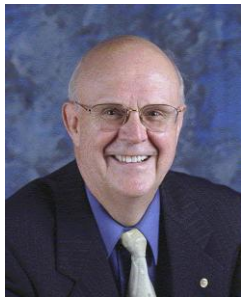
Example Analysis Using a Retention Basin

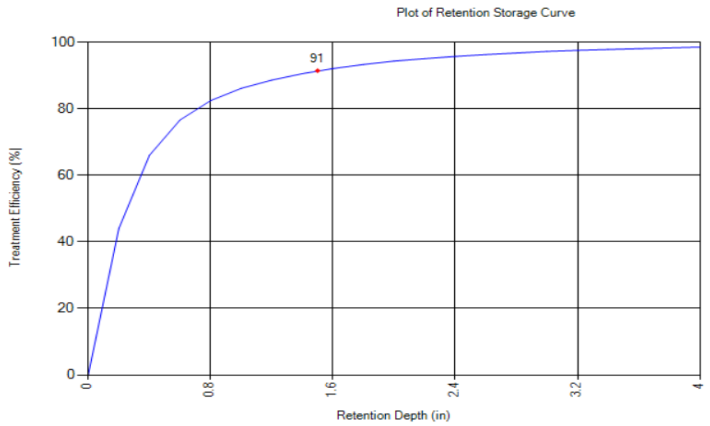
By: Marty Wanielista

December 28, 2025



Learning Objectives

1. What is a retention BMP?
2. BMPFast navigation to enter data for annual mass removal analysis and understand output using retention as the BMP.
3. Demonstrate the use of the worksheets related to analysis using retention basin.
4. Discovery options to aid in mass removal using “plot” and “tools”.
5. Example Problem.



What is a Retention BMP?

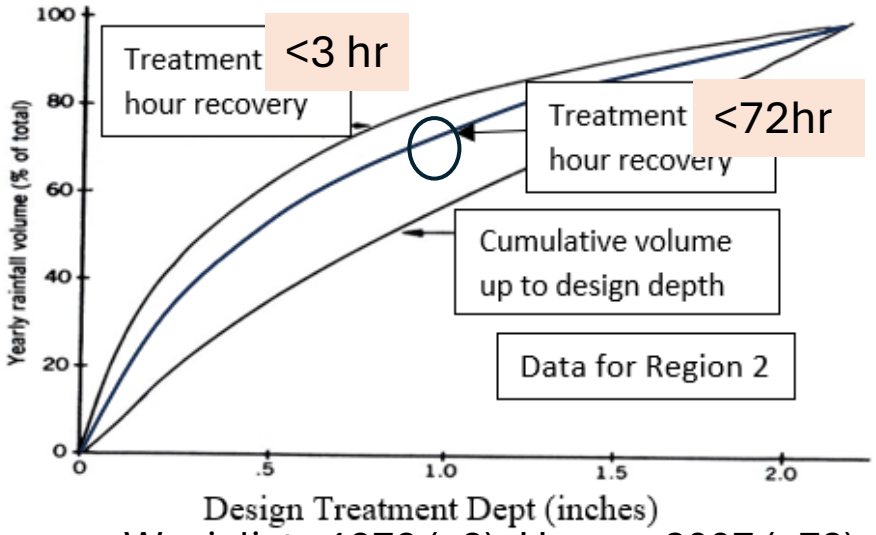
Sources: Applicant's Handbook, Volume 1, Section 2 Definitions and Terms, June 28, 2024.
And Harper and Baker, Evaluation of Current Stormwater Design Criteria within the State of Florida, 2007.

"Retention" means a system designed to prevent the discharge of a given volume of stormwater runoff into surface waters in the state by on-site storage. Examples are systems such as excavated or natural depression storage areas, permeable pavement, rain gardens, exfiltration, swales and others.

Retention Effectiveness – a function of the capture of runoff volume

Source: AH vol 1, Appendix O (retention), and AHs vol 2.

In fast recovery retention, like exfiltration in limestone or pump recovery, the annual effectiveness increases compared to slower recovery (A and B soils).



Source: Wanielista 1978 (<3), Harper, 2007 (<72)

Note challenging interpolation for other than CN and DCIA in increments of 5.

Then for fast recovery, adjust using the above rainfall graph. Increase is up to 10%

For Runoff and up to 72 hr recovery, apply the removal efficiency tables of the new rule (AH Vol 1, Appendix O (80 of them)

Zone 2 by Percent DCIA **1 inch**

Non DCIA CN	70	75	80	85	90	95	100
30	80.0	77.9	75.9	74.0	72.2	70.3	68.6
35	79.9	77.9	75.9	74.0	72.1	70.3	68.6
40	79.8	77.8	75.8	73.9	72.1	70.3	68.6
45	79.6	77.7	75.8	73.9	72.1	70.3	68.6
50	79.5	77.5	75.6	73.8	72.0	70.3	68.6
55	79.2	77.3	75.5	73.7	72.0	70.2	68.6
60	78.9	77.1	75.3	73.6	71.9	70.2	68.6
65	78.5	76.8	75.1	73.4	71.8	70.2	68.6
70	77.9	76.4	74.8	73.2	71.6	70.1	68.6
75	77.2	75.8	74.3	72.9	71.5	70.0	68.6
80	76.3	75.0	73.8	72.5	71.2	69.9	68.6
85	74.9	74.0	72.9	71.9	70.8	69.7	68.6
90	73.2	72.5	71.8	71.0	70.3	69.4	68.6
95	70.9	70.6	70.2	69.9	69.5	69.0	68.6
98	69.4	69.3	69.2	69.0	68.9	68.8	68.6

Assumes initial abstraction of 0.1 inch

Efficiency related to site, rain and TD (in): **TD = Treated Vol / Area**

280 simulations per TD and site
Harper has tables for TDs of 0.25, 0.50, 0.75, etc.

Retention Efficiency

From long term simulation of a catchment area at a rainfall site for design TD

Rainfall Zone: Florida Zone 2 Retention Depth (> 0.25): 0.33

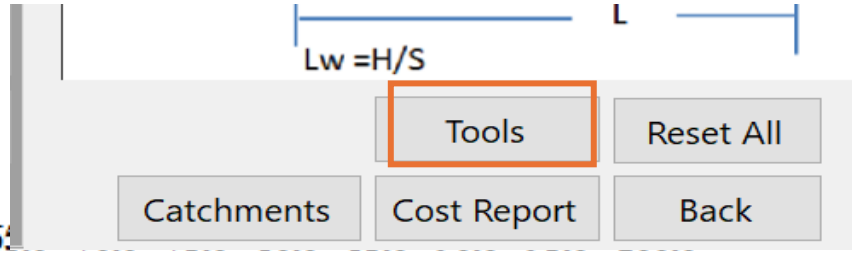
So, not in A.H.

NDCIA CN 64.0 Find DCIA % 27.0 Find Efficiency: 64.5 Find

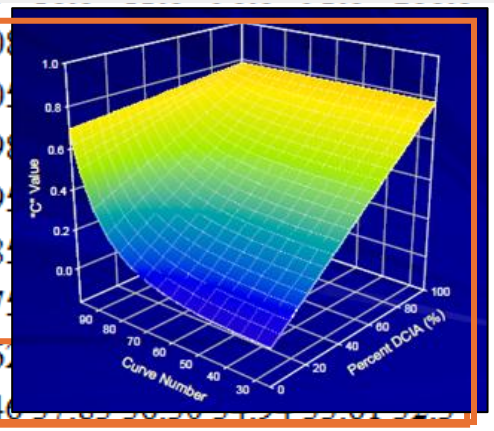
Efficiency at Retention Depth: 0.33 (in) for Rainfall Florida Zone 2

Capture % = Fraction of annual Runoff

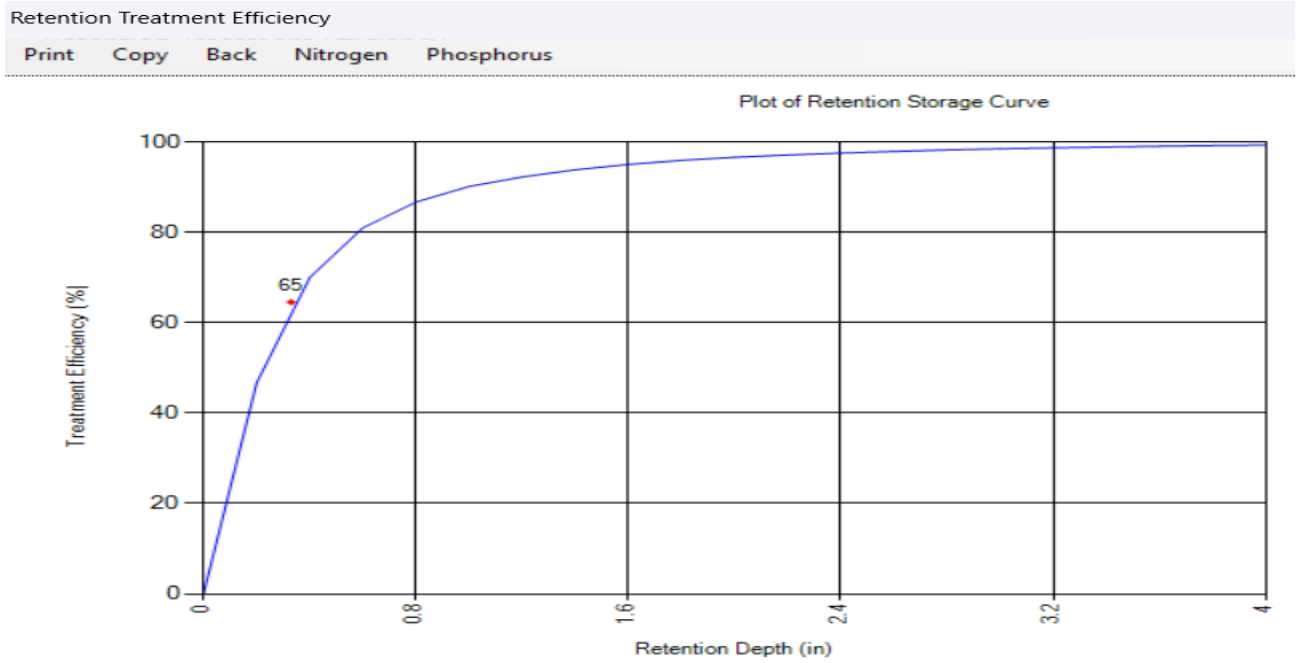
Volume



NDCIA CN \ Percent DCIA	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0	55.0	60.0	65
30.0	95.23	92.42	86.78	80.41	74.37	68.91	63.99	59.65	55.85	52.42	49.42	46.66	44.30	42.08	40.0
35.0	92.89	90.94	85.78	79.75	73.90	68.51	63.73	59.42	55.65	52.32	49.29	46.66	44.20	42.04	40.0
40.0	89.70	88.97	84.41	78.75	73.17	68.01	63.33	59.19	55.42	52.16	49.19	46.53	44.17	41.94	39.9
45.0	85.92	86.39	82.60	77.52	72.31	67.28	62.83	58.82	55.19	51.92	49.03	46.40	44.07	41.91	39.9
50.0	81.33	83.22	80.40	75.92	71.08	66.42	62.17	58.26	54.72	51.59	48.80	46.20	43.87	41.81	39.8
55.0	76.24	79.50	77.70	73.88	69.61	65.32	61.30	57.60	54.26	51.23	48.46	45.97	43.71	41.68	39.7
60.0	70.95	75.26	74.42	71.48	67.75	63.92	60.21	56.80	53.60	50.66	48.03	45.70	43.48	41.45	39.6
65.0	65.50	70.51	70.62	68.55	65.45	62.13	58.81	55.67	52.70	50.07	47.54	45.24	43.14	41.22	39.4



Plot of Effectiveness for “Discovery”



If we need 90% removal
Do we have sufficient area and storage volume to accommodate a higher treatment depth?
If so, what is the treatment depth?

Size of Retention BMP – Treatment Depth (TD)

Relationship to Treatment Volume (TV) acre-feet, given catchment area (acres).

TD = TV/Area or TV = Area x TD

Common units (inches), thus TD = TV (ac-ft) x 12 in/ft / Area (ac)

Example Calculations:

Area = 12 acres, DCIA = 27% and CN for NDCIA is 64

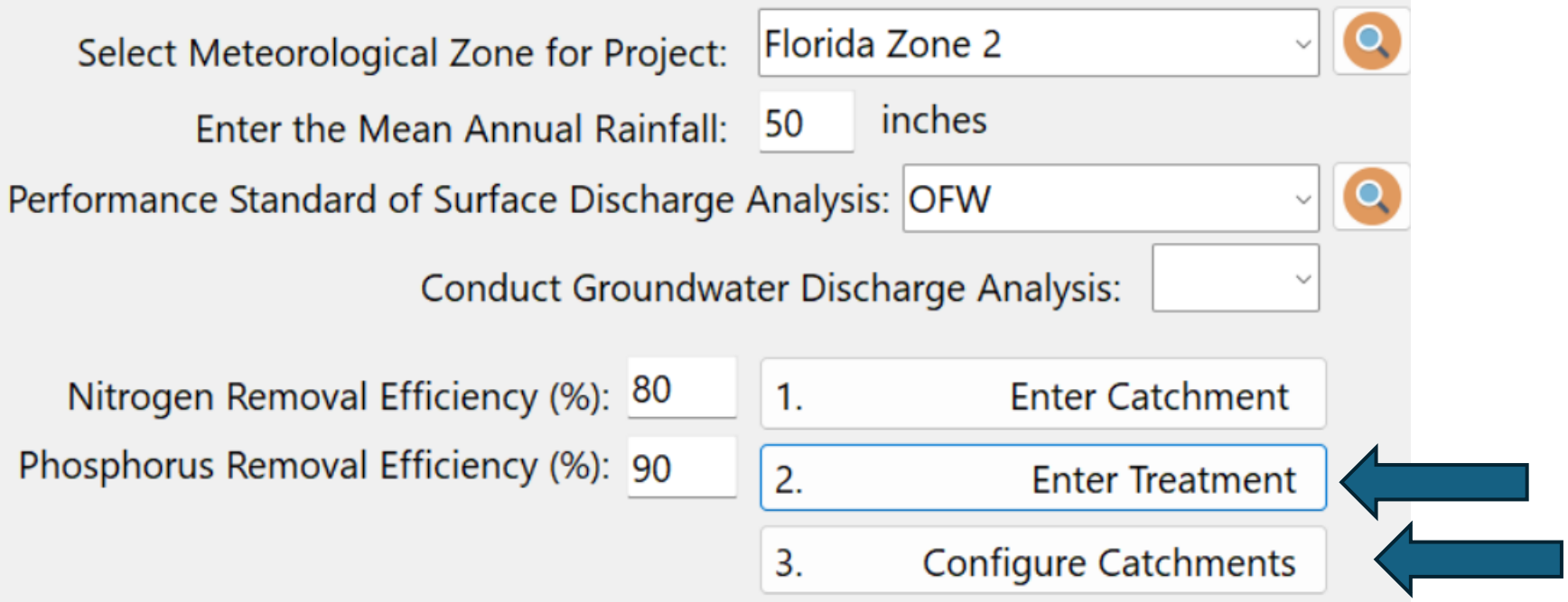
Need 64.5% removal: from previous slide at 64.5% annual removal

TD = 0.33 inch, thus TV = 12 acres x 0.33 in/12 in/ft = 0.33 ac-ft
or 14,375 Cubic Feet.

Or given the volume of treatment, 14,375 CF or 0.33 ac-ft

TD = TV/Area = 0.33 ac-ft x 12 in/ft /12 acres = 0.33 inch

Navigation after Catchment Data Input



BMP Treatment Options Worksheet

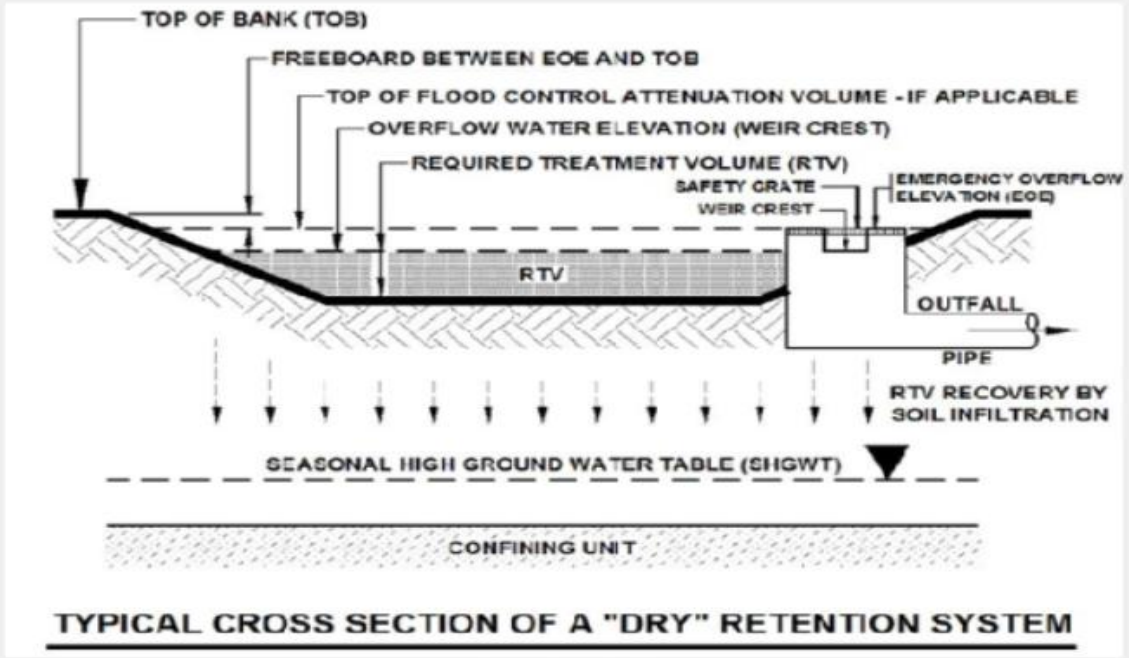
Select Treatment Options for individual performance, not in series or in multiple catchments. Analysis: All sites non-exempted

Catchment 1 commercial

Treatment Options

Retention Basin	Greenroof
Wet Detention	Rainwater Harvesting
Exfiltration Trench/Vault	Vegetated Buffer
Permeable Pavement	Vegetated Filter Strip
Stormwater Harvesting	Rain Garden
Surface Discharge Filter	Tree Well
Swale	User Defined

Current: 1 commercial



TYPICAL CROSS SECTION OF A "DRY" RETENTION SYSTEM

Tools | Reset All

Project Description

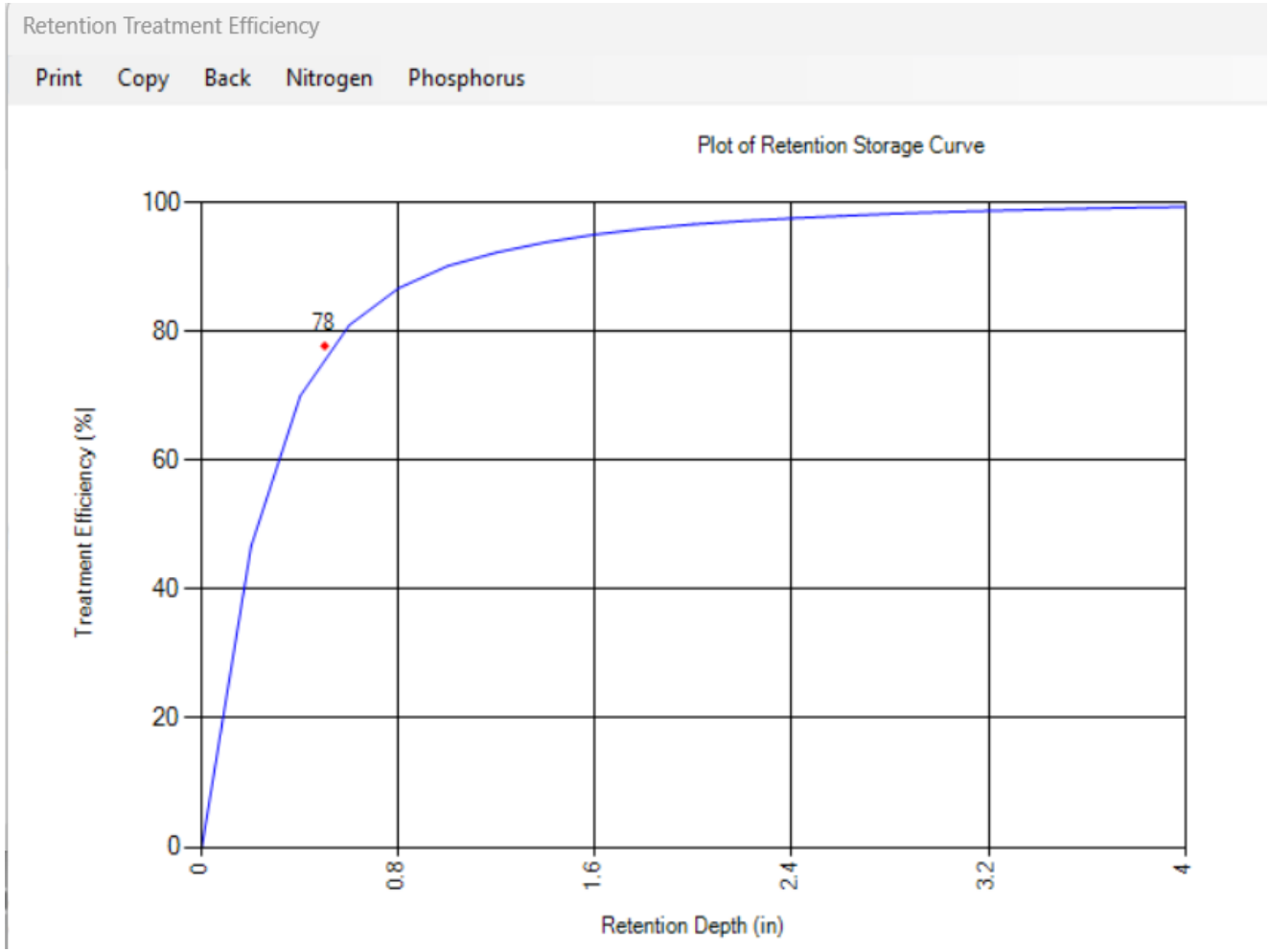
A retention basin is planned as a BMP for a 12.0-acre residential subdivision. The development site is located in Orange County near Orlando, FL on Hydrologic Group Soil A. In the pre-application meeting, the watershed characteristics, performance standards and average annual rainfall were determined. The average annual rainfall in the area is 50 inches. The existing land use condition is defined as citrus with a non-DCIA Curve Number of 50 and 0.0% DCIA. The post-development land use condition is a single-family residential subdivision with a non-DCIA Curve Number of 64 and 27% DCIA. The retention basin will provide treatment sufficient to meet the discharge to an OFW based on annual nutrient loads. An area has been set for a retention basin and the initial design specifies a range of 0.33 to 2.5 acre-feet volume of storage is available.

The retention design treatment depth (TD) for storage is = volume/area
= 0.33 ac-ft x 12 in/ft / 12 acres = .33 inches: and 2.5 inches at 2.5 ac-ft

OPEN BMPFast

We can do it with TD of 2.167 ac-Ft 

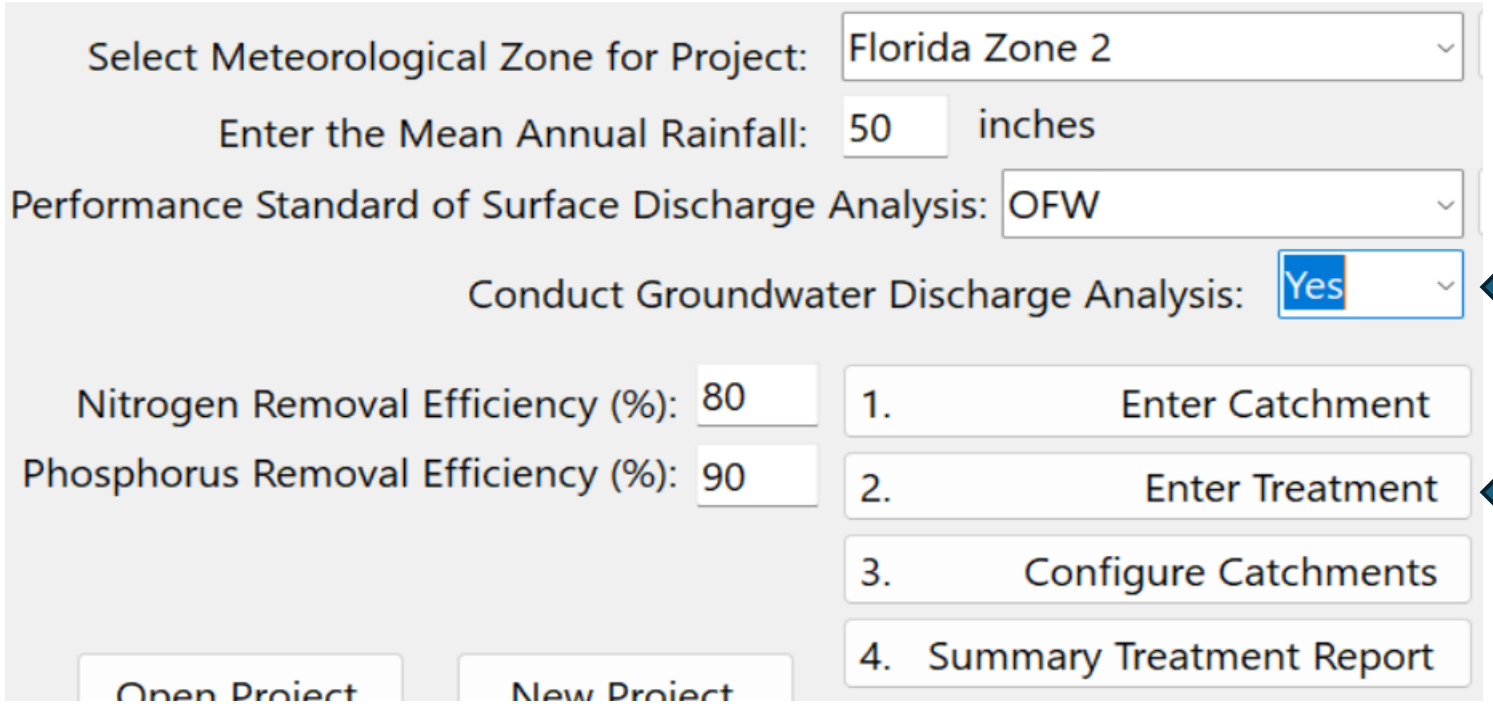
Discovery Using the Plot Option



The plot gives information on the additional retention depth (TD) to increase the average annual effectiveness or a decrease to reduce the average annual effectiveness.

Add Groundwater Protection (springs impact)

Let's estimate the recharge volume as well as the concentration to the groundwater



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Groundwater Discharge (Recharge Volume and TN conc.)

With no treatment and post land use:
N concentration is: 2.07 mg/L (SF)

For the pre land use:
N concentration is: 2.11 mg/L (citrus)

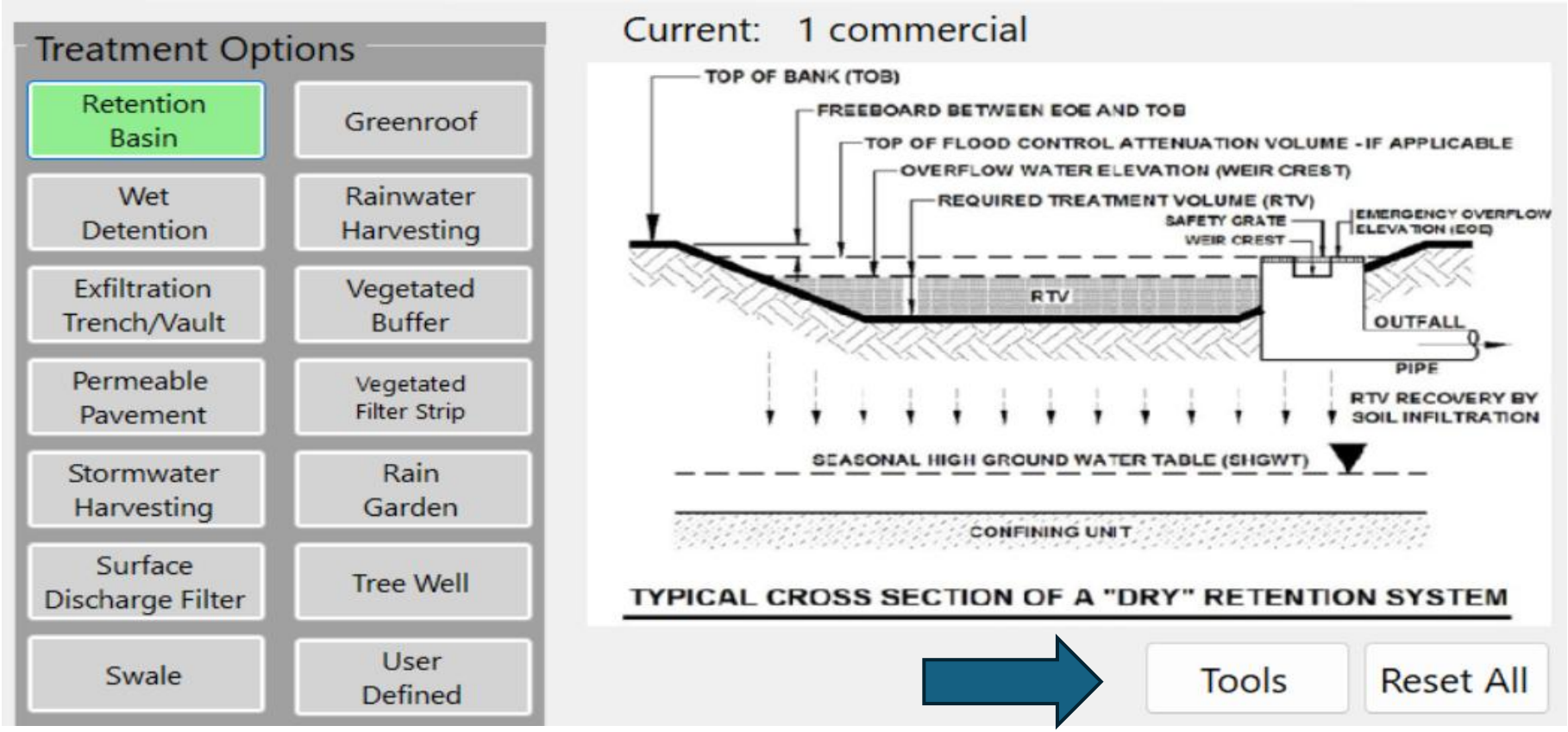
With BAM treatment in the bottom of the retention basin
From the Software:

Groundwater Discharge

Average Annual Recharge	3.911 MG/yr	
Provided N recharge load	7.659 kg/yr	16.89 lb/yr
Provided N Concentration	.517 mg/l	

The owner says how nice, but I want this media to last for at least 10 years

BMP Treatment Options Worksheet



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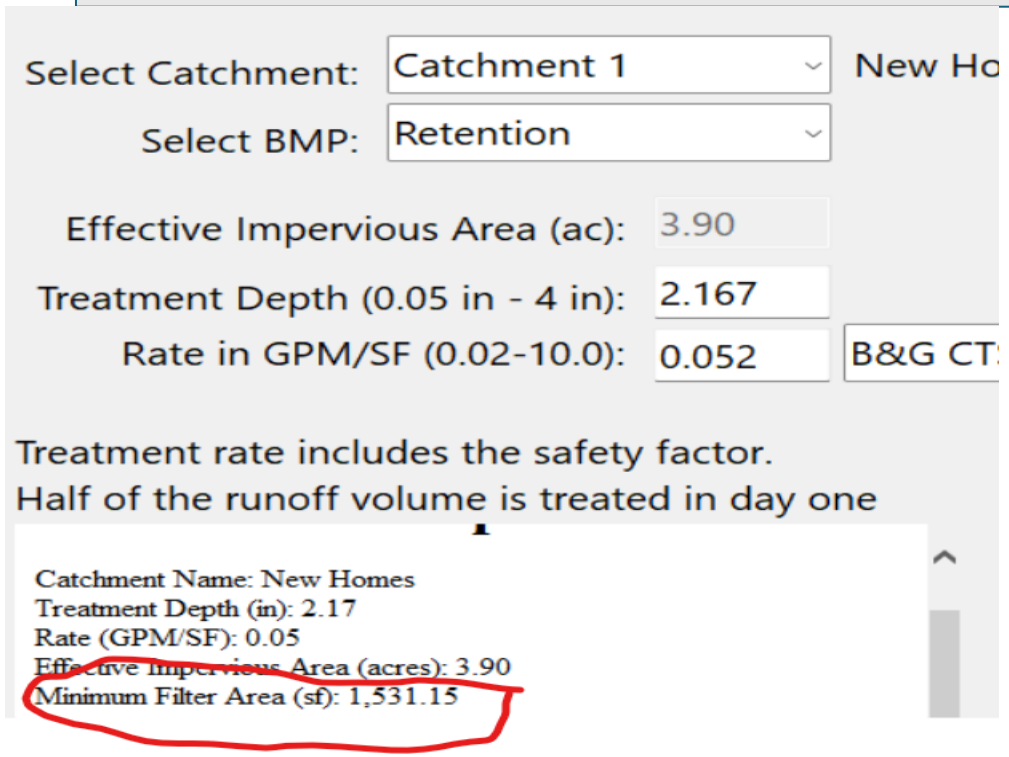
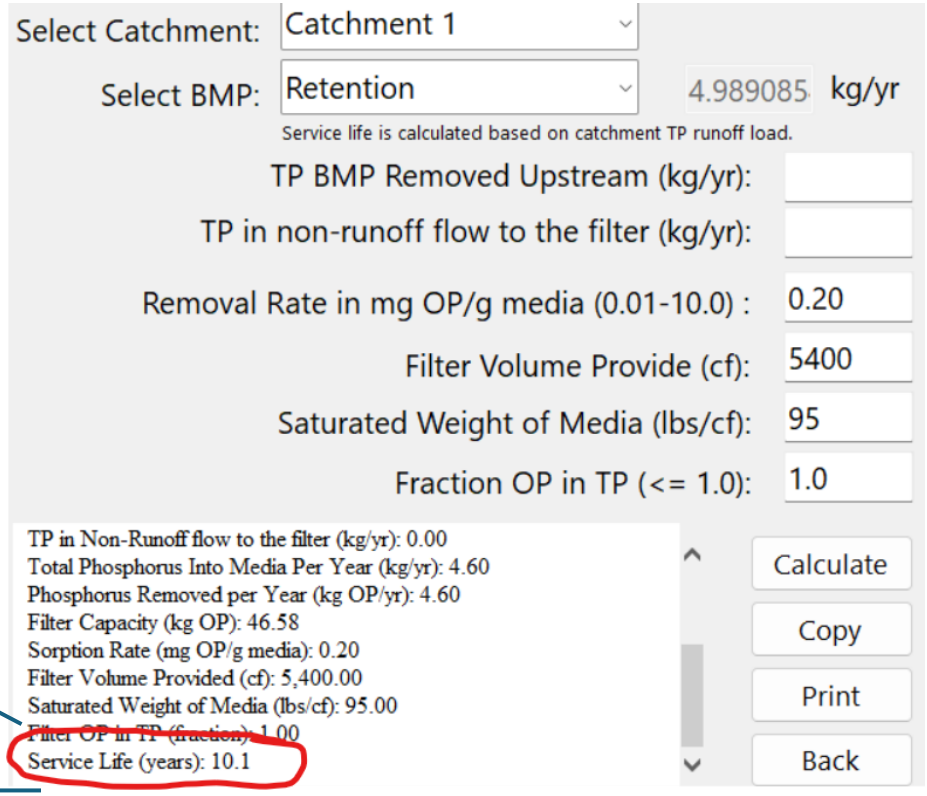
Area, Volume and Service Life of a Filter



Minimum volume of the Filter = 3063 CF: 2'deep
But the recovery must be done in 72 hours, and an agreement to remove 95% is reached between the reviewer and applicant. Thus, 5400 CF is needed

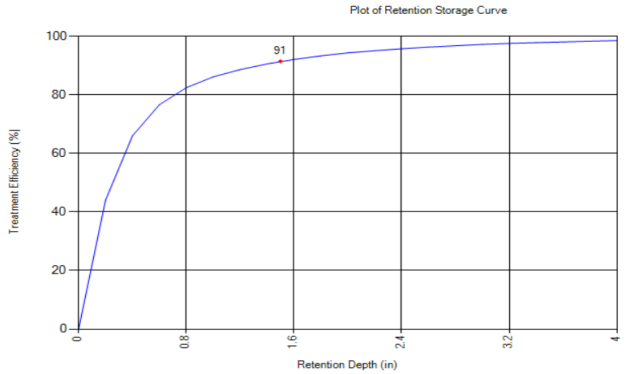


Service Life = 10.1 years

What did we learn?

1. What a retention BMP is.
2. Navigation for annual mass removal analysis using a retention basin BMP.
3. Discovery using retention plot option.
4. Groundwater protection using a media.
5. Discovery from the service life worksheet.

Also, we learn that there are other BMPs whose effectiveness depend on these retention curves. See



BMPFast Software

Example analysis Using a Retention Basin

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