Bay Engineering Inc.
Engineers, Planners and Surveyors

PRELIMINARY STORMWATER MANAGEMENT REPORT

FOR

PLANNED DEVELOPMENT OF ANNAPOLIS TOWNES AT NEAL FARM
TAX MAP 51A, BLOCK 24, PARCELS 6, 8 & 45
TAX MAP 51D, BLOCK 10, PARCEL 60, LOT 10
TAX MAP 51D, BLOCK 6,PARCELS 70,391 &392
DORSEY DRIVE & TYDING DRIVE
ANNAPOLIS, MARYLAND

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DATE PREPARED: DECEMBER 2014

Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the state of Maryland.

License No: 19593, Expiration Date: 3/31/16

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INTRODUCTION AND SITE HISTORY

This report contains design information and calculations related to the proposed storm water management facilities associated with the Planned Development for the proposed Annapolis Townes at Neal Farm Subdivision.

The subject property is located on the east side of Dorsey Drive and the north side of Tyding Drive in the City of Annapolis. The site is in the 2nd Tax District of Anne Arundel County. The lot is adjacent to single family residential areas to the north and south and commercial properties to the west.

The subject site is shown on Tax Map 51A, Block 24, Parcels 6, 8 & 45, Tax Map 51D, Block 10, Parcel 60, Lot 10, Tax Map 51D, Block 6, Parcels 70, 391 & 392 and is zoned R4/R1B/B2 City.

EXISTING CONDITIONS

Soil types shown on the plans were obtained from the SCS Soil Survey for Anne Arundel County, Maryland. Hydrologic soil group C and D soils are present on-site according to the Soil Survey Map.

The site is 7.65 acres accessed from Dorsey Drive and Tydings Drive. The front of the site is open field with scattered trees and the rear of the site is wooded. The site contains steep slopes at the rear. The rear of the site4 also contains an existing FEMA floodplain, non-tidal wetlands with associated buffers, and an intermittent stream with associated buffers. The site is not within the Chesapeake Bay Critical Area. The site contains 26 specimen trees.

PROPOSED CONDITIONS

Under proposed conditions, the site will be developed into a 50 unit townhome development. Every effort has been made to limit the disturbance to the existing trees on site based on previous conversations with the City.

Stormwater Management Location and Design

The site has been designed using Environmental Site Design ("ESD") to the maximum extent practicable ("MEP"). The site consists of a number of practices which provide the required ESD volume and target rainfall. Many of these practices are in series.

ESD BMP'S :

Alternative Surfaces – Permeable Pavement (A-2)

There are several areas of permeable pavement proposed on the site. The parallel spaceds along proposed private road 'B' and the parking spaces located along proposed private road 'E' will be permeable pavement. 12" of sub-base is provided at these locations.

Micro-Scale Practices – Micro-Bioretention (M-6)

Two micro-bioretention areas are proposed on the site. Stormwater enters the micro-bioretention areas through storm drains directed to a gravel curtain at the micro-bioretention area.

An 'S' inlet has been provided in the micro-bioretention areas for conveyance of storms larger than the 1" storm. The micro-bioretention areas also include an underdrain system consisting of 6" perforated PVC pipe that is located within a gravel jacket layer beneath the planting soil. There are some facilities that have an overflow weir in lieu of the 'S" inlet to direct the stormwater as sheet flow to downstream conservation areas.

Micro-Scale Practices – Rain Gardens (M-7)

Seventy-six rain gardens have been provided on site. The proposed rain gardens will be boxes placed next to the proposed dwellings. Each proposed rain garden will serve on-half of a unit.

An overflow drain has been provided for passage of larger storms.

Micro-Scale Practices – Filterra Device

Eight Filterra devices are proposed. The system includes a pretreatment chamber, the Filterra treatment chamber and a bypass inlet. The MDE approval letter for the Filterra is attached in the Appendix.

Micro-Scale Practices – Step Pool Conveyance System

A step pool conveyance system will be placed at the storm drain outfall for the site along the existing flood plain and intermittent stream. The existing pools will provide stormwater management for the site.

METHODOLOGY

Stormwater Management Design

The parameters used in the design of the SWM facilities are in accordance with the 2000 State Design Manual requirements.

STORMWATER MANAGEMENT NOTE

Stormwater management for this site is provided in accordance with the MDE 2000 Maryland Stormwater Design Manual. This development is classified as new development given that the existing development occurs over less than 40% of the site. Stormwater management is provided for the site as follows:

- The Annapolis Townes at Neal Farm site was designed in an effort to employ environmental site design (ESD) to the maximum extent practicable (MEP), and the site layout and grading minimizes disturbance to trees and wooded areas. A combination of ESD practices (including permeable pavement, micro-bioretention, rain gardens, step pool conveyance system and Filterra devices) are proposed throughout the site. The development of the site results in a target PE of 1.60 inches and an ESD volume of 16,218.90 cf. The ESD practices, used to the MEP, result in a treated PE of 1.62 inches and a provided ESD volume of 16,414.36 cf.

- Because all of the ESD requirements are met through ESD practices, channel protection volume requirements are met.

- Overbank Flood Protection, or management of the 10-year storm event, is not required for this project because the outfall is an existing FEMA floodplain.

CONCLUSIONS

Based on the proposed ESD practices and the proposed improvements, it has been determined that this development will not have an adverse impact on downstream conditions.

A summary of the design requirements that have been provided follows:

STORMWATER MANAGEMENT SUMMARY TABLE:

CRITERIA	DRAINAGE AREA	VOLUME REQUIRED	VOLUME PROVIDED	PRACTICE
ESDv	7.65 acres	16,218.90 cf	699.36 cf 3,308.76 cf 3,287.43 cf 3,069 cf 6,049.81 cf **16,414.36 cf**	Permeable Pavement Rain Gardens Micro-bioretention Areas # Step Pool Conveyance System Filterra Devices
CpV	N/A	N/A	N/A	Not applicable because ESD requirements have been met.
Qp	N/A	N/A	N/A	Site discharges to Existing FEMA Floodplain
Qf	N/A	N/A	N/A	Site discharges to Existing FEMA Floodplain

STORMWATER MANAGEMENT REFERENCES

1. Urban Hydrology for Small Watersheds, Technical Release No. 55, Version 2.00, Soil Conservation Service, U.S.D.A., Washington, D.C., February 1973.

2. Soil Survey for Anne Arundel County, Maryland, Soil Conservation Service,U.S.D.A., Washington, D.C., February 1973.

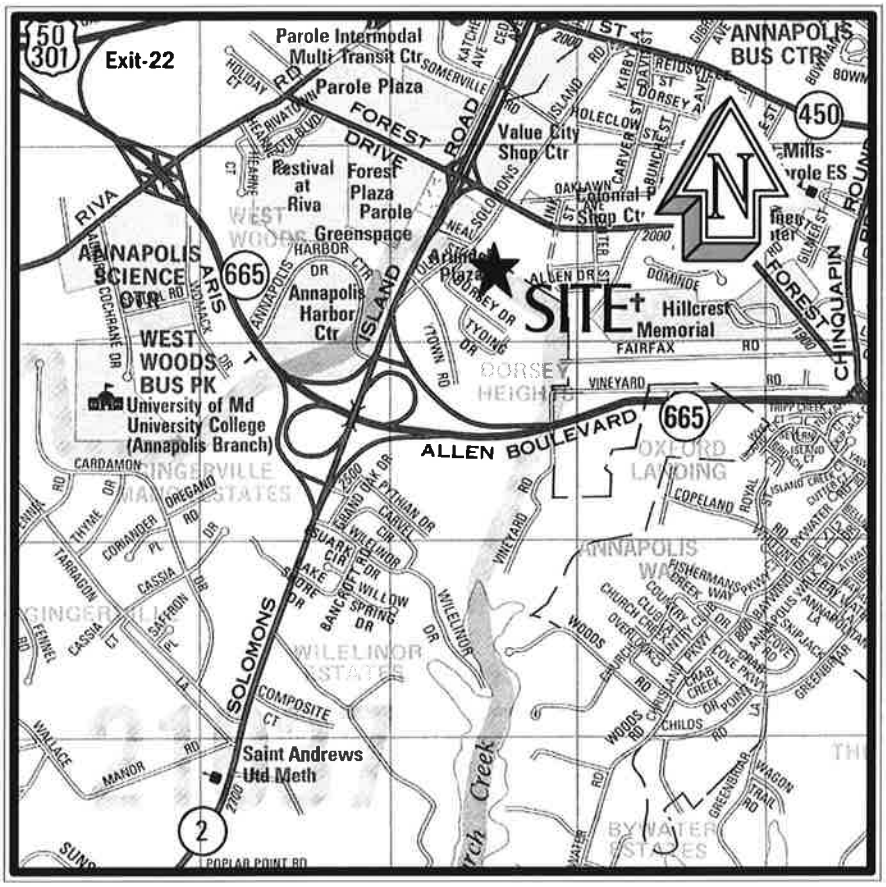
3. Engineering Field Manual, Soil conservation service, U.S.D.A., Washington,D.C., April 1975.

4. U.S. Weather Bureau Technical Paper 149, U.S. Weather Bureau,Washington, D.C.

5. 2000 Maryland Stormwater Design Manual Volumes I and II, Water Management Administration, 2000.

Section 1 – Exhibits

Exhibit A – ADC Vicinity Map



VICINITY MAP

SCALE: 1"=2000'

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Section 2 – Stormwater Management Design Computations

Appendix A – Environmental Site Design

Stormwater Management Requirements

Project:	Annapolis Townes at Neal Farm		
Job No.:	10-3572		
County:	Anne Arundel		
By:	AMD	*Date:*	12/09/14
Check:	TS	*Date:*	12/09/14

Site Data

Existing Conditions

Site Area	7.65	ACRES	OR	333,265	SF	Protected Areas =
Limit of Disturbance	7.65	ACRES	OR	333,265	SF	174138.81 sq.ft.

Soils Types

HSG 'A'	0.00	ACRES	OR	0	SF	0.0%	*of site*
HSG 'B'	0.00	ACRES	OR	0	SF	0.0%	*of site*
HSG 'C'	6.78	ACRES	OR	295,262	SF	88.6%	*of site*
HSG 'D'	0.87	ACRES	OR	38,003	SF	11.4%	*of site*

Impervious Cover

Buildings	0.00	ACRES	OR	0	SF		
Paving	0.05	ACRES	OR	2,123	SF		
TOTAL	**0.05**	ACRES	OR	**2,123**	SF	0.6%	*of site*

Proposed Conditions

Impervious Cover

Buildings	0.84	ACRES	OR	36,500	SF		
Paving	1.22	ACRES	OR	53,239	SF		
Other	0.36	ACRES	OR	15,579	SF		
TOTAL	**2.42**	ACRES	OR	**105,318**	SF	31.6%	*of site*

Impervious Cover on Soils

HSG 'A'	0.00	ACRES	OR	0	SF	0.0%	*of site*
HSG 'B'	0.00	ACRES	OR	0	SF	0.0%	*of site*
HSG 'C'	2.42	ACRES	OR	105,318	SF	31.6%	*of site*
HSG 'D'	0.00	ACRES	OR	0	SF	0.0%	*of site*

Determine Target ESD_V (Total Site)

Target RCN for "Woods in Good Condition"

HSG	Area (SF)	% Site	RCN
A	0	0%	38
B	0	0%	55
C	295,262	89%	70
D	38,003	11%	77

RCN_{WOODS} = **71**

Compute Percent Imperviousness, I (Total Site)

I = Impervious Area / Site Area

Existing Impervious Area=	2,123 SF	I =	**0.6%**	*of site*
Proposed Impervious Area=	105,318 SF	I =	**31.6%**	*of site*

Based on % Site Development Category is : **New Development**

Stormwater Management Requirements

Project:	Annapolis Townes at Neal Farm		
Job No.:	10-3572		
County:	Anne Arundel		
By:	AMD	*Date:*	12/09/14
Check:	TS	*Date:*	12/09/14

Determine Target ESD_V

Percent Imperviousness

I = Impervious Area / Site Area

I =	31.6	%

Where:
Site Area = 333,265 ft^2

Dimensionless Runoff Coefficient

$R_v = 0.05 + 0.009(I)$

R_v =	0.37

Where:
I = 31.6 %

Target Pe

Using Table 5.3 with the Percent Imperviousness and Soil Type above, determine the Target Pe.

HSG	Area (ft^2)	% SITE	Pe (in)
A	0	0.00%	1.0
B	0	0.00%	1.8
C	295,262	88.60%	1.6
D	38,003	11.40%	1.6

P_e =	1.60	in.(s)

Where:
I = 35.0 %

Target ESDv

$$ESD_V = \frac{(P_e)(R_V)(A)}{12}$$

ESD_v =	16,218.90	ft^3

Where:
A = LOD = 333,265 ft^2

ESDv Runoff Depth

$$Q_e = (P_e)(R_v)$$

ESD Runoff Depth, QE (in):	0.58

Where:
Pe= 1.60 in.

Water Quality Volume

$$WQ_V = \frac{(P_e)(R_V)(A)}{12}$$

WQv=	10,136.81	ft^3

Where:
Pe= 1.00 in.

Required Recharge Volume

$$Re_V = \frac{(S)(R_V)(A)}{12}$$

Rev= 0.0310 ac-ft or 1349.80 cf

S=%impervious= 0.133

HSG	Recharge Factor
A	0.42
B	0.29
c	0.14
D	0.08

Environmental Site Design Summary

Practice	Area Treated (ft^2) (sf)	(acres)	Impervious Treated (ft^2)	Rv	Max. 1-yr Treatment	ESDv (ft^3)	Actual Volume (ft^3)
Pervious Pavers	4,371.00	0.100	4,371.00	0.95	934.30	699.36	699.36
Micro-Bioretentions	25,650.00	0.589	16,027.00	0.61	3,534.03	3,287.43	3,287.43
Rain Gardens	28,476.00	0.654	28,476.00	0.95	6,086.75	3,308.76	3,308.76
Filterra Boxes	97,527.00	2.239	75,246.00	0.74	16,334.49	6,049.81	6,049.81
Step Pool Conveyance						3,069.00	3,069.00
				Total	26,889.57	**16,414.36**	16,414.36
				ESD_v Required		**16,218.90**	

Total Site P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.62 in.

Where:

ESD_v = 16,414.36 ft^3

R_v = 0.37

A (Total Site Area) = 333,265 ft^2

**Note: These values taken from the Stormwater Management Requirements sheet of these computations.*

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DETERMINE ESD TREATMENTS WITH PERMEABLE PAVERS DESIGN

Project: Annapolis Townes at Neal Farm **Date:** 6/25/14
Location: Anne Arundel County **Job No.:** 10-3572

Drainage Area:

PERVIOUS PAVERS (A-2)					ESD$_V$ (CF)
Facility:	1				
Drainage Area to Facility:	970	square feet	or	0.02	acres
Impervious Area Treated by Facility:	970	square feet	or	0.02	acres
Impervious (%) (I):	100.00	%			
Area of Permeable Pavers:	970.00	square feet			
Area of Pavers B Soils	0.00	square feet			
Area of Pavers C Soils	970.00	square feet			
Composite Equiv. Pe (in)	2.00	*inch(es)*			
Composite ESDv/ft2	0.16	*feet (per table)*			

Storage Below Pavers:

Pe Required =	1.60	*inch(es)*
Subbase =	12"	
ESDv/ft2 =	0.160	*feet (per composite)*
Equiv. Pe (in) =	2	*inch(es)*
ESDv Provided =	155	*cubic feet*

ESDv = (ESDv/ft2) x Area of Permeable Pavers

$$ESD_V = \frac{(P_e)(R_V)(A)}{12}$$

TREATED	155

ESD Values for Permeable Pavements

	Hydrologic Soil Group								
	A			B			C		
Subbase	RCN	ESDv/ft2	Equiv. PE (in)	RCN	ESDv/ft2	Equiv. PE (in)	RCN	ESDv/ft2	Equiv. PE (in)
6"	76	0.138	1.7	84	0.101	1.3	93	0.043	0.5
9"	62	0.183	2.3	65	0.175	2.2	77	0.134	1.7
12"	40	0.206	2.6	55	0.196	2.5	70	0.16	2

DETERMINE ESD TREATMENTS WITH PERMEABLE PAVERS DESIGN

Project: Annapolis Townes at Neal Farm **Date:** 6/25/14
Location: Anne Arundel County **Job No.:** 10-3572

Drainage Area:

PERVIOUS PAVERS (A-2)					ESD$_V$ (CF)
Facility:	2				
Drainage Area to Facility:	641	square feet	or	0.01 acres	
Impervious Area Treated by Facility:	641	square feet	or	0.01 acres	
Impervious (%) (I):	100.00	%			
Area of Permeable Pavers:	641.00	square feet			
Area of Pavers B Soils	0.00	square feet			
Area of Pavers C Soils	641.00	square feet			
Composite Equiv. Pe (in)	2.00	*inch(es)*			
Composite ESDv/ft2	0.16	*feet (per table)*			

Storage Below Pavers:

Pe Required =	1.60	*inch(es)*
Subbase =	12"	
ESDv/ft2 =	0.160	*feet (per composite)*
Equiv. Pe (in) =	2	*inch(es)*
ESDv Provided =	103	*cubic feet*

ESDv = (ESDv/ft2) x Area of Permeable Pavers

$$ESD_V = \frac{(P_e)(R_V)(A)}{12}$$

TREATED	103

ESD Values for Permeable Pavements

Hydrologic Soil Group									
	A			B			C		
Subbase	RCN	ESDv/ft2	Equiv. PE (in)	RCN	ESDv/ft2	Equiv. PE (in)	RCN	ESDv/ft2	Equiv. PE (in)
6"	76	0.138	1.7	84	0.101	1.3	93	0.043	0.5
9"	62	0.183	2.3	65	0.175	2.2	77	0.134	1.7
12"	40	0.206	2.6	55	0.196	2.5	70	0.16	2

DETERMINE ESD TREATMENTS WITH PERMEABLE PAVERS DESIGN

Project: Annapolis Townes at Neal Farm **Date:** 6/25/14
Location: Anne Arundel County **Job No.:** 10-3572

Drainage Area:

PERVIOUS PAVERS (A-2)					ESD$_V$ (CF)
Facility:	3				
Drainage Area to Facility:	476	square feet	or	0.01 acres	
Impervious Area Treated by Facility:	476	square feet	or	0.01 acres	
Impervious (%) (I):	100.00	%			
Area of Permeable Pavers:	476.00	square feet			
Area of Pavers B Soils	0.00	square feet			
Area of Pavers C Soils	476.00	square feet			
Composite Equiv. Pe (in)	2.00	*inch(es)*			
Composite ESDv/ft2	0.16	*feet (per table)*			

Storage Below Pavers:

Pe Required =	1.60	*inch(es)*
Subbase =	12"	
ESDv/ft2 =	0.160	*feet (per composite)*
Equiv. Pe (in) =	2	*inch(es)*
ESDv Provided =	76	*cubic feet*

ESDv = (ESDv/ft2) x Area of Permeable Pavers

$$ESD_V = \frac{(P_e)(R_V)(A)}{12}$$

TREATED	76

ESD Values for Permeable Pavements

	Hydrologic Soil Group								
	A			B			C		
Subbase	RCN	ESDv/ft2	Equiv. PE (in)	RCN	ESDv/ft2	Equiv. PE (in)	RCN	ESDv/ft2	Equiv. PE (in)
6"	76	0.138	1.7	84	0.101	1.3	93	0.043	0.5
9"	62	0.183	2.3	65	0.175	2.2	77	0.134	1.7
12"	40	0.206	2.6	55	0.196	2.5	70	0.16	2

DETERMINE ESD TREATMENTS WITH PERMEABLE PAVERS DESIGN

Project: Annapolis Townes at Neal Farm **Date:** 6/25/14
Location: Anne Arundel County **Job No.:** 10-3572

Drainage Area:

PERVIOUS PAVERS (A-2)					ESD$_V$ (CF)
Facility:	4				
Drainage Area to Facility:	311	square feet	or	0.01 acres	
Impervious Area Treated by Facility:	311	square feet	or	0.01 acres	
Impervious (%) (I):	100.00	%			
Area of Permeable Pavers:	311.00	square feet			
Area of Pavers B Soils	0.00	square feet			
Area of Pavers C Soils	311.00	square feet			
Composite Equiv. Pe (in)	2.00	*inch(es)*			
Composite ESDv/ft2	0.16	*feet (per table)*			

Storage Below Pavers:

Pe Required =	1.60	*inch(es)*
Subbase =	12"	
ESDv/ft2 =	0.160	*feet (per composite)*
Equiv. Pe (in) =	2	*inch(es)*
ESDv Provided =	50	*cubic feet*

ESDv = (ESDv/ft2) x Area of Permeable Pavers

$$ESD_V = \frac{(P_e)(R_V)(A)}{12}$$

TREATED	50

ESD Values for Permeable Pavements

	Hydrologic Soil Group								
	A			B			C		
Subbase	RCN	ESDv/ft2	Equiv. PE (in)	RCN	ESDv/ft2	Equiv. PE (in)	RCN	ESDv/ft2	Equiv. PE (in)
6"	76	0.138	1.7	84	0.101	1.3	93	0.043	0.5
9"	62	0.183	2.3	65	0.175	2.2	77	0.134	1.7
12"	40	0.206	2.6	55	0.196	2.5	70	0.16	2

DETERMINE ESD TREATMENTS WITH PERMEABLE PAVERS DESIGN

Project: Annapolis Townes at Neal Farm **Date:** 6/25/14
Location: Anne Arundel County **Job No.:** 10-3572

Drainage Area:

PERVIOUS PAVERS (A-2)					ESD$_V$ (CF)
Facility:	5				
Drainage Area to Facility:	1,973	square feet	or	0.05 acres	
Impervious Area Treated by Facility:	1,973	square feet	or	0.05 acres	
Impervious (%) (I):	100.00	%			
Area of Permeable Pavers:	1973.00	square feet			
Area of Pavers B Soils	0.00	square feet			
Area of Pavers C Soils	1973.00	square feet			
Composite Equiv. Pe (in)	2.00	*inch(es)*			
Composite ESDv/ft2	0.16	*feet (per table)*			

Storage Below Pavers:

Pe Required =	1.60	*inch(es)*
Subbase =	12"	
ESDv/ft2 =	0.160	*feet (per composite)*
Equiv. Pe (in) =	2	*inch(es)*
ESDv Provided =	316	*cubic feet*

ESDv = (ESDv/ft2) x Area of Permeable Pavers

$$ESD_V = \frac{(P_e)(R_V)(A)}{12}$$

TREATED	316

ESD Values for Permeable Pavements

Hydrologic Soil Group									
	A			B			C		
Subbase	RCN	ESDv/ft2	Equiv. PE (in)	RCN	ESDv/ft2	Equiv. PE (in)	RCN	ESDv/ft2	Equiv. PE (in)
6"	76	0.138	1.7	84	0.101	1.3	93	0.043	0.5
9"	62	0.183	2.3	65	0.175	2.2	77	0.134	1.7
12"	40	0.206	2.6	55	0.196	2.5	70	0.16	2

Environmental Site Design

M-6	Micro-Bioretention
Drainage Area:	1

Concept Design:

Contributing Drainage Area=	17312	ft^2	0.40	acres
Impervious Coverage =	11149	ft^2	0.26	acres
Percent Impervious (I)=	64.40042	%		
$R_v = 0.05 + 0.009(I)$ =	0.63			

ESD_V Required

$ESD_{V,Req.} = (P_E \times R_V \times A) / 12$ =	1,453	CF
Pe Reqired =	1.60	in.
75% of ESDV,Req. =	1089.97	CF

ESD_V Provided

Planting Media Depth, df =	5.17	FT.
Mulch =	2	in.
Planting Soil =	48	in.
Gravel =	12	in.
Surface Area, Af =	650	SF
Surface Area Required =	347	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	1.00	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
71.00	0.00	650.00	0.00	0.00	0.00	0.00
71.50	0.50	862.50	756.25	378.13	378.13	378.13
72.00	0.50	1,075.00	968.75	484.38	484.38	862.50

Total Storage Volume Provided = **862.50** CF

Total Combine Storage:

Ponding Storage =	862.50	cf	
Media Storage =	1343.33	cf	(n x Af x Media depth (df)) = Media Storage
Enhanced Filter =	0.00	cf	
ESDv provided =	2,205.83	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv=	2452.43	ft^3

Environmental Site Design

M-6	Micro-Bioretention
Drainage Area:	2

Concept Design:

Contributing Drainage Area=	8338	ft^2	0.19	acres
Impervious Coverage =	4878	ft^2	0.11	acres
Percent Impervious (I)=	58.50324	%		
$R_v = 0.05 + 0.009(I)$ =	0.576529			

ESD_V Required

$ESD_{V,Req.} = (P_E \times R_V \times A) / 12$ =	641	CF
Pe Reqired =	1.60	in.
75% of ESDV,Req. =	480.71	CF

ESD_V Provided

Planting Media Depth, df =	5.17	FT.
Mulch =	2	in.
Planting Soil =	48	in.
Gravel =	12	in.
Surface Area, Af =	545	SF
Surface Area Required =	167	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
70.00	0.00	545.00	0.00	0.00	0.00	0.00
70.25	0.25	724.50	634.75	158.69	158.69	158.69
70.50	0.25	904.00	814.25	203.56	203.56	362.25
					Total Storage Volume Provided =	**362.25** CF

Total Combine Storage:

Ponding Storage =	362.25	cf	
Media Storage =	1126.33	cf	(n x Af x Media depth (df)) = Media Storage
Enhanced Filter =	906.40	cf	
ESDv provided =	2,394.98	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv=	1081.60	ft^3

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 1

Concept Design:

Contributing Drainage Area=	387	ft^2	0.01	acres
Impervious Coverage =	387	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
75.50	0.00	48.00	0.00	0.00	0.00	0.00
75.75	0.25	48.00	48.00	12.00	12.00	12.00
76.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 82.72 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.83 in.

Environmental Site Design

M-7 Rain Garden

Drainage Area: Unit 5

Concept Design:

Contributing Drainage Area=	387	ft^2	0.01	acres
Impervious Coverage =	387	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
77.50	0.00	48.00	0.00	0.00	0.00	0.00
77.75	0.25	48.00	48.00	12.00	12.00	12.00
78.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf
Media Storage =	32.00	cf
ESDv provided =	56.00	cf

(n x Af x Media depth (df)) = Media Storage

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 82.72 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.83 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 9

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
77.00	0.00	19.00	0.00	0.00	0.00	0.00
77.25	0.25	19.00	19.00	4.75	4.75	4.75
77.50	0.25	19.00	19.00	4.75	4.75	9.50

Total Storage Volume Provided = **9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf	
Media Storage =	12.67	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	22.17	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 74.39 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 0.80 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 12

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	19.00	0.00	0.00	0.00	0.00
76.75	0.25	19.00	19.00	4.75	4.75	4.75
77.00	0.25	19.00	19.00	4.75	4.75	9.50

Total Storage Volume Provided = **9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf	
Media Storage =	12.67	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	22.17	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 74.39 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 0.80 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 15

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	19.00	0.00	0.00	0.00	0.00
76.75	0.25	19.00	19.00	4.75	4.75	4.75
77.00	0.25	19.00	19.00	4.75	4.75	9.50

Total Storage Volume Provided = **9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf	
Media Storage =	12.67	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	22.17	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 74.39 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 0.80 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 18

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	19.00	0.00	0.00	0.00	0.00
76.75	0.25	19.00	19.00	4.75	4.75	4.75
77.00	0.25	19.00	19.00	4.75	4.75	9.50

Total Storage Volume Provided = **9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf	
Media Storage =	12.67	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	22.17	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 74.39 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 0.80 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 21

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage						
WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	19.00	0.00	0.00	0.00	0.00
76.75	0.25	19.00	19.00	4.75	4.75	4.75
77.00	0.25	19.00	19.00	4.75	4.75	9.50
					Total Storage Volume Provided =	**9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf	
Media Storage =	12.67	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	22.17	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv=	74.39	ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e =	0.80	in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 25

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage						
WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	19.00	0.00	0.00	0.00	0.00
76.75	0.25	19.00	19.00	4.75	4.75	4.75
77.00	0.25	19.00	19.00	4.75	4.75	9.50
					Total Storage Volume Provided =	**9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf	
Media Storage =	12.67	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	22.17	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv=	74.39	ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e =	0.80	in.

M-7 Rain Garden

Drainage Area: Unit 29

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	19.00	0.00	0.00	0.00	0.00
76.75	0.25	19.00	19.00	4.75	4.75	4.75
77.00	0.25	19.00	19.00	4.75	4.75	9.50

Total Storage Volume Provided = **9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf
Media Storage =	12.67	cf
ESDv provided =	22.17	cf

(n x Af x Media depth (df)) = Media Storage

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 74.39 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 0.80 in.

M-7	Rain Garden
Drainage Area:	Unit 33

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage						
WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	19.00	0.00	0.00	0.00	0.00
76.75	0.25	19.00	19.00	4.75	4.75	4.75
77.00	0.25	19.00	19.00	4.75	4.75	9.50
				Total Storage Volume Provided =		**9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf
Media Storage =	12.67	cf
ESDv provided =	22.17	cf

(n x Af x Media depth (df)) = Media Storage

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 74.39 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 0.80 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 37

Concept Design:

Contributing Drainage Area=	387	ft^2	0.01	acres
Impervious Coverage =	387	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf
Media Storage =	32.00	cf
ESDv provided =	56.00	cf

(n x Af x Media depth (df)) = Media Storage

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 82.72 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.83 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 41

Concept Design:

Contributing Drainage Area=	387	ft^2	0.01	acres
Impervious Coverage =	387	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf
Media Storage =	32.00	cf
ESDv provided =	56.00	cf

(n x Af x Media depth (df)) = Media Storage

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 82.72 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.83 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 45

Concept Design:

Contributing Drainage Area=	387	ft^2	0.01	acres
Impervious Coverage =	387	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf
Media Storage =	32.00	cf
ESDv provided =	56.00	cf

(n x Af x Media depth (df)) = Media Storage

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 82.72 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.83 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 48

Concept Design:

Contributing Drainage Area=	387	ft^2	0.01	acres
Impervious Coverage =	387	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 82.72 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.83 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 1

Concept Design:

Contributing Drainage Area=	393	ft^2	0.01	acres
Impervious Coverage =	393	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf
Media Storage =	32.00	cf
ESDv provided =	56.00	cf

(n x Af x Media depth (df)) = Media Storage

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 84.00 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.80 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 9

Concept Design:

Contributing Drainage Area=	393	ft^2	0.01	acres
Impervious Coverage =	393	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage						
WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00
					Total Storage Volume Provided =	**24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv=	84.00	ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e =	1.80	in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 15

Concept Design:

Contributing Drainage Area=	393	ft^2	0.01	acres
Impervious Coverage =	393	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv=	84.00	ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e =	1.80	in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 21

Concept Design:

Contributing Drainage Area=	393	ft^2	0.01	acres
Impervious Coverage =	393	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 84.00 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.80 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 29

Concept Design:

Contributing Drainage Area=	393	ft^2	0.01	acres
Impervious Coverage =	393	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage						
WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00
					Total Storage Volume Provided =	**24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv=	84.00	ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e =	1.80	in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 37

Concept Design:

Contributing Drainage Area=	393	ft^2	0.01	acres
Impervious Coverage =	393	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 84.00 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.80 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 45

Concept Design:

Contributing Drainage Area=	393	ft^2	0.01	acres
Impervious Coverage =	393	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv=	84.00	ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e =	1.80	in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 2

Concept Design:

Contributing Drainage Area=	387	ft^2	0.01	acres
Impervious Coverage =	387	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.00	0.00	48.00	0.00	0.00	0.00	0.00
76.25	0.25	48.00	48.00	12.00	12.00	12.00
76.50	0.25	48.00	48.00	12.00	12.00	24.00
				Total Storage Volume Provided =		**24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv=	82.72	ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e =	1.83	in.

Environmental Site Design

M-7 Rain Garden

Drainage Area: Unit 6

Concept Design:

Contributing Drainage Area=	387	ft^2	0.01	acres
Impervious Coverage =	387	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
77.50	0.00	48.00	0.00	0.00	0.00	0.00
77.75	0.25	48.00	48.00	12.00	12.00	12.00
78.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 82.72 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.83 in.

Environmental Site Design

M-7 Rain Garden

Drainage Area: Unit 10

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
77.00	0.00	19.00	0.00	0.00	0.00	0.00
77.25	0.25	19.00	19.00	4.75	4.75	4.75
77.50	0.25	19.00	19.00	4.75	4.75	9.50

Total Storage Volume Provided = **9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf
Media Storage =	12.67	cf
ESDv provided =	22.17	cf

(n x Af x Media depth (df)) = Media Storage

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 74.39 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 0.80 in.

Environmental Site Design

M-7 | Rain Garden

Drainage Area: Unit 13

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	19.00	0.00	0.00	0.00	0.00
76.75	0.25	19.00	19.00	4.75	4.75	4.75
77.00	0.25	19.00	19.00	4.75	4.75	9.50

Total Storage Volume Provided = **9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf
Media Storage =	12.67	cf
ESDv provided =	22.17	cf

(n x Af x Media depth (df)) = Media Storage

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 74.39 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 0.80 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 16

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	19.00	0.00	0.00	0.00	0.00
76.75	0.25	19.00	19.00	4.75	4.75	4.75
77.00	0.25	19.00	19.00	4.75	4.75	9.50

Total Storage Volume Provided = **9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf	
Media Storage =	12.67	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	22.17	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 74.39 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 0.80 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 19

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	19.00	0.00	0.00	0.00	0.00
76.75	0.25	19.00	19.00	4.75	4.75	4.75
77.00	0.25	19.00	19.00	4.75	4.75	9.50

Total Storage Volume Provided = **9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf	
Media Storage =	12.67	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	22.17	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 74.39 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 0.80 in.

Environmental Site Design

M-7 | Rain Garden

Drainage Area: Unit 22

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	19.00	0.00	0.00	0.00	0.00
76.75	0.25	19.00	19.00	4.75	4.75	4.75
77.00	0.25	19.00	19.00	4.75	4.75	9.50

Total Storage Volume Provided = **9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf
Media Storage =	12.67	cf
ESDv provided =	22.17	cf

(n x Af x Media depth (df)) = Media Storage

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 74.39 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 0.80 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 26

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	19.00	0.00	0.00	0.00	0.00
76.75	0.25	19.00	19.00	4.75	4.75	4.75
77.00	0.25	19.00	19.00	4.75	4.75	9.50

Total Storage Volume Provided = **9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf
Media Storage =	12.67	cf
ESDv provided =	22.17	cf

(n x Af x Media depth (df)) = Media Storage

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 74.39 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 0.80 in.

M-7	Rain Garden
Drainage Area:	Unit 30

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	19.00	0.00	0.00	0.00	0.00
76.75	0.25	19.00	19.00	4.75	4.75	4.75
77.00	0.25	19.00	19.00	4.75	4.75	9.50

Total Storage Volume Provided = **9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf
Media Storage =	12.67	cf
ESDv provided =	22.17	cf

(n x Af x Media depth (df)) = Media Storage

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 74.39 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 0.80 in.

M-7	Rain Garden
Drainage Area:	Unit 34

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage						
WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	19.00	0.00	0.00	0.00	0.00
76.75	0.25	19.00	19.00	4.75	4.75	4.75
77.00	0.25	19.00	19.00	4.75	4.75	9.50
					Total Storage Volume Provided =	**9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf	
Media Storage =	12.67	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	22.17	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv=	74.39	ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e =	0.80	in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 38

Concept Design:

Contributing Drainage Area=	387	ft^2	0.01	acres
Impervious Coverage =	387	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 82.72 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.83 in.

Environmental Site Design

M-7 Rain Garden

Drainage Area: Unit 42

Concept Design:

Contributing Drainage Area=	387	ft^2	0.01	acres
Impervious Coverage =	387	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf
Media Storage =	32.00	cf
ESDv provided =	56.00	cf

(n x Af x Media depth (df)) = Media Storage

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 82.72 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.83 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 46

Concept Design:

Contributing Drainage Area=	387	ft^2	0.01	acres
Impervious Coverage =	387	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 82.72 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.83 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 49

Concept Design:

Contributing Drainage Area=	387	ft^2	0.01	acres
Impervious Coverage =	387	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 82.72 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.83 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 4

Concept Design:

Contributing Drainage Area=	393	ft^2	0.01	acres
Impervious Coverage =	393	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage						
WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00
				Total Storage Volume Provided =		**24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv=	84.00	ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e =	1.80	in.

Environmental Site Design

M-7 | Rain Garden

Drainage Area: Unit 11

Concept Design:

Contributing Drainage Area=	393	ft^2	0.01	acres
Impervious Coverage =	393	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I)$ =	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 84.00 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.80 in.

Environmental Site Design

M-7 | Rain Garden

Drainage Area: **Unit 17**

Concept Design:

Contributing Drainage Area=	393	ft^2	0.01	acres
Impervious Coverage =	393	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf
Media Storage =	32.00	cf
ESDv provided =	56.00	cf

(n x Af x Media depth (df)) = Media Storage

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 84.00 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.80 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 24

Concept Design:

Contributing Drainage Area=	393	ft^2	0.01	acres
Impervious Coverage =	393	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf
Media Storage =	32.00	cf
ESDv provided =	56.00	cf

(n x Af x Media depth (df)) = Media Storage

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 84.00 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.80 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 32

Concept Design:

Contributing Drainage Area=	393	ft^2	0.01	acres
Impervious Coverage =	393	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 84.00 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.80 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 40

Concept Design:

Contributing Drainage Area=	393	ft^2	0.01	acres
Impervious Coverage =	393	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 84.00 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.80 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 50

Concept Design:

Contributing Drainage Area=	393	ft^2	0.01	acres
Impervious Coverage =	393	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf
Media Storage =	32.00	cf
ESDv provided =	56.00	cf

(n x Af x Media depth (df)) = Media Storage

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 84.00 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.80 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 3

Concept Design:

Contributing Drainage Area=	387	ft^2	0.01	acres
Impervious Coverage =	387	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00
				Total Storage Volume Provided =		**24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 82.72 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.83 in.

Environmental Site Design

M-7 Rain Garden

Drainage Area: Unit 7

Concept Design:

Contributing Drainage Area=	387	ft^2	0.01	acres
Impervious Coverage =	387	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
77.50	0.00	48.00	0.00	0.00	0.00	0.00
77.75	0.25	48.00	48.00	12.00	12.00	12.00
78.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf
Media Storage =	32.00	cf
ESDv provided =	56.00	cf

(n x Af x Media depth (df)) = Media Storage

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 82.72 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.83 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 11

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
77.00	0.00	19.00	0.00	0.00	0.00	0.00
77.25	0.25	19.00	19.00	4.75	4.75	4.75
77.50	0.25	19.00	19.00	4.75	4.75	9.50
					Total Storage Volume Provided =	**9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf	
Media Storage =	12.67	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	22.17	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 74.39 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 0.80 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 14

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I)$ =	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	19.00	0.00	0.00	0.00	0.00
76.75	0.25	19.00	19.00	4.75	4.75	4.75
77.00	0.25	19.00	19.00	4.75	4.75	9.50

Total Storage Volume Provided = **9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf	
Media Storage =	12.67	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	22.17	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv=	74.39	ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e =	0.80	in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 17

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage						
WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	19.00	0.00	0.00	0.00	0.00
76.75	0.25	19.00	19.00	4.75	4.75	4.75
77.00	0.25	19.00	19.00	4.75	4.75	9.50
					Total Storage Volume Provided =	**9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf	
Media Storage =	12.67	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	22.17	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv=	74.39	ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e =	0.80	in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 20

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	19.00	0.00	0.00	0.00	0.00
76.75	0.25	19.00	19.00	4.75	4.75	4.75
77.00	0.25	19.00	19.00	4.75	4.75	9.50

Total Storage Volume Provided = **9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf	
Media Storage =	12.67	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	22.17	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 74.39 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 0.80 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 23

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage						
WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	19.00	0.00	0.00	0.00	0.00
76.75	0.25	19.00	19.00	4.75	4.75	4.75
77.00	0.25	19.00	19.00	4.75	4.75	9.50
					Total Storage Volume Provided =	**9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf	
Media Storage =	12.67	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	22.17	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv=	74.39	ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e =	0.80	in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 27

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage						
WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	19.00	0.00	0.00	0.00	0.00
76.75	0.25	19.00	19.00	4.75	4.75	4.75
77.00	0.25	19.00	19.00	4.75	4.75	9.50
					Total Storage Volume Provided =	**9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf	
Media Storage =	12.67	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	22.17	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv=	74.39	ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

$\bar{P}_e$ =	0.80	in.

M-7 Rain Garden

Drainage Area: Unit 31

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	19.00	0.00	0.00	0.00	0.00
76.75	0.25	19.00	19.00	4.75	4.75	4.75
77.00	0.25	19.00	19.00	4.75	4.75	9.50
				Total Storage Volume Provided =		**9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf
Media Storage =	12.67	cf
ESDv provided =	22.17	cf

(n x Af x Media depth (df)) = Media Storage

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 74.39 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 0.80 in.

M-7	Rain Garden
Drainage Area:	Unit 35

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	19.00	0.00	0.00	0.00	0.00
76.75	0.25	19.00	19.00	4.75	4.75	4.75
77.00	0.25	19.00	19.00	4.75	4.75	9.50
					Total Storage Volume Provided =	**9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf	
Media Storage =	12.67	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	22.17	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv=	74.39	ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

$\bar{P}_e$ =	0.80	in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 39

Concept Design:

Contributing Drainage Area=	387	ft^2	0.01	acres
Impervious Coverage =	387	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage						
WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00
				Total Storage Volume Provided =		**24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv=	82.72	ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e =	1.83	in.

Environmental Site Design

M-7 Rain Garden

Drainage Area: Unit 43

Concept Design:

Contributing Drainage Area=	387	ft^2	0.01	acres
Impervious Coverage =	387	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I)$ =	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 82.72 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.83 in.

Environmental Site Design

M-7 | Rain Garden

Drainage Area: **Unit 47**

Concept Design:

Contributing Drainage Area=	387	ft^2	0.01	acres
Impervious Coverage =	387	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 82.72 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.83 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 50

Concept Design:

Contributing Drainage Area=	387	ft^2	0.01	acres
Impervious Coverage =	387	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I)$ =	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00
				Total Storage Volume Provided =		**24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv=	82.72	ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e =	1.83	in.

Environmental Site Design

M-7 Rain Garden

Drainage Area: Unit 5

Concept Design:

Contributing Drainage Area=	393	ft^2	0.01	acres
Impervious Coverage =	393	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage						
WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00
					Total Storage Volume Provided =	**24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 84.00 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.80 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 12

Concept Design:

Contributing Drainage Area=	393	ft^2	0.01	acres
Impervious Coverage =	393	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage						
WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00
				Total Storage Volume Provided =		**24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv=	84.00	ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e =	1.80	in.

Environmental Site Design

M-7 Rain Garden

Drainage Area: Unit 18

Concept Design:

Contributing Drainage Area=	393	ft^2	0.01	acres
Impervious Coverage =	393	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I)$ =	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 84.00 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.80 in.

Environmental Site Design

M-7 Rain Garden

Drainage Area: Unit 25

Concept Design:

Contributing Drainage Area=	393	ft^2	0.01	acres
Impervious Coverage =	393	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I)$ =	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage						
WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00
				Total Storage Volume Provided =		**24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 84.00 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.80 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 33

Concept Design:

Contributing Drainage Area=	393	ft^2	0.01	acres
Impervious Coverage =	393	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I)$ =	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 84.00 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.80 in.

Environmental Site Design

M-7 Rain Garden

Drainage Area: Unit 41

Concept Design:

Contributing Drainage Area=	393	ft^2	0.01	acres
Impervious Coverage =	393	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage						
WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00
					Total Storage Volume Provided =	**24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 84.00 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.80 in.

Environmental Site Design

M-7 Rain Garden

Drainage Area: Unit 4

Concept Design:

Contributing Drainage Area=	387	ft^2	0.01	acres
Impervious Coverage =	387	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I)$ =	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
77.50	0.00	48.00	0.00	0.00	0.00	0.00
77.75	0.25	48.00	48.00	12.00	12.00	12.00
78.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 82.72 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.83 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 8

Concept Design:

Contributing Drainage Area=	387	ft^2	0.01	acres
Impervious Coverage =	387	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
77.50	0.00	48.00	0.00	0.00	0.00	0.00
77.75	0.25	48.00	48.00	12.00	12.00	12.00
78.00	0.25	48.00	48.00	12.00	12.00	24.00
				Total Storage Volume Provided =		**24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 82.72 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.83 in.

Environmental Site Design

M-7 Rain Garden

Drainage Area: Unit 24

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I)$ =	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	19.00	0.00	0.00	0.00	0.00
76.75	0.25	19.00	19.00	4.75	4.75	4.75
77.00	0.25	19.00	19.00	4.75	4.75	9.50

Total Storage Volume Provided = **9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf
Media Storage =	12.67	cf
ESDv provided =	22.17	cf

(n x Af x Media depth (df)) = Media Storage

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 74.39 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 0.80 in.

Environmental Site Design

M-7 Rain Garden

Drainage Area: Unit 28

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I)$ =	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	19.00	0.00	0.00	0.00	0.00
76.75	0.25	19.00	19.00	4.75	4.75	4.75
77.00	0.25	19.00	19.00	4.75	4.75	9.50

Total Storage Volume Provided = **9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf
Media Storage =	12.67	cf
ESDv provided =	22.17	cf

(n x Af x Media depth (df)) = Media Storage

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 74.39 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 0.80 in.

M-7 Rain Garden

Drainage Area: Unit 32

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	19.00	0.00	0.00	0.00	0.00
76.75	0.25	19.00	19.00	4.75	4.75	4.75
77.00	0.25	19.00	19.00	4.75	4.75	9.50

Total Storage Volume Provided = **9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf
Media Storage =	12.67	cf
ESDv provided =	22.17	cf

(n x Af x Media depth (df)) = Media Storage

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 74.39 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 0.80 in.

M-7	Rain Garden
Drainage Area:	Unit 36

Concept Design:

Contributing Drainage Area=	348	ft^2	0.01	acres
Impervious Coverage =	348	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	19	SF
Surface Area Required =	7	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage						
WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	19.00	0.00	0.00	0.00	0.00
76.75	0.25	19.00	19.00	4.75	4.75	4.75
77.00	0.25	19.00	19.00	4.75	4.75	9.50
					Total Storage Volume Provided =	**9.50** CF

Total Combine Storage:

Ponding Storage =	9.50	cf
Media Storage =	12.67	cf
ESDv provided =	22.17	cf

(n x Af x Media depth (df)) = Media Storage

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv=	74.39	ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e =	0.80	in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 40

Concept Design:

Contributing Drainage Area=	387	ft^2	0.01	acres
Impervious Coverage =	387	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 82.72 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.83 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 44

Concept Design:

Contributing Drainage Area=	387	ft^2	0.01	acres
Impervious Coverage =	387	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 82.72 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.83 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 8

Concept Design:

Contributing Drainage Area=	393	ft^2	0.01	acres
Impervious Coverage =	393	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv=	84.00	ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e =	1.80	in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 14

Concept Design:

Contributing Drainage Area=	393	ft^2	0.01	acres
Impervious Coverage =	393	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 84.00 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.80 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 20

Concept Design:

Contributing Drainage Area=	393	ft^2	0.01	acres
Impervious Coverage =	393	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00
				Total Storage Volume Provided =		**24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 84.00 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.80 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 28

Concept Design:

Contributing Drainage Area=	393	ft^2	0.01	acres
Impervious Coverage =	393	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 84.00 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.80 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 36

Concept Design:

Contributing Drainage Area=	393	ft^2	0.01	acres
Impervious Coverage =	393	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 84.00 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.80 in.

Environmental Site Design

M-7	Rain Garden
Drainage Area:	Unit 44

Concept Design:

Contributing Drainage Area=	393	ft^2	0.01	acres
Impervious Coverage =	393	ft^2	0.01	acres
Percent Impervious (I)=	100	%		
$R_v = 0.05 + 0.009(I) =$	0.95			

ESD_V Provided

Planting Media Depth, H =	1.67	FT.
Mulch =	2	in.
Planting Soil =	18	in.
Surface Area, Af =	48	SF
Surface Area Required =	8	*2% of Drainage Area*
Planting Media Porosity, n =	0.4	
Ponding Depth, D =	0.50	FT.

Ponding Storage

WSE	Δ WSE (FT)	Surface Area (SF)	Avg. Surface Area (SF)	Total Volume (CF)	Net Storage (CF)	Total Storage (CF)
76.50	0.00	48.00	0.00	0.00	0.00	0.00
76.75	0.25	48.00	48.00	12.00	12.00	12.00
77.00	0.25	48.00	48.00	12.00	12.00	24.00

Total Storage Volume Provided = **24.00** CF

Total Combine Storage:

Ponding Storage =	24.00	cf	
Media Storage =	32.00	cf	(n x Af x Media depth (df)) = Media Storage
ESDv provided =	56.00	cf	

Maximum ESDv Allowed:

1-year runoff (Max. Pe) = 2.7 in.

$$ESD_v = \frac{(2.7)(A)(R_V)}{12}$$

Max. ESDv= 84.00 ft^3

P_e Provided:

$$P_e = \frac{(ESD_v)(12)}{(R_v)(A)}$$

P_e = 1.80 in.

Environmental Site Design

Filterra System

Drainage Area: **Filterra #1**

Concept Design:

Contributing Drainage Area=	21076	ft^2	0.48	acres
Impervious Coverage =	16693	ft^2	0.38	acres
Percent Impervious (I)=	79.20383	%		
$R_v = 0.05 + 0.009(I) =$	0.76			

ESD_V Provided

$ESD_{V,Prov.} = (P_E \times R_V \times A) / 12 =$	1,340	CF
Pe Reqired (min.)=	1.00	in.
Filter Box Size Provided	6x12	

Available Filterra Box Sizes (Ft)	Total contributing Drainage Area (acres)
4x6 or 6x4	Up to 0.17
4x8 or 8x4	0.18 to 0.22
Stand. 6x6	0.23 to 0.25
6x8 or 8x6	0.26 to 0.33
6x10 or 10x6	0.34 to 0.42
6x12 or 12x6	0.43 to 0.50

Environmental Site Design

Filterra System

Drainage Area: **Filterra #2**

Concept Design:

Contributing Drainage Area=	6734	ft^2	0.15	acres
Impervious Coverage =	5834	ft^2	0.13	acres
Percent Impervious (I)=	86.63499	%		
$R_v = 0.05 + 0.009(I) =$	0.83			

ESD_V Provided

$ESD_{V,Prov.} = (P_E \times R_V \times A) / 12 =$	466	CF
Pe Reqired (min.)=	1.00	in.
Filter Box Size Provided	4X6	

Available Filterra Box	Total contributing
4x6 or 6x4	Up to 0.17
4x8 or 8x4	0.18 to 0.22
Stand. 6x6	0.23 to 0.25
6x8 or 8x6	0.26 to 0.33
6x10 or 10x6	0.34 to 0.42
6x12 or 12x6	0.43 to 0.50

Environmental Site Design

Filterra System

Drainage Area: Filterra #3

Concept Design:

Contributing Drainage Area=	11184	ft^2	0.26	acres
Impervious Coverage =	7183	ft^2	0.16	acres
Percent Impervious (I)=	64.22568	%		
$R_v = 0.05 + 0.009(I) =$	0.63			

ESD_V Provided

$ESD_{V,Prov.} = (P_E \times R_V \times A) / 12 =$	585	CF
Pe Reqired (min.)=	1.00	in.
Filter Box Size Provided	6X8	

Available Filterra Box	Total contributing
4x6 or 6x4	Up to 0.17
4x8 or 8x4	0.18 to 0.22
Stand. 6x6	0.23 to 0.25
6x8 or 8x6	0.26 to 0.33
6x10 or 10x6	0.34 to 0.42
6x12 or 12x6	0.43 to 0.50

Environmental Site Design

Filterra System

Drainage Area: Filterra #4

Concept Design:

Contributing Drainage Area=	17820	ft^2	0.41	acres
Impervious Coverage =	13888	ft^2	0.32	acres
Percent Impervious (I)=	77.9349	%		
$R_v = 0.05 + 0.009(I) =$	0.75			

ESD_V Provided

$ESD_{V,Prov.} = (P_E \times R_V \times A) / 12 =$	1,116	CF
Pe Reqired (min.)=	1.00	in.
Filter Box Size Provided	6x12	

Available Filterra Box	Total contributing
4x6 or 6x4	Up to 0.17
4x8 or 8x4	0.18 to 0.22
Stand. 6x6	0.23 to 0.25
6x8 or 8x6	0.26 to 0.33
6x10 or 10x6	0.34 to 0.42
6x12 or 12x6	0.43 to 0.50

Environmental Site Design

Filterra System

Drainage Area: **Filterra #5**

Concept Design:

Contributing Drainage Area=	14443	ft^2	0.33	acres
Impervious Coverage =	11649	ft^2	0.27	acres
Percent Impervious (I)=	80.65499	%		
$R_v = 0.05 + 0.009(I) =$	0.78			

ESD_V Provided

$ESD_{V,Prov.} = (P_E \times R_V \times A) / 12 =$	934	CF
Pe Reqired (min.)=	1.00	in.
Filter Box Size Provided	6x12	

Available Filterra Box	Total contributing
4x6 or 6x4	Up to 0.17
4x8 or 8x4	0.18 to 0.22
Stand. 6x6	0.23 to 0.25
6x8 or 8x6	0.26 to 0.33
6x10 or 10x6	0.34 to 0.42
6x12 or 12x6	0.43 to 0.50

Environmental Site Design

Filterra System

Drainage Area: **Filterra #6**

Concept Design:

Contributing Drainage Area=	15643	ft^2	0.36	acres
Impervious Coverage =	11845	ft^2	0.27	acres
Percent Impervious (I)=	75.72077	%		
$R_v = 0.05 + 0.009(I) =$	0.73			

ESD_V Provided

$ESD_{V,Prov.} = (P_E \times R_V \times A) / 12 =$	954	CF
Pe Reqired (min.)=	1.00	in.
Filter Box Size Provided	6x12	

Available Filterra Box	Total contributing
4x6 or 6x4	Up to 0.17
4x8 or 8x4	0.18 to 0.22
Stand. 6x6	0.23 to 0.25
6x8 or 8x6	0.26 to 0.33
6x10 or 10x6	0.34 to 0.42
6x12 or 12x6	0.43 to 0.50

Environmental Site Design

Filterra System

Drainage Area: Filterra #7

Concept Design:

Contributing Drainage Area=	3214	ft^2	0.07	acres
Impervious Coverage =	1705	ft^2	0.04	acres
Percent Impervious (I)=	53.04916	%		
$R_v = 0.05 + 0.009(I) =$	0.53			

ESD_V Provided

$ESD_{V,Prov.} = (P_E \times R_V \times A) / 12 =$	141	CF
Pe Reqired (min.)=	1.00	in.
Filter Box Size Provided	6x12	

Available Filterra Box	Total contributing
4x6 or 6x4	Up to 0.17
4x8 or 8x4	0.18 to 0.22
Stand. 6x6	0.23 to 0.25
6x8 or 8x6	0.26 to 0.33
6x10 or 10x6	0.34 to 0.42
6x12 or 12x6	0.43 to 0.50

Environmental Site Design

Filterra System

Drainage Area: Filterra #8

Concept Design:

Contributing Drainage Area=	7413	ft^2	0.17	acres
Impervious Coverage =	6449	ft^2	0.15	acres
Percent Impervious (I)=	86.99582	%		
$R_v = 0.05 + 0.009(I) =$	0.83			

ESD_V Provided

$ESD_{V,Prov.} = (P_E \times R_V \times A) / 12 =$	515	CF
Pe Reqired (min.)=	1.00	in.
Filter Box Size Provided	6x12	

Available Filterra Box	Total contributing
4x6 or 6x4	Up to 0.17
4x8 or 8x4	0.18 to 0.22
Stand. 6x6	0.23 to 0.25
6x8 or 8x6	0.26 to 0.33
6x10 or 10x6	0.34 to 0.42
6x12 or 12x6	0.43 to 0.50

Template Developed by: Hala Flores, P.E.
Template Updated by: Ken Pensyl
pdate: 31-Dec-12

2662 Riva Road
Annapolis, MD 21401
Phone 410 222 4240 ext 3069

Arundel County Government
Department of Public Works
Bureau of Engineering
Watershed and Ecosystem Services and Restoration
Watershed Assessment and Planning

ANNE ARUNDEL COUNTY MARYLAND

Designer Engineer:	Bay Engineering, Inc (AMD)
Project Name:	Hayes Property
SPSC #/description:	

Input values shaded in Grey
Calculated values are noted with dotted pattern
Check parameters in bold

Checking the Channel Conveyance for the design flood

Design Return Period (Yr)	T	100	10	1
Time of Concentration in minutes (Before Development/Reference)	t_c	18.00		
Post development (No SPSC) Runoff Curve Number	RCN	82.00		
Pre development discharge (cfs)	Q_{pre}	6.6	3.0	0.0
Post development (No BMP) discharge (cfs)	Q_{post}	18.9	11.7	4.1
Total available length (ft)	L	62	**Cascade Design (maximum 5 ft drop per segment)**	
Elevation drop over length (ft)	delta E	10.0	Design Width (ft)	10.00
Total Cascade length for project (ft)	$L_{cascade}$	13.80	Design Depth (ft)	5.00
Cascade Slope (ft/ft)	$Slope_{cascade}$	0.50	Roughness	0.05
Water Quality slope (ft/ft)	Slope	0.08	A	33.33
Maximum Length of Riffle Channel/Weir (Not to exceed 8 ft)	L_{riffle}	8.0	θ	1.11
Number of riffle segments/boulder weirs for project	N_{riffle}	3	P	14.79
Number of pool segments for project	N_{pool}	3	R_h	2.25
Minimum required length of pool (ft)	L_{pool}	16	Design Velocity (ft/sec)	36.22
Enter a trial median cobble diameter (ft)	d_{50}	**1.25**	Conveyed Q (cfs)	1207.44
Minimum top width of SPSC riffle channel (ft)	W	30.0	**Cascade inadequate**	
Maximum depth of SPSC riffle channel 10H:1V cross-section (ft)	D	1.5	Minimum Pool Depth "Use 3 pools" following Cascade (ft)	25.10
h_t, Minimum required dead storage depth within the pools of the SPSC (ft)	h_t	1.7	**ok**	
Enter desired pool depth (Maximum 3 ft)	h_t	3.0		
Check Riffle Side Slope, Must be > 10H:1V		**10.0**	**subcritical/ok**	
Check the Froude Number to ensure subcritical flow conditions		1.0	**Entrenchment ok**	
Computed Roughness	n	0.07		
Riffle Cross Section Area (ft2), for parabola	A	30.00	**Pool Depth Adequate**	
Theta - Intermediate step for solving	θ	0.20		
Riffle Hydraulic Perimeter (ft), for parabola	P	30.20		
Riffle Hydraulic Radius (ft), using Chow 1959	R_h	0.99		
Calculated Flow for design parameters (cfs)	Q	165.73		
Check Riffle Velocity (ft/sec)	V	**5.52**	**Number of Pools (This is a preliminary estimate based on uniform length design... The Engineer may use varied pool and riffle length as permitted by the guidelines. Please check provided storage based on actual number of provided pools)**	3
			Provided cumulative pool depths (ft) =	**5.58**

Choose D50 Cobble size = 18 inches

Isbash curve for Stone Density = 165 lb/ft3

Cobble d50 size	Allowable Velocity (Supercritical)	Allowable Velocity (Subcritical)
[inches]	[ft/sec]	[ft/sec]
4	5.1	7.1
5	5.7	8.0
6	6.3	8.7
7	6.8	9.4
8	7.2	10.1
9	7.7	10.7
10	8.1	11.3
11	8.5	11.8
12	8.8	12.3
15	9.9	13.8
18	10.8	15.1

Adequate conveyance of design storm

Selected Cobble Size is Adequate for 100 year storm

Subcritical Flow is Predominant

Entrenchment Ok.

Cobble Gradation Table

D50 MEDIAN STONE SIZE (INCHES)	% OF MATERIAL SMALLER THAN TYPICAL STONE	TYPICAL STONE EQUIVALENT DIAMETER (INCHES)	TYPICAL STONE WEIGHT (POUNDS)
6	70 - 100 50 - 70 35 - 50 2 - 10	12 9 6 2	95< 35 13 0.4
9	70 - 100 50 - 70 35 - 50 2 - 10	18 12 9 3	190 95 38 1.3
12	70 - 100 50 - 70 35 - 50 2 - 10	24 18 12 4	445 275 95 3
18	100 50 - 70 35 - 50 2 - 10	30 24 18 6	1280 570 275 10
24	100 50 - 70 35 - 50 2 - 10	42 30 24 9	3600 1700 570 30

Checking Quantity Management

USDA 2006, n expressed in terms of d_{out} and d_{50} = 8 inches	n	0.05	**Run Solver**
The width at the entrance riffle	W_{in}	30.00	**Required Volume of Storage (Rational Hydrograph)**
The velocity at the entrance riffle is calculated using Manning formula calculator and Q_{pre} for the 1 year storm	V_{in}	5.16	
The depth at the entrance riffle is calculated using Manning formula calculator and Q_{pre} for the 1 year storm	D_{in}	1.20	
Enter Trial Value : The total pool depth needed to render the power equivalent to 100-year predevelopment/desired levels. This should be compared against the total provided pool depth for adequacy.	D_{out}	**3.42**	
This is the typical top width of the dead storage pool parabolic areas, 10:1 side slope	W_{out}	10	
The area is for a semi parabola	A_{out}	23	
Equivalent channel length (ft) required to satisfy the channel protection volume	L_{pool}	115	
Theta - Intermediate step for solving	θ	0.93	
Hydraulic Perimeter (ft), for semi parabola	P_{out}	13	
Hydraulic Radius, using Chow 1959	R_h	1.83	
Darcy Weisbach friction factor expressed in terms of L_{pool}, v_{out}, and d_{out}	f	0.58	
Solved using Solver equation: Bernoulli equation rewritten in terms of d_{out} as the only unknown and is set to equal zero. The spreadsheet solver function is used to balance the equation.		**7.38**	

	100 Yr	10 Yr	1 Yr
Required volume of storage (ft3)	24412	17739	10366
Volume provided in pools (ft3)	1116		
Volume provided in voids (ft3)	1953		
Provided volume of storage (Includes Infiltration and ESD Credit) (ft3)	**3069**		
Infiltration volume (ft3)			
Provided ESD volume (ft3)			

Run Solver
Run Solver
Run Solver

Checking Quality Management

(SPSC maybe used as a structural device beyond ESD to the MEP). SPSC maybe used as an ESD device if it meets the MDE ESD design and sizing criteria). This calculation section is only valid for calculating water quality credit for retrofit projects

Site Drainage Area (Acres)	A	3.65
Contributory Impervious Area (Acres)	I	2.42
Volumetric Runoff Coefficient	Rv	0.65
Water Quality Volume, ft3	WQv	8569
Average Sand filter bed depth (ft) - MDE recommended value (1.5 feet)	$d_{f\ (Average\ of\ Hsu\ and\ Kitsap)}$	3.0
Width of sand filter (ft)	W_{sand}	35
Length of sand filter, where slope < = 5% (ft)	L_{sand}	48
Area of sand filter provided (ft2)	$A_{f\ Provided}$	**1687**
Coefficient of permeability of filter media (ft/day)	k	3.50
Height of water above filter bed- pool depth (ft)	h_f	3.00
Design filter bed drain time (days), MDE recommended value (1.67 days)	t_f	1.67
Required filter bed area (ft2)	$A_{f\ Required}$	**489**

Water quality requirement is satisfied in SPSC

ESD Volume Check (Only for Retrofit projects and when SPSC is deemed appropriate for use as part of an ESD train)

Target RCN (Forested Condition)	55
PE (Use State Tables) inches	1.78
QE (inches)	1.15
ESD Volume (ft^3)	15,252
Af (ESD Required) ft^2	870
% of ESD Volume Provided	194%

TR-55 Current Data Description

--- Identification Data ---

User: AMD
Project: Hayes Property
SubTitle: Existing Conditions to Site Outfalls
State: Maryland
County: Anne Arundel
Filename: F:\10-3572 Hayes Property Annapolis\Computations\Ex Cond.w55

Date: 12/9/2014
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
A	Outfall #1	Outlet	0.98	74	0.31
B	Outfall #2	Outlet	2.09	72	0.30
C	Outfall #3	Outlet	3.05	82	0.31
D	Outfall #4	Outlet	1.82	72	0.57
E	Outfall #5	Outlet	3.84	85	0.43

Total area: 11.78 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.3	4.3	5.2	5.9	6.5	7.4	2.7

Storm Data Source: Anne Arundel County, MD (NRCS)
Rainfall Distribution Type: Type II
Dimensionless Unit Hydrograph: <standard>

Hayes Property
Existing Conditions to Site Outfalls
Anne Arundel County, Maryland

Watershed Peak Table

Sub-Area or Reach Identifier	Peak Flow by Rainfall Return Period 10-Yr (cfs)	100-Yr (cfs)	1-Yr (cfs)
SUBAREAS			
A	2.81	4.89	0.74
B	5.67	10.10	1.37
C	11.29	18.04	3.95
D	3.43	6.18	0.79
E	13.06	20.39	4.95
REACHES			
OUTLET	34.94	57.53	11.32

Hayes Property
Existing Conditions to Site Outfalls
Anne Arundel County, Maryland

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
A							
SHEET	100	0.0130					0.278
SHALLOW	197	0.0200	3.3				0.019
SHALLOW	118	0.0130	3.3				0.014
					Time of Concentration		0.31
B							
SHEET	100	0.0130					0.278
SHALLOW	250	0.0720	3.3				0.016
CHANNEL	160					5.000	0.009
					Time of Concentration		0.30
C							
SHEET	100	0.0200					0.234
SHALLOW	232	0.0250	3.3				0.025
SHALLOW	254	0.0100	3.3				0.035
CHANNEL	244					5.000	0.014
					Time of Concentration		0.31
D							
SHEET	100	0.0250					0.561
SHALLOW	244	0.1700	3.3				0.010
					Time of Concentration		0.57
E							
SHEET	100	0.0600					0.395
SHALLOW	297	0.1000	0.050				0.016
CHANNEL	263					5.000	0.015
					Time of Concentration		0.43

Hayes Property
Existing Conditions to Site Outfalls
Anne Arundel County, Maryland

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
A	Open space; grass cover > 75%	(good)	C	.56	74
	Paved parking lots, roofs, driveways		C	.05	98
	Woods	(good)	C	.37	70
	Total Area / Weighted Curve Number			.98	74
				===	==
B	Open space; grass cover > 75%	(good)	C	1.1	74
	Woods	(good)	C	.94	70
	Woods	(good)	D	.05	77
	Total Area / Weighted Curve Number			2.09	72
				====	==
C	Open space; grass cover > 75%	(good)	C	.66	74
	Residential districts (1/8 acre)		C	1.59	90
	Woods	(good)	C	.67	70
	Woods	(good)	D	.13	77
	Total Area / Weighted Curve Number			3.05	82
				====	==
D	Open space; grass cover > 75%	(good)	C	.05	74
	Residential districts (1/8 acre)		C	.03	90
	Woods	(good)	C	1.41	70
	Woods	(good)	D	.33	77
	Total Area / Weighted Curve Number			1.82	72
				====	==
E	Open space; grass cover > 75%	(good)	C	.01	74
	Residential districts (1/8 acre)		C	2.86	90
	Woods	(good)	C	.95	70
	Woods	(good)	D	.02	77
	Total Area / Weighted Curve Number			3.84	85
				====	==

TR-55 Current Data Description

--- Identification Data ---

User: AMD
Project: Hayes Property
SubTitle: Developed Conditions to Site Outfalls
State: Maryland
County: Anne Arundel
Filename: F:\10-3572 Hayes Property Annapolis\Computations\Prop Cond.w55

Date: 12/9/2014
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
DA A	Site Outfall #1	Outlet	0.14	93	0.10
DA B	Site Outfall #2	Outlet	3.98	88	0.48
DA C	Site Outfall #3	Outlet	2.28	85	0.37
DA D	Site Outfall #4	Outlet	1.55	73	0.25
DA E	Site Outfall #5	Outlet	3.83	85	0.43

Total area: 11.78 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.3	4.3	5.2	5.9	6.5	7.4	2.7

Storm Data Source: Anne Arundel County, MD (NRCS)
Rainfall Distribution Type: Type II
Dimensionless Unit Hydrograph: <standard>

Hayes Property
Developed Conditions to Site Outfalls
Anne Arundel County, Maryland

Watershed Peak Table

Sub-Area or Reach Identifier	Peak Flow by Rainfall Return Period 10-Yr (cfs)	100-Yr (cfs)	1-Yr (cfs)
SUBAREAS			
DA A	0.89	1.30	.00
DA B	13.69	20.85	5.61
DA C	8.38	13.04	3.19
DA D	4.68	8.22	1.20
DA E	13.02	20.32	4.93
REACHES			
OUTLET	38.61	60.36	14.61

Hayes Property
Developed Conditions to Site Outfalls
Anne Arundel County, Maryland

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
DA A							
SHALLOW	206	0.0160	3.3				0.022
					Time of Concentration		0.10
DA B							
SHEET	43	0.0100					0.412
SHALLOW	170	0.0100	3.3				0.023
CHANNEL	681					5.000	0.038
CHANNEL	190					5.000	0.011
					Time of Concentration		0.48
DA C							
SHEET	100	0.0100					0.309
SHALLOW	56	0.0100	3.3				0.010
SHALLOW	254	0.0100	3.3				0.035
CHANNEL	244					5.000	0.014
					Time of Concentration		0.37
DA D							
SHEET	100	0.2000					0.244
SHALLOW	140	0.2100	3.3				0.005
					Time of Concentration		0.25
DA E							
SHEET	100	0.0600					0.395
SHALLOW	297	0.1000	0.050				0.016
CHANNEL	263					5.000	0.015
					Time of Concentration		0.43

Hayes Property
Developed Conditions to Site Outfalls
Anne Arundel County, Maryland

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
DA A	Open space; grass cover > 75%	(good)	C	.03	74
	Paved parking lots, roofs, driveways		C	.11	98
	Total Area / Weighted Curve Number			.14	93
DA B	Open space; grass cover > 75%	(good)	C	.92	74
	Paved parking lots, roofs, driveways		C	2.39	98
	Woods	(good)	C	.62	70
	Woods	(good)	D	.05	77
	Total Area / Weighted Curve Number			3.98	88
DA C	Open space; grass cover > 75%	(good)	C	.04	74
	Residential districts (1/8 acre)		C	1.62	90
	Woods	(good)	C	.48	70
	Woods	(good)	D	.14	77
	Total Area / Weighted Curve Number			2.28	85
DA D	Open space; grass cover > 75%	(good)	C	.07	74
	Paved parking lots, roofs, driveways		C	.06	98
	Woods	(good)	C	1.09	70
	Woods	(good)	D	.33	77
	Total Area / Weighted Curve Number			1.55	73
DA E	Open space; grass cover > 75%	(good)	C	.01	74
	Residential districts (1/8 acre)		C	2.85	90
	Woods	(good)	C	.95	70
	Woods	(good)	D	.02	77
	Total Area / Weighted Curve Number			3.83	85

Section 3 – Additional Information

Appendix B – MDE Approval Letter for Filterra

MDE

MARYLAND DEPARTMENT OF THE ENVIRONMENT
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February 22, 2013

Mr. Chris French
Stormwater Regulatory Manager, Filterra® Bioretention Systems
11352 Virginia Precast Road
Ashland, VA 23005

Dear Mr. French:

Thank you for your letter to the Maryland Department of the Environment (MDE), Water Management Administration (WMA) regarding the Filterra® bioretention system. In your letter, you have asked WMA to reevaluate your product with respect to its use as a micro-bioretention system. You have also asked MDE to waive the requirement for storing 75% of the water quality volume (WQ_v) prior to filtering. Included with this submittal was a report, including computations and third-party studies that support your request.

As you may be aware, in Maryland, environmental site design (ESD) must be used to the maximum extent practicable (MEP) to reduce runoff and mimic natural hydrology. The use of ESD planning techniques and micro-scale practices must be exhausted before any approved structural practices may be used. Because it is an approved bioretention practice, MDE agrees that the Filterra® may also be considered the equivalent ESD practice, the micro-bioretention practice (see pages 5.96 to 5.103 of the *2000 Maryland Stormwater Design Manual, Volumes I and II*, or "the Manual"), provided certain conditions are applied.

These conditions are a maximum drainage area to each application; meeting a reduced holding requirement of 25% of the design volume, primarily for pretreatment and consistency with Maryland's design methods; and limiting the practice to water quality volume (WQ_v) treatment. Where the product (e.g., the Filterra® Boxless System) includes an infiltration component, the recharge volume (Re_v) may be addressed as well. Currently, Filterra® proposes a maximum drainage area of 20,000 square feet to a filter bed of 91 square feet (i.e., 7 ft. x 13 ft. unit). This filter bed size is significantly less than would normally be produced due to the practice's high permeability (*k*) factor and quick drawdown time.

Drainage areas to individual ESD practices are limited in size in order to mimic natural hydrology. Innovative practices like Filterra® are subject to the same drainage area limitations as the most comparable micro-scale practice found in Chapter 5. The sizing charts included in the submittal for your product show that the maximum recommended drainage area for the 7 ft. x 13 ft. unit is 20,000 square feet. This is also the maximum drainage area to any micro-

bioretention practice listed in Chapter 5 of the Manual (see p. 5.98). MDE sees no reason to alter this condition.

The analyses, computations, and third-party studies submitted in 2006 and with your recent letter support the high *k* factor used in Filterra®'s design. This *k* factor allows Filterra® to be considerably smaller than other filtering practices and may warrant a reduction in the volume of runoff that must be stored prior to filtering. However, the stormwater modeling submitted with your letter does not support a complete waiver of Maryland's volumetric sizing criterion. Flow-based calculations require estimating parameters like the time of concentration to each practice to determine storage requirements. These parameters are subject to a greater degree of statistical uncertainty and result in designs that do not provide adequate treatment. More complex design parameters do not necessarily translate into improved performance. In contrast, sizing stormwater practices using a volume-based requirement, which is more accurate, is a simpler and more effective approach. Therefore, the Filterra® system must capture and treat a percentage of the WQ_v. However, considering the Filterra® media's higher *k* factor, MDE will reduce the percentage of runoff that must be stored prior to filtering from 75% to 25% of the design volume (e.g., WQ_v).

In new development designs, Re_v must be distributed across a project as much as practical to mimic natural conditions. Some variants of the Filterra® system (the FocalPoint® or boxless system) address the recharge requirement while others (e.g., the standard Filterra® system) do not. Variants that do not provide recharge may be used as part of a systems approach provided that recharge requirements are addressed by the system.

To protect stream channels from erosion, ESD and structural practices must be used to capture, store, and gradually release the Cp_v over an extended interval (e.g., 24 to 36 hours) as determined by the methods found in Appendix D.11 of the Manual. Practices that release runoff over shorter periods of time may not be used for addressing the Cp_v requirement. According to the submitted report and computations, the Filterra® system has an estimated drawdown time between 15 to 18 minutes (0.25 to 0.30 hours). This is significantly less than that required to address Cp_v requirements. Therefore, the Filterra® system does not meet the Cp_v requirements and may not be used as a stand-alone ESD practice. However, practices that do not meet Cp_v requirements may be used provided they are part of a system of practices that captures, stores, and slowly releases the required volume of runoff at rates meeting the channel protection flow criteria.

In summary, MDE approves the Filterra® system as a filtering device that can be used for any redevelopment, retrofitting, or infill application provided it is accepted locally. Additionally, for new development applications, the Filterra® system is approved as an ESD practice for providing water quality treatment and, where the appropriate variant is used, groundwater recharge. This approval is conditioned on limiting the drainage area to 20,000 sq. ft. to a

standard 7 ft x 13 ft. unit; sizing the system to capture and store 25% of the design volume (e.g., WQ_v); and meeting applicable filtering design criteria in the Manual for feasibility, conveyance, and maintenance. Because it does not address Cp_v, the Filterra® may not be used as a stand-alone ESD practice. However, it may be used as part of a system of practices that, as a whole, addresses all of the ESD requirements.

We will remain open to entertaining any future design changes if sufficiently justified. For now, if you have any questions or would like to discuss this further, please call me at (410) 537-3554 or contact Mr. Stewart Comstock at (410) 537-3550 or scomstock@mde.state.md.us.

Sincerely,

Brian S. Clevenger
Program Manager
Sediment, Stormwater & Dam Safety Program