<td>POST:</td>
</tr>
<tr>
<td>with default EMCs</td>
<td>E{MC(P)}: mg/L</td>
</tr>
<tr>
<td>Total pre-development catchment area:</td>
<td>10.00 AC</td>
</tr>
<tr>
<td>Total post-development catchment or BMP analysis area:</td>
<td>10.00 AC</td>
</tr>
<tr>
<td>Pre-development Non DCIA CN:</td>
<td>67.00</td>
</tr>
<tr>
<td>Pre-development DCIA percentage:</td>
<td>35.00 %</td>
</tr>
<tr>
<td>Post-development Non DCIA CN:</td>
<td>67.00</td>
</tr>
<tr>
<td>Post-development DCIA percentage:</td>
<td>50.00 %</td>
</tr>
<tr>
<td>Estimated BMP Area (No loading from this area)</td>
<td>0.50 AC</td>
</tr>
<tr>
<td>Pre-development Annual Mass Loading - Nitrogen:</td>
<td>20.617 kg/year</td>
</tr>
<tr>
<td>Pre-development Annual Mass Loading - Phosphorus:</td>
<td>4.467 kg/year</td>
</tr>
<tr>
<td>Post-development Annual Mass Loading - Nitrogen:</td>
<td>52.773 kg/year</td>
</tr>
<tr>
<td>Post-development Annual Mass Loading - Phosphorus:</td>
<td>7.586 kg/year</td>
</tr>
</tbody>
</table>

For comingling, the off-site catchment must be upstream. The delay is only for retention BMPs and must be used in hours as measured by the time of concentration at a one inch/hour rain.
Total Required Treatment Efficiency:

- Required Treatment Eff (Nitrogen): 55%
- Required Treatment Eff (Phosphorus): 80%

Select one of the BMPs below to analyze efficiency or review the summary data.

- Retention Basin
- Wet Detention / Map
- Exfiltration Trench
- Rain Garden
- Swale
- User Defined BMP

NOTE!!! All individual systems 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.
15 BMPS AND ONE USER DEFINED

Select one of the BMPs below to analyze efficiency or review the summary data.

<table>
<thead>
<tr>
<th>RETENTION BASIN</th>
<th>WET DETENTION / EXFILTRATION</th>
<th>EXFILTRATION TRENCH</th>
<th>RAIN GARDEN / depression storage</th>
<th>SWALE</th>
<th>USER DEFINED BMP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PERVIOUS PAVEMENT</td>
<td>STORMWATER HARVESTING</td>
<td>FILTRATION</td>
<td>View Media Mixes</td>
<td>GO TO COST ANALYSIS WORKSHEET</td>
</tr>
<tr>
<td></td>
<td>GREENROOF</td>
<td>RAINWATER HARVESTING</td>
<td>LINED REUSE POND &amp; UNDERDRAIN INPUT</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>VEGETATED NATURAL BUFFER</td>
<td>VEGETATED FILTER STRIP</td>
<td>TREE WELL</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.
Loadings from BMP area are contained by the BMP, thus no BMP area load.

Watershed area contributing to basin:
- Pinellas Shores: 11.250 ac
- Catchment 2: 0.000 ac
- Catchment 3: 0.000 ac
- Catchment 4: 0.000 ac

Required Treatment Eff (Nitrogen):
- Pinellas Shores: 55.000%
- Catchment 2: 55.000%
- Catchment 3: 55.000%
- Catchment 4: 55.000%

Required Treatment Eff (Phosphorus):
- Pinellas Shores: 80.000%
- Catchment 2: 80.000%
- Catchment 3: 80.000%
- Catchment 4: 80.000%

Required retention depth over the watershed to meet required efficiency:
- Pinellas Shores: 1.177 in
- Catchment 2: 1.177 in
- Catchment 3: 1.177 in
- Catchment 4: 1.177 in

Required water quality retention volume:
- Pinellas Shores: 1.104 ac-ft
- Catchment 2: 0.000 ac-ft
- Catchment 3: 0.000 ac-ft
- Catchment 4: 0.000 ac-ft

Retention volume based on retention depth and Total area - BMP area
- Pinellas Shores: 1.125 ac-ft
- Catchment 2: 0.000 ac-ft
- Catchment 3: 0.000 ac-ft
- Catchment 4: 0.000 ac-ft

Provided retention depth (0.1-3.99 inches over the watershed)
- Pinellas Shores: 1.200 in
- Catchment 2: 0.000 in
- Catchment 3: 0.000 in
- Catchment 4: 0.000 in

Provided treatment efficiency (Nitrogen):
- Pinellas Shores: 80.560%
- Catchment 2: 0.000%
- Catchment 3: 0.000%
- Catchment 4: 0.000%

Provided treatment efficiency (Phosphorus):
- Pinellas Shores: 80.560%
- Catchment 2: 0.000%
- Catchment 3: 0.000%
- Catchment 4: 0.000%

Remaining treatment efficiency (Nitrogen):
- Pinellas Shores: 0.000%
- Catchment 2: 55.000%
- Catchment 3: 55.000%
- Catchment 4: 55.000%

Remaining treatment efficiency (Phosphorus):
- Pinellas Shores: 0.000%
- Catchment 2: 80.000%
- Catchment 3: 80.000%
- Catchment 4: 80.000%

Remaining retention depth needed:
- Pinellas Shores: 0.000 in
- Catchment 2: 1.177 in
- Catchment 3: 1.177 in
- Catchment 4: 1.177 in
GO TO STORMWATER TREATMENT ANALYSIS

TYPICAL CROSS SECTION OF A "DRY" RETENTION SYSTEM

Total Required Treatment Efficiency:

- Required Treatment Eff (Nitrogen): 55%
- Required Treatment Eff (Phosphorus): 80%

Select one of the BMPs below to analyze efficiency or review the summary data.

<table>
<thead>
<tr>
<th>RETENTION BASIN</th>
<th>WET DETENTION / MAP</th>
<th>EXFILTRATION</th>
<th>RAIN GARDEN</th>
<th>SWALE</th>
<th>USER DEFINED BMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERVIOUS PAVEMENT</td>
<td>STORMWATER HARVESTING</td>
<td>FILTRATION</td>
<td>View Media Mixes</td>
<td>GO TO COST ANALYSIS</td>
<td></td>
</tr>
<tr>
<td>GREENROOF</td>
<td>RAINWATER HARVESTING</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VEGETATED NATURAL BUFFER</td>
<td>VEGETATED FILTER STRIP</td>
<td>TREE WELL</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.

CATCHMENT AND TREATMENT SUMMARY RESULTS
<table>
<thead>
<tr>
<th>Pinellas Shores</th>
<th>Catchment 2</th>
<th>Catchment 3</th>
<th>Catchment 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMP Name</td>
<td>Retention Basin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMP Name</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMP Name</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Surface Water Discharge Summary Performance of Entire Watershed

<table>
<thead>
<tr>
<th>Catchment Configuration</th>
<th>A - Single Catchment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen Pre Load (kg/yr)</td>
<td>29.71</td>
</tr>
<tr>
<td>Phosphorus Pre Load (kg/yr)</td>
<td>4.69</td>
</tr>
<tr>
<td>Nitrogen Post Load (kg/yr)</td>
<td>80.44</td>
</tr>
<tr>
<td>Phosphorus Post Load (kg/yr)</td>
<td>18.03</td>
</tr>
<tr>
<td>Target Load Reduction (N) %</td>
<td>55</td>
</tr>
<tr>
<td>Target Load Reduction (P) %</td>
<td>80</td>
</tr>
<tr>
<td>Target Discharge Load, N (kg/yr)</td>
<td>36.20</td>
</tr>
<tr>
<td>Target Discharge Load, P (kg/yr)</td>
<td>3.61</td>
</tr>
<tr>
<td>Provided Overall Efficiency, N (%):</td>
<td>81</td>
</tr>
<tr>
<td>Provided Overall Efficiency, P (%):</td>
<td>81</td>
</tr>
<tr>
<td>Discharged Load, N (kg/yr &amp; lb/yr):</td>
<td>15.64</td>
</tr>
<tr>
<td>Discharged Load, P (kg/yr &amp; lb/yr):</td>
<td>3.50</td>
</tr>
<tr>
<td>Load Removed, N (kg/yr &amp; lb/yr):</td>
<td>64.80</td>
</tr>
<tr>
<td>Load Removed, P (kg/yr &amp; lb/yr):</td>
<td>14.52</td>
</tr>
</tbody>
</table>
1. Navigation of the BMPTRAINS model is by buttons. Input data are shown in blue while output data are in red.
2. BMPTRAINS model is used to size treatment systems and estimate an average annual nutrient removal effectiveness.
3. The average annual effectiveness is site and BMP specific incorporating rainfall conditions, impervious cover, soil conditions, type of land use, and type of BMP.
4. BMPTRAINS has many (over 100 worksheets) and at least 15 BMPs that can be used to evaluate annual removals.
Pinellas County Stormwater Management Manual Training Workshop

QUESTIONS, REMARKS AND DISCUSSION

THANK YOU!
Retention depth over the watershed area is 1.43 inches for the watershed conditions and rainfall zone.
BUT not sufficient area for one retention basin
But may use 3 BMPs for each catchment in Series in one Watershed

1st BMP is pervious pavement @ 0.6 inch treatment

NOTE: This is the effectiveness curve if pervious pave is only used.
Retention depth over the area is 0.60 inches
For a pervious pavement with reservoir.
Example 3 BMPs in Series in one Watershed

2nd BMP in series is exfiltration @ 0.5 inch treatment

NOTE: This is the effectiveness curve if exfiltration is only used. Retention depth over the equivalent impervious area is 0.50 inches for an exfiltration system.
Annual effectiveness is **not** the sum of the two efficiencies (50+40 = 90%) 
It is however the annual effectiveness at 1.1 inch retention or 70%.

NOTE: order of retention BMPs has no affect on the removal.
BMP TREATMENT TRAIN CREDITS
WHEN THREE EFFICIENCIES ARE IN SERIES

TP LOAD = 100

Pervious Pavement
50% effective
(0.6 inch)

Exfiltration
40%
Effective
(0.5 inch)

Wet detention
33.3%
Effective (16 hours retention)

M = 100 \[ 1- {(1-0.5)(1-0.4)(1-.33)} \] = 100[ 1-.20] = 80 \% removed

NOT 50+40+33.3=123.3%

NOTES 1. Example flow diagram for this problem only.
2. There was no input or additional catchment flow between BMPs
### How to Use the User Defined BMP Worksheet?

**Starting Worksheet**

<table>
<thead>
<tr>
<th>Name of BMP</th>
<th>Contributing catchment area</th>
<th>9.500</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Required treatment efficiency (Nitrogen):</td>
<td>TBD</td>
</tr>
<tr>
<td></td>
<td>Required treatment efficiency (Phosphorus):</td>
<td>TBD</td>
</tr>
<tr>
<td>Is this a retention or other system*?</td>
<td>Retention</td>
<td></td>
</tr>
<tr>
<td>If retention, storage depth is:</td>
<td>0.250</td>
<td></td>
</tr>
<tr>
<td>The calculated storage volume is:</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>Treatment efficiency (Nitrogen):</td>
<td>43.400</td>
<td></td>
</tr>
<tr>
<td>Treatment efficiency (Phosphorus):</td>
<td>43.400</td>
<td></td>
</tr>
<tr>
<td>Provided treatment efficiency (Nitrogen):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provided treatment efficiency (Phosphorus):</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Examples of other systems are street sweeping, dry detention, chemical treatment, and pre-treatment devices

**Notes:** Units defined on full worksheet and Blue font denotes input data for that worksheet.
### Name of BMP

#### Contributing catchment area:

<table>
<thead>
<tr>
<th>Name of BMP</th>
<th>Contributing catchment area:</th>
<th>Required treatment efficiency (Nitrogen):</th>
<th>Required treatment efficiency (Phosphorus):</th>
<th>Is this a retention or other system*?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>TBD</td>
<td>TBD</td>
<td>Other</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Examples of other systems are street sweeping, dry detention, chemical treatment, and pre-treatment devices

**Provided treatment efficiency (Nitrogen):**

<table>
<thead>
<tr>
<th>Provided treatment efficiency (Nitrogen):</th>
<th>Provided treatment efficiency (Phosphorus):</th>
</tr>
</thead>
<tbody>
<tr>
<td>54.00</td>
<td>67.00</td>
</tr>
</tbody>
</table>

**Enter a short description of BMP below (no more than 200 characters):**

**Up-Flow Filters**

<table>
<thead>
<tr>
<th>Name of BMP</th>
<th>Contributing catchment area:</th>
<th>Required treatment efficiency (Nitrogen):</th>
<th>Required treatment efficiency (Phosphorus):</th>
<th>Is this a retention or other system*?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>TBD</td>
<td>TBD</td>
<td>Other</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Examples of other systems are street sweeping, dry detention, chemical treatment, and pre-treatment devices

**Provided treatment efficiency (Nitrogen):**

<table>
<thead>
<tr>
<th>Provided treatment efficiency (Nitrogen):</th>
<th>Provided treatment efficiency (Phosphorus):</th>
</tr>
</thead>
<tbody>
<tr>
<td>54.00</td>
<td>67.00</td>
</tr>
</tbody>
</table>