

LAKEFOREST GATEWAY

PRELIMINARY

STORMWATER MANAGEMENT REPORT

PHASE 1

VIKA #VM50089C
OCTOBER 2024

Prepared for: 417 DEVELOPMENT LLC
6000 Executive Boulevard
North Bethesda, MD 20852
Attn: Brian Lang

Prepared By: VIKA Maryland, LLC
20251 Century Boulevard, Suite 400
Germantown, MD 20874
Attn: Jason Evans, P.E. and
(301) 916 – 4100

CITY OF GAITHERSBURG	
DEPARTMENT OF PUBLIC WORKS	
STORMWATER MANAGEMENT	
APPLICATION NO.	<u>SWM-9620-2023</u>
CONCEPT PLAN	<input type="checkbox"/>
PRELIMINARY PLAN	<input checked="" type="checkbox"/>
APPROVAL DATE	<u>-</u>
BY	_____



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.
ENGINEER'S NAME: JASON A. EVANS, P.E.
LICENSE No.: 39885
EXPIRATION DATE: JANUARY 16, 2025

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INTRODUCTION

The project area, located within the City of Gaithersburg, is a redevelopment of the site to remove two (2) existing concrete buildings as well as surrounding surface parking lot within the property and construct mixed-use (commercial/Residential/Employment) redevelopment and infrastructure. The property is bounded to the north by Lakeforest Boulevard, to the south by an existing commercial development, to the east by Russell Avenue and to the west by Frederick Avenue. The existing land use is commercial buildings and parking lots.

Per the Natural Resources Inventory and site investigations, no rare, threatened, or endangered species were observed on the site. There are no historical elements associated with the property nor forests.

This Stormwater Management Plan has been prepared to comply with the requirements of the 2000 MDE SWM Manual, the July 2010 Environmental Site Design Process and Computations Supplement, and the October 2010 Environmental Site Design Redevelopment Examples. The existing phase of this site is approximately 85% impervious and therefore we will follow MDE guidelines for Redevelopments. In conformance with Redevelopment projects requirements, the proposed development will provide water quality management by treatment of 50% of the existing impervious area within the project limit of disturbance and also stormwater quantity management for any net increase in impervious areas, in accordance with new development criteria. Stormwater quality and quantity management for this project will be achieved through the construction of three (3) planter box micro-bioretenion units and seven (7) roadside bioretention facilities.



HYDROLOGY NARRATIVE

The current site, through storm drain structures and piping on the property, drains and discharges to the existing storm drain system, running along Lakeforest Boulevard and Russell Avenue.

According to the Montgomery County Soil Survey, the soil on the site is classified as 'D' type soils. The locations of the soil boundaries are shown on the NRCS Soil Survey map (refer to Appendix A). There are no wetlands or streams on the project site. The site contributes to Whetstone Run which eventually flows to Seneca Creek and the Potomac River.

The project will be completed in two phases and SWM requirements will be met in both phases.

The entire proposed disturbed area for this phase of the project is 4.95 acres which includes 3.64 acres of proposed impervious areas within the property boundary. The existing site currently has 3.51 acres of impervious cover and meets the redevelopment criteria (Existing Imperviousness $I > 40\%$). Per MDE and City of Gaithersburg regulations, for redevelopment projects, the site must reduce or treat the existing site impervious area by 50% and any increase must be treated as new development. Per this definition, the site is proposing to treat 50% (1.76 acres) of the existing impervious areas per the redevelopment criteria and capture, store, and treat 100% of the net impervious area increase of 0.13 acre (3.64ac-3.51ac) as new development. The treatment of 50% of the existing impervious area for water quality yields a requirement of 6,053 cf. Based on the imperviousness of the entire site under proposed conditions ($I=88\%$), Pe of 1.8" has been determined (See appendix B for target Pe calculations). The required ESD_v for the 0.13 acres of net increase in impervious areas, based on the $Pe=1.8"$, computes to an additional 816 cf for a total ESD_v requirement of 6869 cf for the entire site (See appendix B - Phase 2 ESD_v Summary). Based on this stormwater management plan, the proposed SWM facilities will provide full treatment of 7,511 cf of stormwater.



ENVIRONMENTAL SITE DESIGN MEASURES

Maryland Regulations attempt to preserve the predevelopment characteristics of a project site with environmental site design, ESD, to the maximum extent practicable (MEP). There are several factors to consider for the design and implementation of ESD facilities, including horizontal limitations of the site, location of existing utilities and structures, topography of the site, and existing easements. The development of 101 Lakeforest Boulevard property proposes the use of typical and planter box micro bio-retention units as ESD facilities.

Micro Bio-Retention

Structural micro-bioretenion facilities retain and treat stormwater runoff by filtering the runoff through sand, soil, and organic matter media, before releasing it into the adjacent storm drain system via a perforated underdrain pipe. Per Chapter 5 of the MDE Stormwater Design Manual, each facility shall not have more than 20,000 square feet of drainage and must treat the first inch of runoff at a minimum. Furthermore, large storm events will bypass into the storm drain system via a riser located within the footprint of the facility. The facilities, MBF #1, #2 and #3 as well as seven (7) roadside MBFs along promenade way (shown on plans) are proposed to be in conformance with Montgomery County DPS guidelines and details (See Appendix C). The final plumbing and roof drain layout to planter box MBFs will be provided during final engineering design. Proposed Grading of along promenade way conveys stormwater flow into the seven (7) roadside Micro-bioretenion facilities. See plans for drainage areas to each one of the MBFs. Computations for each one of the MBFs can be found in Appendix B.



Green Roof

Green roof was evaluated but due to the expected type of construction and mechanical requirements, we don't expect there will be a significant and contiguous space for it. Due to space constraints on the site, Micro-bioretenment facility #3 will be located in the courtyard. The remained of the courtyard areas have been identified on the plans and are expected to be utilized and programmed for amenity areas.

Permeable Pavements

Due the soil type 'D' in this area, permeable pavement is not feasible and therefor has not been proposed for this site.

Submerged Gravel Wetland

This practice is impractical due to the site conditions required for a wetland.



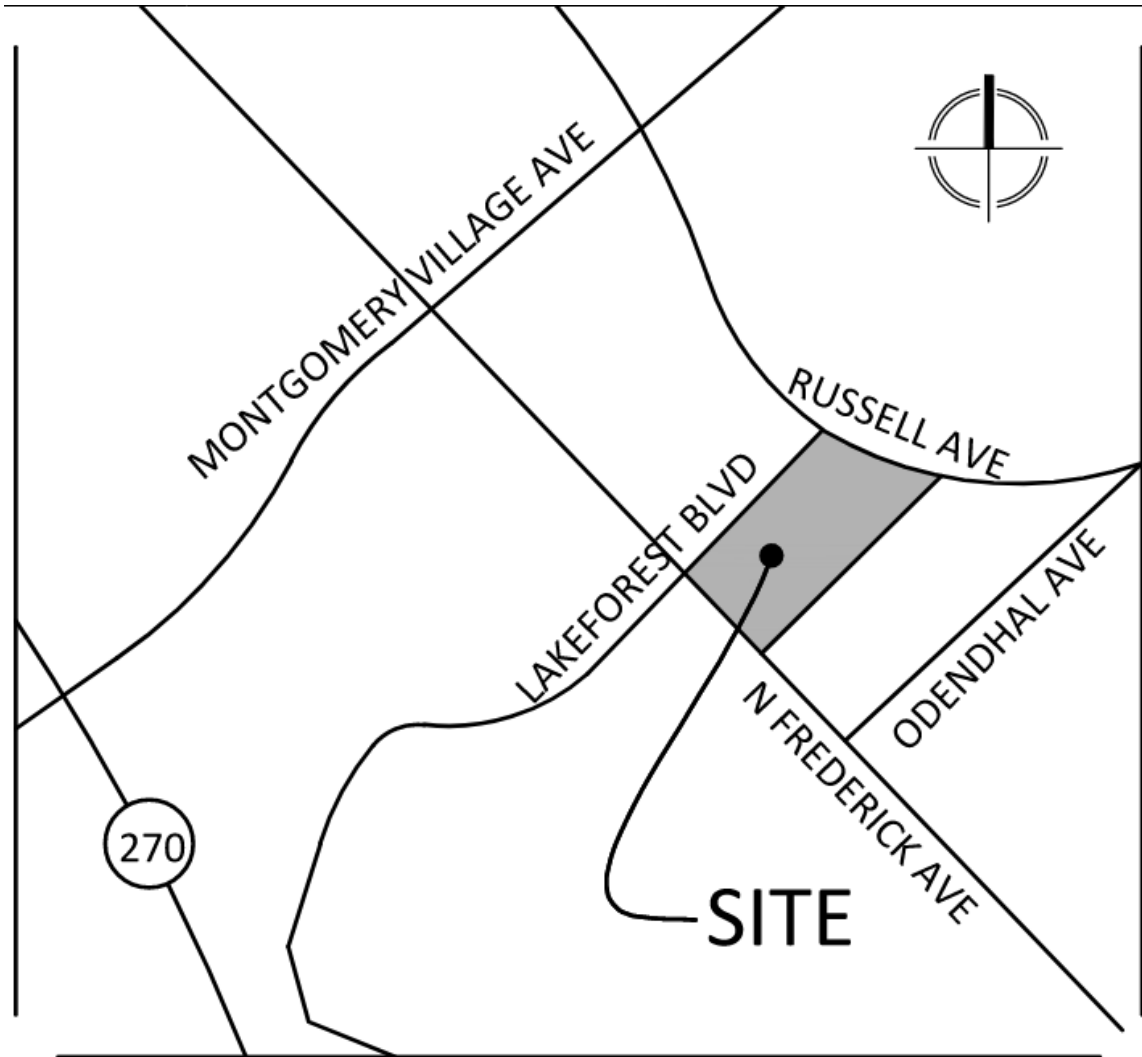
APPENDICES



APPENDIX A- MAPS



VICINITY MAP



VICINITY MAP

SCALE: 1" = 1000'



NRCS SOIL SURVEY MAP

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SOIL TYPE 400 - 'D' SOIL GROUP



APPENDIX B-COMPUTATIONS





Project Name:	Lakeforest Gateway	Computed By:	JAE
Project No.:	VM50089C	Checked By:	
Date:	July 9, 2024		

PHASE 1 PROJECT SITE INFORMATION SUMMARY

Total Site Area (LOD) - (PHASE 1)	215,689	sq. ft	4.95	acres
Development Area within property boundary (Study Area)	179,582	sq. ft	4.12	acres
Existing Impervious Area within Development Area	152,921	sq. ft	3.51	acres
Proposed Impervious Area within Development Area	158,644	sq. ft	3.64	acres
50% Existing Impervious Area	76,461	sq. ft	1.76	acres

Project Name: Lakforest Gateway **Computed:** JAE
Project No.: VM50089C **Checked:**

EXISTING SITE - IMPERVIOUS COMPUTATION

Total Area	179,582	sq. ft	4.12	acres	<div style="border: 1px solid black; padding: 2px; display: inline-block;">INPUT</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">OUTPUT</div>
Impervious Area	152,921	sq. ft	3.51	acres	
Green Area	26,661	sq. ft	0.61	acres	
I (percent impervious cover) 85 percent * Site is Considered Redevelopment					

PROPOSED SITE - IMPERVIOUS COMPUTATION

Total Area	179,582	sq. ft	4.12	acres
Impervious Area	158,644	sq. ft	3.64	acres
Green Area	20,938	sq. ft	0.48	acres

ESDv Sizing Criteria Per MD SWM Design Manual Chapter 5, Section 5.2:

I (percent impervious cover) 88 percent
Required Rainfall Target (P_E) Information
 Required P_E per ESDv Criteria ("D" Soils) = 1.80 inches

		Hydrologic Soil Group D								
%I	RCN*	P _E = 1"	1.2"	1.4"	1.6"	1.8"	2.0"	2.2"	2.4"	2.6"
0%	80									
5%	81									
10%	82									
15%	83									
20%	84	77								
25%	85	78								
30%	85	78	77	77						
35%	86	79	78	78						
40%	87	82	81	79	77					
45%	88	82	81	79	78					
50%	89	83	82	80	78					
55%	90	84	82	80	78					
60%	91	85	83	81	78					
65%	92	85	83	81	78					
70%	93	86	84	81	78					
75%	94	86	84	81	78					
80%	94	86	84	82	79					
85%	95	86	84	82	79					
90%	96	87	84	82	79	77				
95%	97	88	85	82	80	78				
100%	98	89	86	83	80	78	77			

Cp, Addressed (RCN = Woods in Good Condition)
 RCN Applied to Cp, Calculations



Project Name:	Lakeforest Gateway	Computed By:	AD
Project No.:	VM50089C	Checked By:	JRS
Date:	July 7, 2023		

REQUIRED STORMWATER MANAGEMENT VOLUMES - PHASE 1 DEVELOPMENT

EXISTING SITE IMPERVIOUS TREATMENT

Existing Impervious Area	152,921	sq. ft	3.51	acres	INPUT
50% Impervious Area	76,461	sq. ft	1.76	acres	OUTPUT

ESDv Sizing Criteria Per MD SWM Design Manual Chapter 5, Section 5.2:

I (percent impervious cover)	100	percent	Soil Hydrologic Group:	D
$R_v = (0.05 + (0.009 * I))$	0.9500			

Rainfall Target (P_E) Determination per Table 5.2, MDE SWM Manual

WQv Criteria =	1.00	inches		
$WQv = (P_E * R_v * A) / 12$	0.13896	acre-ft	Section 5.5.2 of MD SWM Design Manual (Page 5.18)	
cubic-feet = $WQv * 43560 \text{ ft}^2/\text{acre}$	6,053	cubic feet		

NEW SITE IMPERVIOUS TREATMENT

Total Phase 1 Development site	179,582		4.12	acres
Proposed Impervious Area	158,644	sq. ft	3.64	acres
Increased Impervious Area	5,723	sq. ft	0.13	acres

ESDv Sizing Criteria Per MD SWM Design Manual Chapter 5, Section 5.2:

I (percent impervious cover)	100	percent	Soil Hydrologic Group:	D
$R_v = (0.05 + (0.009 * I))$	0.9500			

Rainfall Target (P_E) Determination per Table 5.2, MDE SWM Manual

ESDv Criteria =	1.80	inches	Table 5.3 of MD SWM Design Manual (Page 5.22)	
$ESDv = (P_E * R_v * A) / 12$	0.51898	acre-ft	Section 5.5.2 of MD SWM Design Manual (Page 5.18)	
cubic-feet = $WQv * 43560 \text{ ft}^2/\text{acre}$	816	cubic feet (Full ESDv for new Impervious)		

ESDv SUMMARY - Redevelopment

Total Required ESDv:	6,869	cf
Total ESDv Provided:	7,516	cf

PHASE 1 ESD COMPUTATIONS





Project Name:	Lakeforest Gateway	Computed By:	AD
Project No.:	VM50089C	Checked By:	JRS
Date:	July 7, 2023		

MICRO BIO-RETENTION #1 (MBF #1)

Total Area	6,400	sq. ft	0.15	acres	INPUT
Impervious Area	6,400	sq. ft	0.15	acres	
Green Area	0	sq. ft	0.00	acres	OUTPUT

ESDv Sizing Criteria Per MD SWM Design Manual Chapter 5, Section 5.2:

I (percent impervious cover)	100	percent	
$R_v = (0.05 + (0.009 * I))$	0.95		

Required Rainfall Target (P_E) Information

Required P _E per ESDv Criteria =	1.00	inches	
$ESD_v = (P_E * R_v * A) / 12$	0.01188	acre-ft	Section 5.2.2 of MD SWM Design Manual (Page 5.18)
ESDv required=	517	cubic feet	

Maximum Amount of Runoff that can be captured by facility(VOL_{MAX}):

$VOL_{MAX} = (2.6 * R_v * A) / 12$	1345	cubic feet	Section 5.2.2 of MD SWM Design Manual (Page 5.18)
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	450	cubic-feet	of Volume Provided Above Filter
$V_{BF} = V.R. * D_{BF} * A_{BF} =$	810	cubic-feet	of Volume Provided Below Filter

Where V_{BF} is the volume within the Bio-Filter; V.R. is the void ratio; D_{BF} is the filter depth; A_{BF} is the filter footprint area

D _{BF} =	4.5	feet	
	1260	Total Storage Provided by Bio-Filter	

Total provided P _E per ESDv Criteria =	2.4	inches
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Storage above the surface of the biofilter and Footprint Size

ELEV	AREA	AREA	H	VOL	TOT VOL	TOT VOL	TOT VOL
FT	SQ FT	SQ FT	FT	CU FT	CU FT	AC-FT	CU YD
0.00	450						
		450.0	1.00				
1.00	450			450	450.00	0.01033	16.7

Underdrain Pipe Design Criteria:

Provide a minimum amount of underdrain (in linear feet) equal to or greater than 5% of footprint size. If two or more lines of underdrain, underdrain shall be a minimum of 5 feet apart measured from centerline of each.

Required Linear Feet	23	
Provided Linear Feet	23	

Surface Area Design Criteria

The surface area of micro-bioretenion practices shall be at least 2% of the contributing drainage area.

Required Biofilter Footprint	128	
Provided Biofilter Footprint	450	



Project Name:	Lakeforest Gateway	Computed By:	AD
Project No.:	VM50089C	Checked By:	JRS
Date:	July 7, 2023		

MICRO BIO-RETENTION #2 (MBF #2)

Total Area	16,000	sq. ft	0.37	acres	INPUT
Impervious Area	16,000	sq. ft	0.37	acres	
Green Area	0	sq. ft	0.00	acres	OUTPUT

ESDv Sizing Criteria Per MD SWM Design Manual Chapter 5, Section 5.2:

I (percent impervious cover) = 100 percent

$R_v = (0.05 + (0.009 * I))$ = 0.95

Required Rainfall Target (P_E) Information

Required P_E per ESDv Criteria = 1.00 inches

$ESDv = (P_E * R_v * A) / 12$ = 0.02929 acre-ft Section 5.2.2 of MD SWM Design Manual (Page 5.18)

ESDv required= 1276 cubic feet

Maximum Amount of Runoff that can be captured by facility(VOL_{MAX}):

$VOL_{MAX} = (2.6 * R_v * A) / 12$ = 3317 cubic feet Section 5.2.2 of MD SWM Design Manual (Page 5.18)

$V_{BF} = V.R. * D_{BF} * A_{BF} =$

1110 cubic-feet of Volume Provided Above Filter

1998 cubic-feet of Volume Provided Below Filter

Where V_{BF} is the volume within the Bio-Filter; V.R. is the void ratio; D_{BF} is the filter depth; A_{BF} is the filter footprint area

$D_{BF} = 4.5$ feet

3108 Total Storage Provided by Bio-Filter

Total provided P_E per ESDv Criteria = 2.44 inches

Storage above the surface of the biofilter and Footprint Size

ELEV	AREA	AREA	H	VOL	TOT VOL	TOT VOL	TOT VOL
FT	SQ FT	SQ FT	FT	CU FT	CU FT	AC-FT	CU YD
0.00	1,110						
		1110.0	1.00				
1.00	1,110			1110	1110.00	0.02548	41.1

Underdrain Pipe Design Criteria:

Provide a minimum amount of underdrain (in linear feet) equal to or greater than 5% of footprint size. If two or more lines of underdrain, underdrain shall be a minimum of 5 feet apart measured from centerline of each.

Required Linear Feet = 56

Provided Linear Feet = 10

10

Surface Area Design Criteria

The surface area of micro-bioretenion practices shall be at least 2% of the contributing drainage area.

Required Biofilter Footprint = 320

Provided Biofilter Footprint = 1,110



Project Name:	Lakeforest Gateway	Computed By:	AD
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Date:	July 7, 2023		

MICRO BIO-RETENTION #3 (MBF #3)

Total Area	8,000	sq. ft	0.18	acres	INPUT
Impervious Area	8,000	sq. ft	0.18	acres	
Green Area	0	sq. ft	0.00	acres	OUTPUT

ESDv Sizing Criteria Per MD SWM Design Manual Chapter 5, Section 5.2:

I (percent impervious cover) = 100 percent

$R_v = (0.05 + (0.009 * I))$ = 0.95

Required Rainfall Target (P_E) Information

Required P_E per ESDv Criteria = 1.00 inches

$ESDv = (P_E * R_v * A) / 12$ = 0.01425 acre-ft Section 5.2.2 of MD SWM Design Manual (Page 5.18)

ESDv required= 621 cubic feet

Maximum Amount of Runoff that can be captured by facility(VOL_{MAX}):

$VOL_{MAX} = (2.6 * R_v * A) / 12$ = 1614 cubic feet Section 5.2.2 of MD SWM Design Manual (Page 5.18)

$V_{BF} = V.R. * D_{BF} * A_{BF} =$

742 cubic-feet of Volume Provided Above Filter

742 cubic-feet of Volume Provided Below Filter

Where V_{BF} is the volume within the Bio-Filter; V.R. is the void ratio; D_{BF} is the filter depth; A_{BF} is the filter footprint area

D_{BF} = 2.5 feet

1484 Total Storage Provided by Bio-Filter

Total provided P_E per ESDv Criteria = 2.39 inches

Storage above the surface of the biofilter and Footprint Size

ELEV	AREA	AREA	H	VOL	TOT VOL	TOT VOL	TOT VOL
FT	SQ FT	SQ FT	FT	CU FT	CU FT	AC-FT	CU YD
0.00	742						
		742.0	1.00				
1.00	742			742	742.00	0.01703	27.5

Underdrain Pipe Design Criteria:

Provide a minimum amount of underdrain (in linear feet) equal to or greater than 5% of footprint size. If two or more lines of underdrain, underdrain shall be a minimum of 5 feet apart measured from centerline of each.

Required Linear Feet = 37

Provided Linear Feet = 10

10

Surface Area Design Criteria

The surface area of micro-bioretenion practices shall be at least 2% of the contributing drainage area.

Required Biofilter Footprint = 160

Provided Biofilter Footprint = 742



Project Name:	Lakeforest Gateway	Computed By:	AD
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MICRO BIO-RETENTION #4 (Single Roadside)

Total Area	1,311	sq. ft	0.03	acres	INPUT
Impervious Area	1,134	sq. ft	0.03	acres	
Green Area	177	sq. ft	0.00	acres	OUTPUT

ESDv Sizing Criteria Per MD SWM Design Manual Chapter 5, Section 5.2:

I (percent impervious cover) = 86 percent

$R_v = (0.05 + (0.009 * I))$ = 0.82

Required Rainfall Target (P_E) Information

Required P_E per ESDv Criteria = 1.00 inches

$ESDv = (P_E * R_v * A) / 12$ = 0.00206 acre-ft Section 5.2.2 of MD SWM Design Manual (Page 5.18)

ESDv required= 90 cubic feet

Maximum Amount of Runoff that can be captured by facility(VOL_{MAX}):

$VOL_{MAX} = (2.6 * R_v * A) / 12$ = 233 cubic feet Section 5.2.2 of MD SWM Design Manual (Page 5.18)

$V_{BF} = V.R. * D_{BF} * A_{BF} =$

87 cubic-feet of Volume Provided Above Filter

156.6 cubic-feet of Volume Provided Below Filter

Where V_{BF} is the volume within the Bio-Filter; V.R. is the void ratio; D_{BF} is the filter depth; A_{BF} is the filter footprint area

D_{BF} = 4.5 feet

233 Total Storage Provided by Bio-Filter

Total provided P_E per ESDv Criteria = 2.6 inches

Storage above the surface of the biofilter and Footprint Size

ELEV	AREA	AREA	H	VOL	TOT VOL	TOT VOL	TOT VOL
FT	SQ FT	SQ FT	FT	CU FT	CU FT	AC-FT	CU YD
0.00	87						
		87.0	1.00				
1.00	87			87	87.00	0.00200	3.2

Number of Roadside Bios 7

MBF Areas 609 SQ FT

Total SWM Provided 1631 CU FT

Total DA 9177 SQ FT

Total imp. DA 7938 SQ FT

7938



Project Name:	Lakeforest Gateway	Computed By:	AD
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MICRO BIO-RETENTION #5 (Single Roadside)

Total Area	1,332	sq. ft	0.03	acres	INPUT
Impervious Area	1,155	sq. ft	0.03	acres	
Green Area	177	sq. ft	0.00	acres	OUTPUT

ESDv Sizing Criteria Per MD SWM Design Manual Chapter 5, Section 5.2:

I (percent impervious cover)	87	percent
$R_v = (0.05 + (0.009 * I))$	0.83	
Required Rainfall Target (P_E) Information		
Required P_E per ESDv Criteria =	1.00	inches
$ESDv = (P_E * R_v * A) / 12$	0.00208	acre-ft Section 5.2.2 of MD SWM Design Manual (Page 5.18)
ESDv required=	91	cubic feet

Maximum Amount of Runoff that can be captured by facility(VOL_{MAX}):

$VOL_{MAX} = (2.6 * R_v * A) / 12$	236	cubic feet Section 5.2.2 of MD SWM Design Manual (Page 5.18)
$V_{BF} = V.R. * D_{BF} * A_{BF} =$	87	cubic-feet of Volume Provided Above Filter
	156.6	cubic-feet of Volume Provided Below Filter
Where V_{BF} is the volume within the Bio-Filter; V.R. is the void ratio; D_{BF} is the filter depth; A_{BF} is the filter footprint area		
$D_{BF} =$	4.5	feet
	236	Total Storage Provided by Bio-Filter
Total provided P_E per ESDv Criteria =	2.6	inches

Storage above the surface of the biofilter and Footprint Size

ELEV	AREA	AREA	H	VOL	TOT VOL	TOT VOL	TOT VOL
FT	SQ FT	SQ FT	FT	CU FT	CU FT	AC-FT	CU YD
0.00	87						
		87.0	1.00				
1.00	87			87	87.00	0.00200	3.2

Number of Roadside Bios	7
MBF Areas	609 SQ FT
Total SWM Provided	1652 CU FT
Total DA	9324 SQ FT
Total imp. DA	8085 SQ FT
	8085



Project Name:	Lakeforest Gateway	Computed By:	AD
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Date:	July 7, 2023		

MICRO BIO-RETENTION #6 (Single Roadside)

Total Area	1,326	sq. ft	0.03	acres	INPUT
Impervious Area	1,149	sq. ft	0.03	acres	
Green Area	177	sq. ft	0.00	acres	OUTPUT

ESDv Sizing Criteria Per MD SWM Design Manual Chapter 5, Section 5.2:

I (percent impervious cover)	87	percent
$R_v = (0.05 + (0.009 * I))$	0.83	
Required Rainfall Target (P_E) Information		
Required P _E per ESDv Criteria =	1.00	inches
$ESDv = (P_E * R_v * A) / 12$	0.00208	acre-ft Section 5.2.2 of MD SWM Design Manual (Page 5.18)
ESDv required=	91	cubic feet

Maximum Amount of Runoff that can be captured by facility(VOL_{MAX}):

$VOL_{MAX} = (2.6 * R_v * A) / 12$	236	cubic feet Section 5.2.2 of MD SWM Design Manual (Page 5.18)
	87	cubic-feet of Volume Provided Above Filter
$V_{BF} = V.R. * D_{BF} * A_{BF} =$	156.6	cubic-feet of Volume Provided Below Filter
Where V _{BF} is the volume within the Bio-Filter; V.R. is the void ratio; D _{BF} is the filter depth; A _{BF} is the filter footprint area		
D _{BF} =	4.5	feet
	236	Total Storage Provided by Bio-Filter
Total provided P_E per ESDv Criteria =	2.6	inches

Storage above the surface of the biofilter and Footprint Size

ELEV	AREA	AREA	H	VOL	TOT VOL	TOT VOL	TOT VOL
FT	SQ FT	SQ FT	FT	CU FT	CU FT	AC-FT	CU YD
0.00	87						
		87.0	1.00				
1.00	87			87	87.00	0.00200	3.2

Number of Roadside Bios 7
 MBF Areas 609 SQ FT
 Total SWM Provided 1652 CU FT
 Total DA 9282 SQ FT
 Total imp. DA 8043 SQ FT
 8043



Project Name:	Lakeforest Gateway	Computed By:	AD
Project No.:	VM50089C	Checked By:	JRS
Date:	July 7, 2023		

MICRO BIO-RETENTION #7 (Single Roadside)

Total Area	1,333	sq. ft	0.03	acres	INPUT
Impervious Area	1,156	sq. ft	0.03	acres	
Green Area	177	sq. ft	0.00	acres	OUTPUT

ESDv Sizing Criteria Per MD SWM Design Manual Chapter 5, Section 5.2:

I (percent impervious cover)	87	percent
$R_v = (0.05 + (0.009 * I))$	0.83	
Required Rainfall Target (P_E) Information		
Required P_E per ESDv Criteria =	1.00	inches
$ESDv = (P_E * R_v * A) / 12$	0.00208	acre-ft Section 5.2.2 of MD SWM Design Manual (Page 5.18)
ESDv required=	91	cubic feet

Maximum Amount of Runoff that can be captured by facility(VOL_{MAX}):

$VOL_{MAX} = (2.6 * R_v * A) / 12$	236	cubic feet Section 5.2.2 of MD SWM Design Manual (Page 5.18)
$V_{BF} = V.R. * D_{BF} * A_{BF} =$	87	cubic-feet of Volume Provided Above Filter
	156.6	cubic-feet of Volume Provided Below Filter
Where V_{BF} is the volume within the Bio-Filter; V.R. is the void ratio; D_{BF} is the filter depth; A_{BF} is the filter footprint area		
$D_{BF} =$	4.5	feet
	236	Total Storage Provided by Bio-Filter
Total provided P_E per ESDv Criteria =	2.6	inches

Storage above the surface of the biofilter and Footprint Size

ELEV	AREA	AREA	H	VOL	TOT VOL	TOT VOL	TOT VOL
FT	SQ FT	SQ FT	FT	CU FT	CU FT	AC-FT	CU YD
0.00	87						
		87.0	1.00				
1.00	87			87	87.00	0.00200	3.2

Number of Roadside Bios	7
MBF Areas	609 SQ FT
Total SWM Provided	1652 CU FT
Total DA	9331 SQ FT
Total imp. DA	8092 SQ FT
	8092



Project Name:	Lakeforest Gateway	Computed By:	AD
Project No.:	VM50089C	Checked By:	JRS
Date:	July 7, 2023		

MICRO BIO-RETENTION #8 (Single Roadside)

Total Area	1,360	sq. ft	0.03	acres	INPUT
Impervious Area	1,183	sq. ft	0.03	acres	
Green Area	177	sq. ft	0.00	acres	OUTPUT

ESDv Sizing Criteria Per MD SWM Design Manual Chapter 5, Section 5.2:

I (percent impervious cover) = 87 percent

$R_v = (0.05 + (0.009 * I))$ = 0.83

Required Rainfall Target (P_E) Information

Required P_E per ESDv Criteria = 1.00 inches

$ESDv = (P_E * R_v * A) / 12$ = 0.00208 acre-ft Section 5.2.2 of MD SWM Design Manual (Page 5.18)

ESDv required = 91 cubic feet

Maximum Amount of Runoff that can be captured by facility (VOL_{MAX}):

$VOL_{MAX} = (2.6 * R_v * A) / 12$ = 236 cubic feet Section 5.2.2 of MD SWM Design Manual (Page 5.18)

$V_{BF} = V.R. * D_{BF} * A_{BF} =$

87 cubic-feet of Volume Provided Above Filter

156.6 cubic-feet of Volume Provided Below Filter

Where V_{BF} is the volume within the Bio-Filter; V.R. is the void ratio; D_{BF} is the filter depth; A_{BF} is the filter footprint area

$D_{BF} = 4.5$ feet

236 Total Storage Provided by Bio-Filter

Total provided P_E per ESDv Criteria = 2.6 inches

Storage above the surface of the biofilter and Footprint Size

ELEV	AREA	AREA	H	VOL	TOT VOL	TOT VOL	TOT VOL
FT	SQ FT	SQ FT	FT	CU FT	CU FT	AC-FT	CU YD
0.00	87						
		87.0	1.00				
1.00	87			87	87.00	0.00200	3.2

Number of Roadside Bios 7

MBF Areas 609 SQ FT

Total SWM Provided 1652 CU FT

Total DA 9520 SQ FT

Total imp. DA 8281 SQ FT

8281



Project Name:	Lakeforest Gateway	Computed By:	AD
Project No.:	VM50089C	Checked By:	JRS
Date:	July 7, 2023		

MICRO BIO-RETENTION #9 (Single Roadside)

Total Area	2,017	sq. ft	0.05	acres	INPUT
Impervious Area	1,197	sq. ft	0.03	acres	
Green Area	820	sq. ft	0.02	acres	OUTPUT

ESDv Sizing Criteria Per MD SWM Design Manual Chapter 5, Section 5.2:

I (percent impervious cover)	59	percent
$R_v = (0.05 + (0.009 * I))$	0.58	
Required Rainfall Target (P_E) Information		
Required P_E per ESDv Criteria =	1.00	inches
$ESDv = (P_E * R_v * A) / 12$	0.00242	acre-ft Section 5.2.2 of MD SWM Design Manual (Page 5.18)
ESDv required=	105	cubic feet

Maximum Amount of Runoff that can be captured by facility(VOL_{MAX}):

$VOL_{MAX} = (2.6 * R_v * A) / 12$	274	cubic feet Section 5.2.2 of MD SWM Design Manual (Page 5.18)
$V_{BF} = V.R. * D_{BF} * A_{BF} =$	87	cubic-feet of Volume Provided Above Filter
	156.6	cubic-feet of Volume Provided Below Filter
Where V_{BF} is the volume within the Bio-Filter; V.R. is the void ratio; D_{BF} is the filter depth; A_{BF} is the filter footprint area		
$D_{BF} =$	4.5	feet
	244	Total Storage Provided by Bio-Filter

Total provided P_E per ESDv Criteria = 2.3 inches

Storage above the surface of the biofilter and Footprint Size

ELEV	AREA	AREA	H	VOL	TOT VOL	TOT VOL	TOT VOL
FT	SQ FT	SQ FT	FT	CU FT	CU FT	AC-FT	CU YD
0.00	87						
		87.0	1.00				
1.00	87			87	87.00	0.00200	3.2

Number of Roadside Bios 7
 MBF Areas 609 SQ FT
 Total SWM Provided 1705.2 CU FT
 Total DA 14119 SQ FT
 Total imp. DA 8379 SQ FT
 8379



Project Name:	Lakeforest Gateway	Computed By:	AD
Project No.:	VM50089C	Checked By:	JRS
Date:	July 7, 2023		

MICRO BIO-RETENTION #10 (Single Roadside)

Total Area	2,251	sq. ft	0.05	acres	INPUT
Impervious Area	1,720	sq. ft	0.04	acres	
Green Area	531	sq. ft	0.01	acres	OUTPUT

ESDv Sizing Criteria Per MD SWM Design Manual Chapter 5, Section 5.2:

I (percent impervious cover)	76	percent
$R_v = (0.05 + (0.009 * I))$	0.73	
Required Rainfall Target (P_E) Information		
Required P_E per ESDv Criteria =	1.00	inches
$ESDv = (P_E * R_v * A) / 12$	0.00306	acre-ft Section 5.2.2 of MD SWM Design Manual (Page 5.18)
ESDv required=	133	cubic feet

Maximum Amount of Runoff that can be captured by facility(VOL_{MAX}):

$VOL_{MAX} = (2.6 * R_v * A) / 12$	346	cubic feet Section 5.2.2 of MD SWM Design Manual (Page 5.18)
$V_{BF} = V.R. * D_{BF} * A_{BF} =$	87	cubic-feet of Volume Provided Above Filter
	156.6	cubic-feet of Volume Provided Below Filter
Where V_{BF} is the volume within the Bio-Filter; V.R. is the void ratio; D_{BF} is the filter depth; A_{BF} is the filter footprint area		
$D_{BF} =$	4.5	feet
	244	Total Storage Provided by Bio-Filter

Total provided P_E per ESDv Criteria = 1.8 inches

Storage above the surface of the biofilter and Footprint Size

ELEV	AREA	AREA	H	VOL	TOT VOL	TOT VOL	TOT VOL
FT	SQ FT	SQ FT	FT	CU FT	CU FT	AC-FT	CU YD
0.00	87						
		87.0	1.00				
1.00	87			87	87.00	0.00200	3.2

Number of Roadside Bios	7
MBF Areas	609 SQ FT
Total SWM Provided	1705.2 CU FT
Total DA	15757 SQ FT
Total imp. DA	12040 SQ FT
	12040