CALVERT COUNTY

STORMWATER MANAGEMENT
&
POLLUTANT REMOVAL REQUIREMENT
(10% RULE)

COMPUTATIONS

FOR

ROD & REEL INC. PROPERTIES

J-B03021-5006

Revised pages 1,2,3,5 & 6 TM 10/28/2020.

Prepared by: Tekle Moges, P.E.
February, 2016

"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. 33846, Expiration Date: 12/24/2019."

11721 WOODMORE ROAD, SUITE 200
MITCHELLVILLE, MARYLAND 20721
BEN DYER ASSOCIATES, INC.
Engineers / Surveyors / Planners
TELEPHONE (301) 430-2000

Revision: Revised Limit of Construction to remove the Rod 'N' Reel Restaurant TM 8/25/17

TM 5/15/17

STATE OF MARYLAND
TEKLEGIORGIS MOGES
33846
PROFESSIONAL ENGINEER

TM 03/26/18.

02/22/16

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Project Summary

The project site is located on the north side of Mears Ave and east side of Bayside Road Chesapeake Beach, MD. The site is approximately 0.35 miles south of the Chesapeake Beach Road and Bayside Road intersection. The site is zoned commercial and is currently developed.

The existing site has a paved parking lot with commercial buildings. The majority of soil type within the site limits is "Ub" which is an HSG D soil. The project proposes to construct a 4 level parking structure, an asphalt parking lot, demolish partially existing buildings and expand existing buildings.

The site is located within 1,000 feet from the head of tide of Chesapeake Bay shoreline: therefore, the site is located in the critical area. This project must reduce stormwater pollutant loads from the development site to a level at least 10% below the load generated by same site prior to development. It is known as Critical Area 10% Rule Compliance.

The total site area is 5.29 acres and the area of the limit of construction (LOC) is 4.59 acres. The existing impervious area within the LOC is 4.42 acres and the proposed impervious area within the LOC is 4.04 acres. The impervious area between the proposed and existing condition within the limit of construction will decrease by 0.38 ac. Current state regulations require that an impervious area shall be reduced and/or water quality treatment provided for 50% of the existing impervious area and the increased impervious area must be treated for water quality and quantity via Environmental Site Design (ESD). ESD is not required because the project will not increase an impervious area. Therefore, 1.83 ac. which is 50% of the existing impervious area minus the reduction in impervious area of 0.38 ac. must be treated for water quality. This project will be treated as a re-development project, because the total site impervious area under existing condition exceeds 40%.

In order to meet the water quality requirements of the site, this project will provide micro bio-retention and planter box facilities on the south and north side of the proposed parking structure. During a storm event, runoff temporarily ponds 6" above the mulch layer and is stored the water quality control volume (WQv) to remove pollutants in the micro-bioretention facilities. The treated runoff is returned to conveyance system through a 6" underdrain pipe.

The storm drain system is designed to convey the peak 10 year storm event.

SWM COMPUTATIONS

ROD & REEL INC. PROPERTIES

Site Area = 5.29 Acres

Limit of Construction = 4.59 Acres

Existing Impervious Area = 4.42 Acres

Proposed Impervious Area = 4.04 Acres

Reduction in Impervious Area = 0.38 Acres

- Redevelopment

Area to be treated:

- 50% of the existing impervious area = 4.42 X 0.5 = 2.21 Acres
- Reduction in impervious area = 4.42 – 4.04= 0.38 Acres

Area to be treated = 2.21 – 0.38 = 1.83 Acres

- Required Water Quality Volume

$$= \frac{1" \times 0.95 \times 1.83}{12} \qquad Rv = 0.95$$

= 0.1449 Ac-Ft

= 6,311 CF

- Required surface area of the ESD Facilities (Bio-Retention Planter Boxes)
  - Each facility will have a 0.5' surface ponding depth and 2.5' bio soil media

6,311 = 0.5 (Surface Area) + (Surface Area) (Media Depth) (0.4)

= 0.5 (Surface Area) + (Surface Area) (2.5) (0.4)

6,311 = 1.5 (Surface Area)

Required Surface Area = 4,207.3 SF

Surface Area Provided = 4,786 SF

- ESDv provided:

I. Facilities with 2.5' media depth (Surface Area = 3,590 SF; Ponding Depth = 0.5')

ESDv = 0.5 (3,590) + 3,590 (2.5) (0.4)
= 3,590 (1.5)
= 5,385 CF

II. Facilities with 2.0' media depth (Surface Area = 1,196 SF; Ponding Depth = 0.75')

ESDv = (0.75) (1,196) + 1,196 (2.0) (0.4)
= 1,854 CF

Total ESDv provided = 7,239 CF

Calculation Summary

Critical Area 10% Calculations

Removal Requirement, RR (lbs P / yr)	**0.19**
after non-structural and micro-scale BMPs (Steps 5 and 6)	
Total Load Reduction (lbs P / year)	2.38
Total Load Reduction Remaining (lbs P / yr)	**0.00**
after structural practices (Step 9)	
Total Load Reduction (lbs P / year)	2.38
Total Load Reduction Remaining (lbs P / yr)	**0.00**

MDE's ESD to the MEP Calculations

ESD Runoff Volume, ESDv (cf)	0.00
Total Treatment Volume (cf)	6310.76

WQv or ESDv Treated (cf)	7238.80
PE achieved (inches)	N/A

Entire ESDv Treated Through Environmental Site Design?	YES
ESDv Remaining? (cf)	0.00
If ESDV is not fully treated, is ESD to MEP achieved?	0.00

Redevelopment WQv Requirements Met Through Environmental Site Design?	YES
WQv Remaining? (cf)	0.00

New Development WQv Requirements Met Through Environmental Site Design?	N/A
WQv Remaining? (cf)	0.00

Maryland ESD Calculations and 10% Phosphorus Removal

Last Update: 10/28/2020

Project Name:	ROD & REEL INC. PROPERTIES
Date:	28-Oct-20

(blue)	data input cells
(grey)	calculation cells

Step 1: Complete ESD Implementation Checklist

Check all of the Following ESD Practices That Were Implemented at Site	*Yes - No - N/A*
Environmental Mapping Was Conducted at Site Prior to Layout	*YES*
Natural Areas Were Conserved (e.g., forests, wetlands, steep slopes, floodplains)	*YES*
Stream, Wetland and Shoreline Buffers Were Reserved	*YES*
Disturbance of Permeable Soils Was Minimized	*YES*
Natural Flow Paths Were Maintained Across the Site	*YES*
Building Layout Was Fingerprinted to Reduce Clearing and Grading at Site	*YES*
Site Grading Promoted Sheetflow From Impervious Areas to Pervious Ones	*YES*
Site Design Was Evaluated to Reduce Creation of Needless Impervious Cover	*YES*
Site Design Was Evaluated to Maximize Disconnection of Impervious Cover	*YES*
Site Design Was Evaluated to Identify Potential Hotspot Generating Area for Stormwater Treatment	*YES*
Erosion and Sediment Control Practices and Post Construction Stormwater Management Practices Were Integrated into a Comprehensive Plan	*YES*
Tree PlantingWas Used at the Site to Convert Turf Areas into Forest	*YES*

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

Site Area, A (acres)	4.59
Existing Impervious Surface Area (acres)	4.42
Proposed Impervious Surface Area (acres)	4.04
Rainfall Depth, P (in)	1.0
Existing Imperviousness, I_{pre}	96.3%
Proposed Imperviousness, I_{post}	88.0%
Water Quality Calculation for Redevelopment Only	
Required Treatment Area (acres)	1.83
Runoff Coefficient, Rv	0.95
Water Quality Volume, WQv (cf)	**6,311**

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

Development Category (for 10%)	**Redevelopment**
New Development	
Average Annual Predevelopment Load, Lpre (lbs P / yr)	2.30
Redevelopment:	
Predevelopment Runoff Coefficient, Rv_{pre}	0.92
Phosphorous Mean Concentration, C (mg/L)	0.3
Average Annual Predevelopment Load, L_{pre} (lbs P / yr)	10.30
Post-Development Runoff Coefficient, Rv_{post}	0.84
Average Annual Post-Development Load, L_{post} (lbs P / yr)	9.46
Removal Requirement, RR (lbs P / yr)	**0.19**

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

Development Category (for ESD)	**Redevelopment**
% Soil Type A	0%
% Soil Type B	0%
% Soil Type C	0%
% Soil Type D	100%
Pre-Developed Condition, RCN_{woods}	77
Soil Type A ESD Rainfall Target, P_E (in)	0.00
Soil Type B ESD Rainfall Target, P_E (in)	0.00
Soil Type C ESD Rainfall Target, P_E (in)	0.00
Soil Type D ESD Rainfall Target, P_E (in)	0.00
Maximum P_E (in)	2.7
Site ESD Rainfall Target, P_E (in)	0.00
ESD Runoff Depth, Q_E (in)	0.00
ESD Runoff Volume, ESDv (cf)	0
Total Treatment Volume (cf)	6,311

Step 5: Select Nonstructural Practices to Treat the ESD Rainfall Target

Critical Area Credits

Nonstructural Practices	P_E Credit Description	Contributing Drainage Area (sf)	Direct WQv or ESDv Received by Practice (cf)	WQv or ESDv from Up-Gradient Practices (cf)	P_E Credit (in)	WQV or ESDv credit (cf)	Runoff Volume Remaining (cf)	Baseline Phosphorous Removal Efficiency	Average Adjusted Removal Efficiency Rate	P Load to Practice (lbs/yr)	Load Reduction (lbs/yr)	Remaining Load (lbs/yr)
Disconnection of Rooftop Runoff (A/B Soils)	Up to 1 inch credit provided based upon disconnection flow length.	0	0	0	#DIV/0!	0	0	50%	0%	0.00	0.00	0.00
Disconnection of Rooftop Runoff (C/D Soils)	Up to 1 inch credit provided based upon disconnection flow length.	0	0	0	#DIV/0!	0	0	25%	0%	0.00	0.00	0.00
Disconnection of Non-Rooftop Runoff (A/B Soils)	Up to 1 inch credit provided based upon disconnection and contributing flow lengths.	0	0	0	#DIV/0!	0	0	50%	0%	0.00	0.00	0.00
Disconnection of Non-Rooftop Runoff (C/D Soils)	disconnection and contributing flow lengths.	0	0	0	#DIV/0!	0	0	25%	0%	0.00	0.00	0.00
Sheetflow to Conservation Areas (A/B Soils)	Up to 1 inch credit provided based upon conservation area width.	0	0	0	0	0	0	50%	0%	0.00	0.00	0.00
Sheetflow to Conservation Areas (C/D Soils)	Up to 1 inch credit provided based upon conservation area width.	0	0	0	0	0	0	25%	0%	0.00	0.00	0.00

Step 6: Select Micro-Scale Practices to Treat the ESD Rainfall Target

Micro-Scale Practices	P_E Credit Description	Contributing Drainage Area (sf)	Direct ESDv Received by Practice (cf)	WQv or ESDv from Up-Gradient Practices (cf)	WQv or ESDv credit (cf)	Runoff Volume Remaining (cf)	Baseline Phosphorous Removal Efficiency	Average Adjusted Removal Efficiency Rate	P Load to Practice (lbs/yr)	Load Reduction (lbs/yr)	Remaining Load (lbs/yr)
Green Roof (Level 1)	ESDv credit is based on roof thickness	0	0	N/A	0	0	45%	0%	0.00	0.00	0.00
Green Roof (Level 2)	ESDv credit is based on roof thickness	0	0	N/A	0	0	60%	0%	0.00	0.00	0.00
Pemeable Pavement (A Soils)	ESDv credit is based on subbase thickness	0	0	N/A	0	0	80%	0%	0.00	0.00	0.00
Pemeable Pavement (B Soils)	ESDv credit is based on subbase thickness	0	0	N/A	0	0	80%	0%	0.00	0.00	0.00
Pemeable Pavement (C Soils)	ESDv credit is based on subbase thickness	0	0	N/A	0	0	40%	0%	0.00	0.00	0.00
Rainwater Harvesting	ESDv credit is based on design storage volume and annual use	0	0	0	0	0	45%	0%	0.00	0.00	0.00
Submerged Gravel Wetlands	ESDv credit is based on design storage volume	0	0	0	0	0	60%	0%	0.00	0.00	0.00
Micro-Infiltration/Dry Wells	ESDv credit is based on design storage volume	0	0	0	0	0	65%	0%	0.00	0.00	0.00
Rain Gardens (A/B Soils)	ESDv credit is based on design storage volume	0	0	0	0	0	65%	0%	0.00	0.00	0.00
Rain Gardens (C/D Soils)	ESDv credit is based on design storage volume	0	0	0	0	0	25%	0%	0.00	0.00	0.00
Micro-Bioretention (A/B Soils)	ESDv credit is based on design storage volume	0	0	0	0	0	75%	0%	0.00	0.00	0.00
Micro-Bioretention (C/D Soils)	ESDv credit is based on design storage volume	88,750	18,970	0	7,239	11,732	50%	49%	4.74	2.38	2.36
Landscape Infiltration	ESDv credit is based on design storage volume	0	0	0	0	0	75%	0%	0.00	0.00	0.00
Grass Swales (A/B Soils)	ESDv credit is based on design storage volume	0	0	0	0	0	40%	0%	0.00	0.00	0.00
Grass Swales (C/D Soils)	ESDv credit is based on design storage volume	0	0	0	0	0	20%	0%	0.00	0.00	0.00
Bio-swales (A/B Soils)	ESDv credit is based on design storage volume	0	0	0	0	0	75%	0%	0.00	0.00	0.00
Bio-swales (C/D Soils)	ESDv credit is based on design storage volume	0	0	0	0	0	50%	0%	0.00	0.00	0.00
Wet Swales	ESDv credit is based on design storage volume	0	0	0	0	0	40%	0%	0.00	0.00	0.00

Step 7: Check for ESDv to MEP compliance and Revise Site If Necessary

Drainage Area Treated (sf)	88,750
WQv or ESDv Treated (cf)	7,239
P_E achieved (inches)	N/A
Total Load Reduction (lbs P / year)	2.38
Total Load Reduction Remaining (lbs P / yr)	0.00
Entire ESDv Treated Through Environmental Site Design?	YES
ESDv Remaining? (cf)	0
If ESDV is not fully treated, is ESD to MEP achieved?	
Redevelopment WQv Requirements Met Through Environmental Site Design?	YES
WQv Remaining? (cf)	0
New Development WQv Requirements Met Through Environmental Site Design?	N/A
WQv Remaining? (cf)	0

New Development Water Quality Volume Requirements

Required Treatment Area (acres)	0.00
Runoff Coefficient, Rv	0.95
Water Quality Volume, WQv (cf)	0

Step 8: Determine Reduced RCN and Volume Management Requirements Based Upon P_E Achieved

Reduced RCN for Type A Soils	N/A
Reduced RCN for Type B Soils	N/A
Reduced RCN for Type C Soils	N/A
Reduced RCN for Type D Soils	N/A
Composite Reduced RCN	N/A
Q_E (in) for Reduced RCN	N/A
V (ft^3) for Reduced RCN	N/A
Q_E (in) for RCN of 55	0.12
V (ft^3) for RCN of 55	822
Volume Management Required (cf)	0

Step 9: Select Structural Practices to Meet Volume Management Requirements

Critical Area Credits

Structural Practices	Contributing Drainage Area (sf)	% Impervious Cover	Direct ESDv Received by Practice (cf)	ESDv from Upstream Practices (cf)	Treatment Volume (cf)	Phosphorous Removal Efficiency	Adjusted Phosphorus Removal Efficiency	P Load to Practice (lbs/yr)	Load Reduction (lbs/yr)	Remaining Load (lbs/yr)
Stormwater Ponds (Level 1)	0	0%	0	0	0	50%	0%	0.00	0.00	0.00
Stormwater Ponds (Level 2)	0	0%	0	0	0	75%	0%	0.00	0.00	0.00
Stormwater Wetlands (Level 1)	0	0%	0	0	0	50%	0%	0.00	0.00	0.00
Stormwater Wetlands (Level 2)	0	0%	0	0	0	75%	0%	0.00	0.00	0.00
Stormwater Filtering Systems (Level 1)	0	0%	0	0	0	60%	0%	0.00	0.00	0.00
Stormwater Filtering Systems (Level 2)	0	0%	0	0	0	65%	0%	0.00	0.00	0.00
Stormwater Infiltration (Level 1)	0	0%	0	0	0	60%	0%	0.00	0.00	0.00
Stormwater Infiltration (Level 2)	0	0%	0	0	0	90%	0%	0.00	0.00	0.00

Total structural CPv provided	0
Management Requirement Met?	YES
Volume Remaining (cf)	0
Total Load Reduction (lbs P / year)	2.38
Total Load Reduction Remaining (lbs P / yr)	0.00

Micro-Scale Practices	P_E Credit Description	Contributing Drainage Area (sf)	% Impervious Cover	Direct ESDv Received by Practice (cf)	WQv or ESDv from Up-Gradient Practices (cf)	Practice Specific Parameter(s)			WQv or ESDv credit (cf)	Runoff Volume Remaining (cf)	Down-Gradient Practice	Baseline Phosphorous Removal Efficiency	Adjusted Removal Efficiency Rate	P Load to Practice (lbs/yr)	Load Reduction (lbs/yr)	Remaining Load (lbs/yr)
						Surface Area (sf)	Ponding Depth (ft)	Media Depth (ft)								
Micro-Bioretention (C/D Soils)	ESDv credit is based on design storage volume	20,000	100%	4,275	0	1,088	0.5	2.5	1,632	2,643		50%	50%	1.07	0.54	0.53
Micro-Bioretention (C/D Soils)	ESDv credit is based on design storage volume	20,000	100%	4,275	0	1,123	0.5	2.5	1,685	2,591		50%	51%	1.07	0.54	0.52
Micro-Bioretention (C/D Soils)	ESDv credit is based on design storage volume	20,000	100%	4,275	0	1,299	0.5	2.5	1,949	2,327		50%	53%	1.07	0.57	0.50
Micro-Bioretention (C/D Soils)	ESDv credit is based on design storage volume	10,454	100%	2,235	0	407	0.75	2	631	1,604		50%	46%	0.56	0.26	0.30
Micro-Bioretention (C/D Soils)	ESDv credit is based on design storage volume	10,890	100%	2,328	0	548	0.75	2	849	1,478		50%	50%	0.58	0.29	0.29
Micro-Bioretention (C/D Soils)	ESDv credit is based on design storage volume	4,792	100%	1,024	0	241	0.75	2	374	651		50%	50%	0.26	0.13	0.13
Micro-Bioretention (C/D Soils)	ESDv credit is based on design storage volume	2,614	100%	559	0	80	0.5	2.5	120	439		50%	41%	0.14	0.06	0.08
Total		88,750		18,970	0				7,239	11,732		50%	49%	4.74	2.38	2.36

AquaShield
STORMWATER TREATMENT SOLUTIONS

AquaShield™ sizing calculation for Rod N Reel Project

Project Name: **Rod N Reel**
Project location: **Chesapeake Beach, MD**

Design flowrate = 0.046 CFS/SF filter media

Design flow rate= 5.2 CFS
Filter area required= 5.2/0.046 = 113 SF
Filtering area per row of filter= 12 SF
Hence number of filter rows= 113/ 12= 9.42= **10 rows**
Swirl pre-treatment chamber size= **AS-6**
Hence filter design size is **AF-6.10**

October 4, 2017

2733 Kanasita Drive, Suite B
Chattanooga, Tennessee 37343
Phone (888) 344-9044
Fax (423) 826-2112
www.AquaShieldInc.com

* * * STORM DRAIN PIPE COMPUTATIONS * * *
Date: 3,22,2018 Time: 14:13: 7

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STRUCTURE FROM no	STRUCTURE TO no	INCRE AREA acres	TOTAL AREA acres	RUN COEF	INCRE AREA*R	TOTAL AREA*R	STORM FREQ yr	TIME CONC min	RAIN INTEN in/hr	`Q' cfs	PIPE `n'	PIPE SIZE in	PIPE SLOPE %	PIPE VEL fps	PIPE LENGTH ft	PIPE TIME min	STRUCTURE NO	STRUCTURE LOSS ft
16	14	.34	.34	.85	.29	.29	10	7.00	6.50	1.88	.013	15	.08	1.53	28	.30	16	.00
14	12	.00	.34	.00	.00	.29	10	7.30	6.43	1.88	.013	15	.08	1.53	92	1.00	14	.26
12	10	.46	.80	.85	.39	.68	10	8.31	6.22	4.23	.013	18	.16	2.39	126	.88	12	.33
18	10	.46	.46	.85	.39	.39	10	7.00	6.50	2.54	.013	15	.15	2.07	56	.45	18	.00
10	8	.46	1.72	.85	.39	1.46	10	9.18	6.04	8.83	.013	24	.15	2.81	43	.26	10	.35
34	8	5.00	5.00	.80	4.00	4.00	10	7.00	6.50	25.99	.013	33	.24	4.38	146	.56	34	.00
8	7	.00	6.72	.00	.00	5.46	10	9.44	5.99	32.71	.013	48	.05	2.60	8	.05	8	.11
23	7	7.50	7.50	.40	3.00	3.00	10	7.00	6.50	19.49	.013	18	3.44	11.03	19	.03	23	.00
7	6	.00	14.22	.00	.00	8.46	10	9.49	5.98	50.59	.013	48	.12	4.03	143	.59	7	.23
6	5	.00	14.22	.00	.00	8.46	10	10.08	5.86	50.59	.013	48	.12	4.03	96	.40	6	.36
9	5	.15	.15	.85	.13	.13	10	7.00	6.50	.83	.013	15	.02	.68	24	.59	9	.00
26	24	1.08	1.08	.85	.92	.92	10	7.00	6.50	5.97	.013	18	.32	3.38	52	.26	26	.00
25	24	.47	.47	.85	.40	.40	10	7.00	6.50	2.60	.013	15	.16	2.12	34	.27	25	.00
24	5	.00	1.55	.00	.00	1.32	10	7.27	6.44	8.48	.013	18	.65	4.80	42	.15	24	.51
5	3	.00	15.92	.00	.00	9.91	10	10.48	5.78	57.26	.013	48	.16	4.56	93	.34	5	.31
22	20	.57	.57	.85	.48	.48	10	7.00	6.50	3.15	.013	15	.24	2.57	88	.57	22	.00
20	3	.18	.75	.85	.15	.64	10	7.57	6.37	4.06	.013	15	.40	3.31	12	.06	20	.36
3	2	.00	16.67	.00	.00	10.54	10	10.82	5.71	60.21	.013	48	.18	4.79	65	.23	3	.28

Facility Name: Pond#1

Rectangular Weir Release

$Q = CLH^{3/2}$

	Design Storm		
	2 Year	10 Year	100 Year
Peak Discharge (cfs)	**0.00**	**20.20**	**0.00**

where:

Discharge Coeff. (C) =	3.1	
Weir Length (L) =	**3.50**	feet
Crest Elevation =	**5.30**	
H = Measured Head in feet		

Head			***Release***			***Water Surface Elevation***	
H2 =	**0.000**	feet	Q2 =	**0.00**	c.f.s.	2 year =	**5.30**
H10 =	**1.513**	feet	Q10 =	**20.20**	c.f.s.	10 year =	**6.81**
H100 =	**0.000**	feet	Q100 =	**0.00**	c.f.s.	100 year =	**5.30**

Notes: This analysis does not allow for quality control orifice flow release simultaneously.

NOTE: Q10= 26 CFS AT STR 34 FROM PIPERUN COMPS
Q1" =5.2 CFS SO 26.0 - 5.2 =20.2 CFS WILL BE OVERFLOWED ON THE WEIR WALL

Compute WQv Storm Discharge -

Sizing Rule: MDE Stormwater Design Manual, Appendix D.10

TR-55 Summary:

Rv	0.95
P =	1
Qa =	0.95
Tc =	0.1

$$Rv = 0.05 + 0.009 * \%Impervious$$

% Impervious = 100%

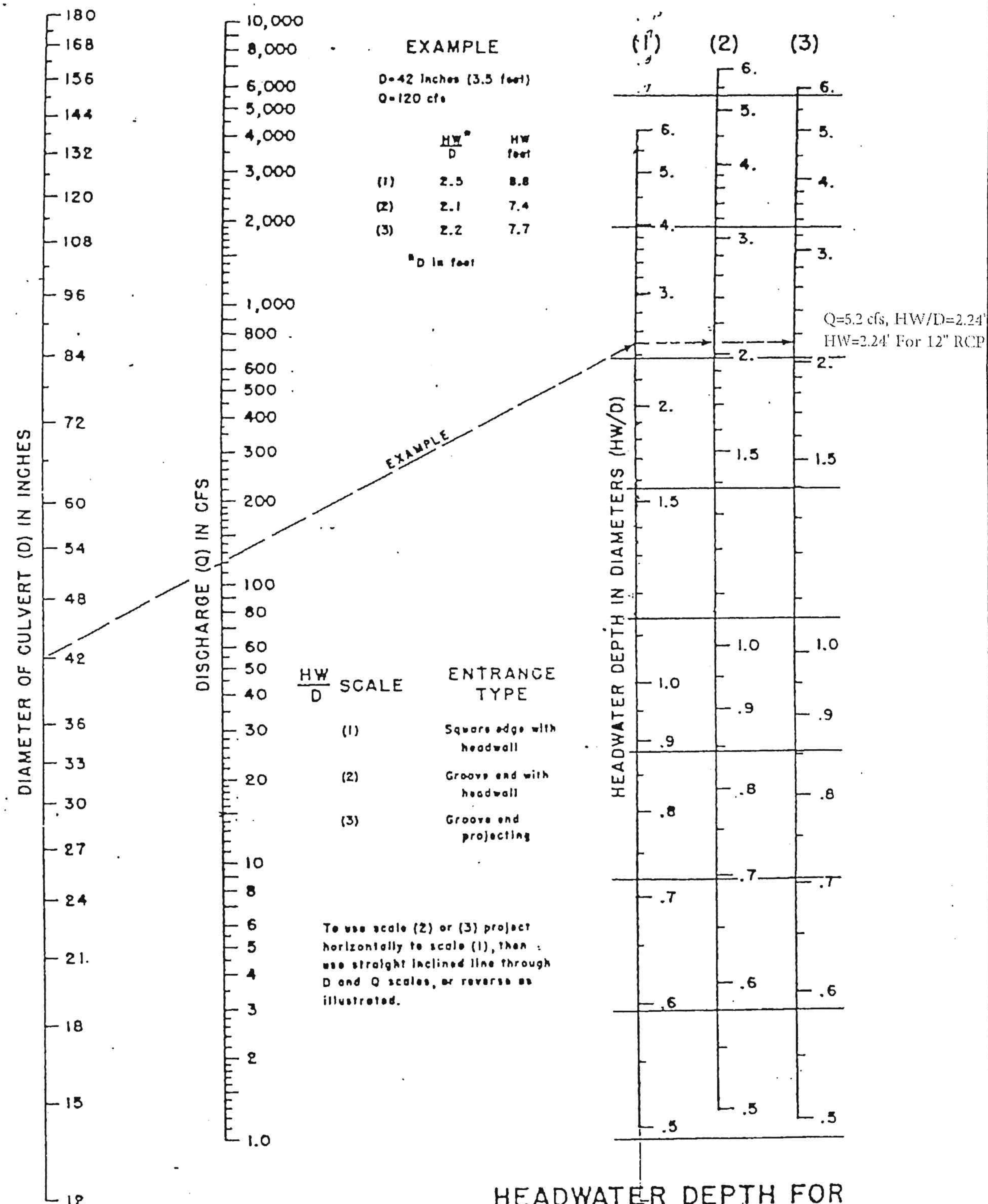
Runoff (Qa) = *Rv*P*

$$CN = \frac{1000}{\left[10 + 5 * P + 10 * Q_a - 10 * \sqrt{Q_a^2 + 1.25 * Q_a * P}\right]}$$

CN =	**99.57**		
Initial Abstraction (Ia) = ***[(200 / CN) - 2]***	**0.009**		
Water Quality Rainfall (P) =	**1.00 inches (ESD Pe)**		
		Ia/P =	**0.009**
Unit Peak Factor (qu) =	**1000 csm / in. (from Figure D-11.1)**		
Site Area (A) =	**3.50** ***acres or***	**0.005469**	***mi² (Am)***
WQv Post Development Peak Discharge (Qp) = ***(qu * Am * Qa) =***		**5.20**	***cfs***

J:\LD7-PROJ\b03021-LD7\SD\COMPUTATIONS\RNR\App D10 WQ storm Calcs Toatl Imper Area 3.5.xlsx

EX. STR. 34 to Storm Filter STR. 28



HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 2&3
REVISED MAY 1964

MARYLAND STATE HIGHWAY ADMINISTRATION 5/64 SHA-61.1-420.1-1.0

INLET CAPACITY COMPUTATIONS

STR. #10.

$Q = CIA$. $C = 0.85$
$I = 7.0$ in/hr. (10-Yr intensity)
$A = 0.36$ Ac.

$Q_{10} = (0.85)(7.0)(0.36)$
$= 2.14$ CFS.

Inlet Capacity: (Single WR-Inlet)
→ 50% blocage.
$Q = 4.28$ CFS → Head (h) ≅ 0.1 FT.
(See Inlet Capacity chart)

STR. # 12.

$C = 0.85$; $I = 7.0$ in/hr ; $A = 0.46$ Ac.

$Q_{10} = (0.85)(7.0)(0.46)$
$= 2.74$ CFS.

Inlet Capacity
→ 50% blocage: (Single WR-Inlet)
$Q = 5.48$ CFS → Head (h) ≅ 0.14 FT.

STR. #18

$C = 0.85$; $I = 7.0$ in/hr ; $A = 0.44$ Ac.

$Q_{10} = (0.85)(7.0)(0.44)$
$= 2.62$ CFS

Inlet Capacity
→ 50% blockage (Single WR-Inlet)
$Q = 5.24$ CFS → Head (h) ≅ 0.12 FT.

INLET CAPACITIES (WR2.WB3) (**50% BLOCKED**)
MSHA STD. MD-374.23
PRECAST SINGLE WR INLET - SINGLE GRATE

Q = CA(2gh)^1/2 C = 0.6, A=6.25 sf*, g=32.2 ft/sec^2

HEAD VS. FLOW RATE

h(ft)	Q(cfs)
0.0	0.0
0.1	4.8
0.2	6.7
0.3	8.2
0.4	9.5
0.5	10.6
0.6	11.7
0.7	12.6
0.8	13.5
0.9	14.3
1.0	15.0

Q = CL(H)^3/2 C=3.[illegible] L=10.58 ft

HEAD VS. FLOW RATE

H(ft)	Q(cfs)
0.0	0.0
0.1	0.5
0.2	1.5
0.3	2.7
0.4	4.1
0.5	5.8
0.6	7.6
0.7	9.6
0.8	11.7
0.9	14.0
1.0	16.4

STR. # 46.

Q = CIA ; C = 0.85, I = 7.0 in/hr. (10-yr Intensity)
A = 0.24 Ac.

Q_{10} = (0.85)(7.0)(0.24)
= 1.43 cfs.

Inlet Capacity:
→ 50% blockage. (18" φ Nyloplast Drain Basin)

Q = 2.86 cfs.

→ Head (h) ≅ 0.33 FT. (See Inlet Capacity chart).

STR. # 48.

Q = CIA ; c = 0.85, I = 7.0 in/hr
A = 0.25 Ac.

Q_{10} = (0.85)(7.0)(0.25)
= 1.49 cfs.

Inlet Capacity:
→ 50% blockage: (18" φ Nyloplast Drain Basin)

Q = 2.98 cfs.

→ Head (h) ≅ 0.34 FT.

STR. # 50.

Q = CIA ; c = 0.85, I = 7.0 in/hr.
A = 0.11 Ac.

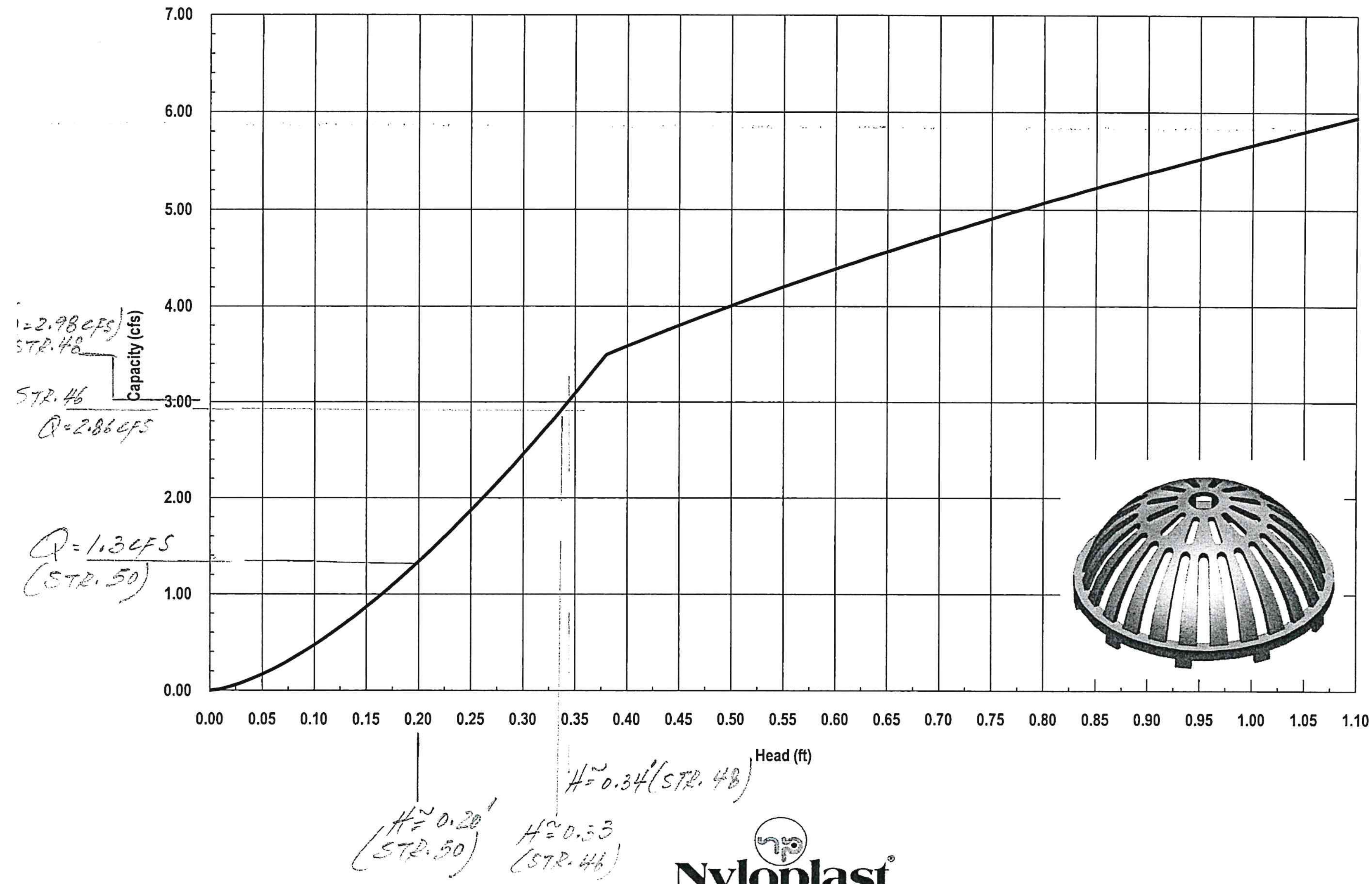
Q = (0.85)(7.0)(0.11)
= 0.65 cfs.

Inlet Capacity:
→ 50% blockage (18" φ Nyloplast Drain Basin

Q = 1.3 cfs

→ Head (h) = 0.20 FT.

Nyloplast 18" Dome Grate Inlet Capacity Chart



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HGL Computation

Outfall at Structure #2 : MHW El. = 0.42'

Start 10-Yr HGL Computation at 0.42'.

STR 3 – STR. 2.

	0.42
+ (65 × 0.21%) =	0.14
	0.56
STR. Loss at Str. #3 :	0.38
	0.94

STR. 5 – STR. 3

	0.94
+ (93 × 0.16%) =	0.15
	1.09
STR. Loss at Str. #5 :	0.30
	1.39

STR. 6 – STR. 5

	1.39
+ (96 × 0.12%) =	0.12
	1.51
STR. Loss at STR. #6 :	0.36
	1.87

STR. EX. 8 – STR. 6.

	1.87
+ (152 × 0.12%) =	0.18
	2.05
STR. Loss at STR. Ex. 8 =	0.11
	2.16.

STR. 10 – STR EX. 8.

	2.16
+ (43 x 0.15%) =	0.06
	2.22
STR. LOSS at STR. 10 :	0.35
	2.57

At. STR. 10 : HGL: 2.57.

STR. #18 – STR. 10.

	2.57
+ (56 x 0.15%) =	0.08
	2.65

STR. #12 – STR. 10.

	2.57
+ (126 x 0.16%) =	0.20
	2.77
STR. LOSS at STR. 12 :	0.33
	3.10

STR. #14 – STR. 12.

	3.10
+ (92 x 0.08%) =	0.07
	3.17
STR. LOSS at STR. 14 :	0.26
	3.43

STR. #16 - STR. #14.

$$\begin{array}{r} 3.43 \\ +\left(28 \times 0.08\%\right) = 0.02 \\ \hline 3.45 \end{array}$$

HGL at STR. #5 . 1.39

STR. #9 - STR. #5.

$$\begin{array}{r} 1.39 \\ +\left(24 \times 0.02\%\right) = 0.01 \\ \hline 1.40 \end{array}$$

STR. #26 - STR. #5.

$$\begin{array}{r} 1.39 \\ +\left(94 \times 0.65\%\right) = 0.61 \\ \hline 2.00 \end{array}$$

HGL @ STR. #24. 1.66

STR Loss at STR #24. 0.51

STR. #24: 2.17

STR. #25 - STR. 24.

$$\begin{array}{r} 2.17 \\ +\left(34 \times 0.16\%\right) = 0.05 \\ \hline 2.22 \end{array}$$

HGL at #7. 2.04.

STR. Loss at Str. #7: 0.23

HGL @ #7. 2.27.

STR EX.23 - STR #7

2.27

+ (19 × 3.44%) = 0.65

2.92

HGL at STR. #3: 0.94.

STR. #20 - STR. #3: 0.94

+ (12 × 0.40%) = 0.05

0.99.

STR. Loss at STR. #20: 0.36

1.35

STR. #22 — STR. #20

1.35

+ (88 × 0.24%) = 0.21

1.56