

STORMWATER MANAGEMENT REPORT

for:

Livingston Warehouse

Block(s): 140.01

Lot(s): 5.02 & 7.01

Township of North Brunswick

Middlesex County, New Jersey

Prepared By:

Menlo Engineering Associates, Inc

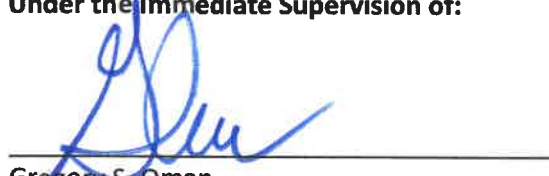
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MEA # 2018.047.01

Dated: February 12, 2021

Revised: October 4, 2021



menlo
engineering
associates

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INTRODUCTION

The following Stormwater Management Report details the design of the stormwater management plan for two proposed warehouses located in the Township of North Brunswick, Middlesex County, New Jersey and has been prepared by Menlo Engineering Associates, Inc. in accordance with the standards of the Township of North Brunswick, the County of Middlesex, the New Jersey Soil Conservation Service, and the New Jersey Department of Environmental Protection. This report supplements, and should be reviewed in conjunction with, the project development plans prepared by Menlo Engineering Associates, Inc.

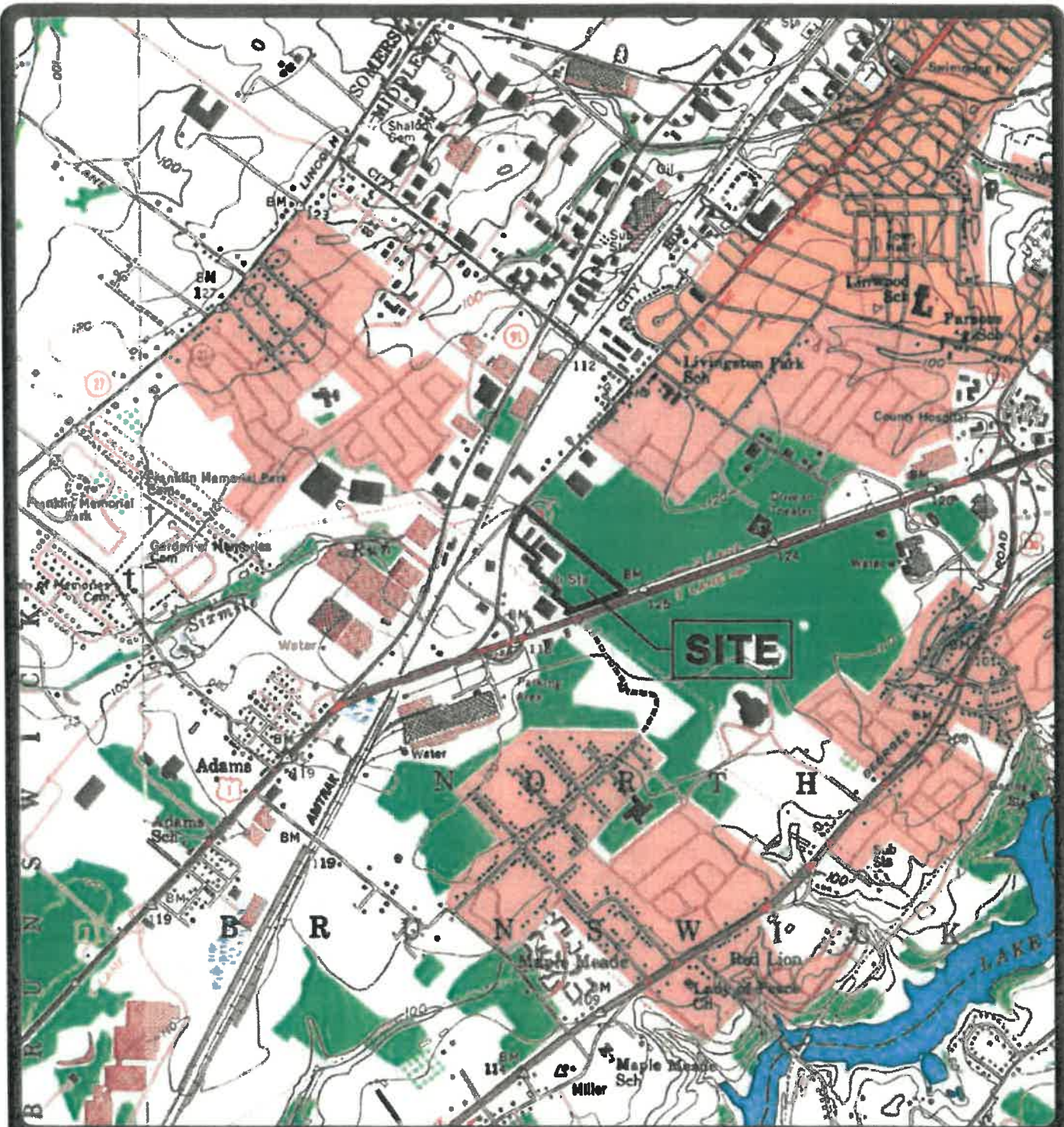
It is the intent of this report to aid and assist Engineers at the Municipal, County, and State levels in evaluating the drainage calculations and considerations incorporated in the design as shown on the plans submitted. This office will readily respond to questions and requests for additional calculations or verification of the proposed design by Municipal, County, or State Engineers, and will be responsive to their suggestions and modifications to the design in conformance to the applicable codes in the interest of land use control consistent with environmental protection.

CRITERIA

In the hydraulic designs involved in this project, the drainage areas have been determined by electronic digitizer from the U.S.G.S. Quadrangle map, topographic survey prepared by Control Layouts, Inc. and field observations to determine basin limits and off-site and on-site areas. The Soil Conservation Service Soil Survey maps are used for hydrological soil group classification. Existing and proposed conditions are calculated for the 2, 10, 25 and 100-year flows. On-site storm sewer collection systems were sized for the 25-year storm and employed the Rational Method for design calculations.

PROJECT LOCATION & DESCRIPTION

This report examines the drainage characteristics and designs for a 20.96-acre tract of land situated in the Township of North Brunswick, Middlesex County, New Jersey. The applicant proposes two 43,200 square foot warehouses. Access to the site is provided through Livingston Avenue, also known as New Jersey State Highway Route No. 26..



U.S.G.S. MAP

*Quad Name: New Brunswick
Township of North Brunswick
Middlesex County*



BLOCK
140.01

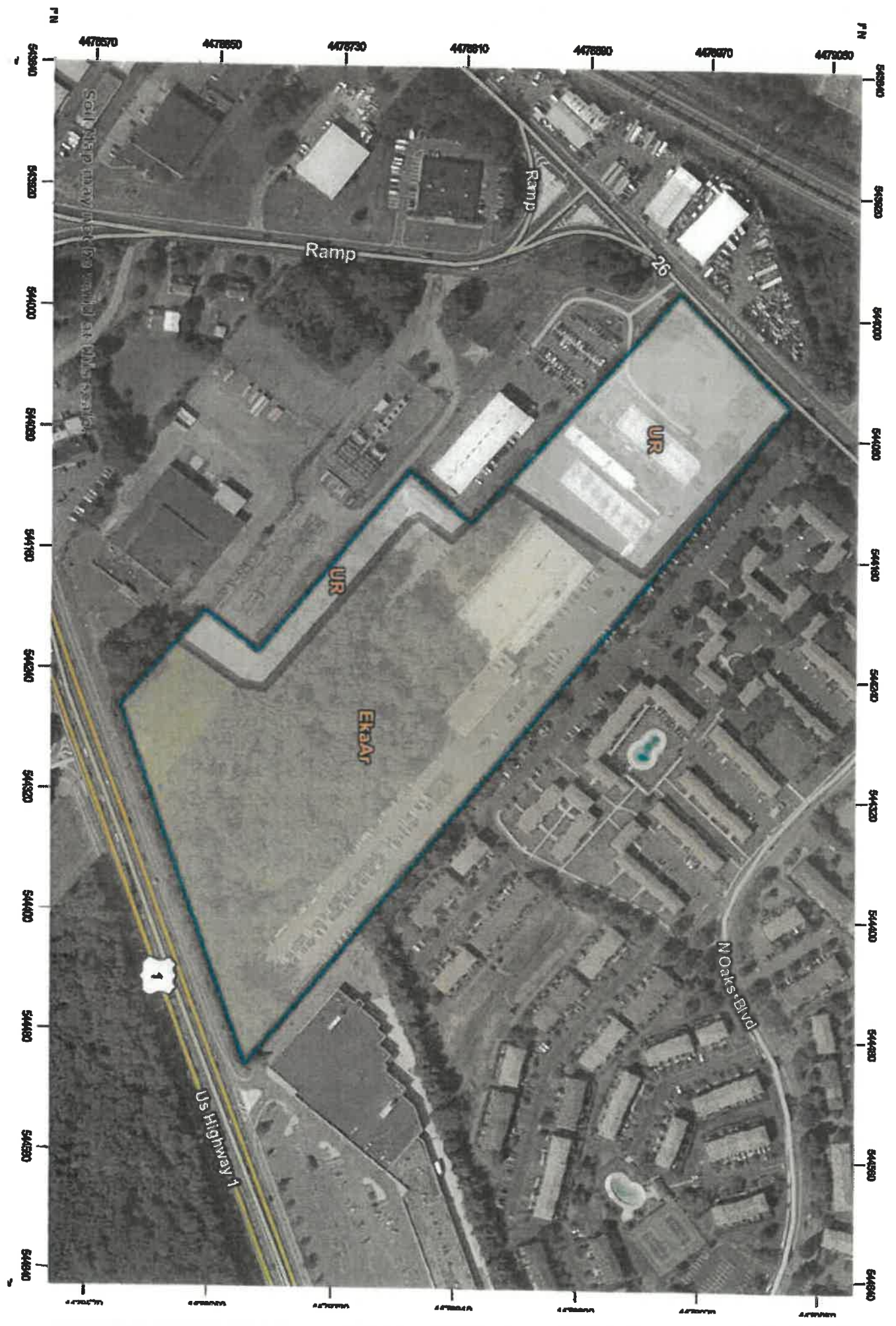
LOTS
5.02
&
7.01

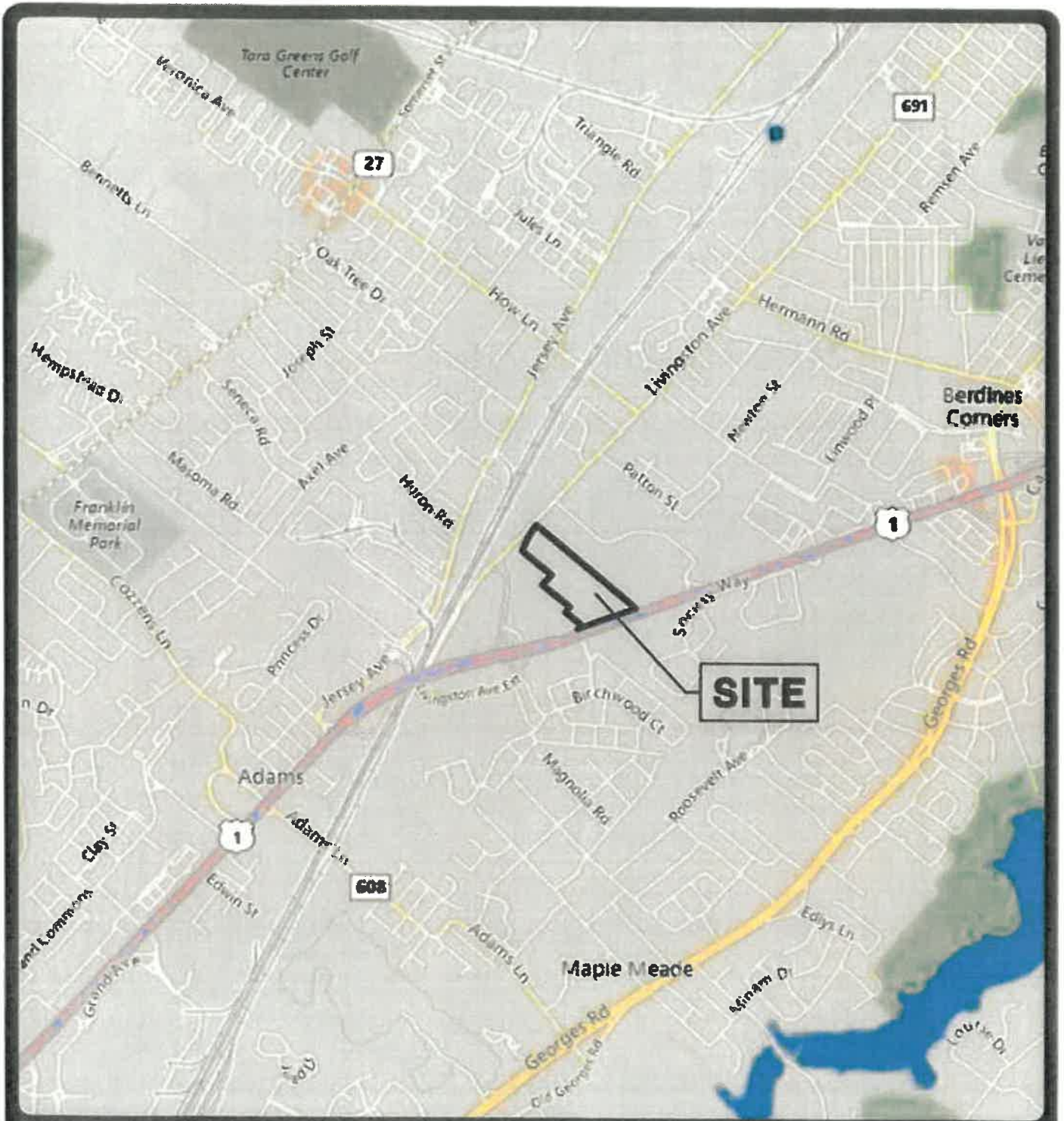
MENLO ENGINEERING ASSOCIATES, INC.
261 CLEVELAND AVENUE
HIGHLAND PARK, NJ 08904
(732) 846-8585

State Plane Coordinates:
N: 591,908.07 ft.
E: 498,199.16 ft.



Scale: 1"=2,000±ft Job # 2018.047





ROAD MAP

*Township of North Brunswick
Middlesex County*



BLOCK
140.01

LOTS
5.02
&
7.01

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Scale: 1"=2,000±ft Job # 2018.047

STORMWATER MANAGEMENT PLAN & DESIGN

The guidelines for hydraulic design, as prepared by the Soil Conservation District, the Township of North Brunswick, Middlesex County and the New Jersey Department of Environmental Protection have been utilized for the drainage design of this project. The purpose of the drainage design is for the post-development peak drainage flow pattern to continue, as it exists today.

The stormwater management plan for the site is to be constructed with one detention basin located near the Southern property line.

Summary of the Runoff Analysis:

The 20.96-acre parcel is currently partial developed with three buildings. The project seeks to develop 7.46 acres of the Southern portion of the site. The area currently consists of 1.87 acres of impervious pavement and 5.67 acres of woods. The existing drainage pattern drains from the North to the South portion of the site except for 0.26 acres which drains north to the existing drainage system on Livingston avenue. The site's HSG is classified as D soil. In a conservative effort in quantity runoff analysis, the existing site drainage has been analyzed as B soils and the proposed site drainage has been analyzed as D soils.

Summary Tables:

The following tables summarize the reduction of runoff for the 2, 10, 25, and 100-year storm events:

EXISTING & PROPOSED CONDITIONS

STORM	EXISTING RUNOFF FROM AREA OF ANALYSIS (CFS)	UNDETAINED RUNOFF FROM SITE (CFS)	FLOW FROM STRUCTURE C1 (CFS)	TOTAL FLOW FROM SITE (CFS)	PERCENT REDUCTION	CONDITION
100	20.5	3.3	11.60	14.90	27%	Complies
25	17.5	2.8	3.64	6.44	63%	Complies
10	15.3	2.5	1.52	4.02	74%	Complies
2	11.1	1.9	1.28	3.18	71%	Complies

Summary of the Groundwater Recharge Analysis:

Base on the Soils Report the infiltration rate for Test Pit-1 is 0.75 inches per hour which triggers the groundwater recharge requirement. Therefore, a section of the basin has been designed as an infiltration area to infiltrate the ground water deficit generated from the proposed impervious. Nixon Soil Group B has been used in the New Jersey Groundwater Recharge Spreadsheet program to calculate for ground water recharge since the site consist of Elkton Loam Soil is considered Hydrologic Soil Group D.

The following tables summarizes the groundwater recharge rates:

<u>Pre-Developed Condition</u>	<u>Post Development Conditions</u>
Total Annual Recharge (cf) = <u>363,966</u>	Annual Recharge Deficit (cf) = <u>218,232</u>
	Annual Recharge Provided (cf) = <u>234,567</u>

Summary of the Water Quality Analysis:

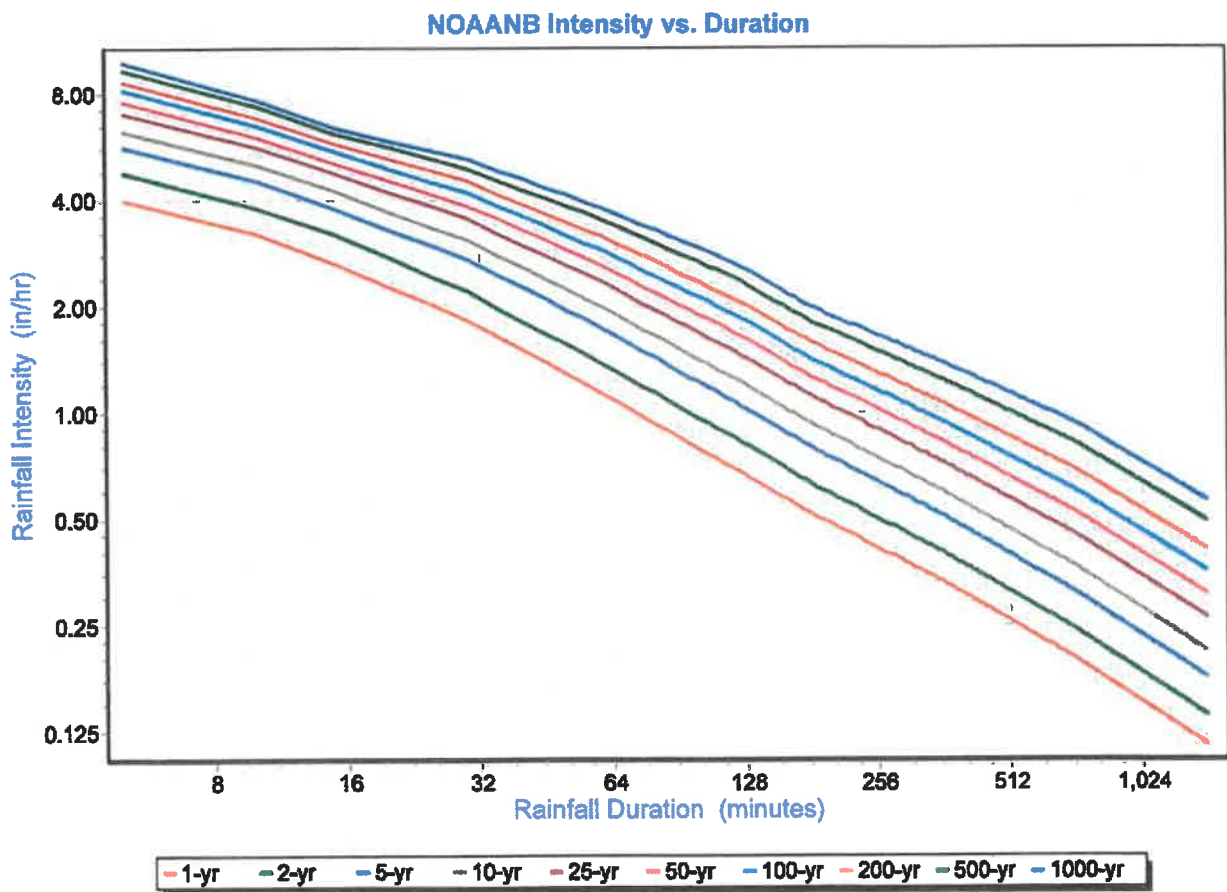
The existing drainage area has a total of 1.87 acres of pavement area. The propose drainage area has 3.85 acres of pavement which means there is a net gain of 1.98 acres in pavement. NJDEP requires 50% TSS removal for existing impervious areas draining towards the existing impervious areas, 80% TSS removal for the existing impervious areas draining towards the drainage ditch and 80% for proposed drainage areas. Water quality calculations have been provided in Appendix D.

Summary of the Rate of Runoff:

Proposed drainage area #2A, #2B, #2C, #2D & #2E drain into the wetlands along route 1. The detention basin reduces the flow from drainage area #2A. Areas #2B, #2C, #2D and #2E remain undetained. The combine flow meets the required reductions for the 2-year, 10-year and 100-year storm events. Proposed area #1 flows to the existing stormwater sewer on site which enter an existing basin along Livingston Avenue. The amount of area contributing flow to this existing basin within the proposed development has been reduced from 0.26 Acres to 0.23 Acres. The C-Value has been reduced from 0.99 to 0.68. Therefore, the hydrograph of the proposed area #1 is completely under the hydrograph of existing drainage area #1.

APPENDIX A: EXISTING CONDITIONS

IDF Curve Report



PRE-DEVELOPMENT DRAINAGE CONDITION

Existing Area #1

I. Total Drainage Area: 0.26 Acres

II. Soil Groups/Types: Type
B

III. Time of Concentration: 10 Minutes

IV. Rainfall Intensity:

<u>Storm</u>	<u>Rainfall(in.)</u>
100-YR	6.54
25-YR	5.65
10-YR	5.03
2-YR	3.81
1-YR	3.20

V. Weighted 'c' Calculation:

<u>Land Use</u>	<u>Area</u>	<u>% of Cover</u>	<u>C Value</u>	<u>Total</u>
Impervious	0.26 Acres	1.00	0.99	0.99
Gravel	0.00 Acres	0.00	0.76	0.00
Grass	0.00 Acres	0.00	0.25	0.00
Woods	0.00 Acres	0.00	0.45	0.00
Weighted 'c':				0.99

VI. $Q=ciA$

<u>Q=</u>	<u>c</u>	<u>I</u>	<u>A</u>	<u>=</u>	<u>Q</u>	<u>Reduction</u>	<u>QAllowed</u>
$Q_{100} =$	0.99	6.54	0.26	=	1.7	20%	1.3
$Q_{25} =$	0.99	5.65	0.26	=	1.5		
$Q_{10} =$	0.99	5.03	0.26	=	1.3	25%	1.0
$Q_2 =$	0.99	3.81	0.26	=	1.0	50%	0.5

PRE-DEVELOPMENT DRAINAGE CONDITION

Existing Area #2

I. Total Drainage Area: 7.31 Acres

II. Soil Groups/Types: Type
B

III. Time of Concentration: 25 Minutes

IV Rainfall Intensity:

<u>Storm</u>	<u>Rainfall(in.)</u>
100-YR	4.50
25-YR	3.83
10-YR	3.35
2-YR	2.43
1-YR	2.02

V. Weighted 'c' Calculation:

<u>Land Use</u>	<u>Area</u>	<u>% of Cover</u>	<u>C Value</u>	<u>Total</u>
Impervious	1.61 Acres	0.22	0.99	0.22
Gravel	0.00 Acres	0.00	0.76	0.00
Grass	0.00 Acres	0.00	0.25	0.00
Woods	5.70 Acres	0.78	0.45	0.35
			Weighted 'c':	0.57

VI. $Q=cIA$

$Q=$	c	I	A	$=$	Q	<u>Reduction</u>	<u>QAllowed</u>
$Q_{100}=$	0.57	4.50	7.31	=	18.8	20%	15.0
$Q_{25}=$	0.57	3.83	7.31	=	16.0		
$Q_{10}=$	0.57	3.35	7.31	=	14.0	25%	10.5
$Q_2=$	0.57	2.43	7.31	=	10.1	50%	5.1

APPENDIX B: PROPOSED CONDITIONS

POST DEVELOPMENT RUNOFF CONDITION

Proposed Area #1

I. Total Drainage Area: 0.23 Acres

II. Soil Groups/Types: Type
D

III. Time of Concentration: 10 Minutes

IV Rainfall Intensity:

<u>Storm</u>	<u>Rainfall(in.)</u>
100-YR	6.54
25-YR	5.65
10-YR	5.03
2-YR	3.81
1-YR	3.20

V. Weighted 'c' Calculation:

<u>Land Use</u>	<u>Area</u>	<u>% of Cover</u>	<u>C Value</u>	<u>Total</u>
Impervious	0.20 Acres	0.87	0.99	0.86
Gravel	0.00 Acres	0.00	0.84	0.00
Grass	0.03 Acres	0.13	0.65	0.08
Woods	0.00 Acres	0.00	0.59	0.00
Weighted 'c':				0.94

VI. $Q=ciA$

Q=	<u>c</u>	<u>I</u>	<u>A</u>	=	<u>Q</u>
Q ₁₀₀ =	0.94	6.54	0.23	=	1.41
Q ₂₅ =	0.94	5.65	0.23	=	1.22
Q ₁₀ =	0.94	5.03	0.23	=	1.09
Q ₂ =	0.94	3.81	0.23	=	0.82

POST DEVELOPMENT RUNOFF CONDITION

Proposed Area #2B

I. Total Drainage Area: 0.11 Acres

II. Soil Groups/Types: Type
D

III. Time of Concentration: 10 Minutes

IV Rainfall Intensity:

<u>Storm</u>	<u>Rainfall(in.)</u>
100-YR	6.54
25-YR	5.65
10-YR	5.03
2-YR	3.81
1-YR	3.20

V. Weighted 'c' Calculation:

<u>Land Use</u>	<u>Area</u>	<u>% of Cover</u>	<u>C Value</u>	<u>Total</u>
Impervious	0.09 Acres	0.82	0.99	0.81
Gravel	0.00 Acres	0.00	0.84	0.00
Grass	0.02 Acres	0.18	0.65	0.12
Woods	0.00 Acres	0.00	0.59	0.00
Weighted 'c':				0.93

VI. $Q=ciA$

$Q=$	c	I	A	$=$	Q
$Q_{100}=$	0.93	6.54	0.11	$=$	0.67
$Q_{25}=$	0.93	5.65	0.11	$=$	0.58
$Q_{10}=$	0.93	5.03	0.11	$=$	0.51
$Q_2=$	0.93	3.81	0.11	$=$	0.39

POST DEVELOPMENT RUNOFF CONDITION

Proposed Area #2C

I. Total Drainage Area: 0.11 Acres

II. Soil Groups/Types: Type
D

III. Time of Concentration: 10 Minutes

IV Rainfall Intensity:

<u>Storm</u>	<u>Rainfall(in.)</u>
100-YR	6.54
25-YR	5.65
10-YR	5.03
2-YR	3.81
1-YR	3.20

V. Weighted 'c' Calculation:

<u>Land Use</u>	<u>Area</u>	<u>% of Cover</u>	<u>C Value</u>	<u>Total</u>
Impervious	0.00 Acres	0.00	0.99	0.00
Gravel	0.00 Acres	0.00	0.84	0.00
Grass	0.11 Acres	1.00	0.65	0.65
Woods	0.00 Acres	0.00	0.59	0.00
			Weighted 'c':	0.65

VI. $Q=ciA$

<u>Q=</u>	<u>c</u>	<u>I</u>	<u>A</u>	<u>=</u>	<u>Q</u>
$Q_{100} =$	0.65	6.54	0.11	=	0.47
$Q_{25} =$	0.65	5.65	0.11	=	0.40
$Q_{10} =$	0.65	5.03	0.11	=	0.36
$Q_2 =$	0.65	3.81	0.11	=	0.27

POST DEVELOPMENT RUNOFF CONDITION

Proposed Area #2D

I. Total Drainage Area: 0.39 Acres

II. Soil Groups/Types: Type
D

III. Time of Concentration: 10 Minutes

IV Rainfall Intensity:

<u>Storm</u>	<u>Rainfall(in.)</u>
100-YR	6.54
25-YR	5.65
10-YR	5.03
2-YR	3.81
1-YR	3.20

V. Weighted 'c' Calculation:

<u>Land Use</u>	<u>Area</u>	<u>% of Cover</u>	<u>C Value</u>	<u>Total</u>
Impervious	0.00 Acres	0.00	0.99	0.00
Gravel	0.00 Acres	0.00	0.84	0.00
Grass	0.39 Acres	1.00	0.65	0.65
Woods	0.00 Acres	0.00	0.59	0.00
Weighted 'c':				0.65

VI. $Q=ciA$

$Q=$	c	I	A	$=$	Q
$Q_{100}=$	0.65	6.54	0.39	$=$	1.66
$Q_{25}=$	0.65	5.65	0.39	$=$	1.43
$Q_{10}=$	0.65	5.03	0.39	$=$	1.28
$Q_2=$	0.65	3.81	0.39	$=$	0.97

POST DEVELOPMENT RUNOFF CONDITION

Proposed Area #2E

I. Total Drainage Area: 0.11 Acres

II. Soil Groups/Types: Type
D

III. Time of Concentration: 10 Minutes

IV Rainfall Intensity:

<u>Storm</u>	<u>Rainfall(in.)</u>
100-YR	6.54
25-YR	5.65
10-YR	5.03
2-YR	3.81
1-YR	3.20

V. Weighted 'c' Calculation:

<u>Land Use</u>	<u>Area</u>	<u>% of Cover</u>	<u>C Value</u>	<u>Total</u>
Impervious	0.00 Acres	0.00	0.99	0.00
Gravel	0.00 Acres	0.00	0.84	0.00
Grass	0.11 Acres	1.00	0.65	0.65
Woods	0.00 Acres	0.00	0.59	0.00
Weighted 'c':				0.65

VI. $Q=ciA$

$Q=$	c	I	A	$=$	Q
$Q_{100}=$	0.65	6.54	0.11	$=$	0.47
$Q_{25}=$	0.65	5.65	0.11	$=$	0.40
$Q_{10}=$	0.65	5.03	0.11	$=$	0.36
$Q_2=$	0.65	3.81	0.11	$=$	0.27

Targets Values

Storm Event	Ex. Area #2	Pr. Area #2B, #2C, #2D & #2E	Target Flow
100 yr	15.0 -	3.3 =	11.7 cfs
25 yr			11.5 cfs
10 yr	10.5 -	2.5 =	8.0 cfs
2 yr	5.1 -	1.9 =	3.2 cfs

POST DEVELOPMENT RUNOFF CONDITION

Proposed Area #2A

I. Total Drainage Area: 6.62 Acres

II. Soil Groups/Types: Type
D

III. Time of Concentration: 20 Minutes

IV Rainfall Intensity:

<u>Storm</u>	<u>Rainfall(in.)</u>
100-YR	4.91
25-YR	4.21
10-YR	3.71
2-YR	2.74
1-YR	2.28

V. Weighted 'c' Calculation:

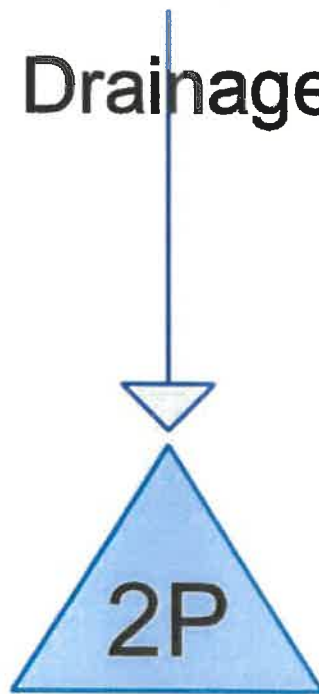
<u>Land Use</u>	<u>Area</u>	<u>% of Cover</u>	<u>C Value</u>	<u>Total</u>
Impervious	5.69 Acres	0.86	0.99	0.85
Gravel	0.00 Acres	0.00	0.84	0.00
Grass	0.93 Acres	0.14	0.65	0.09
Woods	0.00 Acres	0.00	0.59	0.00
Weighted 'c':				0.94

VI. $Q=ciA$

$Q=$	c	I	A	$=$	Q
$Q_{100}=$	0.94	4.91	6.62	$=$	30.6
$Q_{25}=$	0.94	4.21	6.62	$=$	26.2
$Q_{10}=$	0.94	3.71	6.62	$=$	23.1
$Q_2=$	0.94	2.74	6.62	$=$	17.1



Prop. Drainage Area



Basin 1



Quick TR-55 Ver.5.46 S/N:
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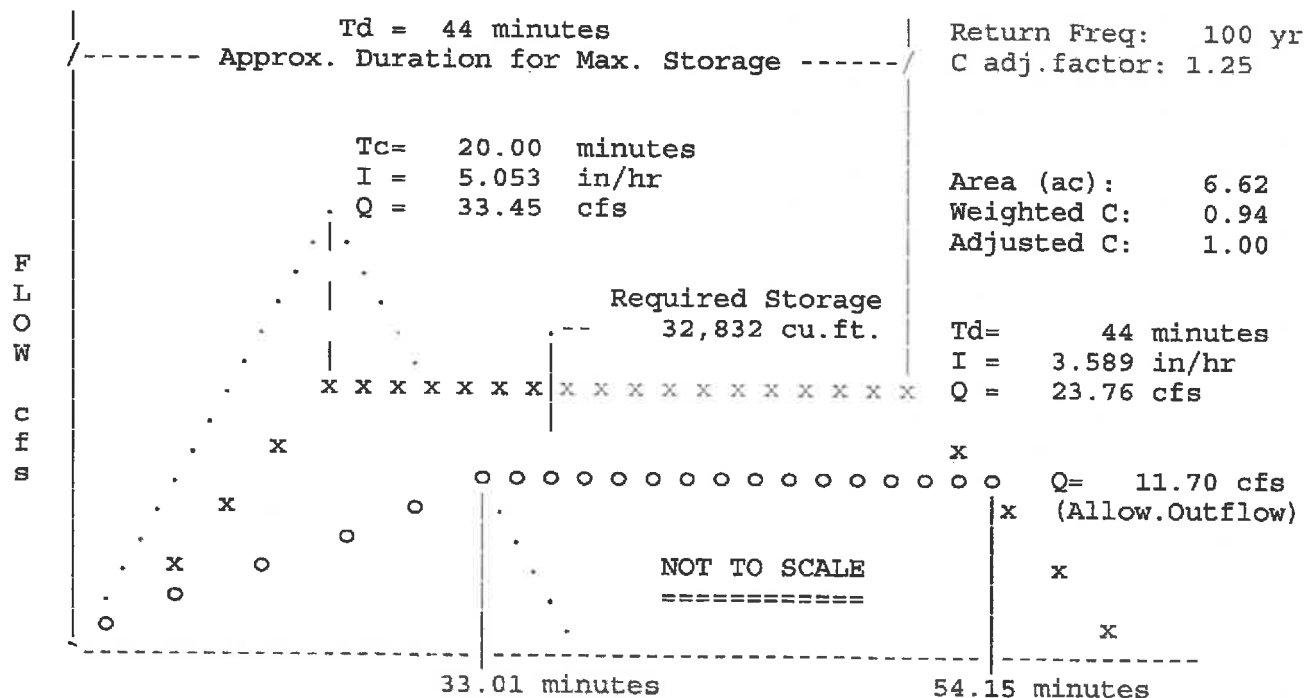
MODIFIED RATIONAL METHOD
 ---- Graphical Summary for Maximum Required Storage ----

First peak outflow point assumed to occur at Tc hydrograph recession leg.

Livingston Warehouse

 * RETURN FREQUENCY: 100 yr | Allowable Outflow: 11.70 cfs *
 * 'C' Adjustment: 1.250 | Required Storage: 32,832 cu.ft. *

 * Peak Inflow: 23.76 cfs | Inflow .HYD stored: NONE STORED *



Quick TR-55 Ver.5.46 S/N:
 Executed: 08:45:51 11-21-2019

Livingston Warehouse

**** Modified Rational Hydrograph ****

Weighted C = 0.942 Area= 6.620 acres Tc = 20.00 minutes

Adjusted C = 1.000 Td= 44.00 min. I= 3.59 in/hr Qp= 23.76 cfs

RETURN FREQUENCY: 100 year storm Adj.factor = 1.25

Output file: NONE STORED

HYDROGRAPH FOR MAXIMUM STORAGE

For the 100 Year Storm

Time Hours	Time increment = 0.017 Hours						
	Time on left represents time for first Q in each row.						
0.000	0.00	1.19	2.38	3.56	4.75	5.94	7.13
0.117	8.31	9.50	10.69	11.88	13.07	14.25	15.44
0.233	16.63	17.82	19.01	20.19	21.38	22.57	23.76
0.350	23.76	23.76	23.76	23.76	23.76	23.76	23.76
0.467	23.76	23.76	23.76	23.76	23.76	23.76	23.76
0.583	23.76	23.76	23.76	23.76	23.76	23.76	23.76
0.700	23.76	23.76	23.76	22.57	21.38	20.19	19.01
0.817	17.82	16.63	15.44	14.25	13.07	11.88	10.69
0.933	9.50	8.31	7.13	5.94	4.75	3.56	2.38
1.050	1.19	0.00					

Quick TR-55 Ver.5.46 S/N:
 Executed: 08:45:51 11-21-2019

Livingston Warehouse

* * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * *

$$Q = \text{adj} * C * I * A$$

Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
 adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 100 years
 'C' adjustment, k = 1.25
 Adj. 'C' = Wtd.'C' x 1.25

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
Impervious	0.990	5.69						
Pervious	0.650	0.93						
			20.00	0.942	1.000	5.053	6.62	33.45

Quick TR-55 Ver.5.46 S/N:
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MODIFIED RATIONAL METHOD
 ---- Summary for Single Storm Frequency ----

First peak outflow point assumed to occur at Tc hydrograph recession leg.

Livingston Warehouse

RETURN FREQUENCY: 100 yr 'C' Adjustment = 1.250 Allowable Q = 11.70 cfs

Hydrograph file: NONE STORED Tc = 20.00 minutes
 ::

						VOLUMES	
Weighted 'C'	Adjusted 'C'	Duration minutes	Intens. in/hr	Areas acres	Qpeak cfs	Inflow (cu.ft.)	Storage (cu.ft.)
0.942	1.000	20	5.053	6.62	33.45	40,144	26,104
0.942	1.000	30	4.200	6.62	27.80	50,047	29,486
0.942	1.000	40	3.763	6.62	24.91	59,792	32,553
***** Storage Maximum							
0.942	1.000	44	3.589	6.62	23.76	62,718	32,832

0.942	1.000	50	3.327	6.62	22.02	66,068	32,242
0.942	1.000	60	2.890	6.62	19.13	68,874	28,592
0.942	1.000	120	1.900	6.62	12.58	90,562	10,396

2018.047-ModRational-NEW

Prepared by Menlo Engineering Associates, Inc.

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Area Listing (selected nodes)

Area (acres)	C	Description (subcatchment-numbers)
0.930	0.65	(1S)
5.690	0.99	(1S)
6.620	0.94	TOTAL AREA

2018.047-ModRational-NEW

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100 Year Storm Event

Rainfall Duration=44 min, Inten=3.59 in/hr, Cf=1.25

Printed 11/21/2019

Time span=0.00-5.00 hrs, dt=0.01 hrs, 501 points

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Prop. Drainage Area Runoff Area=6.620 ac 85.95% Impervious Runoff Depth=2.63"
Tc=20.0 min Frequency Adjusted C=1.00 Runoff=23.96 cfs 1.452 af

Pond 2P: Basin 1 Peak Elev=118.86' Storage=51,158 cf Inflow=23.96 cfs 1.452 af
Outflow=11.60 cfs 0.905 af

Total Runoff Area = 6.620 ac Runoff Volume = 1.452 af Average Runoff Depth = 2.63"
14.05% Pervious = 0.930 ac 85.95% Impervious = 5.690 ac

2018.047-ModRational-NEW

100 Year Storm Event
Rainfall Duration=44 min, Inten=3.59 in/hr, Cf=1.25

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Summary for Subcatchment 1S: Prop. Drainage Area

Runoff = 23.96 cfs @ 0.34 hrs, Volume= 1.452 af, Depth= 2.63"

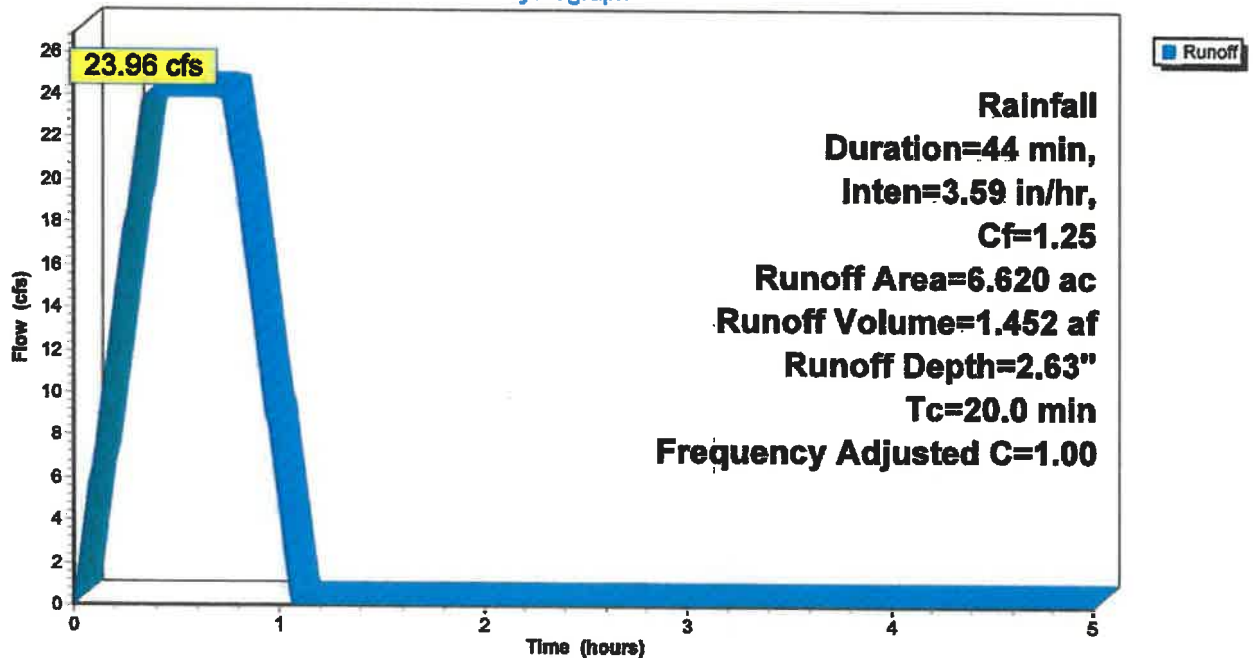
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Rainfall Duration=44 min, Inten=3.59 in/hr, Cf=1.25

Area (ac)	C	Adj	Description
0.930	0.65		
5.690	0.99		
6.620	0.94	1.00	Weighted Average, Frequency Adjusted
0.930			14.05% Pervious Area
5.690			85.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 1S: Prop. Drainage Area

Hydrograph



2018.047-ModRational-NEW

100 Year Storm Event
Rainfall Duration=44 min, Inten=3.59 in/hr, Cf=1.25

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Hydrograph for Subcatchment 1S: Prop. Drainage Area

<u>Time</u> <u>(hours)</u>	<u>Runoff</u> <u>(cfs)</u>	<u>Time</u> <u>(hours)</u>	<u>Runoff</u> <u>(cfs)</u>
0.00	0.00	2.60	0.00
0.05	3.59	2.65	0.00
0.10	7.19	2.70	0.00
0.15	10.78	2.75	0.00
0.20	14.38	2.80	0.00
0.25	17.97	2.85	0.00
0.30	21.57	2.90	0.00
0.35	23.96	2.95	0.00
0.40	23.96	3.00	0.00
0.45	23.96	3.05	0.00
0.50	23.96	3.10	0.00
0.55	23.96	3.15	0.00
0.60	23.96	3.20	0.00
0.65	23.96	3.25	0.00
0.70	23.96	3.30	0.00
0.75	22.77	3.35	0.00
0.80	19.17	3.40	0.00
0.85	15.58	3.45	0.00
0.90	11.98	3.50	0.00
0.95	8.39	3.55	0.00
1.00	4.79	3.60	0.00
1.05	1.20	3.65	0.00
1.10	0.00	3.70	0.00
1.15	0.00	3.75	0.00
1.20	0.00	3.80	0.00
1.25	0.00	3.85	0.00
1.30	0.00	3.90	0.00
1.35	0.00	3.95	0.00
1.40	0.00	4.00	0.00
1.45	0.00	4.05	0.00
1.50	0.00	4.10	0.00
1.55	0.00	4.15	0.00
1.60	0.00	4.20	0.00
1.65	0.00	4.25	0.00
1.70	0.00	4.30	0.00
1.75	0.00	4.35	0.00
1.80	0.00	4.40	0.00
1.85	0.00	4.45	0.00
1.90	0.00	4.50	0.00
1.95	0.00	4.55	0.00
2.00	0.00	4.60	0.00
2.05	0.00	4.65	0.00
2.10	0.00	4.70	0.00
2.15	0.00	4.75	0.00
2.20	0.00	4.80	0.00
2.25	0.00	4.85	0.00
2.30	0.00	4.90	0.00
2.35	0.00	4.95	0.00
2.40	0.00	5.00	0.00
2.45	0.00		
2.50	0.00		
2.55	0.00		

2018.047-ModRational-NEW100 Year Storm Event
Rainfall Duration=44 min, Inten=3.59 in/hr, Cf=1.25

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Summary for Pond 2P: Basin 1

Inflow Area = 6.620 ac, 85.95% Impervious, Inflow Depth = 2.63"
 Inflow = 23.96 cfs @ 0.34 hrs, Volume= 1.452 af
 Outflow = 11.60 cfs @ 0.91 hrs, Volume= 0.905 af, Atten= 52%, Lag= 33.9 min
 Primary = 11.60 cfs @ 0.91 hrs, Volume= 0.905 af

Routing by Stor-Ind method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
 Peak Elev= 118.86' @ 0.91 hrs Surf.Area= 16,156 sf Storage= 51,158 cf

Plug-Flow detention time= 93.3 min calculated for 0.903 af (62% of inflow)
 Center-of-Mass det. time= 84.7 min (116.7 - 32.0)

Volume	Invert	Avail.Storage	Storage Description
#1	114.50'	53,460 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
114.50	0	0	0
115.00	7,560	1,890	1,890
116.00	11,480	9,520	11,410
117.00	13,320	12,400	23,810
118.00	14,800	14,060	37,870
119.00	16,380	15,590	53,460

Device	Routing	Invert	Outlet Devices
#1	Primary	115.20'	6.0" Vert. Orifice/Grate C= 0.600
#2	Primary	118.10'	4.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s) 0.5' Crest Height

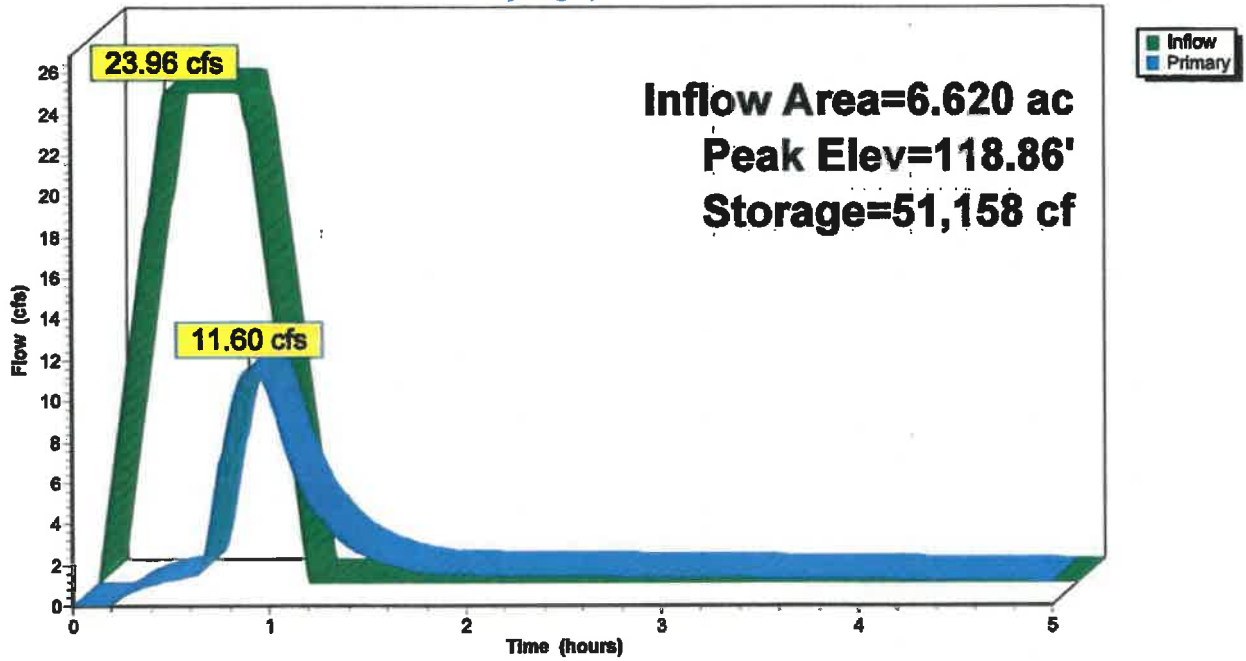
Primary OutFlow Max=11.60 cfs @ 0.91 hrs HW=118.86' (Free Discharge)

└1=Orifice/Grate (Orifice Controls 1.75 cfs @ 8.89 fps)

└2=Sharp-Crested Rectangular Weir (Weir Controls 9.85 cfs @ 3.38 fps)

Pond 2P: Basin 1

Hydrograph



2018.047-ModRational-NEW100 Year Storm Event
Rainfall Duration=44 min, Inten=3.59 in/hr, Cf=1.25

Prepared by Menlo Engineering Associates, Inc.

Printed 11/21/2019

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Hydrograph for Pond 2P: Basin 1

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	114.50	0.00
0.10	7.19	1,294	114.91	0.00
0.20	14.38	5,171	115.39	0.11
0.30	21.57	11,484	116.01	0.71
0.40	23.96	19,645	116.68	1.05
0.50	23.96	27,849	117.30	1.29
0.60	23.96	35,979	117.87	1.47
0.70	23.96	43,856	118.40	3.85
0.80	19.17	49,459	118.75	9.46
0.90	11.98	51,154	118.86	11.60
1.00	4.79	50,151	118.80	10.31
1.10	0.00	47,548	118.63	7.28
1.20	0.00	45,352	118.49	5.11
1.30	0.00	43,769	118.39	3.79
1.40	0.00	42,569	118.31	2.94
1.50	0.00	41,621	118.25	2.37
1.60	0.00	40,841	118.20	1.99
1.70	0.00	40,176	118.15	1.73
1.80	0.00	39,582	118.11	1.59
1.90	0.00	39,026	118.08	1.53
2.00	0.00	38,476	118.04	1.52
2.10	0.00	37,930	118.00	1.51
2.20	0.00	37,388	117.97	1.50
2.30	0.00	36,850	117.93	1.49
2.40	0.00	36,316	117.89	1.48
2.50	0.00	35,786	117.86	1.47
2.60	0.00	35,259	117.82	1.46
2.70	0.00	34,737	117.79	1.44
2.80	0.00	34,219	117.75	1.43
2.90	0.00	33,705	117.71	1.42
3.00	0.00	33,195	117.68	1.41
3.10	0.00	32,689	117.64	1.40
3.20	0.00	32,187	117.61	1.39
3.30	0.00	31,689	117.57	1.38
3.40	0.00	31,195	117.54	1.37
3.50	0.00	30,705	117.50	1.35
3.60	0.00	30,219	117.47	1.34
3.70	0.00	29,738	117.43	1.33
3.80	0.00	29,260	117.40	1.32
3.90	0.00	28,787	117.37	1.31
4.00	0.00	28,318	117.33	1.30
4.10	0.00	27,853	117.30	1.29
4.20	0.00	27,393	117.27	1.27
4.30	0.00	26,936	117.23	1.26
4.40	0.00	26,484	117.20	1.25
4.50	0.00	26,036	117.17	1.24
4.60	0.00	25,593	117.13	1.23
4.70	0.00	25,153	117.10	1.21
4.80	0.00	24,718	117.07	1.20
4.90	0.00	24,287	117.04	1.19
5.00	0.00	23,861	117.00	1.18

Quick TR-55 Ver.5.46 S/N:
 Executed: 08:45:51 11-21-2019

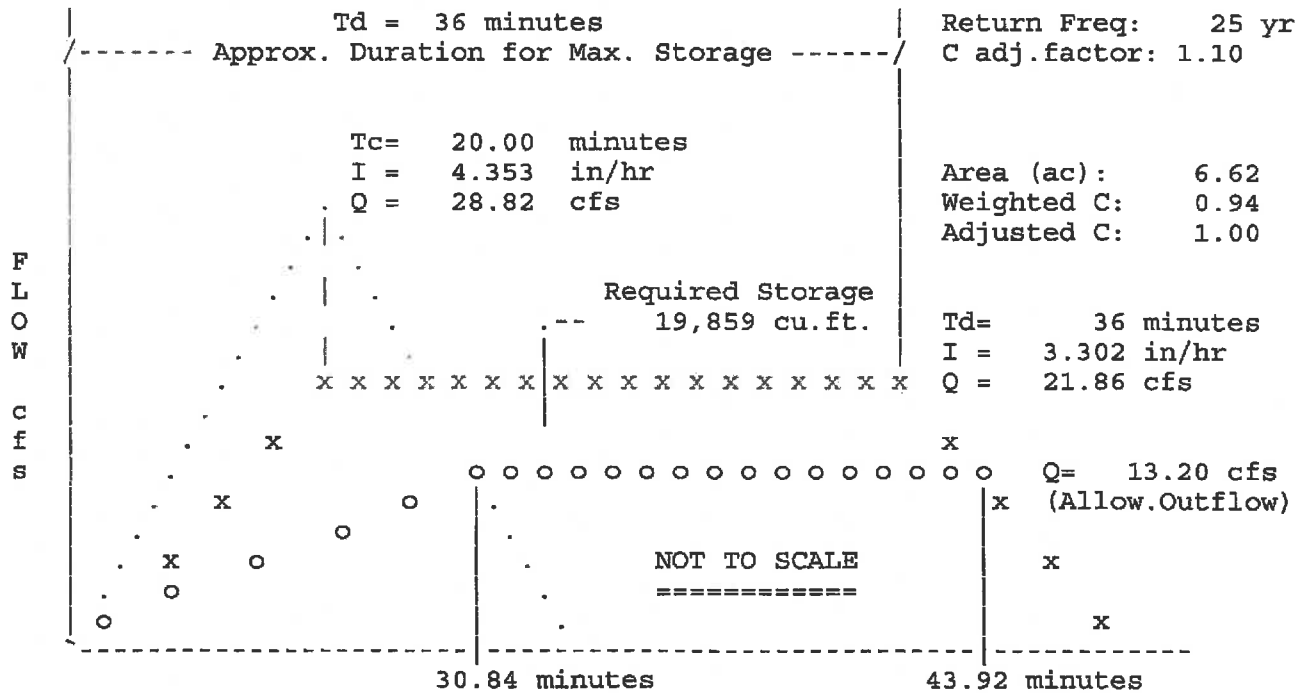
MODIFIED RATIONAL METHOD
 ---- Graphical Summary for Maximum Required Storage ----

First peak outflow point assumed to occur at Tc hydrograph recession leg.

Livingston Warehouse

```

*****
* RETURN FREQUENCY: 25 yr | Allowable Outflow: 13.20 cfs *
* 'C' Adjustment: 1.100 | Required Storage: 19,859 cu.ft. *
*-----*
* Peak Inflow: 21.86 cfs | Inflow .HYD stored: NONE STORED *
*****
  
```



Quick TR-55 Ver.5.46 S/N:
 Executed: 08:45:51 11-21-2019

Livingston Warehouse

**** Modified Rational Hydrograph ****
 Weighted C = 0.942 Area= 6.620 acres Tc = 20.00 minutes
 Adjusted C = 1.000 Td= 36.00 min. I= 3.30 in/hr Qp= 21.86 cfs
 RETURN FREQUENCY: 25 year storm Adj.factor = 1.10
 Output file: NONE STORED

HYDROGRAPH FOR MAXIMUM STORAGE
 For the 25 Year Storm

Time Hours	Time increment = 0.017 Hours						
	Time on left represents time for first Q in each row.						
0.000	0.00	1.09	2.19	3.28	4.37	5.46	6.56
0.117	7.65	8.74	9.84	10.93	12.02	13.12	14.21
0.233	15.30	16.39	17.49	18.58	19.67	20.77	21.86
0.350	21.86	21.86	21.86	21.86	21.86	21.86	21.86
0.467	21.86	21.86	21.86	21.86	21.86	21.86	21.86
0.583	21.86	21.86	20.77	19.67	18.58	17.49	16.39
0.700	15.30	14.21	13.12	12.02	10.93	9.84	8.74
0.817	7.65	6.56	5.46	4.37	3.28	2.19	1.09
0.933	0.00						

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 Executed: 08:45:51 11-21-2019

Livingston Warehouse

* * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * *

$$Q = \text{adj} * C * I * A$$

Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
 adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 25 years
 'C' adjustment, k = 1.1
 Adj. 'C' = Wtd.'C' x 1.1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
Impervious	0.990	5.69						
Pervious	0.650	0.93						
			20.00	0.942	1.000	4.353	6.62	28.82

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MODIFIED RATIONAL METHOD
 ---- Summary for Single Storm Frequency ----

First peak outflow point assumed to occur at Tc hydrograph recession leg.

Livingston Warehouse

RETURN FREQUENCY: 25 yr 'C' Adjustment = 1.100 Allowable Q = 13.20 cfs

Hydrograph file: NONE STORED Tc = 20.00 minutes
 ::

						VOLUMES	
Weighted 'C'	Adjusted 'C'	Duration minutes	Intens. in/hr	Areas acres	Qpeak cfs	Inflow (cu.ft.)	Storage (cu.ft.)
0.942	1.000	20	4.353	6.62	28.82	34,583	18,743
0.942	1.000	30	3.540	6.62	23.43	42,183	19,256

***** Storage Maximum
 0.942 1.000 36 3.302 6.62 21.86 | 47,216 19,859

0.942	1.000	40	3.143	6.62	20.81	49,941	19,658
0.942	1.000	50	2.747	6.62	18.18	54,549	17,071
0.942	1.000	60	2.350	6.62	15.56	56,005	11,578
0.942	1.000	120	1.500	6.62	9.93	Qpeak < Qallow	

2018.047-ModRational-NEW

25 Year Storm Event
 Rainfall Duration=36 min, Inten=3.30 in/hr, Cf=1.10

Prepared by Menlo Engineering Associates, Inc.

Printed 11/21/2019

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Summary for Subcatchment 1S: Prop. Drainage Area

Runoff = 22.03 cfs @ 0.34 hrs, Volume= 1.092 af, Depth= 1.98"

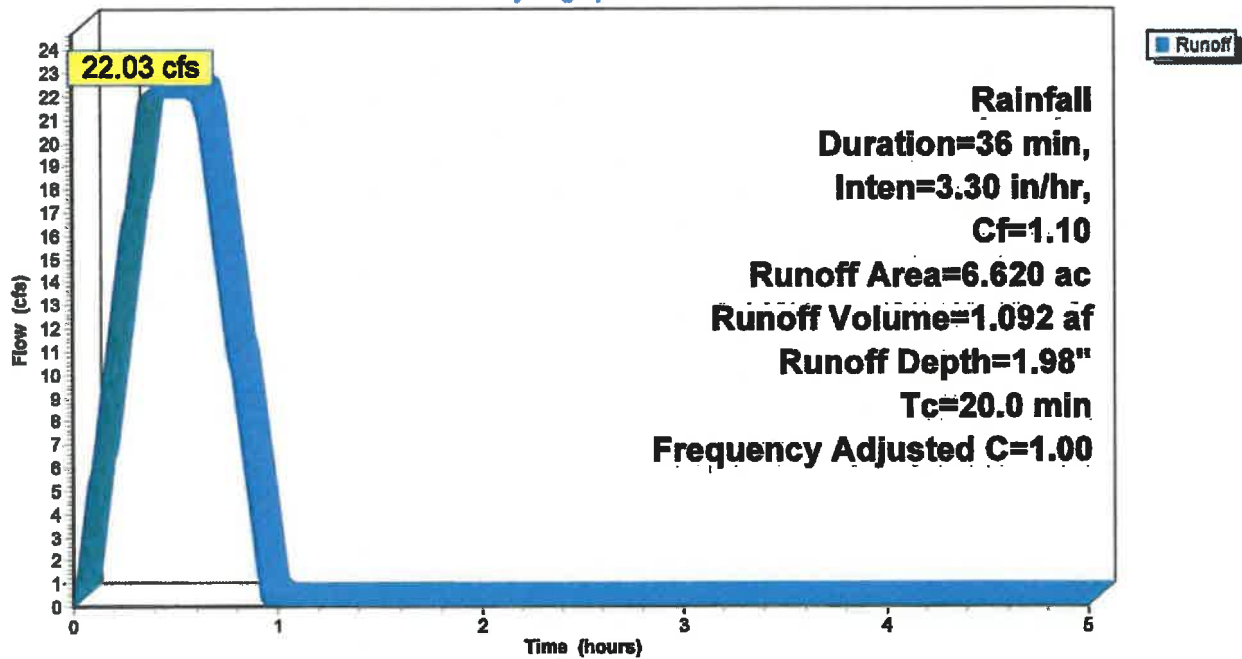
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
 Rainfall Duration=36 min, Inten=3.30 in/hr, Cf=1.10

Area (ac)	C	Adj	Description
0.930	0.65		
5.690	0.99		
6.620	0.94	1.00	Weighted Average, Frequency Adjusted
0.930			14.05% Pervious Area
5.690			85.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 1S: Prop. Drainage Area

Hydrograph



2018.047-ModRational-NEW

Prepared by Menlo Engineering Associates, Inc.

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25 Year Storm Event

Rainfall Duration=36 min, Inten=3.30 in/hr, Cf=1.10

Printed 11/21/2019

Hydrograph for Subcatchment 1S: Prop. Drainage Area

Time (hours)	Runoff (cfs)	Time (hours)	Runoff (cfs)
0.00	0.00	2.60	0.00
0.05	3.30	2.65	0.00
0.10	6.61	2.70	0.00
0.15	9.91	2.75	0.00
0.20	13.22	2.80	0.00
0.25	16.52	2.85	0.00
0.30	19.83	2.90	0.00
0.35	22.03	2.95	0.00
0.40	22.03	3.00	0.00
0.45	22.03	3.05	0.00
0.50	22.03	3.10	0.00
0.55	22.03	3.15	0.00
0.60	22.03	3.20	0.00
0.65	18.72	3.25	0.00
0.70	15.42	3.30	0.00
0.75	12.12	3.35	0.00
0.80	8.81	3.40	0.00
0.85	5.51	3.45	0.00
0.90	2.20	3.50	0.00
0.95	0.00	3.55	0.00
1.00	0.00	3.60	0.00
1.05	0.00	3.65	0.00
1.10	0.00	3.70	0.00
1.15	0.00	3.75	0.00
1.20	0.00	3.80	0.00
1.25	0.00	3.85	0.00
1.30	0.00	3.90	0.00
1.35	0.00	3.95	0.00
1.40	0.00	4.00	0.00
1.45	0.00	4.05	0.00
1.50	0.00	4.10	0.00
1.55	0.00	4.15	0.00
1.60	0.00	4.20	0.00
1.65	0.00	4.25	0.00
1.70	0.00	4.30	0.00
1.75	0.00	4.35	0.00
1.80	0.00	4.40	0.00
1.85	0.00	4.45	0.00
1.90	0.00	4.50	0.00
1.95	0.00	4.55	0.00
2.00	0.00	4.60	0.00
2.05	0.00	4.65	0.00
2.10	0.00	4.70	0.00
2.15	0.00	4.75	0.00
2.20	0.00	4.80	0.00
2.25	0.00	4.85	0.00
2.30	0.00	4.90	0.00
2.35	0.00	4.95	0.00
2.40	0.00	5.00	0.00
2.45	0.00		
2.50	0.00		
2.55	0.00		

2018.047-ModRational-NEW25 Year Storm Event
Rainfall Duration=36 min, Inten=3.30 in/hr, Cf=1.10

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Summary for Pond 2P: Basin 1

Inflow Area = 6.620 ac, 85.95% Impervious, Inflow Depth = 1.98"
 Inflow = 22.03 cfs @ 0.34 hrs, Volume= 1.092 af
 Outflow = 3.64 cfs @ 0.88 hrs, Volume= 0.584 af, Atten= 83%, Lag= 32.3 min
 Primary = 3.64 cfs @ 0.88 hrs, Volume= 0.584 af

Routing by Stor-Ind method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
 Peak Elev= 118.38' @ 0.88 hrs Surf.Area= 15,398 sf Storage= 43,580 cf

Plug-Flow detention time= 125.8 min calculated for 0.584 af (53% of inflow)
 Center-of-Mass det. time= 116.6 min (144.6 - 28.0)

Volume	Invert	Avail.Storage	Storage Description
#1	114.50'	53,460 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
114.50	0	0	0
115.00	7,560	1,890	1,890
116.00	11,480	9,520	11,410
117.00	13,320	12,400	23,810
118.00	14,800	14,060	37,870
119.00	16,380	15,590	53,460

Device	Routing	Invert	Outlet Devices
#1	Primary	115.20'	6.0" Vert. Orifice/Grate C= 0.600
#2	Primary	118.10'	4.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s) 0.5' Crest Height

Primary OutFlow Max=3.64 cfs @ 0.88 hrs HW=118.38' (Free Discharge)
 1=Orifice/Grate (Orifice Controls 1.62 cfs @ 8.24 fps)
 2=Sharp-Crested Rectangular Weir (Weir Controls 2.02 cfs @ 1.84 fps)

2018.047-ModRational-NEW

25 Year Storm Event
Rainfall Duration=36 min, Inten=3.30 in/hr, Cf=1.10

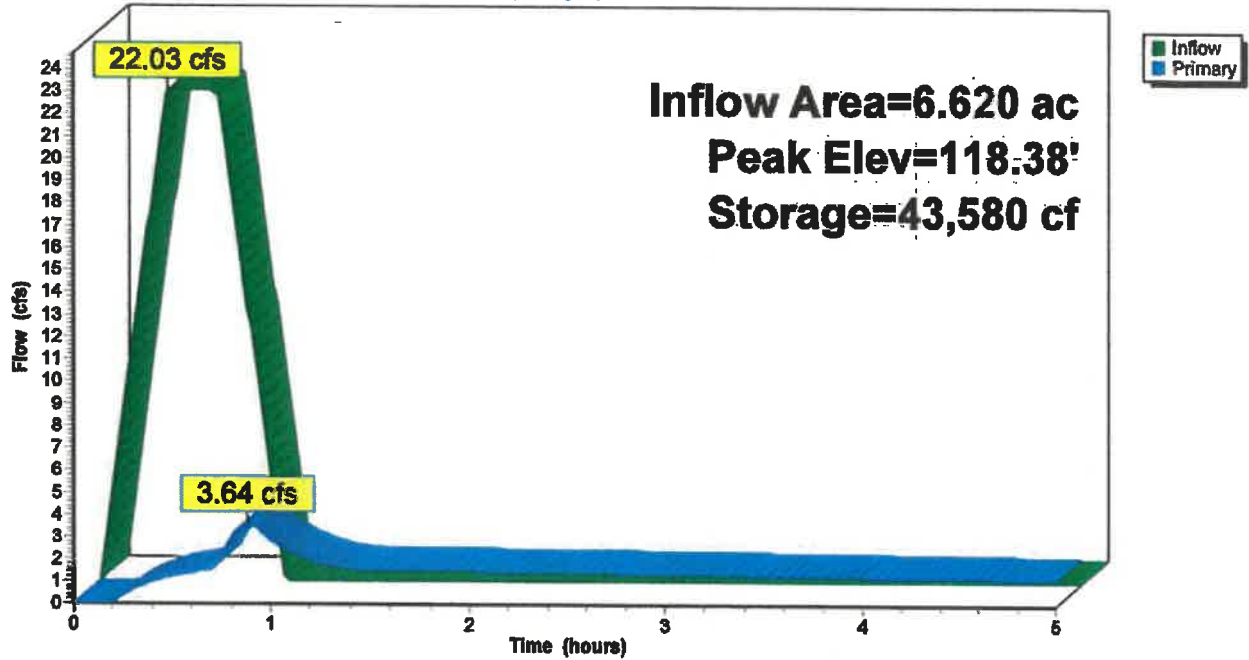
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Pond 2P: Basin 1

Hydrograph



2018.047-ModRational-NEW25 Year Storm Event
Rainfall Duration=36 min, Inten=3.30 in/hr, Cf=1.10

Prepared by Menlo Engineering Associates, Inc.

Printed 11/21/2019

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Hydrograph for Pond 2P: Basin 1

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	114.50	0.00
0.10	6.61	1,190	114.90	0.00
0.20	13.22	4,756	115.35	0.06
0.30	19.83	10,568	115.93	0.65
0.40	22.03	18,063	116.55	0.99
0.50	22.03	25,591	117.13	1.23
0.60	22.03	33,046	117.67	1.41
0.70	15.42	39,254	118.09	1.54
0.80	8.81	42,800	118.33	3.09
0.90	2.20	43,525	118.37	3.60
1.00	0.00	42,489	118.31	2.89
1.10	0.00	41,556	118.25	2.33
1.20	0.00	40,787	118.20	1.96
1.30	0.00	40,128	118.15	1.71
1.40	0.00	39,538	118.11	1.58
1.50	0.00	38,983	118.07	1.53
1.60	0.00	38,434	118.04	1.52
1.70	0.00	37,888	118.00	1.51
1.80	0.00	37,346	117.96	1.50
1.90	0.00	36,809	117.93	1.49
2.00	0.00	36,275	117.89	1.48
2.10	0.00	35,745	117.86	1.47
2.20	0.00	35,219	117.82	1.46
2.30	0.00	34,697	117.78	1.44
2.40	0.00	34,179	117.75	1.43
2.50	0.00	33,665	117.71	1.42
2.60	0.00	33,156	117.68	1.41
2.70	0.00	32,650	117.64	1.40
2.80	0.00	32,148	117.61	1.39
2.90	0.00	31,650	117.57	1.38
3.00	0.00	31,157	117.54	1.37
3.10	0.00	30,667	117.50	1.35
3.20	0.00	30,182	117.47	1.34
3.30	0.00	29,701	117.43	1.33
3.40	0.00	29,224	117.40	1.32
3.50	0.00	28,751	117.36	1.31
3.60	0.00	28,282	117.33	1.30
3.70	0.00	27,818	117.30	1.28
3.80	0.00	27,357	117.26	1.27
3.90	0.00	26,901	117.23	1.26
4.00	0.00	26,449	117.20	1.25
4.10	0.00	26,002	117.16	1.24
4.20	0.00	25,559	117.13	1.23
4.30	0.00	25,119	117.10	1.21
4.40	0.00	24,685	117.07	1.20
4.50	0.00	24,254	117.03	1.19
4.60	0.00	23,828	117.00	1.18
4.70	0.00	23,407	116.97	1.17
4.80	0.00	22,989	116.94	1.15
4.90	0.00	22,576	116.91	1.14
5.00	0.00	22,168	116.88	1.13

Quick TR-55 Ver.5.46 S/N:
 Executed: 08:45:51 11-21-2019

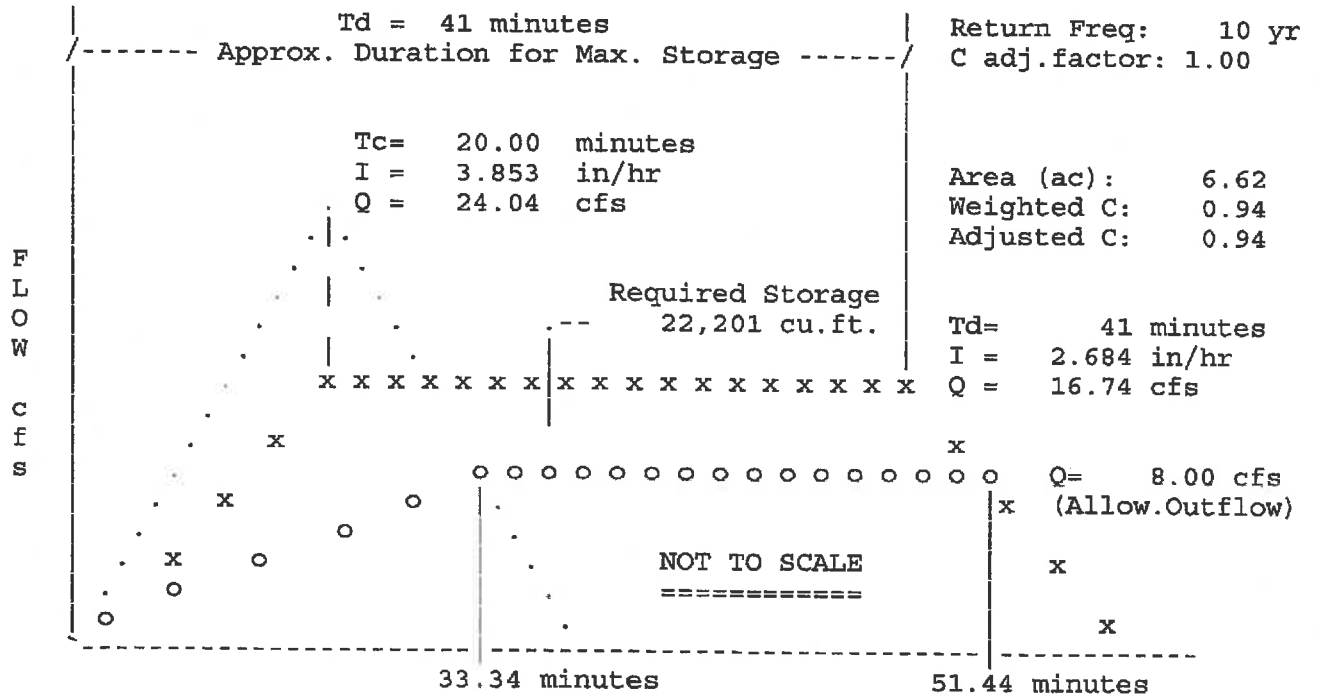
MODIFIED RATIONAL METHOD
 ---- Graphical Summary for Maximum Required Storage ----

First peak outflow point assumed to occur at Tc hydrograph recession leg.

Livingston Warehouse

 * RETURN FREQUENCY: 10 yr | Allowable Outflow: 8.00 cfs *
 * 'C' Adjustment: 1.000 | Required Storage: 22,201 cu.ft. *

 * Peak Inflow: 16.74 cfs Inflow .HYD stored: NONE STORED *



Quick TR-55 Ver.5.46 S/N:
 Executed: 08:45:51 11-21-2019

Livingston Warehouse

**** Modified Rational Hydrograph ****

Weighted C = 0.942 Area= 6.620 acres Tc = 20.00 minutes

Adjusted C = 0.942 Td= 41.00 min. I= 2.68 in/hr Qp= 16.74 cfs

RETURN FREQUENCY: 10 year storm Adj.factor = 1.00

Output file: NONE STORED

HYDROGRAPH FOR MAXIMUM STORAGE
 For the 10 Year Storm

Time increment = 0.017 Hours
 Time on left represents time for first Q in each row.

Time Hours	Time on left represents time for first Q in each row.						
0.000	0.00	0.84	1.67	2.51	3.35	4.19	5.02
0.117	5.86	6.70	7.53	8.37	9.21	10.05	10.88
0.233	11.72	12.56	13.39	14.23	15.07	15.90	16.74
0.350	16.74	16.74	16.74	16.74	16.74	16.74	16.74
0.467	16.74	16.74	16.74	16.74	16.74	16.74	16.74
0.583	16.74	16.74	16.74	16.74	16.74	16.74	16.74
0.700	15.90	15.07	14.23	13.39	12.56	11.72	10.88
0.817	10.05	9.21	8.37	7.53	6.70	5.86	5.02
0.933	4.19	3.35	2.51	1.67	0.84	0.00	

Quick TR-55 Ver.5.46 S/N:
 Executed: 08:45:51 11-21-2019

Livingston Warehouse

* * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * *

$$Q = \text{adj} * C * I * A$$

Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
 adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
 'C' adjustment, k = 1
 Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
Impervious	0.990	5.69						
Pervious	0.650	0.93						
			20.00	0.942	0.942	3.853	6.62	24.04

Quick TR-55 Ver.5.46 S/N:
 Executed: 08:45:51 11-21-2019

MODIFIED RATIONAL METHOD
 ---- Summary for Single Storm Frequency ----

First peak outflow point assumed to occur at Tc hydrograph recession leg.

Livingston Warehouse

RETURN FREQUENCY: 10 yr 'C' Adjustment = 1.000 Allowable Q = 8.00 cfs

Hydrograph file: NONE STORED Tc = 20.00 minutes

.....

						VOLUMES	
Weighted 'C'	Adjusted 'C'	Duration minutes	Intens. in/hr	Areas acres	Qpeak cfs	Inflow (cu.ft.)	Storage (cu.ft.)
0.942	0.942	20	3.853	6.62	24.04	28,843	19,243
0.942	0.942	30	3.080	6.62	19.21	34,581	20,582
0.942	0.942	40	2.720	6.62	16.97	40,719	22,185
***** Storage Maximum							
0.942	0.942	41	2.684	6.62	16.74	41,185	22,201

0.942	0.942	50	2.360	6.62	14.72	44,162	21,173
0.942	0.942	60	2.000	6.62	12.48	44,911	17,591
0.942	0.942	120	1.260	6.62	7.86	Qpeak < Qallow	

2018.047-ModRational-NEW

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10 Year Storm Event

Rainfall Duration=41 min, Inten=2.68 in/hr

Printed 11/21/2019

Summary for Subcatchment 1S: Prop. Drainage Area

Runoff = 16.82 cfs @ 0.34 hrs, Volume= 0.950 af, Depth= 1.72"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs

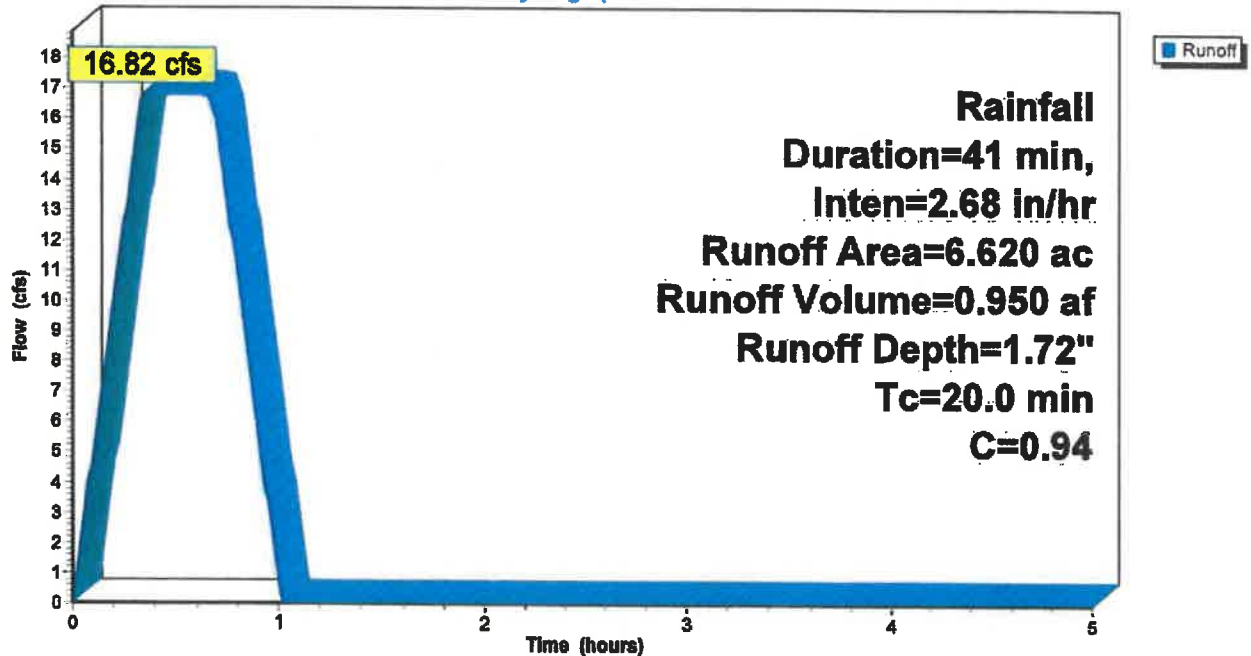
Rainfall Duration=41 min, Inten=2.68 in/hr

Area (ac)	C	Description
0.930	0.65	
5.690	0.99	
6.620	0.94	Weighted Average
0.930		14.05% Pervious Area
5.690		85.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 1S: Prop. Drainage Area

Hydrograph



2018.047-ModRational-NEW

Prepared by Menlo Engineering Associates, Inc.

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10 Year Storm Event

Rainfall Duration=41 min, Inten=2.68 in/hr

Printed 11/21/2019

Hydrograph for Subcatchment 1S: Prop. Drainage Area

Time (hours)	Runoff (cfs)	Time (hours)	Runoff (cfs)
0.00	0.00	2.60	0.00
0.05	2.52	2.65	0.00
0.10	5.04	2.70	0.00
0.15	7.57	2.75	0.00
0.20	10.09	2.80	0.00
0.25	12.61	2.85	0.00
0.30	15.13	2.90	0.00
0.35	16.82	2.95	0.00
0.40	16.82	3.00	0.00
0.45	16.82	3.05	0.00
0.50	16.82	3.10	0.00
0.55	16.82	3.15	0.00
0.60	16.82	3.20	0.00
0.65	16.82	3.25	0.00
0.70	15.98	3.30	0.00
0.75	13.45	3.35	0.00
0.80	10.93	3.40	0.00
0.85	8.41	3.45	0.00
0.90	5.89	3.50	0.00
0.95	3.36	3.55	0.00
1.00	0.84	3.60	0.00
1.05	0.00	3.65	0.00
1.10	0.00	3.70	0.00
1.15	0.00	3.75	0.00
1.20	0.00	3.80	0.00
1.25	0.00	3.85	0.00
1.30	0.00	3.90	0.00
1.35	0.00	3.95	0.00
1.40	0.00	4.00	0.00
1.45	0.00	4.05	0.00
1.50	0.00	4.10	0.00
1.55	0.00	4.15	0.00
1.60	0.00	4.20	0.00
1.65	0.00	4.25	0.00
1.70	0.00	4.30	0.00
1.75	0.00	4.35	0.00
1.80	0.00	4.40	0.00
1.85	0.00	4.45	0.00
1.90	0.00	4.50	0.00
1.95	0.00	4.55	0.00
2.00	0.00	4.60	0.00
2.05	0.00	4.65	0.00
2.10	0.00	4.70	0.00
2.15	0.00	4.75	0.00
2.20	0.00	4.80	0.00
2.25	0.00	4.85	0.00
2.30	0.00	4.90	0.00
2.35	0.00	4.95	0.00
2.40	0.00	5.00	0.00
2.45	0.00		
2.50	0.00		
2.55	0.00		

2018.047-ModRational-NEW

Prepared by Menlo Engineering Associates, Inc.

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10 Year Storm Event

Rainfall Duration=41 min, Inten=2.68 in/hr

Printed 11/21/2019

Summary for Pond 2P: Basin 1

Inflow Area = 6.620 ac, 85.95% Impervious, Inflow Depth = 1.72"
 Inflow = 16.82 cfs @ 0.34 hrs, Volume= 0.950 af
 Outflow = 1.52 cfs @ 0.99 hrs, Volume= 0.498 af, Atten= 91%, Lag= 38.8 min
 Primary = 1.52 cfs @ 0.99 hrs, Volume= 0.498 af

Routing by Stor-Ind method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
 Peak Elev= 118.03' @ 0.99 hrs Surf.Area= 14,841 sf Storage= 38,252 cf

Plug-Flow detention time= 134.1 min calculated for 0.498 af (52% of inflow)
 Center-of-Mass det. time= 123.6 min (154.1 - 30.5)

Volume	Invert	Avail.Storage	Storage Description
#1	114.50'	53,460 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
114.50	0	0	0
115.00	7,560	1,890	1,890
116.00	11,480	9,520	11,410
117.00	13,320	12,400	23,810
118.00	14,800	14,060	37,870
119.00	16,380	15,590	53,460

Device	Routing	Invert	Outlet Devices
#1	Primary	115.20'	6.0" Vert. Orifice/Grate C= 0.600
#2	Primary	118.10'	4.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s) 0.5' Crest Height

Primary OutFlow Max=1.52 cfs @ 0.99 hrs HW=118.03' (Free Discharge)

1=Orifice/Grate (Orifice Controls 1.52 cfs @ 7.73 fps)
 2=Sharp-Crested Rectangular Weir (Controls 0.00 cfs)

2018.047-ModRational-NEW

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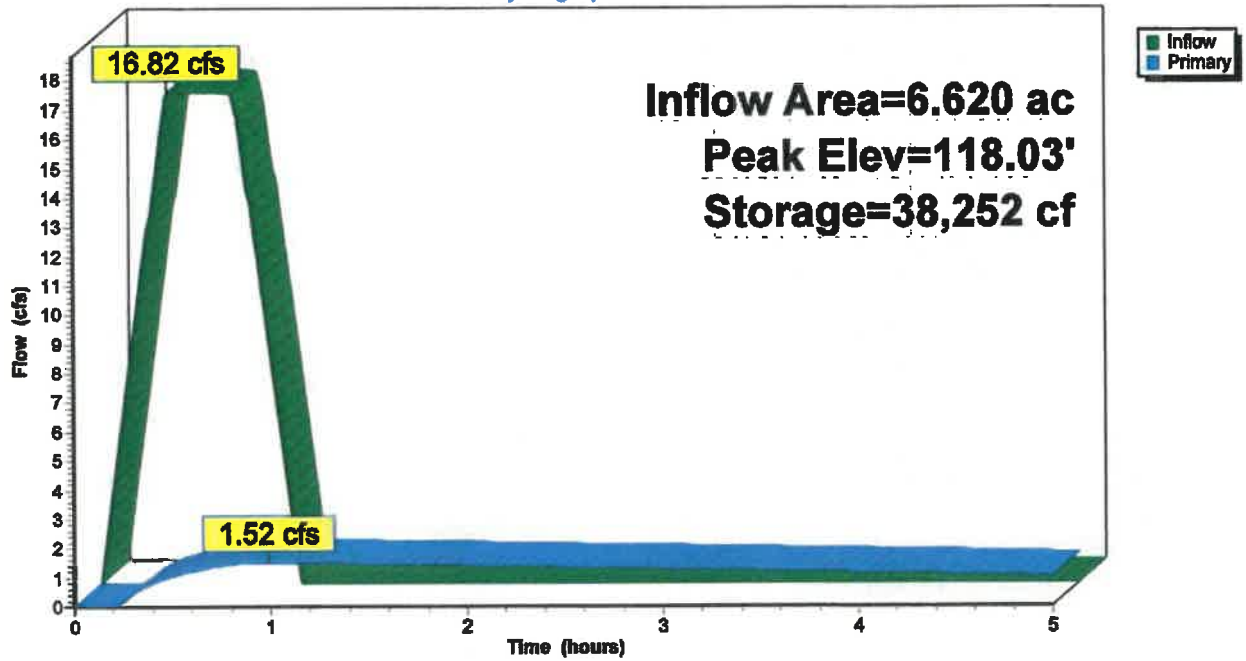
10 Year Storm Event

Rainfall Duration=41 min, Inten=2.68 in/hr

Printed 11/21/2019

Pond 2P: Basin 1

Hydrograph



2018.047-ModRational-NEW

Prepared by Menlo Engineering Associates, Inc.

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10 Year Storm Event
Rainfall Duration=41 min, Inten=2.68 in/hr

Printed 11/21/2019

Hydrograph for Pond 2P: Basin 1

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	114.50	0.00
0.10	5.04	908	114.85	0.00
0.20	10.09	3,632	115.22	0.00
0.30	15.13	8,104	115.70	0.47
0.40	16.82	13,816	116.21	0.82
0.50	16.82	19,531	116.67	1.04
0.60	16.82	25,177	117.10	1.22
0.70	15.98	30,740	117.51	1.36
0.80	10.93	35,076	117.81	1.45
0.90	5.89	37,570	117.98	1.50
1.00	0.84	38,236	118.02	1.52
1.10	0.00	37,719	117.99	1.51
1.20	0.00	37,178	117.95	1.50
1.30	0.00	36,642	117.92	1.48
1.40	0.00	36,109	117.88	1.47
1.50	0.00	35,581	117.84	1.46
1.60	0.00	35,056	117.81	1.45
1.70	0.00	34,535	117.77	1.44
1.80	0.00	34,019	117.74	1.43
1.90	0.00	33,506	117.70	1.42
2.00	0.00	32,998	117.67	1.41
2.10	0.00	32,493	117.63	1.40
2.20	0.00	31,993	117.59	1.38
2.30	0.00	31,496	117.56	1.37
2.40	0.00	31,004	117.52	1.36
2.50	0.00	30,516	117.49	1.35
2.60	0.00	30,032	117.46	1.34
2.70	0.00	29,552	117.42	1.33
2.80	0.00	29,076	117.39	1.32
2.90	0.00	28,604	117.35	1.30
3.00	0.00	28,137	117.32	1.29
3.10	0.00	27,674	117.29	1.28
3.20	0.00	27,215	117.25	1.27
3.30	0.00	26,760	117.22	1.26
3.40	0.00	26,310	117.19	1.25
3.50	0.00	25,863	117.15	1.23
3.60	0.00	25,421	117.12	1.22
3.70	0.00	24,984	117.09	1.21
3.80	0.00	24,550	117.06	1.20
3.90	0.00	24,121	117.02	1.19
4.00	0.00	23,696	116.99	1.17
4.10	0.00	23,276	116.96	1.16
4.20	0.00	22,860	116.93	1.15
4.30	0.00	22,448	116.90	1.14
4.40	0.00	22,041	116.87	1.12
4.50	0.00	21,638	116.84	1.11
4.60	0.00	21,240	116.80	1.10
4.70	0.00	20,846	116.77	1.09
4.80	0.00	20,457	116.74	1.08
4.90	0.00	20,072	116.71	1.06
5.00	0.00	19,692	116.68	1.05

Quick TR-55 Ver.5.46 S/N:
 Executed: 08:45:51 11-21-2019

MODIFIED RATIONAL METHOD

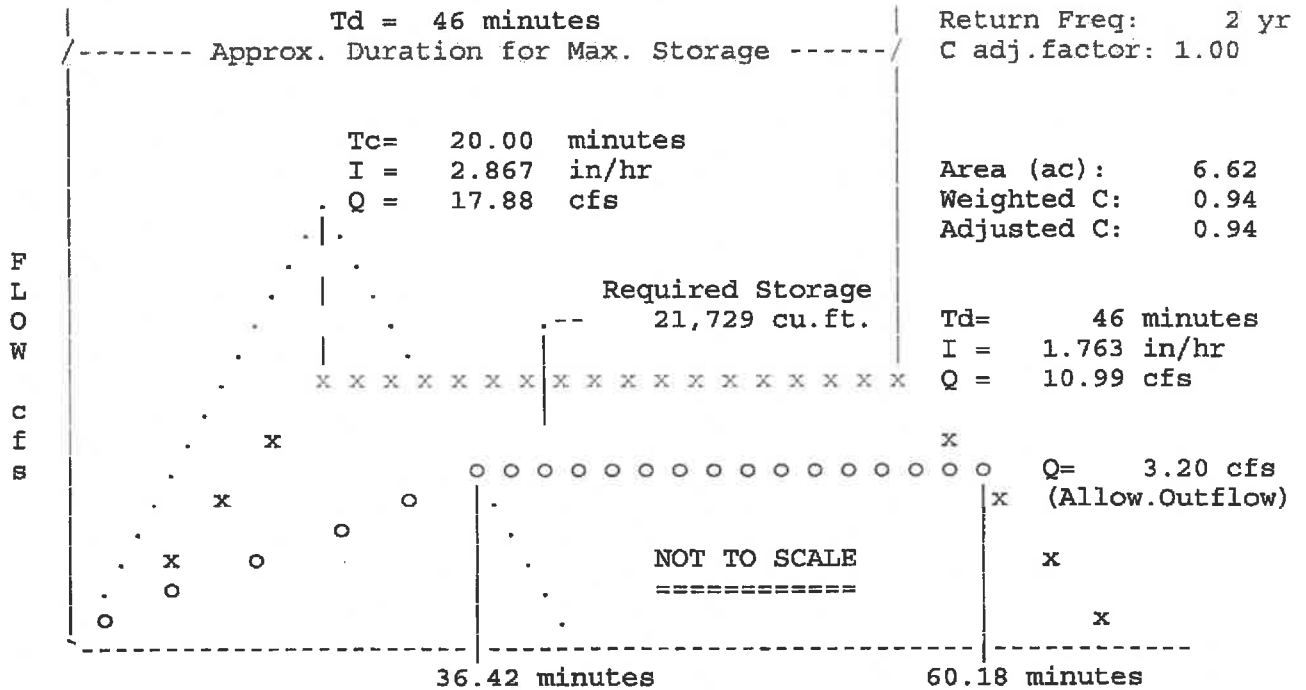
---- Graphical Summary for Maximum Required Storage ----

First peak outflow point assumed to occur at Tc hydrograph recession leg.

Livingston Warehouse

```

*****
* RETURN FREQUENCY: 2 yr | Allowable Outflow: 3.20 cfs *
* 'C' Adjustment: 1.000 | Required Storage: 21,729 cu.ft. *
*-----*
* Peak Inflow: 10.99 cfs | Inflow .HYD stored: NONE STORED *
*****
  
```



Quick TR-55 Ver.5.46 S/N:
 Executed: 08:45:51 11-21-2019

Livingston Warehouse

**** Modified Rational Hydrograph ****
 Weighted C = 0.942 Area= 6.620 acres Tc = 20.00 minutes
 Adjusted C = 0.942 Td= 46.00 min. I= 1.76 in/hr Qp= 10.99 cfs
 RETURN FREQUENCY: 2 year storm Adj.factor = 1.00
 Output file: NONE STORED

HYDROGRAPH FOR MAXIMUM STORAGE
 For the 2 Year Storm

Time Hours	Time increment = 0.017 Hours Time on left represents time for first Q in each row.						
0.000	0.00	0.55	1.10	1.65	2.20	2.75	3.30
0.117	3.85	4.40	4.95	5.50	6.05	6.60	7.15
0.233	7.70	8.25	8.80	9.35	9.90	10.45	10.99
0.350	10.99	10.99	10.99	10.99	10.99	10.99	10.99
0.467	10.99	10.99	10.99	10.99	10.99	10.99	10.99
0.583	10.99	10.99	10.99	10.99	10.99	10.99	10.99
0.700	10.99	10.99	10.99	10.99	10.99	10.45	9.90
0.817	9.35	8.80	8.25	7.70	7.15	6.60	6.05
0.933	5.50	4.95	4.40	3.85	3.30	2.75	2.20
1.050	1.65	1.10	0.55	0.00			

Quick TR-55 Ver.5.46 S/N:
 Executed: 08:45:51 11-21-2019

Livingston Warehouse

* * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * *

$$Q = \text{adj} * C * I * A$$

Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
 adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 2 years
 'C' adjustment, k = 1
 Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
Impervious	0.990	5.69						
Pervious	0.650	0.93						
			20.00	0.942	0.942	2.867	6.62	17.88

Quick TR-55 Ver.5.46 S/N:
 Executed: 08:45:51 11-21-2019

MODIFIED RATIONAL METHOD
 ---- Summary for Single Storm Frequency ----

First peak outflow point assumed to occur at Tc hydrograph recession leg.

Livingston Warehouse

RETURN FREQUENCY: 2 yr 'C' Adjustment = 1.000 Allowable Q = 3.20 cfs

Hydrograph file: NONE STORED Tc = 20.00 minutes
 :::

						VOLUMES	
Weighted 'C'	Adjusted 'C'	Duration minutes	Intens. in/hr	Areas acres	Qpeak cfs	Inflow (cu.ft.)	Storage (cu.ft.)
0.942	0.942	20	2.867	6.62	17.88	21,457	17,617
0.942	0.942	30	2.200	6.62	13.72	24,701	19,045
0.942	0.942	40	1.927	6.62	12.02	28,843	21,330
*****						Storage Maximum	
0.942	0.942	46	1.763	6.62	10.99	30,346	21,729

0.942	0.942	50	1.653	6.62	10.31	30,938	21,591
0.942	0.942	60	1.380	6.62	8.61	30,988	19,839
0.942	0.942	120	0.850	6.62	5.30	38,174	15,949

2018.047-ModRational-NEW

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2 Year Storm Event
Rainfall Duration=46 min, Inten=1.76 in/hr

Printed 11/21/2019

Summary for Subcatchment 1S: Prop. Drainage Area

Runoff = 11.04 cfs @ 0.34 hrs, Volume= 0.700 af, Depth= 1.27"

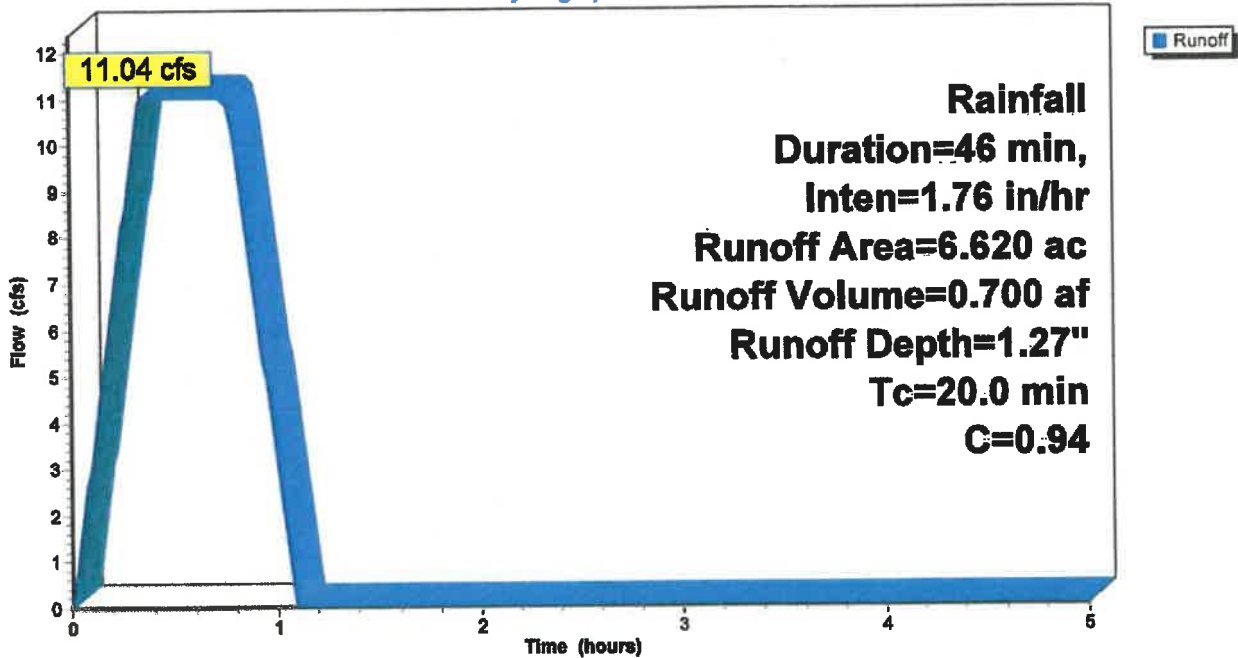
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Rainfall Duration=46 min, Inten=1.76 in/hr

Area (ac)	C	Description
0.930	0.65	
5.690	0.99	
6.620	0.94	Weighted Average
0.930		14.05% Pervious Area
5.690		85.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 1S: Prop. Drainage Area

Hydrograph



2018.047-ModRational-NEW

Prepared by Menlo Engineering Associates, Inc.

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2 Year Storm Event

Rainfall Duration=46 min, Inten=1.76 in/hr

Printed 11/21/2019

Hydrograph for Subcatchment 1S: Prop. Drainage Area

Time (hours)	Runoff (cfs)	Time (hours)	Runoff (cfs)
0.00	0.00	2.60	0.00
0.05	1.66	2.65	0.00
0.10	3.31	2.70	0.00
0.15	4.97	2.75	0.00
0.20	6.63	2.80	0.00
0.25	8.28	2.85	0.00
0.30	9.94	2.90	0.00
0.35	11.04	2.95	0.00
0.40	11.04	3.00	0.00
0.45	11.04	3.05	0.00
0.50	11.04	3.10	0.00
0.55	11.04	3.15	0.00
0.60	11.04	3.20	0.00
0.65	11.04	3.25	0.00
0.70	11.04	3.30	0.00
0.75	11.04	3.35	0.00
0.80	9.94	3.40	0.00
0.85	8.28	3.45	0.00
0.90	6.63	3.50	0.00
0.95	4.97	3.55	0.00
1.00	3.31	3.60	0.00
1.05	1.66	3.65	0.00
1.10	0.00	3.70	0.00
1.15	0.00	3.75	0.00
1.20	0.00	3.80	0.00
1.25	0.00	3.85	0.00
1.30	0.00	3.90	0.00
1.35	0.00	3.95	0.00
1.40	0.00	4.00	0.00
1.45	0.00	4.05	0.00
1.50	0.00	4.10	0.00
1.55	0.00	4.15	0.00
1.60	0.00	4.20	0.00
1.65	0.00	4.25	0.00
1.70	0.00	4.30	0.00
1.75	0.00	4.35	0.00
1.80	0.00	4.40	0.00
1.85	0.00	4.45	0.00
1.90	0.00	4.50	0.00
1.95	0.00	4.55	0.00
2.00	0.00	4.60	0.00
2.05	0.00	4.65	0.00
2.10	0.00	4.70	0.00
2.15	0.00	4.75	0.00
2.20	0.00	4.80	0.00
2.25	0.00	4.85	0.00
2.30	0.00	4.90	0.00
2.35	0.00	4.95	0.00
2.40	0.00	5.00	0.00
2.45	0.00		
2.50	0.00		
2.55	0.00		

2018.047-ModRational-NEW

2 Year Storm Event
Rainfall Duration=46 min, Inten=1.76 in/hr

Prepared by Menlo Engineering Associates, Inc.

Printed 11/21/2019

HydroCAD® 10.00-24 s/n 01129 © 2018 HydroCAD Software Solutions LLC

Summary for Pond 2P: Basin 1

Inflow Area = 6.620 ac, 85.95% Impervious, Inflow Depth = 1.27"
Inflow = 11.04 cfs @ 0.34 hrs, Volume= 0.700 af
Outflow = 1.28 cfs @ 1.06 hrs, Volume= 0.400 af, Atten= 88%, Lag= 43.3 min
Primary = 1.28 cfs @ 1.06 hrs, Volume= 0.400 af

Routing by Stor-Ind method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Peak Elev= 117.29' @ 1.06 hrs Surf.Area= 13,752 sf Storage= 27,759 cf

Plug-Flow detention time= 130.5 min calculated for 0.399 af (57% of inflow)
Center-of-Mass det. time= 120.3 min (153.3 - 33.0)

Volume	Invert	Avail.Storage	Storage Description
#1	114.50'	53,460 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
114.50	0	0	0
115.00	7,560	1,890	1,890
116.00	11,480	9,520	11,410
117.00	13,320	12,400	23,810
118.00	14,800	14,060	37,870
119.00	16,380	15,590	53,460

Device	Routing	Invert	Outlet Devices
#1	Primary	115.20'	6.0" Vert. Orifice/Grate C= 0.600
#2	Primary	118.10'	4.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s) 0.5' Crest Height

Primary OutFlow Max=1.28 cfs @ 1.06 hrs HW=117.29' (Free Discharge)
1=Orifice/Grate (Orifice Controls 1.28 cfs @ 6.53 fps)
2=Sharp-Crested Rectangular Weir (Controls 0.00 cfs)

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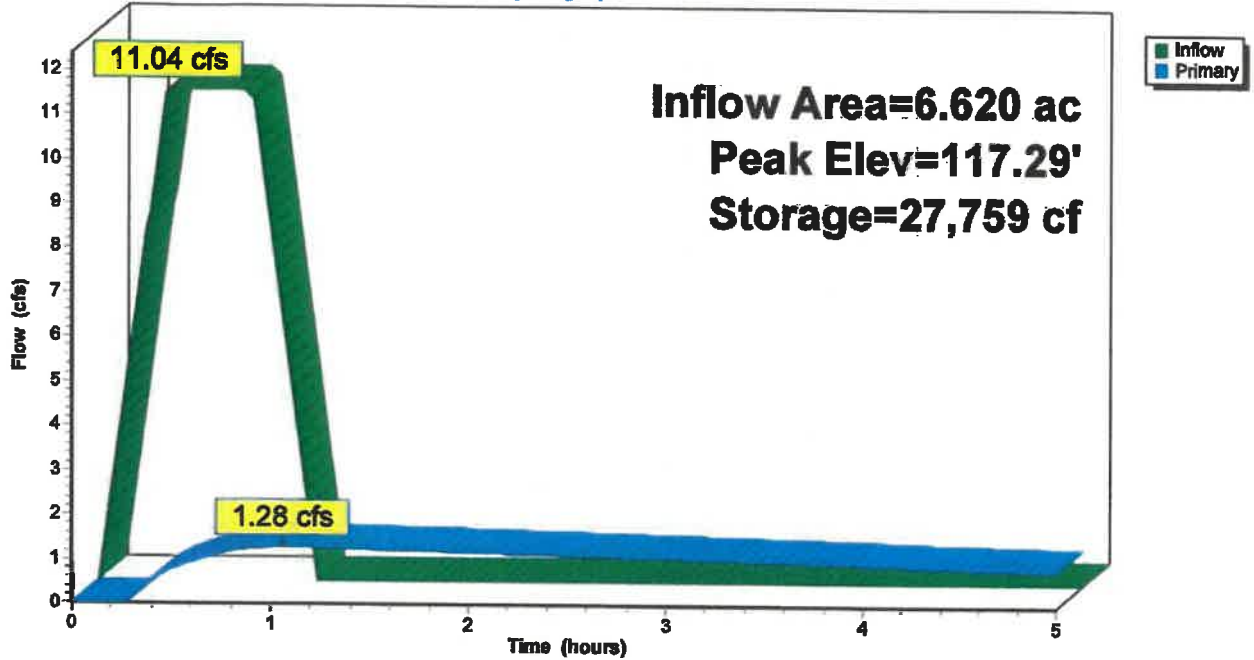
2 Year Storm Event

Rainfall Duration=46 min, Inten=1.76 in/hr

Printed 11/21/2019

Pond 2P: Basin 1

Hydrograph



2018.047-ModRational-NEW

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2 Year Storm Event

Rainfall Duration=46 min, Inten=1.76 in/hr

Printed 11/21/2019

Hydrograph for Pond 2P: Basin 1

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	114.50	0.00
0.10	3.31	596	114.78	0.00
0.20	6.63	2,385	115.06	0.00
0.30	9.94	5,358	115.41	0.13
0.40	11.04	9,136	115.79	0.55
0.50	11.04	12,869	116.13	0.78
0.60	11.04	16,535	116.43	0.94
0.70	11.04	20,150	116.72	1.07
0.80	9.94	23,654	116.99	1.17
0.90	6.63	26,200	117.18	1.24
1.00	3.31	27,534	117.28	1.28
1.10	0.00	27,669	117.29	1.28
1.20	0.00	27,210	117.25	1.27
1.30	0.00	26,756	117.22	1.26
1.40	0.00	26,305	117.19	1.25
1.50	0.00	25,859	117.15	1.23
1.60	0.00	25,417	117.12	1.22
1.70	0.00	24,979	117.09	1.21
1.80	0.00	24,546	117.06	1.20
1.90	0.00	24,117	117.02	1.19
2.00	0.00	23,692	116.99	1.17
2.10	0.00	23,272	116.96	1.16
2.20	0.00	22,856	116.93	1.15
2.30	0.00	22,444	116.90	1.14
2.40	0.00	22,037	116.87	1.12
2.50	0.00	21,635	116.83	1.11
2.60	0.00	21,236	116.80	1.10
2.70	0.00	20,842	116.77	1.09
2.80	0.00	20,453	116.74	1.08
2.90	0.00	20,068	116.71	1.06
3.00	0.00	19,688	116.68	1.05
3.10	0.00	19,312	116.65	1.04
3.20	0.00	18,941	116.62	1.02
3.30	0.00	18,575	116.60	1.01
3.40	0.00	18,213	116.57	1.00
3.50	0.00	17,855	116.54	0.99
3.60	0.00	17,503	116.51	0.97
3.70	0.00	17,155	116.48	0.96
3.80	0.00	16,811	116.45	0.95
3.90	0.00	16,472	116.43	0.93
4.00	0.00	16,139	116.40	0.92
4.10	0.00	15,809	116.37	0.91
4.20	0.00	15,485	116.35	0.89
4.30	0.00	15,165	116.32	0.88
4.40	0.00	14,850	116.29	0.87
4.50	0.00	14,540	116.27	0.85
4.60	0.00	14,235	116.24	0.84
4.70	0.00	13,935	116.22	0.83
4.80	0.00	13,639	116.19	0.81
4.90	0.00	13,349	116.17	0.80
5.00	0.00	13,063	116.14	0.79

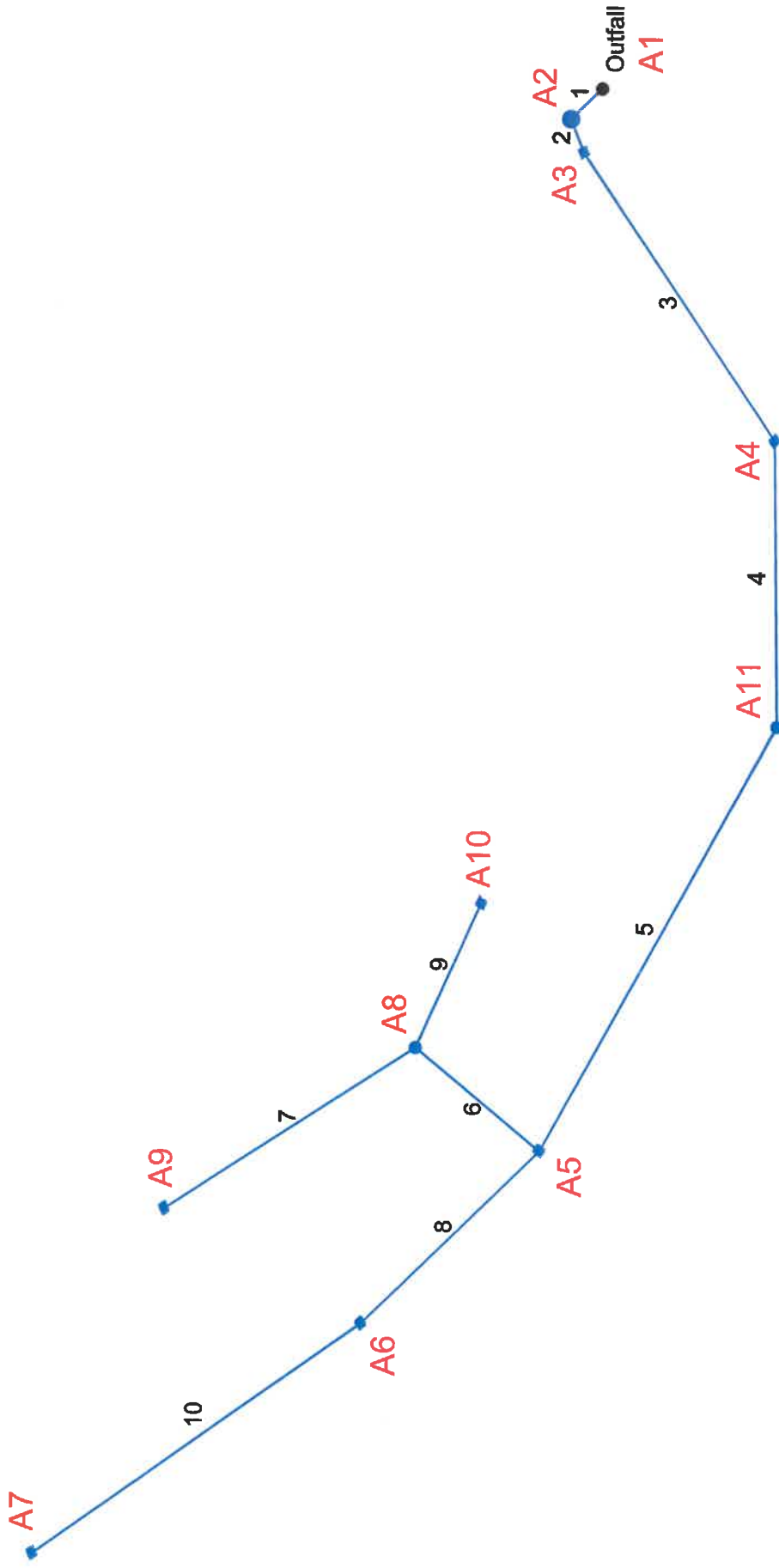
APPENDIX C: PIPE CALCULATIONS, RIP RAP, SCOUR HOLE, SPILLWAY

LIVINGSTON WAREHOUSE - WEIGHTED 'C' VALUES

SOIL TYPE(S) : UR - (TYPE 'D')*

STRUCTURE	TOTAL AREA (acres)		'C' =		IMPERVIOUS		'C' =		GRASS 'D'		'C' =		WOODS 'D'		'C' =		TOTAL WEIGHTED 'C' (F+J+N)
	AREA (acres)	%	AREA (acres)	%	AREA (acres)	%	AREA (acres)	%	AREA (acres)	%	AREA (acres)	%	AREA (acres)	%	AREA (acres)	%	
A3	0.33	91%	0.30	91%	0.90	9%	0.03	0.65	0.06	0.59	0.00	0.00	0.00	0.96			
A4	0.18	89%	0.16	89%	0.88	11%	0.02	0.65	0.07	0.59	0.00	0.00	0.00	0.95			
A5	0.43	88%	0.38	88%	0.87	12%	0.05	0.65	0.08	0.59	0.00	0.00	0.00	0.95			
A6	0.20	85%	0.17	85%	0.84	15%	0.03	0.65	0.10	0.59	0.00	0.00	0.00	0.94			
A7	0.13	85%	0.11	85%	0.84	15%	0.02	0.65	0.10	0.59	0.00	0.00	0.00	0.94			
A9	1.32	98%	1.29	98%	0.97	2%	0.03	0.65	0.01	0.59	0.00	0.00	0.00	0.98			
A10	0.82	96%	0.79	96%	0.95	4%	0.03	0.65	0.02	0.59	0.00	0.00	0.00	0.98			
B2	1.02	7%	0.07	7%	0.07	93%	0.95	0.65	0.61	0.59	0.00	0.00	0.00	0.67			
D3	0.27	78%	0.21	78%	0.77	22%	0.06	0.65	0.14	0.59	0.00	0.00	0.00	0.91			
D5	0.31	84%	0.26	84%	0.83	16%	0.05	0.65	0.10	0.59	0.00	0.00	0.00	0.94			
D6	0.11	82%	0.09	82%	0.81	18%	0.02	0.65	0.12	0.59	0.00	0.00	0.00	0.93			
D7	0.50	100%	0.50	100%	0.99	0%	0.00	0.65	0.00	0.59	0.00	0.00	0.00	0.99			
D8	0.21	81%	0.17	81%	0.80	19%	0.04	0.65	0.12	0.59	0.00	0.00	0.00	0.93			
E2	0.36	58%	0.21	58%	0.58	42%	0.15	0.65	0.27	0.59	0.00	0.00	0.00	0.85			
TOTALS	6.19	76%	4.71	76%	0.99	24%	1.48	0.65	0.16	0.59	0.00	0.00	0.00	0.85			

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Pipe Calc

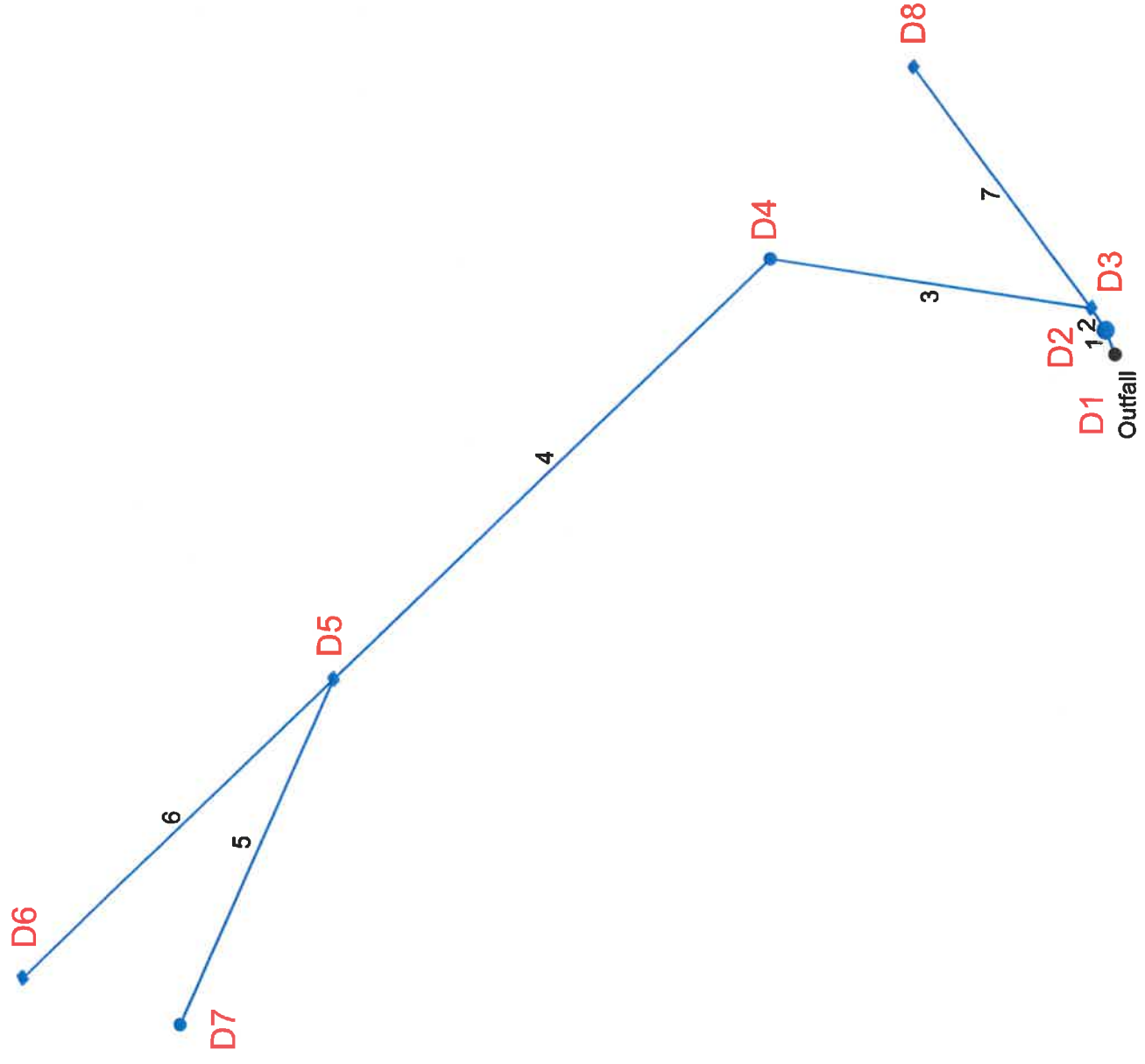
Line No.	Inlet ID	Line ID	Gnd/Rim El Up (ft)	Line Length (ft)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	i Inlet (in/hr)	Incr Q (cfs)	Total Area (ac)	Tc (min)	i Sys (in/hr)	Total Runoff (cfs)	Known Q (cfs)	Flow Rate (cfs)	Capac Full (cfs)	Line Size (in)	Line Slope (%)	Vel Ave (ft/s)	Invert Up (ft)	Invert Dn (ft)	n-val Pipe
1	A2	A2	123.00	18.067	0.00	0.00	10.0	0.00	0.00	3.38	19.0	4.90	16.05	0.00	16.05	35.08	36	0.28	4.85	115.56	115.51	0.013
2	A3	A3	119.48	13.548	0.30	0.96	10.0	6.73	1.94	3.38	18.9	4.91	16.09	0.00	16.09	47.94	36	0.52	4.63	115.63	115.56	0.013
3	A4	A4	123.00	136.690	0.18	0.95	10.0	6.73	1.15	3.08	18.3	5.00	14.94	0.00	14.94	16.07	30	0.15	3.72	115.84	115.63	0.013
4	A11	A11	124.50	104.519	0.00	0.00	0.0	0.00	0.00	2.90	17.8	5.08	14.30	0.00	14.30	16.05	30	0.15	3.24	116.00	115.84	0.013
5	A5	A5	121.00	188.952	0.43	0.95	10.0	6.73	2.75	2.90	16.9	5.21	14.68	0.00	14.68	15.79	30	0.15	3.26	116.28	116.00	0.013
6	A8	A8	122.00	67.635	0.00	0.00	0.0	0.00	0.00	2.14	10.8	6.51	13.65	0.00	13.65	14.29	24	0.40	4.35	116.55	116.28	0.013
7	A9	A9	120.80	127.822	1.32	0.98	10.0	6.73	8.71	1.32	10.0	6.73	8.71	0.00	8.71	11.32	24	0.25	2.77	116.87	116.55	0.013
8	A6	A6	121.00	102.498	0.20	0.94	10.0	6.73	1.27	0.33	14.2	5.69	1.77	0.00	1.77	5.00	24	0.05	0.56	116.33	116.28	0.013
9	A10	A10	120.80	60.472	0.82	0.98	10.0	6.73	5.41	0.82	10.0	6.73	5.41	0.00	5.41	9.13	15	2.00	4.41	117.71	116.50	0.013
10	A7	A7	119.35	170.546	0.13	0.94	10.0	6.73	0.82	0.13	10.0	6.73	0.82	0.00	0.82	1.56	15	0.06	0.67	116.43	116.33	0.013

Project File: 2018.047_STORM A.stm Date: 10/4/2021

Number of lines: 10

NOTES: Intensity = 42.39 / (Inlet time + 5.10) ^ 0.68 -- Return period = 25 Yrs. ; ** Critical depth

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



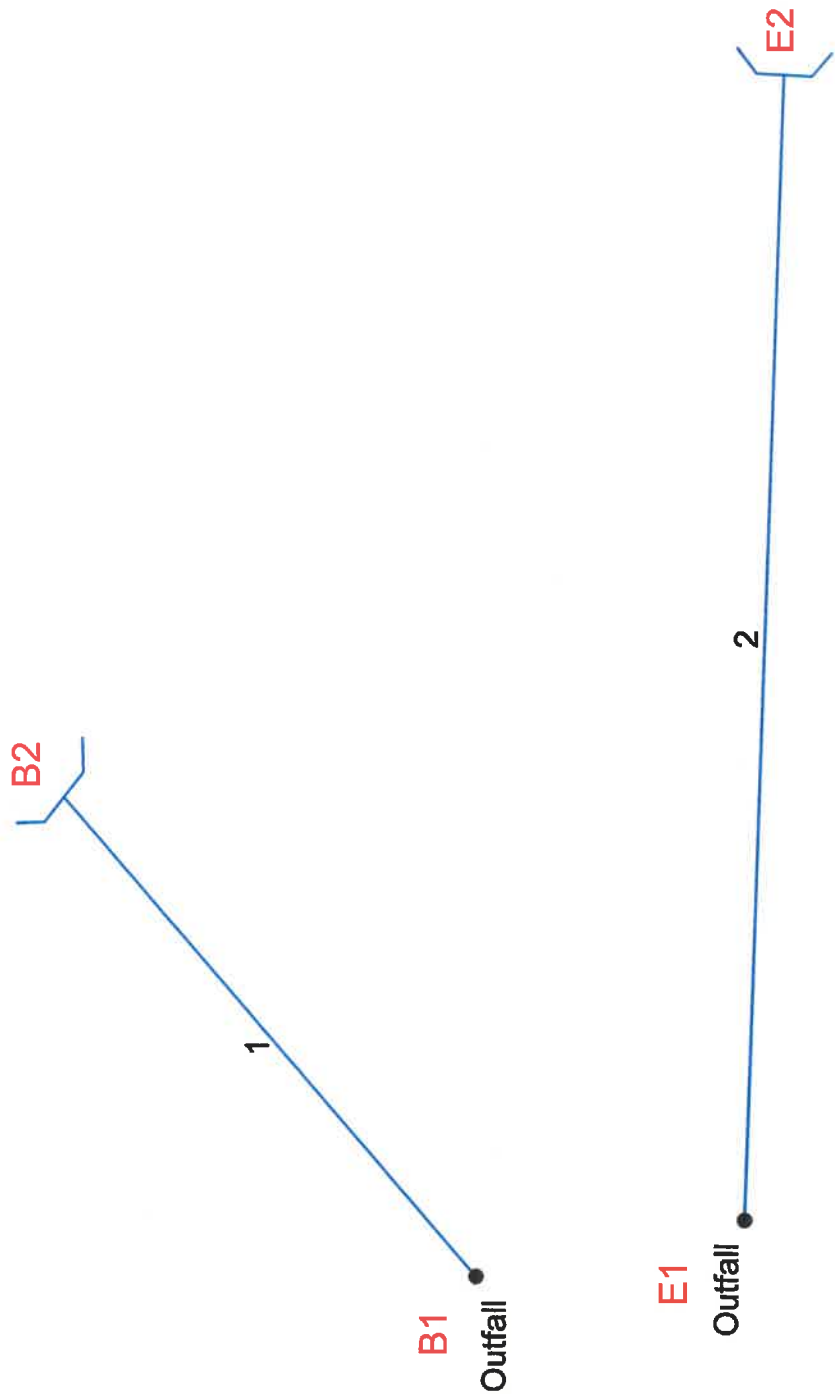
Pipe Calc

Line No.	Inlet ID	Line ID	Gnd/Rim El Up	Line Length	Dmg Area	Runoff Coeff	Inlet Time	i Inlet	Incr Q	Total Area	Tc	i Sys	Total Runoff	Known Q	Flow Rate	Capac Full	Line Size	Line Slope	Vel Ave	Invert Up	Invert Dn	n-val Pipe
			(ft)	(ft)	(ac)	(C)	(min)	(in/hr)	(cfs)	(ac)	(min)	(in/hr)	(cfs)	(cfs)	(cfs)	(cfs)	(in)	(%)	(ft/s)	(ft)	(ft)	
1	D2	D2	120.50	9.690	0.00	0.00	10.0	0.00	0.00	1.57	18.5	4.98	7.45	0.00	7.45	26.35	30	0.41	4.65	115.74	115.70	0.013
2	D3	D3	120.00	10.198	0.21	0.94	10.0	6.73	1.33	1.57	18.4	4.99	7.47	0.00	7.47	25.69	30	0.39	3.78	115.78	115.74	0.013
3	D4	D4	122.20	144.113	0.11	0.93	10.0	6.73	0.69	1.15	16.6	5.26	5.81	0.00	5.81	9.04	30	0.05	1.95	115.85	115.78	0.013
4	D5	D5	121.00	245.786	0.42	0.93	10.0	6.73	2.63	1.04	14.6	5.62	5.62	0.00	5.62	6.45	24	0.08	2.23	116.05	115.85	0.013
5	D7	D7	123.10	141.866	0.50	0.99	10.0	6.73	3.33	0.50	10.0	6.73	3.33	0.00	3.33	3.64	15	0.32	3.36	117.25	116.80	0.013
6	D6	D6	118.50	174.912	0.12	0.96	10.0	6.73	0.78	0.12	10.0	6.73	0.78	0.00	0.78	1.09	15	0.03	0.63	116.10	116.05	0.013
7	D8	D8	120.00	117.126	0.21	0.93	10.0	6.73	1.31	0.21	10.0	6.73	1.31	0.00	1.31	6.45	15	1.00	2.18	117.00	115.83	0.013

Project File: 2018.047_STORM D.stm Number of lines: 7 Date: 10/4/2021

NOTES: Intensity = 42.39 / (Inlet time + 5.10) ^ 0.68 -- Return period = 25 Yrs. ; ** Critical depth

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Pipe Calc

Line No.	Inlet ID	Line ID	Gnd/Rim El Up (ft)	Line Length (ft)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	i Inlet (in/hr)	Incr Q (cfs)	Total Area (ac)	Tc (min)	i Sys (in/hr)	Total Runoff (cfs)	Known Q (cfs)	Flow Rate (cfs)	Capac Full (cfs)	Line Size (in)	Line Slope (%)	Vel Ave (ft/s)	Invert Up (ft)	Invert Dn (ft)	n-val Pipe
1	B2	B2	116.50	40.610	1.02	0.67	10.0	6.73	4.60	1.02	10.0	6.73	4.60	0.00	4.60	7.16	14 x 23	0.49	3.68	114.50	114.30	0.013
2	E2	E2	116.44	66.745	0.36	0.85	10.0	6.73	2.06	0.36	10.0	6.73	2.06	0.00	2.06	3.53	15	0.30	2.99	114.50	114.30	0.013

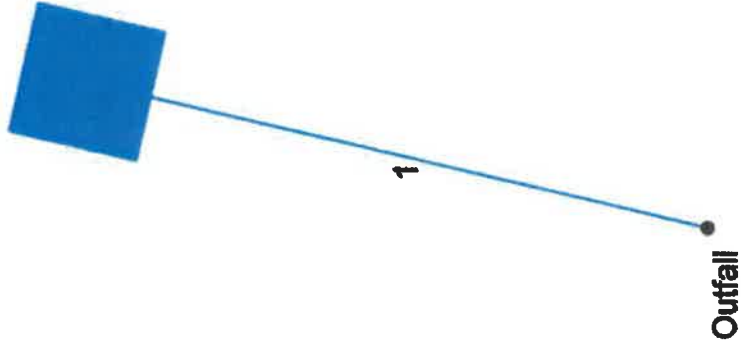
Project File: 2018.047_STORM B&E.stm

Number of lines: 2

Date: 10/4/2021

NOTES: Intensity = 42.39 / (Inlet time + 5.10) ^ 0.68 -- Return period = 25 Yrs. ; ** Critical depth

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: New.stm

Number of lines: 1

Date: 11/22/2019

Pipe Calc

Line No.	Inlet ID	Line ID	Gnd/Rim El Up (ft)	Line Length (ft)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	i Inlet (in/hr)	Incr Q (cfs)	Total Area (ac)	Tc (min)	i Sys (in/hr)	Total Runoff (cfs)	Known Q (cfs)	Flow Rate (cfs)	Capac Full (cfs)	Line Size (in)	Line Slope (%)	Vel Ave (ft/s)	Invert Up (ft)	Invert Dn (ft)	n-val Pipe
1	C1	P72	118.00	19.000	0.00	0.00	0.0	0.00	3.64	0.00	0.0	0.00	0.00	3.64	3.64	5.34	15	0.88	4.59	114.53	114.40	0.013

Project File: New.stm

Number of lines: 1

Date: 11/22/2019

NOTES: Intensity = 42.39 / (inlet time + 5.10) ^ 0.68 – Return period = 25 Yrs. ; ** Critical depth

PREFORMED SCOUR HOLE CALCULATIONS

The following calculations are done in accordance with The Soil Conservation District's Standards for Conduit Outlet Protection.

Length of Bottom:

$$L = (3)D_o$$

Width of Bottom:

$$W = (2)W_o$$

Length of Side Slopes in all directions:

$$H = (3)Y$$

Y = Depth of Scour Hole

Total Length (L_T):

$$L_T = L + 2(H)$$

Total Width (W_T):

$$W_T = W + 2(H)$$

d50 Stone Size:

$$\text{If, } Y = \left(\frac{1}{2}\right)D_o$$

$$\text{Then, } d_{50} = \left(\frac{0.0125}{T_w}\right)q^{1.33}$$

Where $q = \frac{Q}{D_o}$ in cfs per foot

$$\text{If, } Y = D_o$$

$$\text{Then, } d_{50} = \left(\frac{0.0082}{T_w}\right)q^{1.33}$$

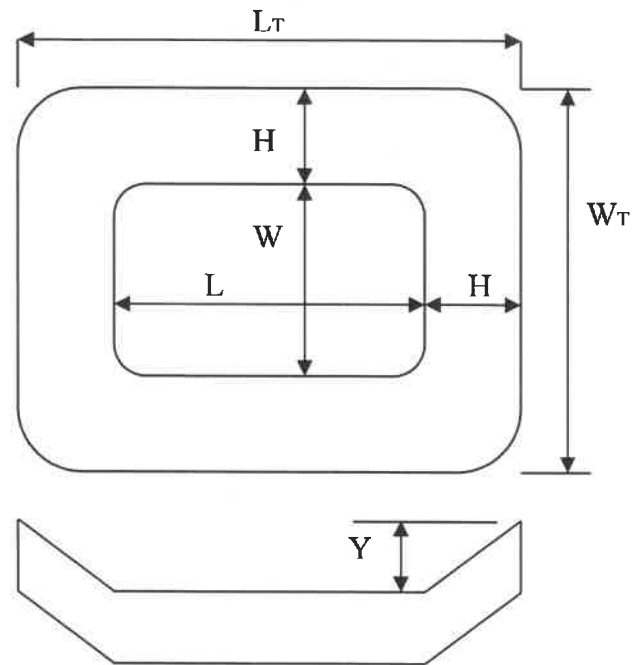
Minimum d₅₀ = 6.00 inches

Calculations for discharge into a basin based on:

Q of 25 yr storm, and

T_w = difference between 2 yr storm elevation in basin and culvert invert.

For areas where T_w cannot be computed, T_w = 0.2D_o



<u>Outfall</u>	<u>Q(cfs)</u>	<u>Y(in)</u>	<u>D_o(in)</u>	<u>W_o(in)</u>	<u>T_w(ft)</u>	<u>L_T(ft)</u>	<u>W_T(ft)</u>	<u>d50(in)</u>
A 1	16.05	12.0	36	36	0.60	15.0	12.0	6.00
B 1	4.60	7.5	14	23	0.40	9.0	7.6	6.00
C 3	3.64	7.5	15	15	3.20	7.5	6.3	6.00
D 1	7.45	12.0	30	30	0.40	13.5	11.0	6.00

* Rip-Rap to extend to top of banks of channel

EMERGENCY SPILLWAY CALCULATIONS

<u>BASIN #1</u>				
<u>Inflow</u>	$Q_{100} =$	24.0	cfs	
<u>Target</u>	$Q_{150} =$	150% of Q_{100}	=	36.0 cfs
<u>Length</u>	<u>Height(H)</u>	=	0.40	
	$\frac{Q}{C} =$	$\frac{L}{H^{3/2}}$	\times	
	36.0 =	3.1	\times	L
	L =	45.9	ft	
<u>Velocity Over Spillway</u>	$\frac{Q}{V} =$	$\frac{L}{H}$	\times	
	36.0 =	V	\times	45.9
	V =	2.0	ft/sec	0.4
<u>Check</u>	2.0	\leq	2.0	? No Erosion Protection Required

APPENDIX D: WATER QUALITY



Prop. Drainage Area



Basin 1



2018.047-ModRational-NEW

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Water Quality Storm Event
Rainfall Duration=120 min, Inten=0.62 in/hr

Printed 11/22/2019

Summary for Subcatchment 1S: Prop. Drainage Area

Runoff = 3.89 cfs @ 0.34 hrs, Volume= 0.643 af, Depth= 1.17"

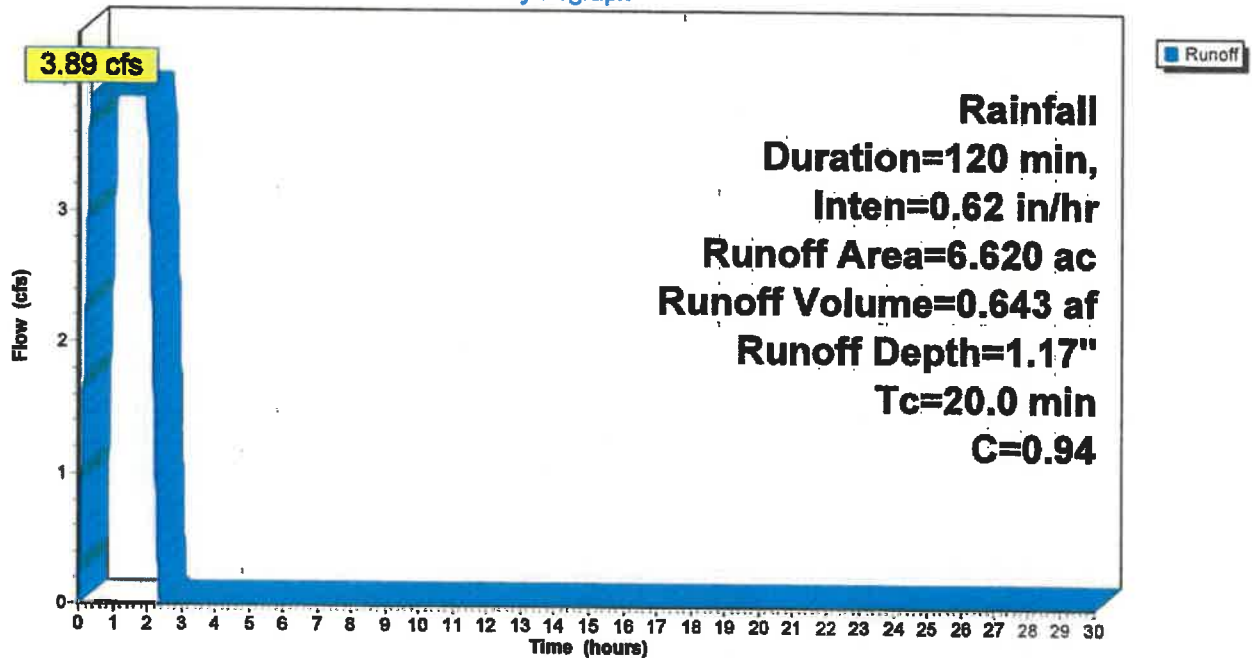
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Rainfall Duration=120 min, Inten=0.62 in/hr

Area (ac)	C	Description
0.930	0.65	
5.690	0.99	
6.620	0.94	Weighted Average
0.930		14.05% Pervious Area
5.690		85.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					Direct Entry,

Subcatchment 1S: Prop. Drainage Area

Hydrograph



2018.047-ModRational-NEW

Prepared by Menlo Engineering Associates, Inc.

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Water Quality Storm Event
Rainfall Duration=120 min, Inten=0.62 in/hr
 Printed 11/22/2019

Hydrograph for Subcatchment 1S: Prop. Drainage Area

Time (hours)	Runoff (cfs)	Time (hours)	Runoff (cfs)	Time (hours)	Runoff (cfs)
0.00	0.00	10.40	0.00	20.80	0.00
0.20	2.33	10.60	0.00	21.00	0.00
0.40	3.89	10.80	0.00	21.20	0.00
0.60	3.89	11.00	0.00	21.40	0.00
0.80	3.89	11.20	0.00	21.60	0.00
1.00	3.89	11.40	0.00	21.80	0.00
1.20	3.89	11.60	0.00	22.00	0.00
1.40	3.89	11.80	0.00	22.20	0.00
1.60	3.89	12.00	0.00	22.40	0.00
1.80	3.89	12.20	0.00	22.60	0.00
2.00	3.89	12.40	0.00	22.80	0.00
2.20	1.56	12.60	0.00	23.00	0.00
2.40	0.00	12.80	0.00	23.20	0.00
2.60	0.00	13.00	0.00	23.40	0.00
2.80	0.00	13.20	0.00	23.60	0.00
3.00	0.00	13.40	0.00	23.80	0.00
3.20	0.00	13.60	0.00	24.00	0.00
3.40	0.00	13.80	0.00	24.20	0.00
3.60	0.00	14.00	0.00	24.40	0.00
3.80	0.00	14.20	0.00	24.60	0.00
4.00	0.00	14.40	0.00	24.80	0.00
4.20	0.00	14.60	0.00	25.00	0.00
4.40	0.00	14.80	0.00	25.20	0.00
4.60	0.00	15.00	0.00	25.40	0.00
4.80	0.00	15.20	0.00	25.60	0.00
5.00	0.00	15.40	0.00	25.80	0.00
5.20	0.00	15.60	0.00	26.00	0.00
5.40	0.00	15.80	0.00	26.20	0.00
5.60	0.00	16.00	0.00	26.40	0.00
5.80	0.00	16.20	0.00	26.60	0.00
6.00	0.00	16.40	0.00	26.80	0.00
6.20	0.00	16.60	0.00	27.00	0.00
6.40	0.00	16.80	0.00	27.20	0.00
6.60	0.00	17.00	0.00	27.40	0.00
6.80	0.00	17.20	0.00	27.60	0.00
7.00	0.00	17.40	0.00	27.80	0.00
7.20	0.00	17.60	0.00	28.00	0.00
7.40	0.00	17.80	0.00	28.20	0.00
7.60	0.00	18.00	0.00	28.40	0.00
7.80	0.00	18.20	0.00	28.60	0.00
8.00	0.00	18.40	0.00	28.80	0.00
8.20	0.00	18.60	0.00	29.00	0.00
8.40	0.00	18.80	0.00	29.20	0.00
8.60	0.00	19.00	0.00	29.40	0.00
8.80	0.00	19.20	0.00	29.60	0.00
9.00	0.00	19.40	0.00	29.80	0.00
9.20	0.00	19.60	0.00	30.00	0.00
9.40	0.00	19.80	0.00		
9.60	0.00	20.00	0.00		
9.80	0.00	20.20	0.00		
10.00	0.00	20.40	0.00		
10.20	0.00	20.60	0.00		

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Water Quality Storm Event

Rainfall Duration=120 min, Inten=0.62 in/hr

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Summary for Pond 2P: Basin 1

Inflow Area = 6.620 ac, 85.95% Impervious, Inflow Depth = 1.17"
 Inflow = 3.89 cfs @ 0.34 hrs, Volume= 0.643 af
 Outflow = 1.15 cfs @ 2.24 hrs, Volume= 0.557 af, Atten= 71%, Lag= 113.7 min
 Primary = 1.15 cfs @ 2.24 hrs, Volume= 0.557 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
 Peak Elev= 116.92' @ 2.24 hrs Surf.Area= 13,177 sf Storage= 22,780 cf

Plug-Flow detention time= 234.7 min calculated for 0.557 af (87% of inflow)
 Center-of-Mass det. time= 227.1 min (297.1 - 70.0)

Volume	Invert	Avail.Storage	Storage Description
#1	114.50'	53,460 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
114.50	0	0	0
115.00	7,560	1,890	1,890
116.00	11,480	9,520	11,410
117.00	13,320	12,400	23,810
118.00	14,800	14,060	37,870
119.00	16,380	15,590	53,460

Device	Routing	Invert	Outlet Devices
#1	Primary	115.20'	6.0" Vert. Orifice/Grate C= 0.600
#2	Primary	118.10'	4.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s) 0.5' Crest Height

Primary OutFlow Max=1.15 cfs @ 2.24 hrs HW=116.92' (Free Discharge)
 1=Orifice/Grate (Orifice Controls 1.15 cfs @ 5.84 fps)
 2=Sharp-Crested Rectangular Weir (Controls 0.00 cfs)

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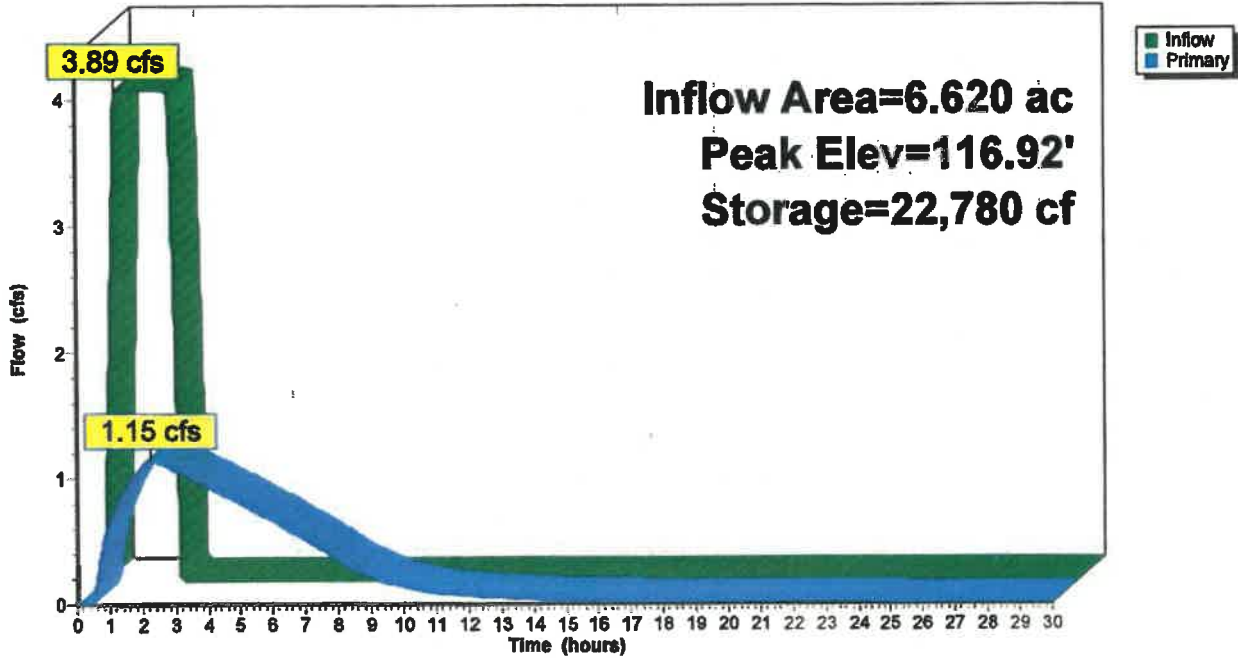
Water Quality Storm Event

Rainfall Duration=120 min, Inten=0.62 in/hr

Printed 11/21/2019

Pond 2P: Basin 1

Hydrograph



2018.047-ModRational-NEW

Rainfall Duration=120 min, Inten=0.62 in/hr

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Hydrograph for Pond 2P: Basin 1

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	114.50	0.00
0.10	1.17	210	114.67	0.00
0.20	2.33	840	114.83	0.00
0.30	3.50	1,891	115.00	0.00
0.40	3.89	3,267	115.17	0.00
0.50	3.89	4,662	115.34	0.06
0.60	3.89	6,016	115.48	0.21
0.70	3.89	7,309	115.62	0.39
0.80	3.89	8,547	115.74	0.51
0.90	3.89	9,747	115.85	0.60
1.00	3.89	10,919	115.96	0.67
1.10	3.89	12,065	116.06	0.74
1.20	3.89	13,190	116.15	0.79
1.30	3.89	14,296	116.25	0.84
1.40	3.89	15,384	116.34	0.89
1.50	3.89	16,456	116.43	0.93
1.60	3.89	17,514	116.51	0.97
1.70	3.89	18,557	116.59	1.01
1.80	3.89	19,587	116.68	1.05
1.90	3.89	20,604	116.76	1.08
2.00	3.89	21,610	116.83	1.11
2.10	2.72	22,396	116.89	1.14
2.20	1.56	22,755	116.92	1.15
2.30	0.39	22,692	116.92	1.14
2.40	0.00	22,306	116.89	1.13
2.50	0.00	21,900	116.86	1.12
2.60	0.00	21,499	116.82	1.11
2.70	0.00	21,102	116.79	1.10
2.80	0.00	20,710	116.76	1.08
2.90	0.00	20,322	116.73	1.07
3.00	0.00	19,939	116.70	1.06
3.10	0.00	19,560	116.67	1.05
3.20	0.00	19,186	116.64	1.03
3.30	0.00	18,817	116.61	1.02
3.40	0.00	18,452	116.59	1.01
3.50	0.00	18,091	116.56	0.99
3.60	0.00	17,735	116.53	0.98
3.70	0.00	17,384	116.50	0.97
3.80	0.00	17,038	116.47	0.96
3.90	0.00	16,696	116.44	0.94
4.00	0.00	16,359	116.42	0.93
4.10	0.00	16,027	116.39	0.92
4.20	0.00	15,699	116.36	0.90
4.30	0.00	15,376	116.34	0.89
4.40	0.00	15,058	116.31	0.88
4.50	0.00	14,745	116.28	0.86
4.60	0.00	14,437	116.26	0.85
4.70	0.00	14,133	116.23	0.84
4.80	0.00	13,834	116.21	0.82
4.90	0.00	13,541	116.18	0.81
5.00	0.00	13,252	116.16	0.80
5.10	0.00	12,968	116.13	0.78
5.20	0.00	12,689	116.11	0.77

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Rainfall Duration=120 min, Inten=0.62 in/hr

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Hydrograph for Pond 2P: Basin 1 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
5.30	0.00	12,415	116.09	0.75
5.40	0.00	12,145	116.06	0.74
5.50	0.00	11,881	116.04	0.73
5.60	0.00	11,622	116.02	0.71
5.70	0.00	11,368	116.00	0.70
5.80	0.00	11,119	115.97	0.68
5.90	0.00	10,875	115.95	0.67
6.00	0.00	10,637	115.93	0.66
6.10	0.00	10,403	115.91	0.64
6.20	0.00	10,175	115.89	0.63
6.30	0.00	9,951	115.87	0.61
6.40	0.00	9,734	115.85	0.60
6.50	0.00	9,521	115.83	0.58
6.60	0.00	9,314	115.81	0.57
6.70	0.00	9,112	115.79	0.55
6.80	0.00	8,916	115.77	0.54
6.90	0.00	8,725	115.76	0.52
7.00	0.00	8,539	115.74	0.51
7.10	0.00	8,360	115.72	0.49
7.20	0.00	8,185	115.70	0.48
7.30	0.00	8,016	115.69	0.46
7.40	0.00	7,852	115.67	0.45
7.50	0.00	7,694	115.66	0.43
7.60	0.00	7,542	115.64	0.41
7.70	0.00	7,396	115.63	0.40
7.80	0.00	7,256	115.61	0.38
7.90	0.00	7,123	115.60	0.36
8.00	0.00	6,996	115.59	0.34
8.10	0.00	6,875	115.57	0.33
8.20	0.00	6,760	115.56	0.31
8.30	0.00	6,651	115.55	0.30
8.40	0.00	6,546	115.54	0.28
8.50	0.00	6,447	115.53	0.27
8.60	0.00	6,353	115.52	0.26
8.70	0.00	6,263	115.51	0.24
8.80	0.00	6,177	115.50	0.23
8.90	0.00	6,096	115.49	0.22
9.00	0.00	6,018	115.49	0.21
9.10	0.00	5,944	115.48	0.20
9.20	0.00	5,874	115.47	0.19
9.30	0.00	5,806	115.46	0.18
9.40	0.00	5,742	115.46	0.17
9.50	0.00	5,681	115.45	0.17
9.60	0.00	5,622	115.44	0.16
9.70	0.00	5,566	115.44	0.15
9.80	0.00	5,513	115.43	0.15
9.90	0.00	5,461	115.43	0.14
10.00	0.00	5,412	115.42	0.13
10.10	0.00	5,365	115.41	0.13
10.20	0.00	5,320	115.41	0.12
10.30	0.00	5,277	115.41	0.12
10.40	0.00	5,235	115.40	0.11
10.50	0.00	5,195	115.40	0.11

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Rainfall Duration=120 min, Inten=0.62 in/hr

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Hydrograph for Pond 2P: Basin 1 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
10.60	0.00	5,157	115.39	0.10
10.70	0.00	5,120	115.39	0.10
10.80	0.00	5,085	115.38	0.10
10.90	0.00	5,051	115.38	0.09
11.00	0.00	5,018	115.38	0.09
11.10	0.00	4,986	115.37	0.09
11.20	0.00	4,955	115.37	0.08
11.30	0.00	4,926	115.37	0.08
11.40	0.00	4,897	115.36	0.08
11.50	0.00	4,870	115.36	0.07
11.60	0.00	4,844	115.36	0.07
11.70	0.00	4,818	115.35	0.07
11.80	0.00	4,794	115.35	0.07
11.90	0.00	4,770	115.35	0.07
12.00	0.00	4,747	115.35	0.06
12.10	0.00	4,724	115.34	0.06
12.20	0.00	4,702	115.34	0.06
12.30	0.00	4,681	115.34	0.06
12.40	0.00	4,661	115.34	0.06
12.50	0.00	4,641	115.33	0.05
12.60	0.00	4,622	115.33	0.05
12.70	0.00	4,603	115.33	0.05
12.80	0.00	4,585	115.33	0.05
12.90	0.00	4,567	115.33	0.05
13.00	0.00	4,550	115.32	0.05
13.10	0.00	4,533	115.32	0.05
13.20	0.00	4,517	115.32	0.04
13.30	0.00	4,501	115.32	0.04
13.40	0.00	4,486	115.32	0.04
13.50	0.00	4,472	115.32	0.04
13.60	0.00	4,457	115.31	0.04
13.70	0.00	4,443	115.31	0.04
13.80	0.00	4,430	115.31	0.04
13.90	0.00	4,417	115.31	0.04
14.00	0.00	4,404	115.31	0.04
14.10	0.00	4,392	115.31	0.03
14.20	0.00	4,379	115.31	0.03
14.30	0.00	4,367	115.30	0.03
14.40	0.00	4,356	115.30	0.03
14.50	0.00	4,344	115.30	0.03
14.60	0.00	4,333	115.30	0.03
14.70	0.00	4,322	115.30	0.03
14.80	0.00	4,311	115.30	0.03
14.90	0.00	4,301	115.30	0.03
15.00	0.00	4,290	115.29	0.03
15.10	0.00	4,280	115.29	0.03
15.20	0.00	4,270	115.29	0.03
15.30	0.00	4,261	115.29	0.03
15.40	0.00	4,251	115.29	0.03
15.50	0.00	4,242	115.29	0.03
15.60	0.00	4,233	115.29	0.02
15.70	0.00	4,224	115.29	0.02
15.80	0.00	4,215	115.29	0.02

2018.047-ModRational-NEW*Rainfall Duration=120 min, Inten=0.62 in/hr*

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Hydrograph for Pond 2P: Basin 1 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
15.90	0.00	4,207	115.29	0.02
16.00	0.00	4,198	115.28	0.02
16.10	0.00	4,190	115.28	0.02
16.20	0.00	4,182	115.28	0.02
16.30	0.00	4,174	115.28	0.02
16.40	0.00	4,167	115.28	0.02
16.50	0.00	4,159	115.28	0.02
16.60	0.00	4,152	115.28	0.02
16.70	0.00	4,145	115.28	0.02
16.80	0.00	4,138	115.28	0.02
16.90	0.00	4,131	115.28	0.02
17.00	0.00	4,124	115.28	0.02
17.10	0.00	4,117	115.27	0.02
17.20	0.00	4,111	115.27	0.02
17.30	0.00	4,105	115.27	0.02
17.40	0.00	4,098	115.27	0.02
17.50	0.00	4,092	115.27	0.02
17.60	0.00	4,086	115.27	0.02
17.70	0.00	4,081	115.27	0.02
17.80	0.00	4,075	115.27	0.02
17.90	0.00	4,069	115.27	0.02
18.00	0.00	4,064	115.27	0.01
18.10	0.00	4,059	115.27	0.01
18.20	0.00	4,053	115.27	0.01
18.30	0.00	4,048	115.27	0.01
18.40	0.00	4,043	115.27	0.01
18.50	0.00	4,038	115.27	0.01
18.60	0.00	4,034	115.27	0.01
18.70	0.00	4,029	115.26	0.01
18.80	0.00	4,024	115.26	0.01
18.90	0.00	4,020	115.26	0.01
19.00	0.00	4,015	115.26	0.01
19.10	0.00	4,011	115.26	0.01
19.20	0.00	4,006	115.26	0.01
19.30	0.00	4,002	115.26	0.01
19.40	0.00	3,997	115.26	0.01
19.50	0.00	3,993	115.26	0.01
19.60	0.00	3,989	115.26	0.01
19.70	0.00	3,985	115.26	0.01
19.80	0.00	3,981	115.26	0.01
19.90	0.00	3,976	115.26	0.01
20.00	0.00	3,972	115.26	0.01
20.10	0.00	3,968	115.26	0.01
20.20	0.00	3,964	115.26	0.01
20.30	0.00	3,960	115.26	0.01
20.40	0.00	3,957	115.26	0.01
20.50	0.00	3,953	115.26	0.01
20.60	0.00	3,949	115.26	0.01
20.70	0.00	3,945	115.25	0.01
20.80	0.00	3,941	115.25	0.01
20.90	0.00	3,938	115.25	0.01
21.00	0.00	3,934	115.25	0.01
21.10	0.00	3,931	115.25	0.01

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Rainfall Duration=120 min, Inten=0.62 in/hr

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Hydrograph for Pond 2P: Basin 1 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
21.20	0.00	3,927	115.25	0.01
21.30	0.00	3,923	115.25	0.01
21.40	0.00	3,920	115.25	0.01
21.50	0.00	3,917	115.25	0.01
21.60	0.00	3,913	115.25	0.01
21.70	0.00	3,910	115.25	0.01
21.80	0.00	3,906	115.25	0.01
21.90	0.00	3,903	115.25	0.01
22.00	0.00	3,900	115.25	0.01
22.10	0.00	3,897	115.25	0.01
22.20	0.00	3,894	115.25	0.01
22.30	0.00	3,890	115.25	0.01
22.40	0.00	3,887	115.25	0.01
22.50	0.00	3,884	115.25	0.01
22.60	0.00	3,881	115.25	0.01
22.70	0.00	3,878	115.25	0.01
22.80	0.00	3,875	115.25	0.01
22.90	0.00	3,872	115.25	0.01
23.00	0.00	3,869	115.25	0.01
23.10	0.00	3,866	115.25	0.01
23.20	0.00	3,864	115.25	0.01
23.30	0.00	3,861	115.24	0.01
23.40	0.00	3,858	115.24	0.01
23.50	0.00	3,855	115.24	0.01
23.60	0.00	3,852	115.24	0.01
23.70	0.00	3,850	115.24	0.01
23.80	0.00	3,847	115.24	0.01
23.90	0.00	3,844	115.24	0.01
24.00	0.00	3,842	115.24	0.01
24.10	0.00	3,839	115.24	0.01
24.20	0.00	3,837	115.24	0.01
24.30	0.00	3,834	115.24	0.01
24.40	0.00	3,832	115.24	0.01
24.50	0.00	3,829	115.24	0.01
24.60	0.00	3,827	115.24	0.01
24.70	0.00	3,824	115.24	0.01
24.80	0.00	3,822	115.24	0.01
24.90	0.00	3,820	115.24	0.01
25.00	0.00	3,817	115.24	0.01
25.10	0.00	3,815	115.24	0.01
25.20	0.00	3,813	115.24	0.01
25.30	0.00	3,810	115.24	0.01
25.40	0.00	3,808	115.24	0.01
25.50	0.00	3,806	115.24	0.01
25.60	0.00	3,804	115.24	0.01
25.70	0.00	3,802	115.24	0.01
25.80	0.00	3,799	115.24	0.01
25.90	0.00	3,797	115.24	0.01
26.00	0.00	3,795	115.24	0.01
26.10	0.00	3,793	115.24	0.01
26.20	0.00	3,791	115.24	0.01
26.30	0.00	3,789	115.24	0.01
26.40	0.00	3,787	115.24	0.01

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Rainfall Duration=120 min, Inten=0.62 in/hr

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Hydrograph for Pond 2P: Basin 1 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
26.50	0.00	3,785	115.24	0.01
26.60	0.00	3,783	115.24	0.01
26.70	0.00	3,781	115.24	0.01
26.80	0.00	3,779	115.24	0.01
26.90	0.00	3,777	115.24	0.01
27.00	0.00	3,775	115.23	0.01
27.10	0.00	3,774	115.23	0.01
27.20	0.00	3,772	115.23	0.01
27.30	0.00	3,770	115.23	0.01
27.40	0.00	3,768	115.23	0.00
27.50	0.00	3,766	115.23	0.00
27.60	0.00	3,765	115.23	0.00
27.70	0.00	3,763	115.23	0.00
27.80	0.00	3,761	115.23	0.00
27.90	0.00	3,760	115.23	0.00
28.00	0.00	3,758	115.23	0.00
28.10	0.00	3,756	115.23	0.00
28.20	0.00	3,755	115.23	0.00
28.30	0.00	3,753	115.23	0.00
28.40	0.00	3,751	115.23	0.00
28.50	0.00	3,750	115.23	0.00
28.60	0.00	3,748	115.23	0.00
28.70	0.00	3,747	115.23	0.00
28.80	0.00	3,745	115.23	0.00
28.90	0.00	3,744	115.23	0.00
29.00	0.00	3,742	115.23	0.00
29.10	0.00	3,741	115.23	0.00
29.20	0.00	3,739	115.23	0.00
29.30	0.00	3,738	115.23	0.00
29.40	0.00	3,736	115.23	0.00
29.50	0.00	3,735	115.23	0.00
29.60	0.00	3,733	115.23	0.00
29.70	0.00	3,732	115.23	0.00
29.80	0.00	3,731	115.23	0.00
29.90	0.00	3,729	115.23	0.00
30.00	0.00	3,728	115.23	0.00



State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Nonpoint Pollution Control
Division of Water Quality
401-02B
Post Office Box 420
Trenton, New Jersey 08625-0420
609-633-7021 Fax: 609-777-0432
http://www.state.nj.us/dep/dwq/bnpc_home.htm

CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

BOB MARTIN
Commissioner

March 21, 2017

Derek M. Berg
Contech Engineered Solutions, LLC
71 US Route 1, Suite F
Scarborough, ME 04074

Re: Revised MTD Lab Certification
Continuous Deflective Separator (CDS®) Stormwater Treatment Device by Contech Engineered
Solutions, LLC
On-line Installation

TSS Removal Rate 50%

Dear Mr. Berg:

This revised certification letter supersedes the Department's prior certification dated January 9, 2015. This revision was completed to reflect the updated Manufactured Treatment Device (MTD) scaling methodology as agreed upon by the manufacturers' working group on September 19, 2016. In part, the updated scaling for hydrodynamic MTDs is based on the depth of the reference (tested) MTD from the top of the false floor utilized during removal efficiency testing, not from the physical bottom of the unit. Based on the above decision, Table A-2 of the NJCAT Technology Verification report located at <http://www.njcat.org/uploads/newDocs/CDSVerificationReportFinal1.pdf> has been revised, and Table 1 noted below has been added.

The Stormwater Management rules under N.J.A.C. 7:8-5.5(b) and 5.7 (c) allow the use of manufactured treatment devices (MTDs) for compliance with the design and performance standards at N.J.A.C. 7:8-5 if the pollutant removal rates have been verified by the New Jersey Corporation for Advanced Technology (NJCAT) and have been certified by the New Jersey Department of Environmental Protection (NJDEP). Contech Engineered Solutions, LLC has requested an MTD Laboratory Certification for the CDS® Stormwater Treatment Device.

The verification is subject to the "Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation for Advance Technology" dated January 25, 2013. The applicable protocol is the "New Jersey Laboratory Testing Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device" dated January 25, 2013.

NJCAT verification documents submitted to the NJDEP indicate that the requirements of the aforementioned protocol have been met or exceeded. The NJCAT letter also included a recommended certification TSS removal rate and the required maintenance plan. The NJCAT Verification Report with the Verification

Appendix dated September 2014 (Revised January 2017) for this device is published online at <http://www.njcat.org/verification-process/technology-verification-database.html>.

The NJDEP certifies the use of the CDS[®] Stormwater Treatment Device by Contech Engineered Solutions, LLC at a TSS removal rate of 50% when designed, operated, and maintained in accordance with the information provided in the Verification Appendix and the following conditions:

1. The maximum treatment flow rate (MTFR) for the manufactured treatment device (MTD) is calculated using the New Jersey Water Quality Design Storm (1.25 inches in 2 hrs) in N.J.A.C. 7:8-5.5.
2. The CDS[®] Stormwater Treatment Device shall be installed using the same configuration reviewed by NJCAT and shall be sized in accordance with the criteria specified in item 6 below.
3. This CDS[®] Stormwater Treatment Device cannot be used in series with another MTD or a media filter (such as a sand filter) to achieve an enhanced removal rate for total suspended solids (TSS) removal under N.J.A.C. 7:8-5.5.
4. Additional design criteria for MTDs can be found in Chapter 9.6 of the New Jersey Stormwater Best Management Practices (NJ Stormwater BMP) Manual which can be found on-line at www.njstormwater.org.
5. The maintenance plan for a site using this device shall incorporate, at a minimum, the maintenance requirements for the CDS[®] Stormwater Treatment Device. A copy of the maintenance plan is attached to this certification. However, it is recommended to review the maintenance website at <http://www.conteches.com/products/stormwater-management/treatment/cds.aspx#1822141-technical-info> for any changes to the maintenance requirements.
6. Sizing Requirements:

The example below demonstrates the sizing procedure for the CDS[®]:

Example: A 0.25-acre impervious site is to be treated to 50% TSS removal using a CDS[®]. The impervious site runoff (Q) based on the New Jersey Water Quality Design Storm was determined to be 0.79 cfs.

Maximum Treatment Flow Rate (MTFR) Evaluation:

The site runoff (Q) was based on the following:

time of concentration = 10 minutes
 $i=3.2$ in/hr (page 5-8, Fig. 5-3 of the NJ Stormwater BMP Manual)
 $c=0.99$ (runoff coefficient for impervious)
 $Q=ciA=0.99 \times 3.2 \times 0.25=0.79$ cfs

Given the site runoff is 0.79 cfs and based on Table 1 below, the CDS[®] Model CDS-4 with an MTFR of 0.93 cfs would be the smallest model approved that could be used for this site that could remove 50% of the TSS from the impervious area without exceeding the MTFR.

The sizing table corresponding to the available system models is noted below. Additional specifications regarding each model can be found in the Verification Appendix under Table A-1 and A-2.

Table 1 CDS Models

CDS Model	Manhole Diameter (ft.)	Treatment Chamber Depth (ft.)	MTFR (cfs)
CDS-3	3	3.50	0.52
CDS-4	4	3.50	0.93
CDS-5	5	3.75	1.5
CDS-6	6	4.50	2.1
CDS-7	7	5.25	2.8
CDS-8	8	6.00	3.7
CDS-10	10	7.50	5.8
CDS-12	12	9.00	8.4

MAX. TREATMENT FLOW RATE TO CDS= 3.89 CFS (SEE FLOW OF PROP. DRAINAGE AREA)

USE CDS-10

- Treatment Chamber Depth is defined as the depth below the invert to the top of the false floor installed at 50% sediment depth.

A detailed maintenance plan is mandatory for any project with a Stormwater BMP subject to the Stormwater Management Rules, N.J.A.C. 7:8. The plan must include all of the items identified in the Stormwater Management Rules, N.J.A.C. 7:8-5.8. Such items include, but are not limited to, the list of inspection and maintenance equipment and tools, specific corrective and preventative maintenance tasks, indication of problems in the system, and training of maintenance personnel. Additional information can be found in Chapter 8: Maintenance and Retrofit of Stormwater Management Measures.

If you have any questions regarding the above information, please contact Mr. Shashi Nayak of my office at (609) 633-7021.

Sincerely,



James J. Murphy, Chief
Bureau of Nonpoint Pollution Control

Attachment: Maintenance Plan

- c:
- Chron File
 - Richard Magee, NJCAT
 - Vince Mazzei, NJDEP - DLUR
 - Ravi Patraju, NJDEP - BES
 - Gabriel Mahon, NJDEP - BNPC
 - Shashi Nayak, NJDEP - BNPC

Infiltration Basin Drain Time Calculation

Livingston Warehouse

Township of North Brunswick, Middlesex County, New Jersey

2018.047

Design Summary:

- Portion of WQ Design Storm Volume = 3,770 CF
- Infiltration Area = 6,560 SF
- Design Permeability Rate = Boring B-5: 0.75 in/hr / F.S. 2 = 0.38 inches/hour

$$\text{Drain Time} = \frac{\text{WQ Design Storm Volume}}{(\text{Infiltration Area} \times \text{Design Permeability})} = \frac{3,770 \text{ cf} \times (12 \frac{\text{in}}{\text{ft}})}{(6,560 \text{ sf} \times 0.38 \frac{\text{inch}}{\text{hr}})} = 18.148 \text{ hr} \rightarrow \mathbf{18.15 \text{ Hours}}$$

The Proposed Drain Time for the Infiltration Basin is 18.15 hours which is less than the allowable maximum drain time of 72 hours. Therefore, the infiltration basin drains within the maximum allowable time frame.

TSS Removal Rate Calculations

Basin TSS Removal Rate

Time to Peak Elevation (hr)	Peak Storage Volume for WQ Design Storm (cf)	10% Peak Storage Volume (cf)	Time to 10% WQ volume (hr)	Detention time used (12<=Td<=24) (hr)	% TSS Removal
2.2	22,780	2,278.00	27.3	25.1	60

$$\begin{aligned} \text{\%TSS Removal Rate} &= 40 + [(t-12/12) \times 20] && t=25.1 \text{ hrs.} \\ &= 40 + [1 \times 20] \\ &= 60 \end{aligned}$$

TSS Removal Rate for BMPs in Series

$$\begin{aligned} \text{Total TSS Removal Rate} &= A+B-[(A \times B)/100] && \text{A= First Defense} \\ &= 60+50-((60 \times 50)/100) && \text{60\% TSS Removal Rate} \\ &= 60+20 && \text{B= Basin} \\ & && \text{50\% TSS Removal Rate} \end{aligned}$$

The total Removal Rate = **80 % TSS Removal**

APPENDIX E: WATER BALANCE

New Jersey
Groundwater
Recharge
Spreadsheet
Version 2.0
November 2005

Annual Groundwater Recharge Analysis (based on GSR-32)

Select Township ↓ **AVRIDGE**
 Average Annual P (in) **48.9**
 Climate Factor **1.48**

Project Name: **Livinston Warehouse**
 Description: **2018.047**
 Analysis Date: **11/20/19**

Pre-Developed Conditions

Land Segment	Area (acres)	TR-55 Land Cover	Soil	Annual Recharge (in)	Annual Recharge (cu-ft)
1	14.06	Impervious areas	Nixon	0.0	-
2	6.67	Woods	Nixon	14.5	298,404
3	1.23	Open space	Nixon	14.5	64,882
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
Total =	21.0			4.5	363,966

Post-Developed Conditions

Land Segment	Area (acres)	TR-55 Land Cover	Soil	Annual Recharge (in)	Annual Recharge (cu-ft)
1	18.19	Impervious areas	Nixon	0.0	-
2	1.07	Woods	Nixon	14.5	88,801
3	1.7	Open space	Nixon	14.5	89,233
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
Total =	21.0			1.9	145,734

Procedure to fill the Pre-Development and Post-Development Conditions Tables

For each land segment, first enter the area, then select TR-55 Land Cover, then select Soil. Start from the top of the table and proceed downward. Don't leave blank rows (with A=0) in between your segment entries. Rows with A=0 will not be displayed or used in calculations. For impervious areas outside of standard lots select 'Impervious Areas' as the Land Cover. Soil type for impervious areas are only required if an infiltration facility will be built within these areas.

Annual Recharge Requirements Calculation

% of Pre-Developed Annual Recharge to Preserve = **100%**

Post-Development Annual Recharge Deficit = **218,232** (cubic feet)

Recharge Efficiency Parameters Calculations (area averages)	
RWC = 3.83 (in)	DRWC = 3.22 (in)
ERWC = 1.00 (in)	EDRW = 0.84 (in)

Total Annual Recharge Requirements = **782,386**

Project Name **Winston Warehouse** **Description** **2018.047** **Analysis Date** **11/20/19** **BMP or LID Type** **Infiltration Basin**

Parameter	Symbol	Value	Unit	Parameter	Symbol	Value	Unit	Parameter	Symbol	Value	Unit
BMP Area	ABMP	6660.0	sq.ft	Empty Portion of RWC under Post-D Natural Recharge	ERWC	1.00	in	Inches of Runoff to capture	Odesign	0.17	in
BMP Effective Depth, this is the design variable (upper level of the BMP surface (negative if above ground))	dBMP	7.0	in	RWC Modified to consider dEXC	EDRWC	0.84	in	Inches of Rainfall to capture	Pdesign	0.24	in
Depth of lower surface of BMP, must be > dBMPu	dBMPu	1.0	in	Empty Portion of RWC under Infiltr. BMP	RERWC	0.66	in	Recharge Provided Avg. over Imp. Area		9.8	in
Post-development Land Segment, Location of BMP	dEXC	8.0	in					Runoff Captured Avg. over Imp. Area		10.9	in
Input Zone if Location is distributed or undetermined	SegBMP	0	unitless								

Parameter	Symbol	Value	Unit	Parameter	Symbol	Value	Unit
Post-D Deficit Recharge (or desired recharge volume)	Vdef	218,232	cu.ft	Annual BMP Recharge Volume		234,587	cu.ft
Post-D ImperVIOUS Area (or target ImperVIOUS Area)	AImp	288,330	sq.ft	Avg BMP Recharge Efficiency		89.2%	% Infiltration Recharged
Root Zone Water Capacity	RWC	3.63	in	%Rainfall becomes Runoff		77.9%	%
RWC Modified to consider dEXC	DRWC	3.22	in	%Runoff infiltrated		30.6%	%
Climatic Factor	C-factor	1.48	no units	%Runoff Recharged		8.9%	%
Average Annual P	Pavg	45.9	in	%Rainfall Recharged		7.7%	%
Recharge Requirement over Imp. Area	dr	3.3	in				

Parameter	Symbol	Value	Unit
ABMP/AImp		0.82	unitless
BMP Volume	VBMP	3,827	cu.ft
Annual BMP Recharge		234,587	cu.ft

System Performance Calculated Parameters

Volume Balance → Solve Problem to satisfy Annual Recharge
 dBMP Check → OK
 dEXC Check → OK

BMP Location → Location is selected as distributed or undetermined

OTHER NOTES

Parcel is accurate only after BMP dimensions are updated to make rech volume= deficit volume. The portion of BMP infiltration prior to filling and the area occupied by BMP are ignored in these calculations. Results are sensitive to dBMP, make sure dBMP selected is small enough for BMP to apply in less than 3 days. For land Segment Location of BMP if you select "ImperVIOUS area" RWC will be minimal but not zero as determined by the soil type and a shallow root zone for this Land Cover showing consideration of lateral flow and other losses.

How to solve for different recharge volumes: By default the spreadsheet assigns the values of total deficit recharge volume "Vdef" and total proposed imperVIOUS area "AImp" from the "Annual Recharge" sheet to "Vdef" and "AImp" on this page. This allows solution for a single BMP to handle the entire recharge requirement assuming the runoff from entire imperVIOUS area is available to the BMP. To solve for a smaller BMP or a LD-MP to recharge only part of the recharge requirement, set Vdef to your target value and AImp to imperVIOUS area directly connected to your Infiltration facility and then solve for ABMP or dBMP. To go back to the default configuration click the "Default Vdef & AImp" button.

Calculation Check Messages

Volume Balance → Solve Problem to satisfy Annual Recharge
 dBMP Check → OK
 dEXC Check → OK

BMP Location → Location is selected as distributed or undetermined

Other Notes

Parcel is accurate only after BMP dimensions are updated to make rech volume= deficit volume. The portion of BMP infiltration prior to filling and the area occupied by BMP are ignored in these calculations. Results are sensitive to dBMP, make sure dBMP selected is small enough for BMP to apply in less than 3 days. For land Segment Location of BMP if you select "ImperVIOUS area" RWC will be minimal but not zero as determined by the soil type and a shallow root zone for this Land Cover showing consideration of lateral flow and other losses.

APPENDIX F: LOW IMPACT DEVELOPMENT

NJDEP Nonstructural Strategies Points System (NSPS)

Version: January 31, 2006

Note: Input Values in Yellow Cells Only

Project:

Date:

User:

Notes:

Step 1 - Provide Basic Major Development Site Information

A. Specify Total Area in Acres of Development Site Described in Steps 2 and 3 = Acres

B. Specify by Percent the Various Planning Areas Located within the Development Site:

State Plan Planning Area:	PA-1	PA-2	PA-3	PA-4	PA-4B	PA-5	Total % Area
Percent of Each Planning Area within Site:	<input type="text" value="100.0%"/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="100.0%"/>

Note: See User's Guide for Equivalent Zones within Designated Centers and the NJ Meadowlands, Pinelands, and Highlands Districts

Step 2 - Describe Existing or Pre-Developed Site Conditions

A. Specify Existing Land Use/Land Cover Descriptions and Areas:

Specify Land Use/Land Cover in Acres for Each HSG

Site Segment	Land Use/Land Cover Description	HSG A	HSG B	HSG C	HSG D	Use/Cover Subtotals	Points
1	Wetlands and Undisturbed Stream Buffers				0.8	0.8	12
2	Lawn and Open Space				5.2	5.2	44
3	Brush and Shrub				0.0	0.0	0
4	Meadow, Pasture, Grassland, or Range				0.0	0.0	0
5	Row Crop				0.0	0.0	0
6	Small Grain and Legumes				5.7	5.7	69
7	Woods - Indigenous				0.0	0.0	0
8	Woods - Planted				0.0	0.0	0
9	Woods and Grass Combination				0.0	0.0	0
10	Ponds, Lakes, and Other Open Water				0.0	0.0	0
11	Gravel and Dirt				0.0	0.0	0
12	Porous and Permeable Paving				9.4	9.4	0
13	Directly Connected Impervious				0.0	0.0	0
14	Unconnected Impervious with Small D/S Pervious				0.0	0.0	0
15	Unconnected Impervious with Large D/S Pervious				0.0	0.0	0
HSG Subtotals (Acres):		0.0	0.0	0.0	21.0	21.0	21.0
HSG Subtotals (%):		0.0%	0.0%	0.0%	100.0%	100.0%	100.0%

Total Area: 21.0
Total % Area: 100.0%

Points Subtotal: 125

Total Existing Site Points: 125

Step 3 - Describe Proposed or Post-Developed Site Conditions

A. Specify Proposed Land Use/Land Cover Descriptions and Areas:

Site Segment	Land Use/Land Cover Description	Specify Land Use/Land Cover in Acres for Each HSG				Use/Cover Subtotals	Points	
		HSG A	HSG B	HSG C	HSG D			
1	Wetlands and Undisturbed Stream Buffers				0.6	0.6	10	
2	Lawn and Open Space				5.7	5.7	49	
3	Brush and Shrub				0.0	0.0	0	
4	Meadow, Pasture, Grassland, or Range				0.0	0.0	0	
5	Row Crop				0.0	0.0	0	
6	Small Grain and Legumes				0.0	0.0	0	
7	Woods - Indigenous				1.4	1.4	17	
8	Woods - Planted				0.0	0.0	0	
9	Woods and Grass Combination				0.0	0.0	0	
10	Ponds, Lakes, and Other Open Water				0.0	0.0	0	
11	Gravel and Dirt				0.0	0.0	0	
12	Porous and Permeable Paving				0.0	0.0	0	
13	Directly Connected Impervious				11.7	11.7	0	
14	Unconnected Impervious with Small D/S Pervious				0.0	0.0	0	
15	Unconnected Impervious with Large D/S Pervious				1.6	1.6	11	
HSG Subtotals (Acres):		0.0	0.0	0.0	21.0		21.0	
HSG Subtotals (%):		0.0%	0.0%	0.0%	100.0%		100.0%	
Total Area:							21.0	
Total % Area:							100.0%	
Points Subtotal:							86	

B. Compare Proposed Impervious Coverage with Maximum Allowable Impervious Coverage:

Total Directly Connected Impervious Coverage =
 Total Unconnected Impervious Coverage with Small D/S Pervious =
 Total Unconnected Impervious Coverage with Large D/S Pervious =
 Total Site Impervious Coverage =
 Effective Site Impervious Coverage =

56%	% of Site
0%	% of Site
8%	% of Site
63%	% of Site
60%	% of Site

Specify Source of Maximum Allowable Impervious Coverage:

Table (None or Table)

Allowable Site Impervious Cover from Maximum Impervious Cover Table:

72%

Note: See Maximum Impervious Cover Table Worksheet for Details

Points Subtotal: 6

C. Compare Proposed Site Disturbance with Maximum Allowable Site Disturbance:

Total Proposed Site Disturbance =
 Maximum Allowable Site Disturbance by Municipal Ordinance =

	% of Site
	% of Site

Points Subtotal: 0

D. Describe Proposed Runoff Conveyance System:

Total Length of Runoff Conveyance System =
 Length of Vegetated Runoff Conveyance System =
 % of Total Runoff Conveyance System That is Vegetated =

5150	Feet
765	Feet
15%	

Points Subtotal: 11

E. Residential Lot Clustering:

Percent of Total Site Area that will be Clustered =
 Minimum Standard Lot Size as Per Zoning (Note: 1/2 Acre or Greater) =
 Maximum Proposed Cluster Lot Size (Note: 1/4 Acre or Less) =
 Percent of Clustered Portion of Site to be Preserved as Vegetated Open Space =

	% of Site
	Acres
	Acres
	% of Clustered Site Portion

Points Subtotal: 0

F. Will the Following be Utilized to Minimize Soil Compaction?

Proposed Lawn Areas will be Graded with Lightweight Construction Equipment:
Percent of Proposed Lawn Areas to be Graded with Such Equipment:

No
25%

(Yes or No)
% of Lawn Areas

Points Subtotal: 0

G. Are Any of the Following Stormwater Management Standards Met Using Only Nonstructural Strategies and Measures?

Groundwater Recharge Standards (NJAC 7:8-5.4-a-2):
Stormwater Runoff Quality Standards (NJAC 7:8-5.5):
Stormwater Runoff Quantity Standards (NJAC 7:8-5.4-a-3):

No
No
No

(Yes or No)
(Yes or No)
(Yes or No)

Points Subtotal: 0

Note: If the Answers to All Three Questions at G Above are "Yes", Adequate Nonstructural Measures have been Utilized.

Total Proposed Site Points: 103

Ratio of Proposed to Existing Site Points: 82%

Required Site Points Ratio: 80%

Nonstructural Point System Results:

Proposed Nonstructural Measures are Adequate

DRAINAGE AREA MAPS