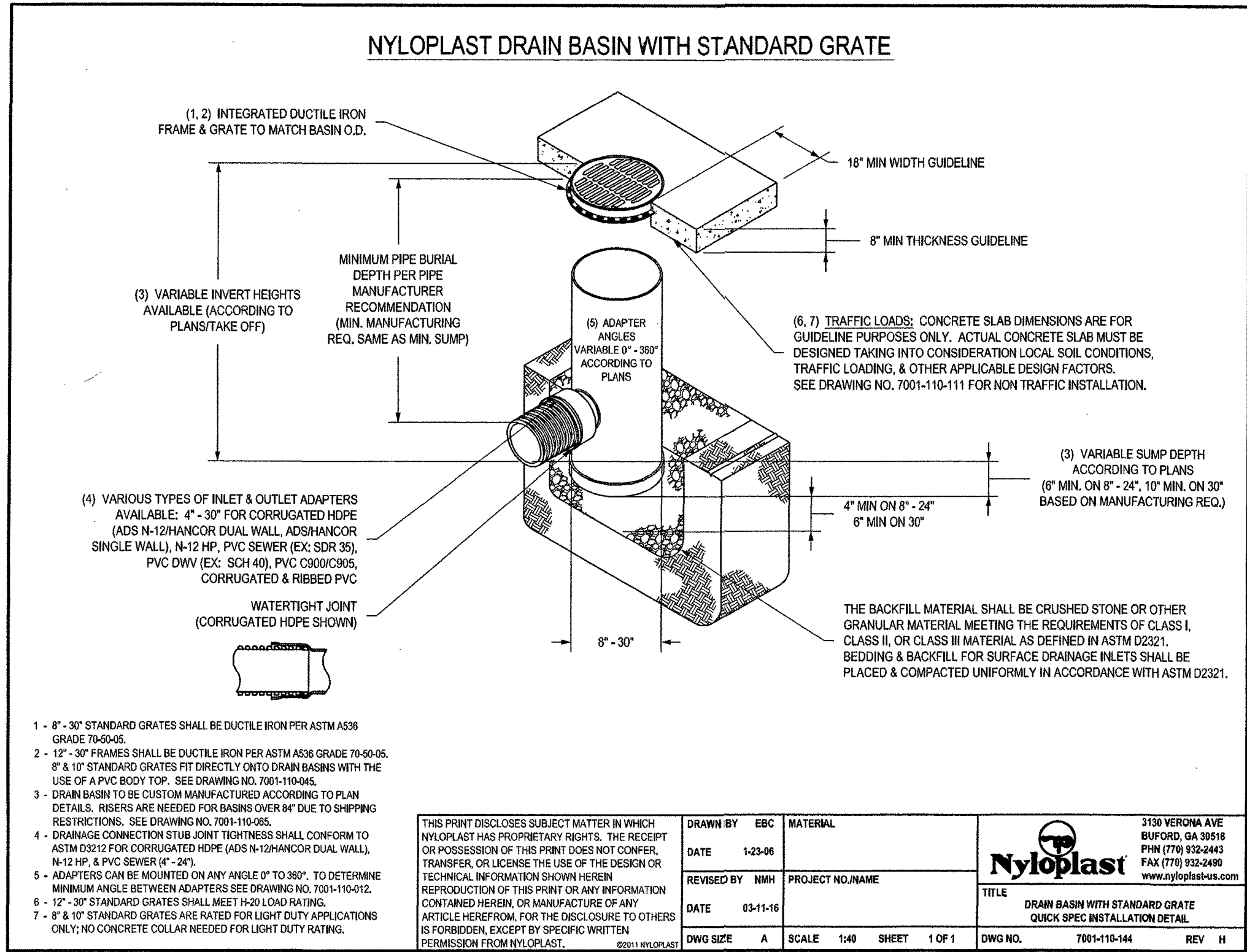




Storm 1 STORM SEWER DESIGN COMPUTATIONS

STORM FREQUENCY 10 YEAR

PIPE NO	FROM POINT	TO POINT	DRAIN AREA "A" Acres	RUNOFF COEFF. "C"	CA			TOTAL INLET TIME Minutes	RAIN FALL In/Hr	RUNOFF Q CFS	INVERT ELEVATIONS		LENGTH of Pipe Ft.	SLOPE Ft./Ft.	SIZE (Dia. Or Span/Rise) In.	SHAPE	Capacity CFS	Friction Slope Ft./Ft.	VEL Vn Ft/Sec	FLOW TIME Min.	REMARKS
	REFERENCE	REFERENCE			INCRE-MENT	ACCUM-ULATED	ADDTL. CA				UPPER END	LOWER END									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)				
2	1	3	0.050	0.300	0.015	0.015	0.000	5.000	6.037	0.091	1123.000	1122.471	52.860	0.010	10.000	Circular	2.373	0.000	1.906	0.462	
4	3	5	0.680	0.720	0.490	0.505	0.000	8.900	5.114	2.581	1122.000	1121.756	48.764	0.005	15.000	Circular	4.947	0.001	3.749	0.217	
6	5	7	0.050	0.540	0.027	0.532	0.000	9.117	5.072	2.696	1121.660	1121.224	87.162	0.005	15.000	Circular	4.947	0.001	3.792	0.383	
8	7	9	0.290	0.860	0.249	0.781	0.000	9.500	5.000	3.905	1121.120	1121.820	137.750	0.060	15.000	Circular	17.173	0.003	10.327	0.222	
9B	9	9A	0.170	0.790	0.134	0.915	0.000	9.722	4.959	4.539	1112.721	1112.550	17.055	0.010	15.000	Circular	6.996	0.004	5.607	0.051	
EX. 15in. RCP	9A		1.200	0.670	0.804	1.719	0.000	9.773	4.950	8.511	1112.550	1112.296	50.855	0.005	15.000	Circular	4.566	0.017	6.935	0.122	

Storm 2 STORM SEWER DESIGN COMPUTATIONS

STORM FREQUENCY 10 YEAR

PIPE NO	FROM POINT REFERENCE	TO POINT REFERENCE	DRAIN AREA "A" Acres	RUNOFF COEFF. "C"	CA			TOTAL INLET TIME Minutes	RAIN FALL In/Hr	RUNOFF Q CFS	INVERT ELEVATIONS		LENGTH of Pipe Ft.	SLOPE Ft./Ft.	SIZE (Dia. Or Span/Rise) In.	SHAPE	Capacity CFS	Friction Slope Ft./Ft.	VEL Vn Ft/Sec	FLOW TIME Min.	REMARKS
					INCRE-MENT	ACCUM-ULATED	ADDTL CA				UPPER END	LOWER END									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)				
11	10	12	0.390	0.790	0.308	0.308	0.000	6.200	5.714	1.760	1117.000	1116.807	38.668	0.005	15.000	Circular	4.947	0.000	3.387	0.190	
Ex 36" RCP	12		14.540	0.850	12.359	12.667	0.000	20.500	3.611	45.744	1110.110	1109.965	28.979	0.005	36.000	Circular	47.163	0.002	7.622	0.063	

Storm 1 HYDRAULIC GRADE LINE ANALYSIS

INCIDENCE PROBABILITY 10 Year

INLET OR JUNCTION	OUTLET WATER SURFACE ELEV. (ft)	DIA. PIPE Do (in)	DESIGN DISCH. Qo (CFS)	LENGTH PIPE Lo (ft)	FRICTION SLOPE, Sfo (Ft/Ft)	FRICTION LOSS Hf (ft)	JUNCTION LOSS												FINAL H (ft)	Inlet Water Surface Elevation	Rim Elev	Comments
							Vo	Ho	Qi	Vi	Q/Vi	V1^2/2g	Hi	Angle	HA	Ht	1.3 Ht	0.5 Ht				
9A	1,113.30	15	8.51	50.86	1.74%	0.88	6.94	0.19	4.54	5.81	25.45	0.49	0.17	54.57	0.24	0.6	0.78	FALSE	1.68	1,114.96	1,116.89	OK -1.93
9	1,113.55	15	4.54	17.06	0.42%	0.07	5.61	0.12	3.91	10.33	40.33	1.66	0.58	21.42	0.41	1.12	0	TRUE	0.83	1,114.18	1,118.10	OK -3.92
7	1,114.18	15	3.91	137.75	0.31%	0.43	10.33	0.41	2.7	3.79	10.22	0.22	0.08	16.3	0.04	0.53	0.69	TRUE	0.78	1,114.96	1,124.50	OK -9.54
5	1,122.22	15	2.7	87.16	0.15%	0.13	3.79	0.06	2.58	3.75	9.67	0.22	0.08	88.47	0.15	0.28	0	TRUE	0.27	1,122.50	1,124.88	OK -2.38
3	1,122.78	15	2.58	48.76	0.14%	0.07	3.75	0.05	0.09	1.91	0.17	0.06	0.02	16.19	0.01	0.09	0.11	TRUE	0.12	1,122.88	1,127.40	OK -4.52
1	1,123.14	10	0.09	52.86	0.00%	0	1.91	0.01	0	0	0	0	0	0	0	0.01	0.02	FALSE	0.02	1,123.16	1,124.85	OK -1.69

Storm 2 HYDRAULIC GRADE LINE ANALYSIS

INCIDENCE PROBABILITY 10 Year

INLET OR JUNCTION	OUTLET WATER SURFACE ELEV. (ft)	DIA. PIPE Do (in)	DESIGN DISCH. Qo (CFS)	LENGTH PIPE Lo (ft)	FRICTION SLOPE, Sfo (Ft/Ft)	FRICTION LOSS Hf (ft)	JUNCTION LOSS												FINAL H (ft)	Inlet Water Surface Elevation	Rim Elev	Comments
							Vo	Ho	Qi	Vi	Q/Vi	V1^2/2g	Hi	Angle	HA	Ht	1.3 Ht	0.5 Ht				
12	1,112.37	36	45.74	28.88	0.47%	0.14	7.62	0.23	1.76	3.7	6.51	0.21	0.07	71.79	0.13	0.43	0.56	TRUE	0.42	1,112.79	1,119.60	OK -6.81
10	1,117.81	15	1.76	38.67	0.06%	0.02	3.7	0.05	0	0	0	0	0	0	0	0.05	0.07	TRUE	0.06	1,117.87	1,121.00	OK -3.13



Date: November 3, 2016

To: Benjamin S. McMillan, PE, LEED AP
Project Engineer III
Timmons Group

From: Claire Wolanski
Credit Sales Coordinator
Resource Environmental Solutions

Subject: Roanoke River Watershed - Nutrient Credit Availability

Project Reference: Lewis Gale Emergency Center; 0.29 Credits Requested; HUC 03010101

This letter is to confirm the availability of 0.29 authorized nutrient credits ("Nutrient Credits") from Resource Environmental Solutions' ("RES") Hawkins Forest Nutrient Bank facility for use by permit applicants within the Roanoke watershed, including HUC 03010101, to compensate for nutrient loadings in excess of state or local regulations, as per Virginia Code § 62.1-44.15:35 and § 62.1-44.19:14 and Virginia Administrative Code 9 VAC 25-820-10 et seq. These Nutrient Credits are generated and managed under the terms of the Banking Instruments known as the Hawkins Forest Nutrient Reduction Implementation Plan.

Please feel free to contact me if you have any questions.

Sincerely,

Claire Wolanski

Claire E. Wolanski
Resource Environmental Solutions
804-591-4060

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Suite 130
Columbia, MD 21117

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Charleston, SC 29403

5020 Montrose Blvd.
Suite 650
Houston, TX 77066

1200 Camella Blvd.
Suite 220
Lafayette, LA 70509

13711 East Main St.
Suite 210
Oak Hill, WV 25901

33 Terminal Way
Suite 431
Pittsburgh, PA 15219

302 Jefferson St.
Suite 110
Raleigh, NC 27605

1521 W. Main
2nd Floor
Richmond, VA 23220

DEQ Virginia Runoff Reduction Method Re-Development Compliance Spreadsheet - Version 3.0

© 2013 BMP Standards and Specifications © 2013 Draft BMP Standards and Specifications

Project Name: Lewis Gale Emergency Center
Date: 11/1/2016
Linear Development Project? No

CLEAR ALL

data input cells
constant values
calculation cells
final results

Site Information

Post-Development Project (Treatment Volume and Loads)

Enter Total Disturbed Area (acres) → 1.20

Maximum reduction required
The site's net increase in impervious cover (acres) is
Post-Development TP Load Reduction for Site (lb/yr): 0.29

Check:
BMP Design Specifications List: 2011 Sds & Specs
Linear project? No
Land cover areas entered correctly? ✓
Total disturbed area entered? ✓

Pre-Development Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) - undisturbed, protected forest/open space or reforested land					0.00
Managed Turf (acres) - disturbed, graded for yards or other turf to be mowed/maintained			0.23		0.23
Impervious Cover (acres)			0.87		0.87
					1.20

Post-Development Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) - undisturbed, protected forest/open space or reforested land					0.00
Managed Turf (acres) - disturbed, graded for yards or other turf to be mowed/maintained			0.33		0.33
Impervious Cover (acres)			0.87		0.87
					1.20

Area Check

OK	OK	OK	OK	OK
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Constants

Annual Rainfall (inches)	43
Target Rainfall Excess (inches)	1.80
Total Phosphorus (TP) (lb/acre)	0.28
Total Nitrogen (TN) (lb/acre)	1.86
Target TP Load (lb/acre/yr)	0.41
TP Loading Reduction Factor	0.95

Runoff Coefficients (Rv)

	A Soils	B Soils	C Soils	D Soils
Forest/Open Space	0.02	0.03	0.04	0.05
Managed Turf	0.15	0.20	0.23	0.25
Impervious Cover	0.95	0.95	0.95	0.95

LAND COVER SUMMARY - PRE-REDEVELOPMENT

Pre-Development	United	Adjusted
Forest/Open Space (acres)	0.00	0.00
Weighted Rv (acres)	0.00	0.00
% Forest	0%	0%
Managed Turf (acres)	0.23	0.23
Weighted Rv (acres)	0.23	0.23
% Managed Turf	19%	19%
Impervious Cover (acres)	0.97	0.97
Rv (Impervious)	0.95	0.95
% Impervious	81%	81%
Total Site Area (acres)	1.20	1.20
Site Rv	0.82	0.82

LAND COVER SUMMARY - POST DEVELOPMENT

Post-Development	United	Adjusted
Forest/Open Space (acres)	0.00	0.00
Weighted Rv (acres)	0.00	0.00
% Forest	0%	0%
Managed Turf (acres)	0.33	0.33
Weighted Rv (acres)	0.25	0.25
% Managed Turf	28%	28%
Impervious Cover (acres)	0.87	0.87
Rv (Impervious)	0.95	0.95
% Impervious	73%	73%
Total Site Area (acres)	1.20	1.20
Final Post Dev Site Rv	0.76	0.76

Treatment Volume and Nutrient Load

Pre-Development	Post-Development
Treatment Volume (acre-ft)	0.0816
TP Load (lb/yr)	2.23
TP Load per acre (lb/acre/yr)	1.86
Adjusted TP Load (lb/yr)	0.49

Treatment Volume and Nutrient Load

Post-Development	Post-Development
Treatment Volume (acre-ft)	0.0758
TP Load (lb/yr)	3.300
TP Load per acre (lb/acre/yr)	2.07
Adjusted TP Load (lb/yr)	0.76

TP Load Reduction Required for Redeveloped Area (lb/yr)

TP Load Reduction Required for Redeveloped Area (lb/yr)	0.29
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TP Load Reduction Required for New Impervious Area (lb/yr)

TP Load Reduction Required for New Impervious Area (lb/yr)	0
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Post-Development Requirement for Site Area

TP Load Reduction Required (lb/yr)	0.29
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Nitrogen Loads (Informational Purposes Only)

Pre-Development TN Load (lb/yr)	15.97
Final Post-Development TN Load (Post-Development & New Impervious) (lb/yr)	14.83

Storm 1 STORM SEWER DESIGN COMPUTATIONS

STORM FREQUENCY 2 YEAR

PIPE NO	FROM POINT REFERENCE	TO POINT REFERENCE	DRAIN AREA "A" Acres	RUNOFF COEFF. "C"	CA		ADDTL. CA	TOTAL INLET TIME Minutes	RAIN FALL In/Hr	RUNOFF CFS	INVERT ELEVATIONS		LENGTH of Pipe Ft.	SLOPE Ft/Ft	SIZE (Dia. Or Span/Rise) In.	SHAPE	Capacity CFS	Friction Slope Ft/Ft	VEL Vn Ft/Sec	FLOW TIME Min.	REMARKS
					INCRE-MENT	ACCUM-ULATED					UPPER END	LOWER END									
	(1)	(2)	(3)	(4)	(5)	(6)		(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)		(15)	(16)	(17)	(18)	
2	1	3	0.050	0.300	0.015	0.015	0.000	5.000	4.395	0.066	1123.000	1122.471	52.860	0.010	10.000	Circular	2.373	0.000	2.096	0.420	
4	3	5	0.680	0.720	0.490	0.505	0.000	8.900	3.669	1.852	1122.000	1121.756	48.764	0.005	15.000	Circular	4.947	0.001	4.083	0.199	
6	5	7	0.050	0.540	0.027	0.532	0.000	9.099	3.639	1.935	1121.660	1121.224	87.162	0.005	15.000	Circular	4.947	0.001	4.128	0.352	
8	7	9	0.290	0.860	0.249	0.781	0.000	9.451	3.587	2.802	1121.120	1121.820	137.750	0.060	15.000	Circular	17.173	0.003	11.359	0.202	
9B	9	9A	0.170	0.790	0.134	0.915	0.000	9.653	3.558	3.257	1112.721	1112.550	17.055	0.010	15.000	Circular	6.996	0.004	6.084	0.047	
Ex. 15in. RCP	9A		1.200	0.670	0.804	1.719	0.000	9.700	3.551	6.106	1112.550	1112.296	50.855	0.005	15.000	Circular	4.566	0.017	6.954	0.122	

Storm 2 STORM SEWER DESIGN COMPUTATIONS

STORM FREQUENCY 2 YEAR

PIPE NO	FROM POINT REFERENCE	TO POINT REFERENCE	DRAIN AREA "A" Acres	RUNOFF COEFF. "C"	INCRE-MENT	ACCUM-ULATED	ADDTL. CA	TOTAL INLET TIME Minutes	RAIN FALL In/Hr	RUNOFF Q CFS	INVERT ELEVATIONS UPPER END
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