Chesapeake and Atlantic Coastal Bays Critical Area Training Day 4

Stormwater Management

November 17, 2022

10% Phosphorus Removal

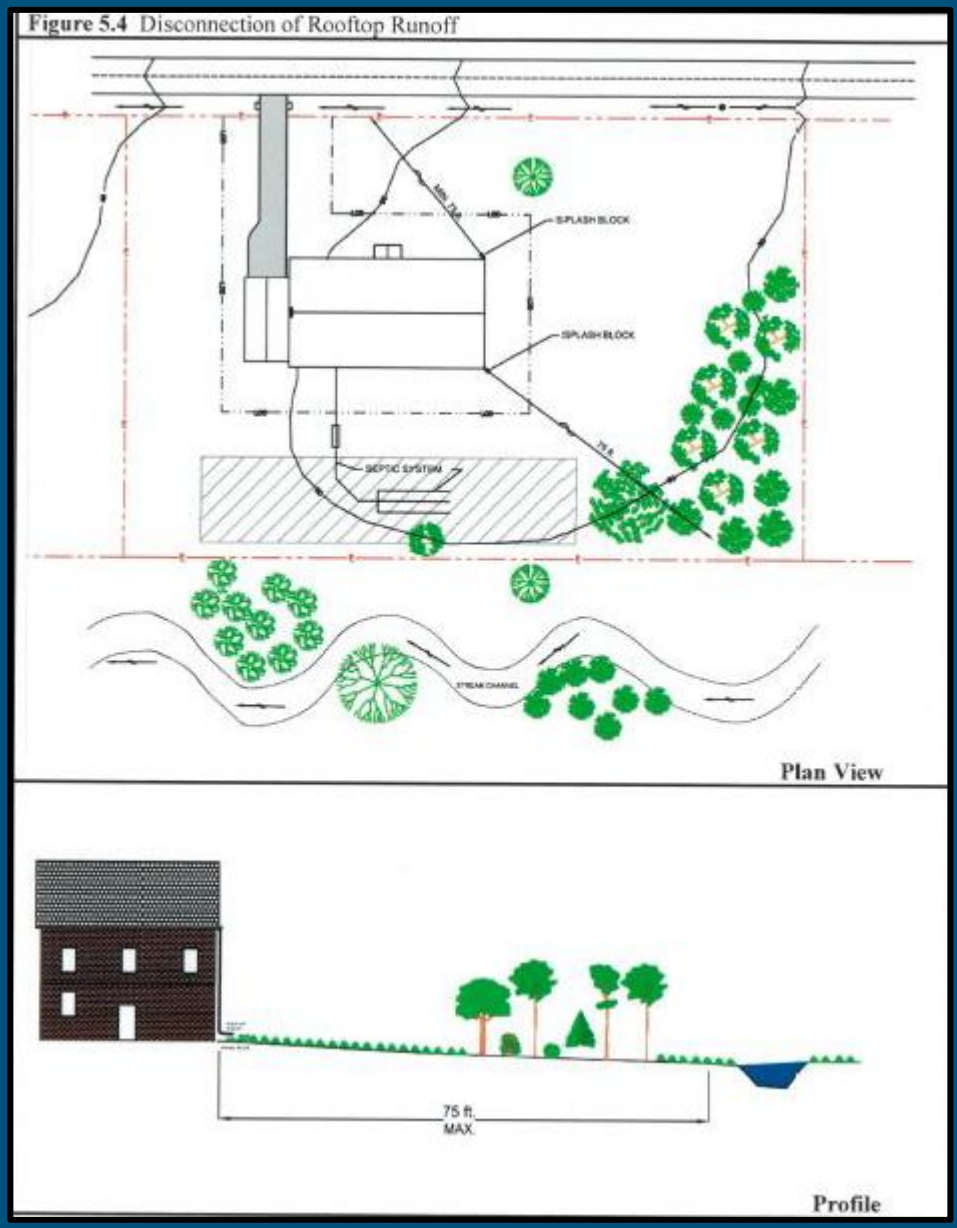
What is the 10% Rule?

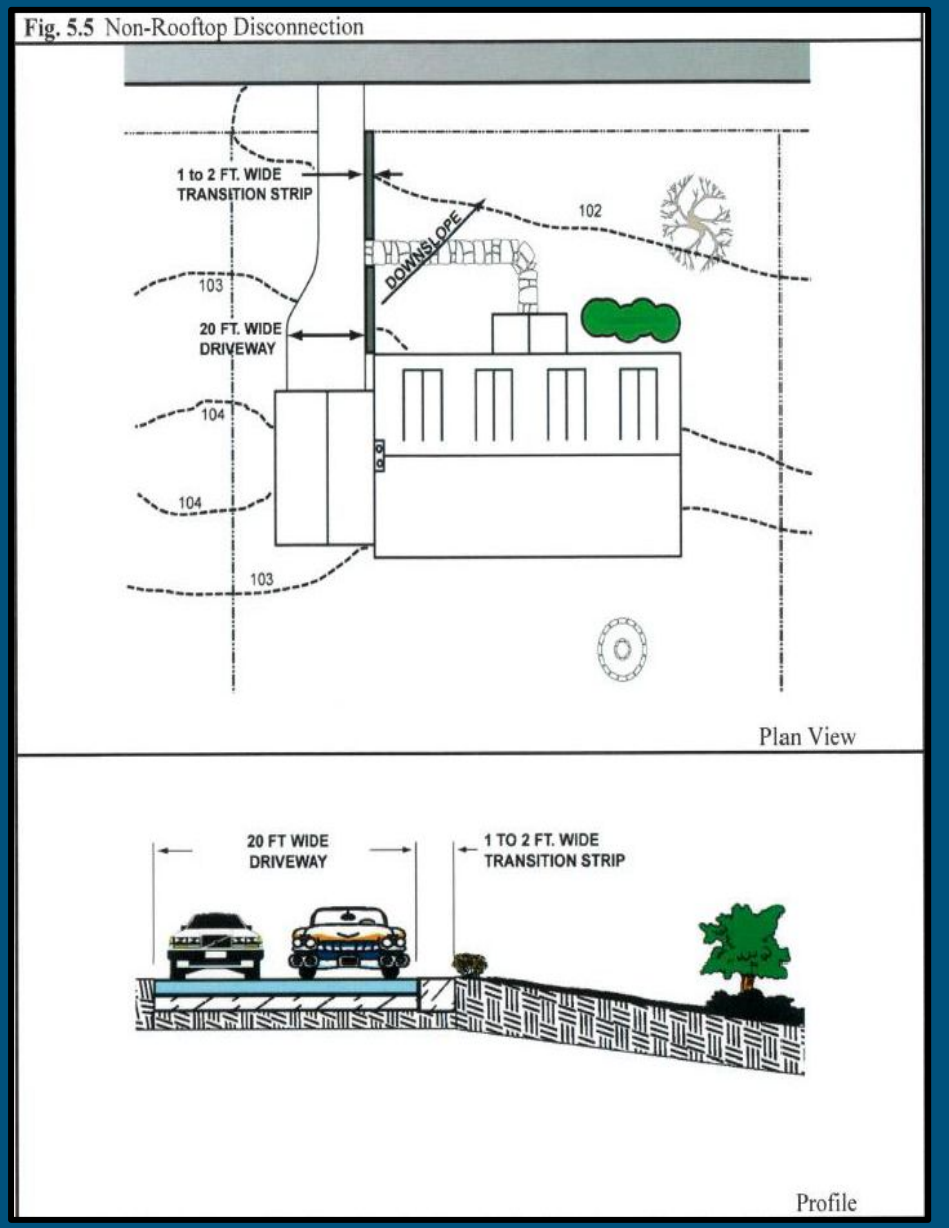
- Required for projects with 250 square feet or more of disturbance
  - Private and local re/development projects: IDA only
  - State re/development projects: All designations
- Requires post-development water quality to be 10% better than it was prior to development or redevelopment
- Quantified as a 10% reduction in Phosphorus
- Separate requirement from MDE ESD

How the Spreadsheet Works

- Blue cells = Inputs
- Gray cells = Formulas (DO NOT TOUCH)
- Summary Tab for Quick Check
- Individual tabs for each BMP

Rooftop and Non-Rooftop Disconnect





Rooftop Disconnect

- Requires restoration of D soils prior to use
- Max 500 sf drainage area for residential
- Max 1,000 sf drainage area for others
- Filter path must be 15-75 linear feet
- Min 10 ft between filter path and adjacent impervious surface
- Slope of filter path = 1-3%
- Nonerosive flow at 2 yr storm event
- Min 2 ft depth between seasonally high water table and filter path
- Min 25 ft between any two disconnects
- Filter path does not intersect with impervious surface

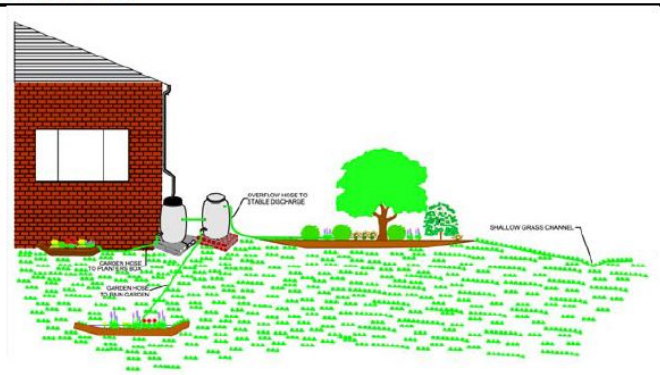
Nonrooftop Disconnect

- Driveways, sidewalks, and small parking lots (6-10 spaces)
- Max 1,000 sf drainage area
- Filter path must be 15-75 linear feet
- Min 10 ft between filter path and adjacent impervious surface
- Slope of filter path > 5%
- Nonerosive flow at 2 yr storm event
- Min 2 ft depth between seasonally high water table and filter path
- Min 25 ft between any two disconnects
- Filter path does not intersect with impervious surface

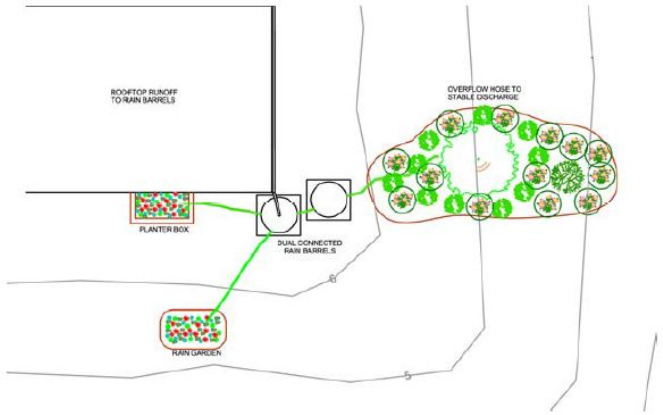
Rain Garden

- Permeable soils
- Max 2,000 sf drainage area for residential
- Max 10,000 sf drainage area for commercial
- Max ponding depth = 6 inches
- Filter bed = 12-18 inches
- Location, purpose, and function should be disclosed to homebuyer

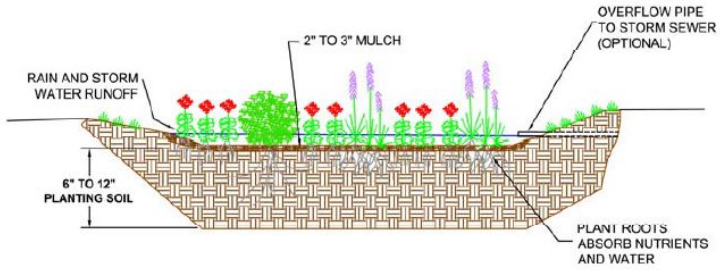
Figure 5.17 Rain Garden



Section



Plan View

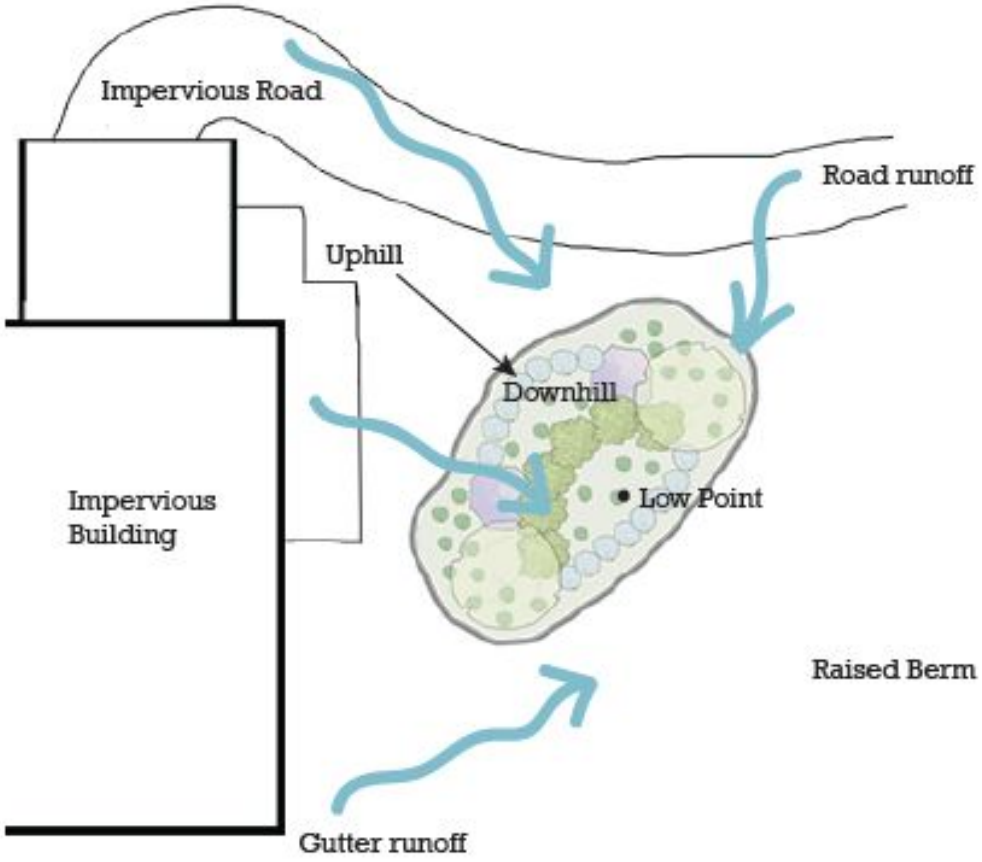


Section

Rain Garden – Landscaped depression that collects stormwater and allows it to be absorbed by soils.

Tips and Suggestions

When selecting the location and size of a rain garden there are a few things to keep in mind. A rain garden is used to infiltrate water that would otherwise wash away as runoff. Your rain garden should be located where water naturally flows or is redirected to flow on the site. A small berm should be built on the far side of the rain garden to allow the water to pool to the correct depth, and permeable soils are preferred to allow proper drainage. A rain garden can be planted with very aesthetically pleasing plants, and can be a showcase of any site. Rain gardens serve many purposes and filtering your rainwater runoff is only the beginning.



Example Rain Garden Sizing

Project LOD	Rain Garden Surface Area	Ponding Depth	Media Depth
500-1000 Sf	115 Sf	0.5 Ft	1.5 Ft

-Starting Your Own Rain Garden-

1. Avoid rainy weather, which may compromise the installation and materials.
2. Locate all utility lines that go underneath the site.
3. Excavate all vegetation off of the site.
4. Amend soil with compost and sand as needed to create the proper well-draining soils needed.
5. Excavate your site down to the desired depth, in this case 18", at the bottom add in a layer of gravel to atleast 3".
6. Fill in your garden with the amended soil removed previously.
7. Construct a berm on the low side of the garden, the height of the berm in the center should equal the desired ponding depth of the garden.
8. Plant your native plants in the desired arrangement to nursery specifications for spacing.
9. Mulch the entire planting bed to a depth of no more than 2-3" deep in an even surface.

Fee Schedule and Offset Policy

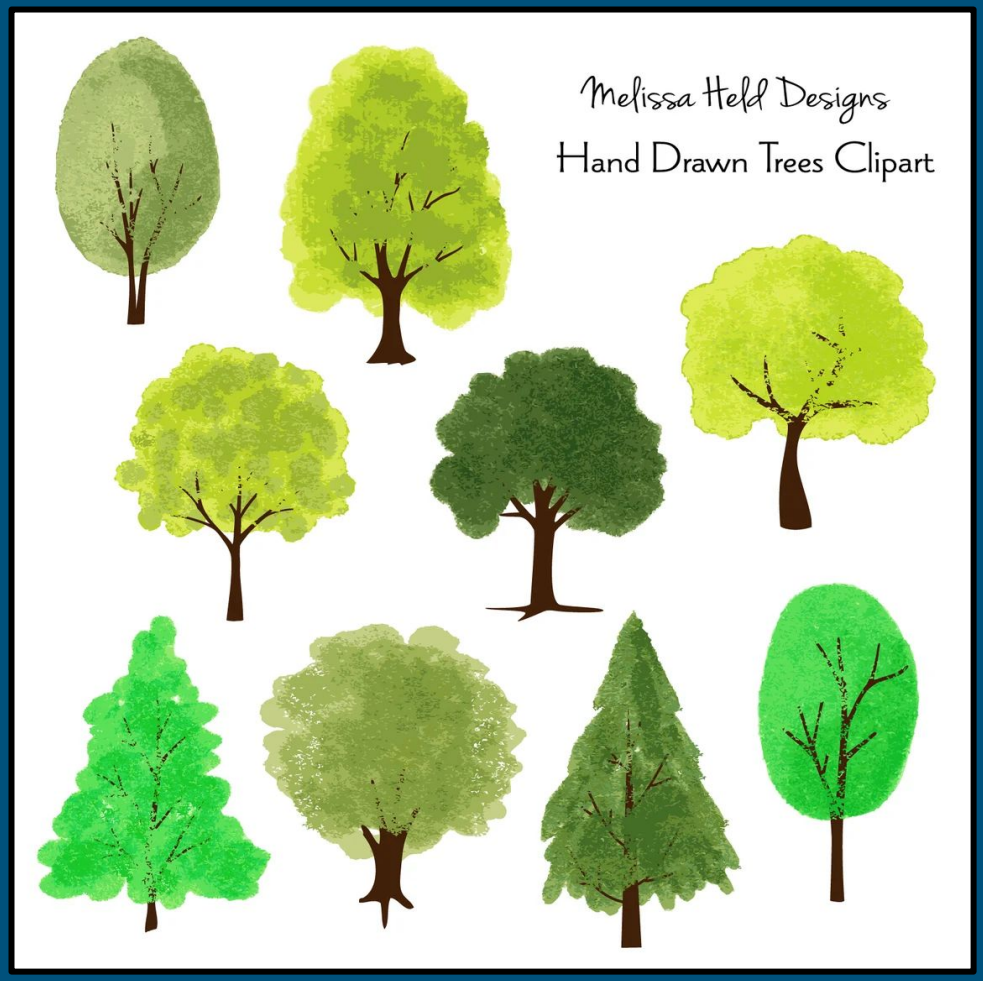
- Fee-in-Lieu: Minimum Rate of $35,000/lb
  - Local jurisdiction must have program set up to manage, track and implement FIL for stormwater requirements.
  - SWM FIL account should be separate from other FIL accounts.

- Guidance for planting offsets is in the IDA 10% SWM Manual

Planting to Meet 10%

- Small residential projects
- 100 sf of disturbance = 1 ¾-inch caliper native tree
- 1 acre = 2 lbs P = 400 stems

- EX: 0.35 lbs/P per year = 70 native trees



Stormwater in the Critical Area Buffer

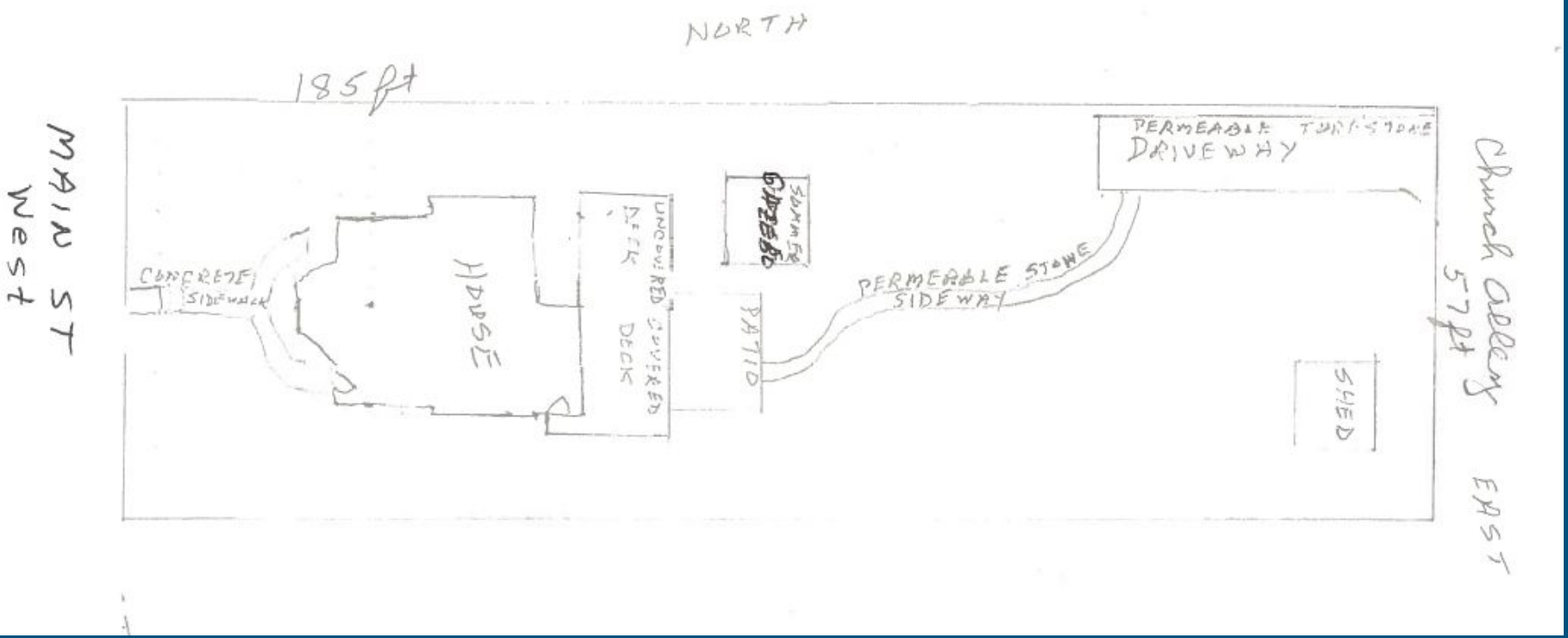
- In general, SWM is not permitted in the Buffer
  - Exception: MBA setbacks
- Stormwater pipes and outfalls are allowed within the Buffer
- Buffer cannot be used for disconnection purposes, i.e. rooftop disconnects, non-rooftop disconnects, or sheetflow to conservation areas
  - Exception: minimum distance
- Regenerative Stormwater Conveyances/Coastal Plain Outfalls are permitted to correct erosion around stormwater outfalls or within a stream valley

10% Spreadsheet Demo

Town of Betterton Example

- Site Area: 0.24 acres
- Existing Impervious: 0.04 acres (to remain)
- New Impervious: 0.05 acres
- Soil Type: 100% B soils

Site Plan


NORTH
185ft
MAIN ST
West
CONCRETE SIDEWALK
HOUSE
UNCOVERED DECK
SUNKEN FIRE PIT
PATIO
PERMEABLE STONE SIDEWAY
PERMEABLE TURF-STONE DRIVEWAY
SHED
Church Alley
57ft
EAST

	A	B	C	D
12	**Step 1: Complete ESD Implementation Checklist**			
13				
14	*Check all of the Following ESD Practices That Were Implemented at Site*			*Yes - No - N/A*
15	Environmental Mapping Was Conducted at Site Prior to Layout			
16	Natural Areas Were Conserved (e.g., forests, wetlands, steep slopes, floodplains)			
17	Stream, Wetland and Shoreline Buffers Were Reserved			
18	Disturbance of Permeable Soils Was Minimized			
19	Natural Flow Paths Were Maintained Across the Site			
20	Building Layout Was Fingerprinted to Reduce Clearing and Grading at Site			
21	Site Grading Promoted Sheetflow From Impervious Areas to Pervious Ones			
22	Site Design Was Evaluated to Reduce Creation of Needless Impervious Cover			
23	Site Design Was Evaluated to Maximize Disconnection of Impervious Cover			
24	Site Design Was Evaluated to Identify Potential Hotspot Generating Area for Stormwater Treatment			
25	Erosion and Sediment Control Practices and Post Construction Stormwater Management Practices Were Integrated into a Comprehensive Plan			
26	Tree PlantingWas Used at the Site to Convert Turf Areas into Forest			
27				

Step 2: Calculate Site Imperviousness and Water Quality Volume, WQv (for redevelopment)

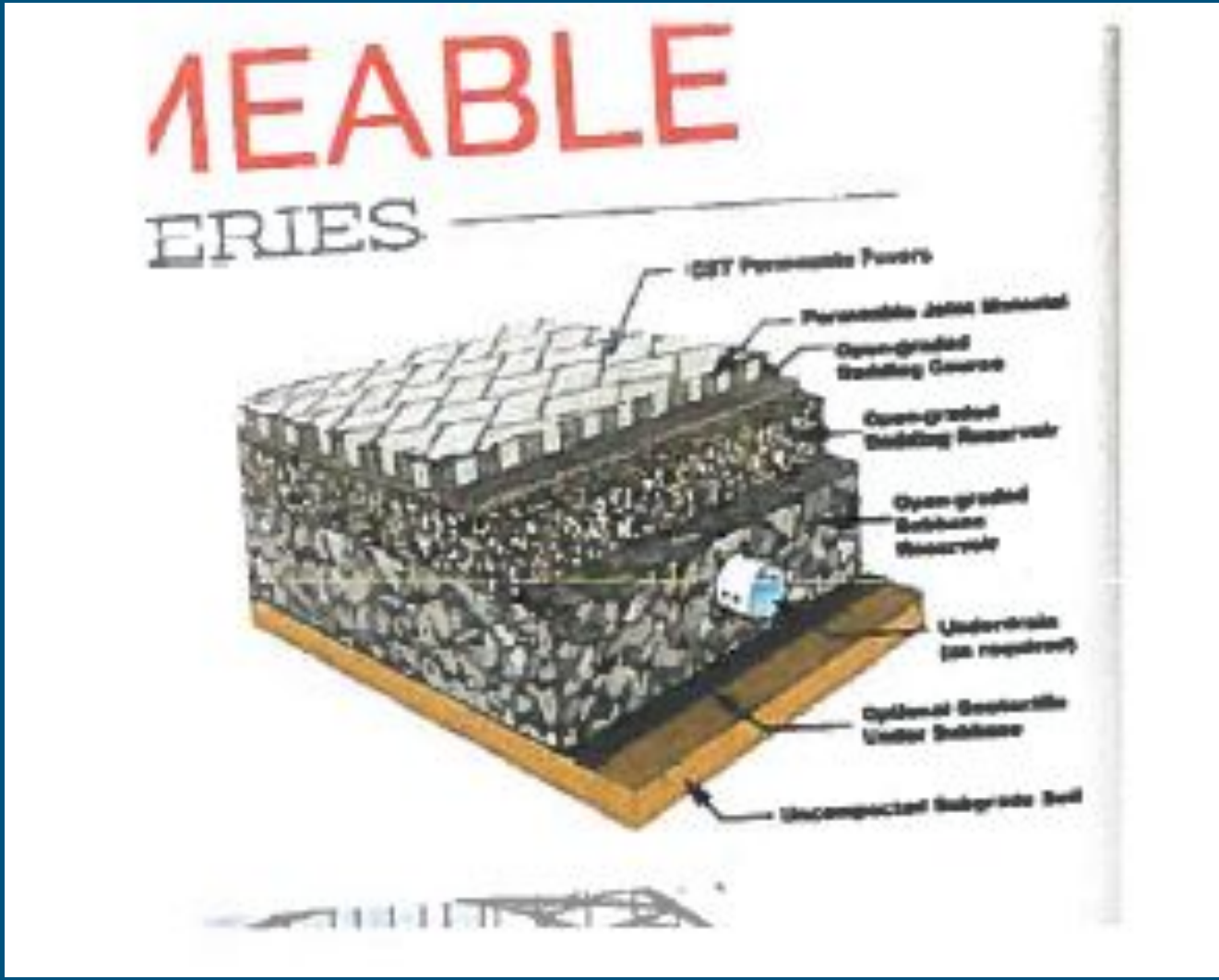
Site Area, A (acres)	0.24	
Existing Impervious Surface Area (acres)	0.04	
Proposed Impervious Surface Area (acres)	0.05	existing (.04 acres) + new (.01 acres)
Rainfall Depth, P (in)	1.0	
Existing Imperviousness, I_{pre}	15.0%	
Proposed Imperviousness, I_{post}	20.8%	
Water Quality Calculation for Redevelopment Only		
Required Treatment Area (acres)	0.00	
Runoff Coefficient, Rv	0.95	
Water Quality Volume, WQv (cf)	**0**	

Step 4: Calculate Environmental Site Design (ESD) Rainfall Target, P_E

Development Category (for ESD)	**New Development**	
% Soil Type A	0%	
% Soil Type B	100%	(Determined using NRCS Soil Survey)
% Soil Type C	0%	
% Soil Type D	0%	

Step 3: Calculate Phosphorous Removal Requirement, RR for Critical Area Sites

Development Category (for 10%)	**Redevelopment**
New Development	
Average Annual Predevelopment Load, Lpre (lbs P / yr)	0.12
Redevelopment:	
Predevelopment Runoff Coefficient, Rv_{pre}	0.19
Phosphorous Mean Concentration, C (mg/L)	0.3
Average Annual Predevelopment Load, L_{pre} (lbs P / yr)	0.11
Post-Development Runoff Coefficient, Rv_{post}	0.24
Average Annual Post-Development Load, L_{post} (lbs P / yr)	0.14
Removal Requirement, RR (lbs P / yr)	**0.04**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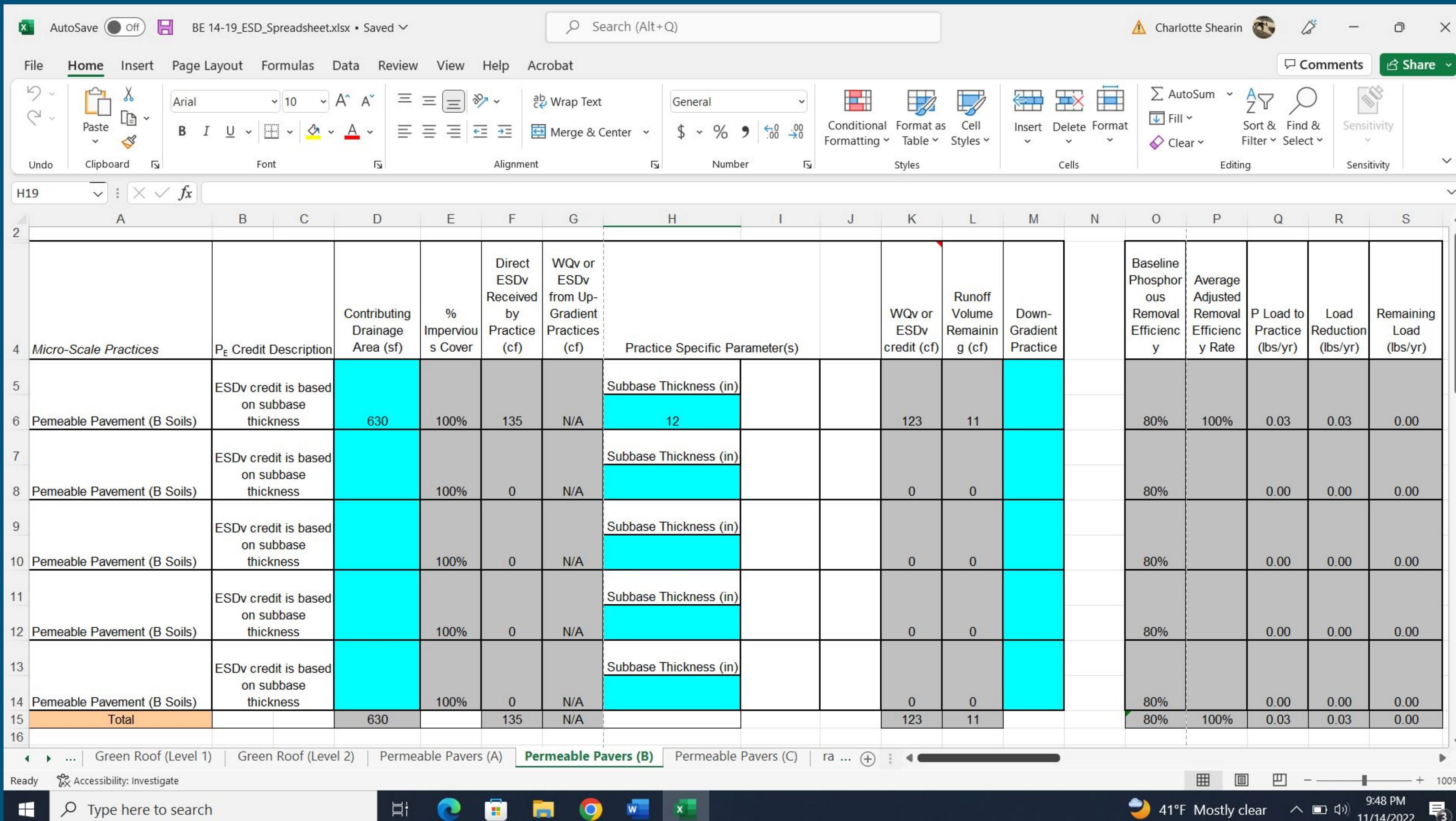
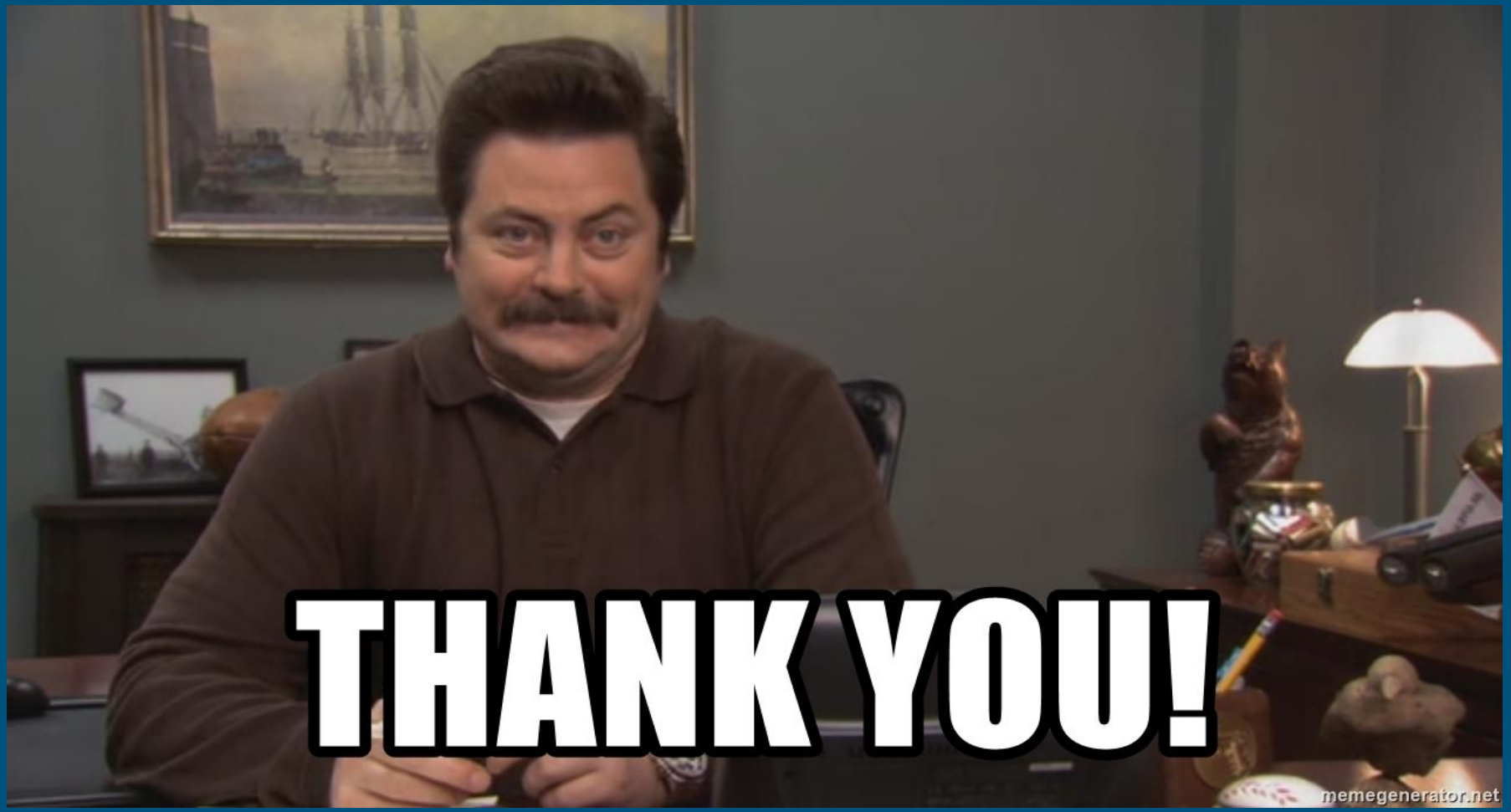


Micro-Scale Practices	P_E Credit Description	Contributing Drainage Area (sf)	% Imperviou s Cover	Direct ESDv Received by Practice (cf)	WQv or ESDv from Up-Gradient Practices (cf)	Practice Specific Parameter(s)	WQv or ESDv credit (cf)	Runoff Volume Remainin g (cf)	Down-Gradient Practice	Baseline Phosphor ous Removal Efficienc y	Average Adjusted Removal Efficienc y Rate	P Load to Practice (lbs/yr)	Load Reduction (lbs/yr)	Remaining Load (lbs/yr)
Pemeable Pavement (B Soils)	ESDv credit is based on subbase thickness	630	100%	135	N/A	Subbase Thickness (in) 12	123	11		80%	100%	0.03	0.03	0.00
Pemeable Pavement (B Soils)	ESDv credit is based on subbase thickness		100%	0	N/A	Subbase Thickness (in)	0	0		80%		0.00	0.00	0.00
Pemeable Pavement (B Soils)	ESDv credit is based on subbase thickness		100%	0	N/A	Subbase Thickness (in)	0	0		80%		0.00	0.00	0.00
Pemeable Pavement (B Soils)	ESDv credit is based on subbase thickness		100%	0	N/A	Subbase Thickness (in)	0	0		80%		0.00	0.00	0.00
Pemeable Pavement (B Soils)	ESDv credit is based on subbase thickness		100%	0	N/A	Subbase Thickness (in)	0	0		80%		0.00	0.00	0.00
Total		630		135	N/A		123	11		80%	100%	0.03	0.03	0.00

Calculation Summary	0.5 acre site .25 acres to .38 acres 50% to 75%
Critical Area 10% Calculations	
Removal Requirement, RR (lbs P / yr)	**0.04**
after non-structural and micro-scale BMPs (Steps 5 and 6)	
Total Load Reduction (lbs P / year)	0.03
Total Load Reduction Remaining (lbs P / yr)	**0.01**
after structural practices (Step 9)	
Total Load Reduction (lbs P / year)	0.03
Total Load Reduction Remaining (lbs P / yr)	**0.01**
MDE's ESD to the MEP Calculations	
ESD Runoff Volume, ESDv (cf)	331.00
Total Treatment Volume (cf)	331.00
WQv or ESDv Treated (cf)	123.48
PE achieved (inches)	0.60
Entire ESDv Treated Through Environmental Site Design?	NO
ESDv Remaining? (cf)	207.52
If ESDV is not fully treated, is ESD to MEP achieved?	0.00
Redevelopment WQv Requirements Met Through Environmental Site Design?	N/A
WQv Remaining? (cf)	0.00
New Development WQv Requirements Met Through Environmental Site Design?	NO
WQv Remaining? (cf)	83.43


THANK YOU!
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Frequently Asked Questions

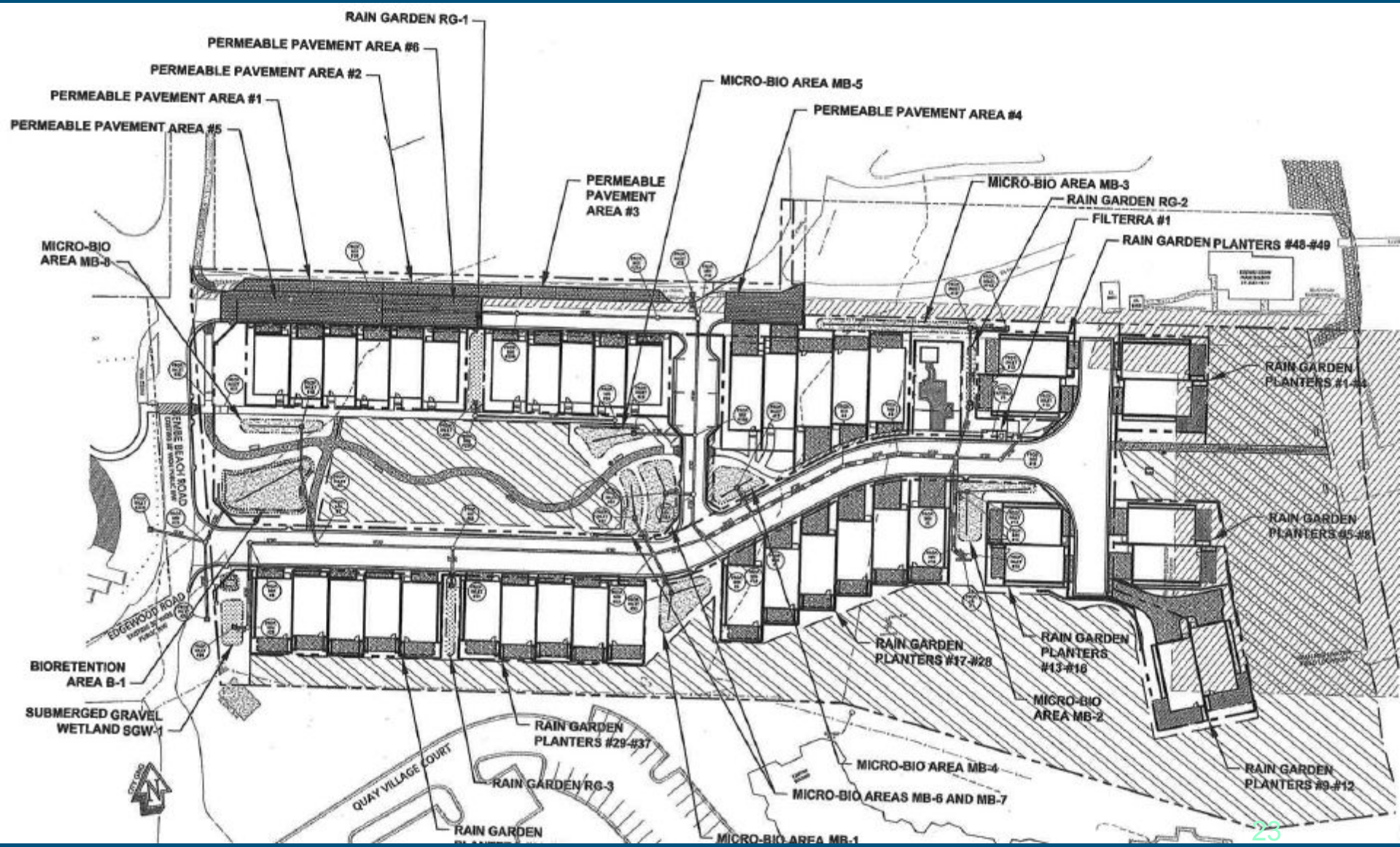
- What are the rules for measuring impervious cover?
- How do permeable pavements and green roofs affect impervious cover?
- How do you define site area for new/redevelopment?
- Where do you get data on predevelopment hydrologic soil groups?
- How do you deal with projects that cross the Critical Area boundary?

10% Spreadsheet Demo

Bembe Beach Example

- Site Area: 5.28 acres
- Existing Impervious: 0.28 acres (to remain)
- New Impervious: 1.84 acres
- Soil Type: 100% C soils

Overall Site & SWM Plan

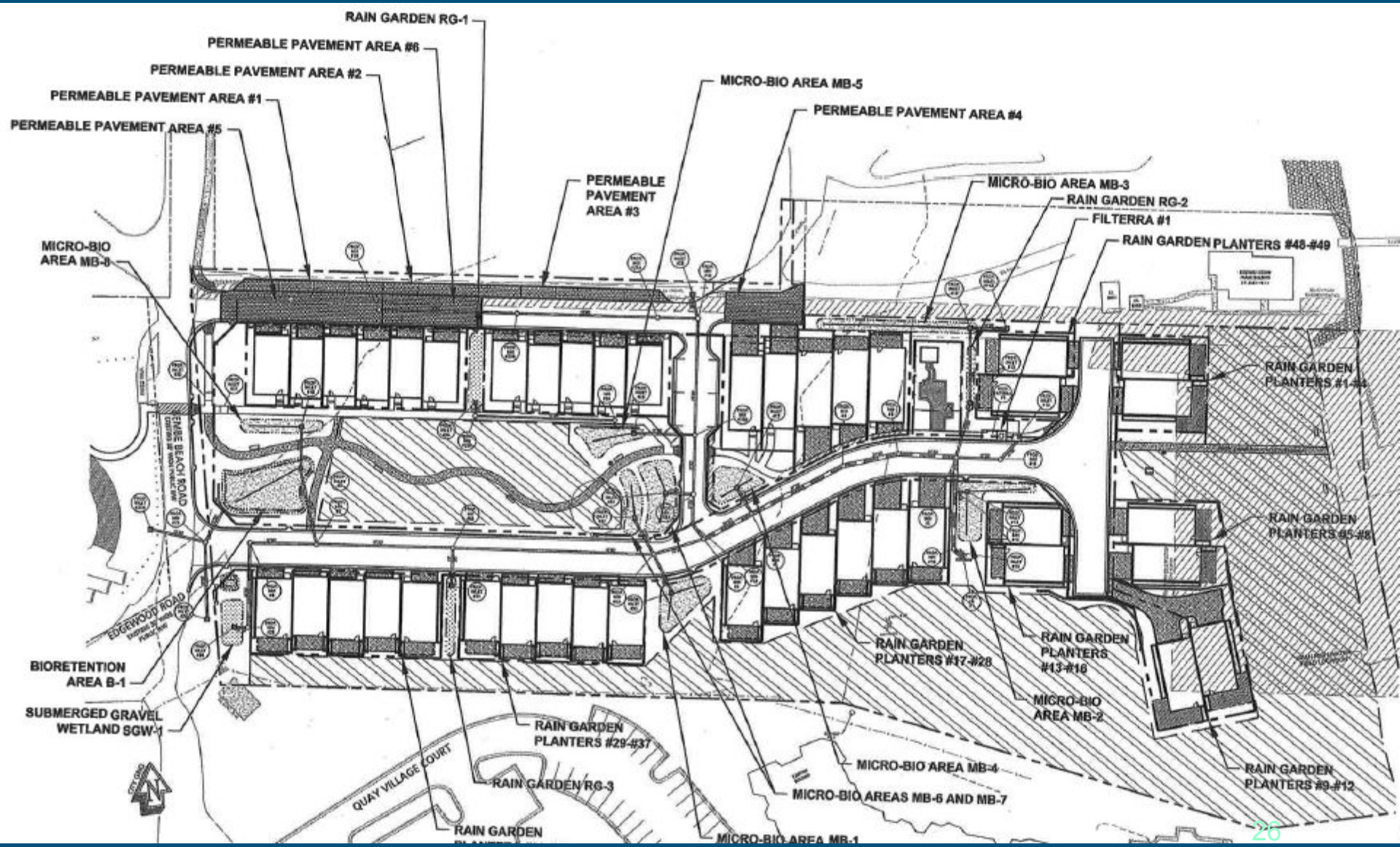


	A	B	C	D	E
27					
28	**Step 2: Calculate Site Imperviousness and Water Quality Volume, WQv (for redevelopment)**				
29					
30	Site Area, A (acres)	5.28	⇦ site area, or LOD		
31	Existing Impervious Surface Area (acres)	0.28			
32	Proposed Impervious Surface Area (acres)	2.12	⇦ total impervious (existing to remain + proposed)		
33	Rainfall Depth, P (in)	1.0			
34					
35	Existing Imperviousness, I_{pre}	5.3%			
36	Proposed Imperviousness, I_{post}	40.2%			
37					
38	*Water Quality Calculation for Redevelopment Only*				
39	Required Treatment Area (acres)	0.00			
40	Runoff Coefficient, Rv	0.95			
41					
42	**Water Quality Volume, WQv (cf)**	**0**			
43					
44	**Step 4: Calculate Environmental Site Design (ESD) Rainfall Target, P_E**				
45					
46	**Development Category (for ESD)**	**New Development**			
47					
48	% Soil Type A	0%			
49	% Soil Type B	0%			
50	% Soil Type C	100%			
51	% Soil Type D	0%			
52					

Step 3: Calculate Phosphorous Removal Requirement, RR for Critical Area Sites

Development Category (for 10%)	New Development
New Development	
Average Annual Predevelopment Load, Lpre (lbs P / yr)	2.64
Redevelopment:	
Predevelopment Runoff Coefficient, Rv_{pre}	0.10
Phosphorous Mean Concentration, C (mg/L)	0.3
Average Annual Predevelopment Load, L_{pre} (lbs P / yr)	1.26
Post-Development Runoff Coefficient, Rv_{post}	0.41
Average Annual Post-Development Load, L_{post} (lbs P / yr)	5.32
Removal Requirement, RR (lbs P / yr)	**2.94**

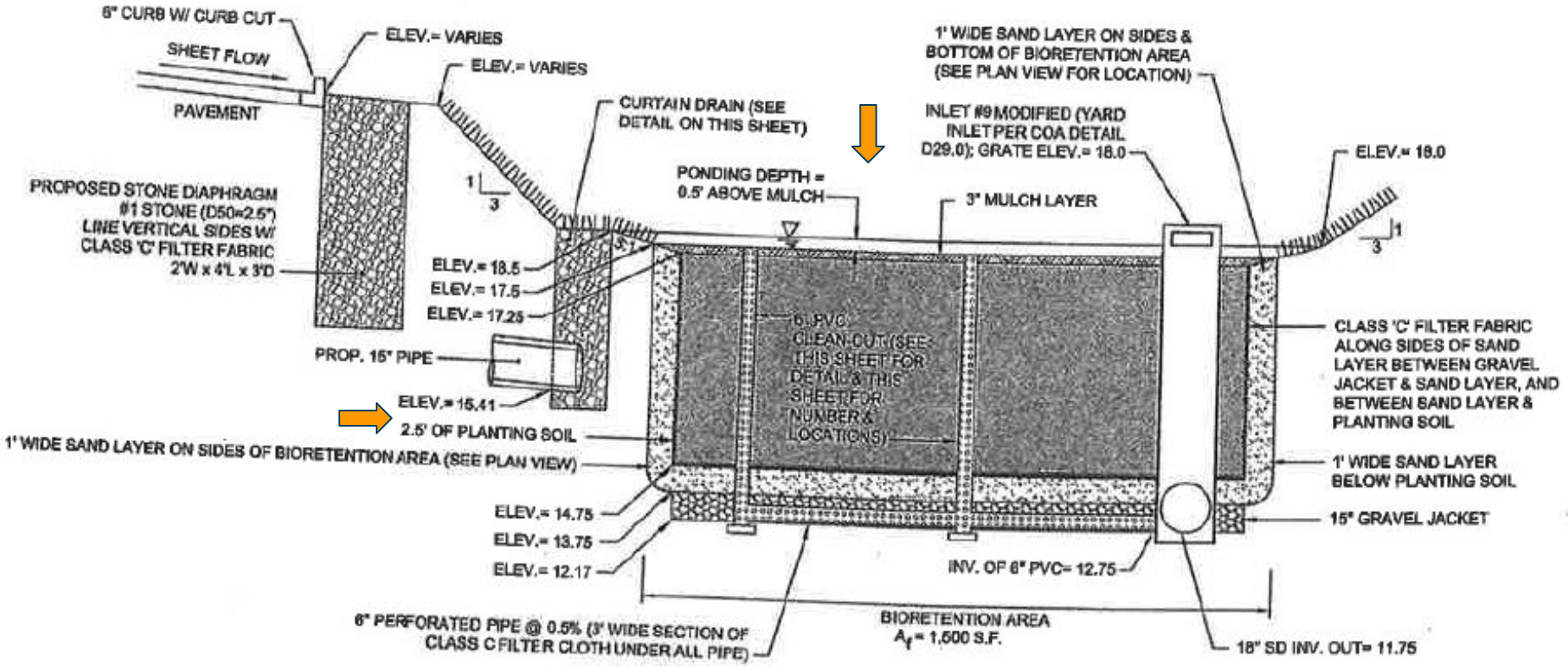
Overall Site & SWM Plan



SWM Practices Drainage Areas

MICRO-SCALE PRACTICES

DA	PRACTICE	DRAINAGE AREA - SQ. FT.	IMPERVIOUS AREA - SQ. FT.
MB1	MICRO-BIORETENTION AREA (M-6)	6,715	5,031
MB2	MICRO-BIORETENTION AREA (M-6)	9,736	6,975
MB3	MICRO-BIORETENTION AREA (M-6)	10,453	4,606
MB4	MICRO-BIORETENTION AREA (M-6)	7,243	4,642
MB5	MICRO-BIORETENTION AREA (M-6)	12,064	9,338
MB6	MICRO-BIORETENTION AREA (M-6)	13,161	10,369
MB7	MICRO-BIORETENTION AREA (M-6)	19,249	3,561
MB9	MICRO-BIORETENTION AREA (M-6)	7,417	3,684
SGW1	SUBMERGED GRAVEL WETLANDS (M-2)	2,640	1,396
RG1	RAIN GARDEN (M-7)	9,529	7,885
RG2	RAIN GARDEN (M-7)	2,617	1,406
RG3	RAIN GARDEN (M-7)	6,411	4,285
F1	FILTERRA	7,323	6,169
RGP1-49*	RAIN GARDEN PLANTERS	16,257	16,257



BIORETENTION AREA B-1 CROSS SECTION

SCALE: NONE

	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
3	P_E Credit Description		Contributing Drainage Area (sf)	% Impervious Cover	Direct ESDv Received by Practice	WQv or ESDv from Up-Gradient Practices	Practice Specific Parameter(s)			WQv or ESDv credit (cf)	Runoff Volume Remaining (cf)	Down-Gradient Practice		Baseline Phosphorous Removal Efficiency	Adjusted Removal Efficiency Rate	P Load to Practice (lbs/yr)	Load Reduction (lbs/yr)	Remaining Load (lbs/yr)
4	ESDv credit is based on design storage volume						Surface Area (sf)	Ponding Depth (ft)	Media Depth (ft)									
5			6,717	70%	1,025	1179	740	0.5	2.3	1,051	1,153			50%	66%	0.26	0.17	0.09
6	ESDv credit is based on design storage volume						Surface Area (sf)	Ponding Depth (ft)	Media Depth (ft)									
7			9,583	80%	1,660	0	763	0.5	2.25	1,068	592			50%	59%	0.41	0.24	0.17
8	ESDv credit is based on design storage volume						Surface Area (sf)	Ponding Depth (ft)	Media Depth (ft)									
9			10,625	53%	1,260	0	739	0.5	2.25	1,035	225			50%	62%	0.31	0.20	0.12
10	ESDv credit is based on design storage volume						Surface Area (sf)	Ponding Depth (ft)	Media Depth (ft)									
11			7,243	62%	991	0	535	0.5	3.5	991	0			50%	66%	0.25	0.16	0.09
12	ESDv credit is based on design storage volume						Surface Area (sf)	Ponding Depth (ft)	Media Depth (ft)									
13			12,956	77%	2,166	0	497	0.5	4	1,044	1,122			50%	54%	0.54	0.29	0.25
14	ESDv credit is based on design storage volume						Surface Area (sf)	Ponding Depth (ft)	Media Depth (ft)									
15			13,372	84%	2,425	0	884	0.5	4	1,856	569			50%	61%	0.61	0.37	0.23
16	ESDv credit is based on design						Surface Area (sf)	Ponding Depth (ft)	Media Depth (ft)									
17	storage volume		19,463	16%	865	0	420	0.5	4	865	0			50%	66%	0.22	0.14	0.07
18	ESDv credit is based on design storage volume						Surface Area (sf)	Ponding Depth (ft)	Media Depth (ft)									
19			7,417	50%	834	0	435	0.5	3.7	834	0			50%	66%	0.21	0.14	0.07
20	ESDv credit is based on design storage volume						Surface Area (sf)	Ponding Depth (ft)	Media Depth (ft)									
21			6,996	75%	1,141	0	119	0.5	1.75	143	998			50%	33%	0.29	0.09	0.19
22			94,372		12,368	1,179				8,887	4,660			50%	59%	3.09	1.81	1.28
23																		
24																		

Site Design | Calculation Summary | Nonrooftop Disconnect (C_D) | Permeable Pavers (C) | **Microbioretention(C_D)** | submerged gravel wetlands | Rain Garden C_D | storn

SWM Practices Drainage Areas

MICRO-SCALE PRACTICES

DA	PRACTICE	DRAINAGE AREA - SQ. FT.	IMPERVIOUS AREA - SQ. FT.
MB1	MICRO-BIORETENTION AREA (M-6)	6,715	5,031
MB2	MICRO-BIORETENTION AREA (M-6)	9,736	6,975
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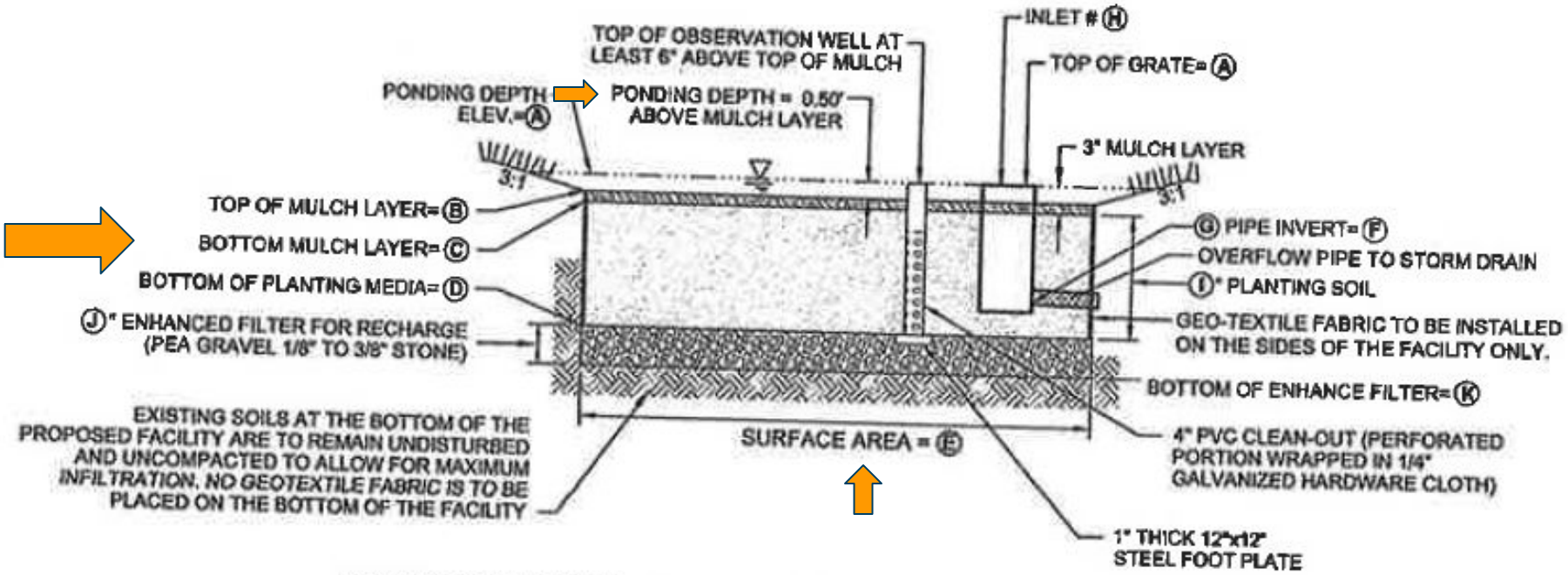
SGW1	SUBMERGED GRAVEL WETLANDS (M-2)	2,840	1,396
RG1	RAIN GARDEN (M-7)	9,529	7,885
RG2	RAIN GARDEN (M-7)	2,617	1,408
RG3	RAIN GARDEN (M-7)	6,411	4,285
F1	FILTERRA	7,323	6,169
RGP1-49*	RAIN GARDEN PLANTERS	18,257	18,257

	RG-1	RG-2	RG-3
A	17.75	8.50	16.00
B	17.25	8.00	15.50
C	17.00	7.75	15.25
D	15.75	6.75	14.00
E	471	200	620
F	14.25	3.77	13.00
G	12	15	15
H	28	13	34
I	12	12	12
J	N/A	N/A	N/A
K	N/A	N/A	N/A

C to D depth (media depth) = 1.25 ft

E (surface area)



NOTE: SEE TABLE B.4.1 (MDE MANUAL) FOR MATERIAL SPECIFICATIONS FOR RAIN GARDENS.

RAIN GARDEN CROSS SECTION

SCALE: NONE

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
5	*Micro-Scale Practices*	P_E Credit Description		Contributing Drainage Area (sf)	% Impervious Cover	Direct ESDv Received by Practice (cf)	WQv or ESDv from Up-Gradient Practices (cf)	Practice Specific Parameter(s)			WQv or ESDv credit (cf)	Runoff Volume Remaining (cf)	Down-Gradient Practice		Baseline Phosphorous Removal Efficiency	Average Adjusted Removal Efficiency Rate
6		ESDv credit is based on design storage						Surface Area (sf)	Ponding Depth (ft)	Media Depth (ft)			Micro-Bioretention (C/D			
7	Rain Gardens (C/D Soils)	volume		6,358	86%	1,177	278	500	0.5	1	450	1,005			25%	25%
8		ESDv credit is based on design storage						Surface Area (sf)	Ponding Depth (ft)	Media Depth (ft)						
9	Rain Gardens (C/D Soils)	volume		2,617	42%	252	0	210	0.5	1	189	63			25%	31%
10		ESDv credit is based on design storage						Surface Area (sf)	Ponding Depth (ft)	Media Depth (ft)						
11	Rain Gardens (C/D Soils)	volume		4,950	76%	817	0	620	0.5	1.25	620	197			25%	31%
12		ESDv credit is based on design storage						Surface Area (sf)	Ponding Depth (ft)	Media Depth (ft)						
13	Rain Garden Planter Boxes	volume		15,862	100%	3,391	0	1,975	0.5	1.25	1,975	1,416			25%	29%
14		ESDv credit is based on design storage						Surface Area (sf)	Ponding Depth (ft)	Media Depth (ft)						
15	Rain Gardens (C/D Soils)	volume				0	0				0	0			25%	
16	Total			29,787		5,637	278				3,234	2,681			25%	29%
17																
18																

	A	B
1	**Calculation Summary**	
2		
3	**Critical Area 10% Calculations**	
4	Removal Requirement, RR (lbs P / yr)	**2.94**
5	after non-structural and micro-scale BMPs (Steps 5 and 6)	
6	Total Load Reduction (lbs P / year)	2.93
7	Total Load Reduction Remaining (lbs P / yr)	**0.01**
8	after structural practices (Step 9)	
9	Total Load Reduction (lbs P / year)	3.79
10	Total Load Reduction Remaining (lbs P / yr)	**0.00**
11		
12		
13	**MDE's ESD to the MEP Calculations**	
14	ESD Runoff Volume, ESDv (cf)	14191.00
15	Total Treatment Volume (cf)	14191.00
16		
17	WQv or ESDv Treated (cf)	14742.24
18	PE achieved (inches)	1.87
19		
20	Entire ESDv Treated Through Environmental Site Design?	YES
21	ESDv Remaining? (cf)	0.00
22	If ESDV is not fully treated, is ESD to MEP achieved?	0.00
23		
24	Redevelopment WQv Requirements Met Through Environmental Site Design?	N/A
25	WQv Remaining? (cf)	0.00
26		
27	New Development WQv Requirements Met Through Environmental Site Design?	YES
28	WQv Remaining? (cf)	0.00
29		