Stormwater Management Report

for:

Oscar and Ella Wilf Campus for Senior Living Solar Field

Block: 386.07
Lots: 54.01 & 54.03
Township of Franklin
Somerset County, New Jersey

Prepared By:
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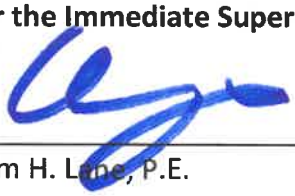
Under the Immediate Supervision of:



William H. Lane, P.E.
NJ PE # 40262

WAL/CJS
MEA # 2012.033.02
Dated: November 22, 2019

menlo engineering associates

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INTRODUCTION

The following Stormwater Management Report details the design of the stormwater management plan for a proposed solar field associated with the Oscar and Ella Wilf Campus for Senior Living, in the Township of Franklin, Somerset County, New Jersey. This report has been prepared by Menlo Engineering Associates, Inc. in accordance with the standards of the Township of Franklin, the County of Somerset, 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.

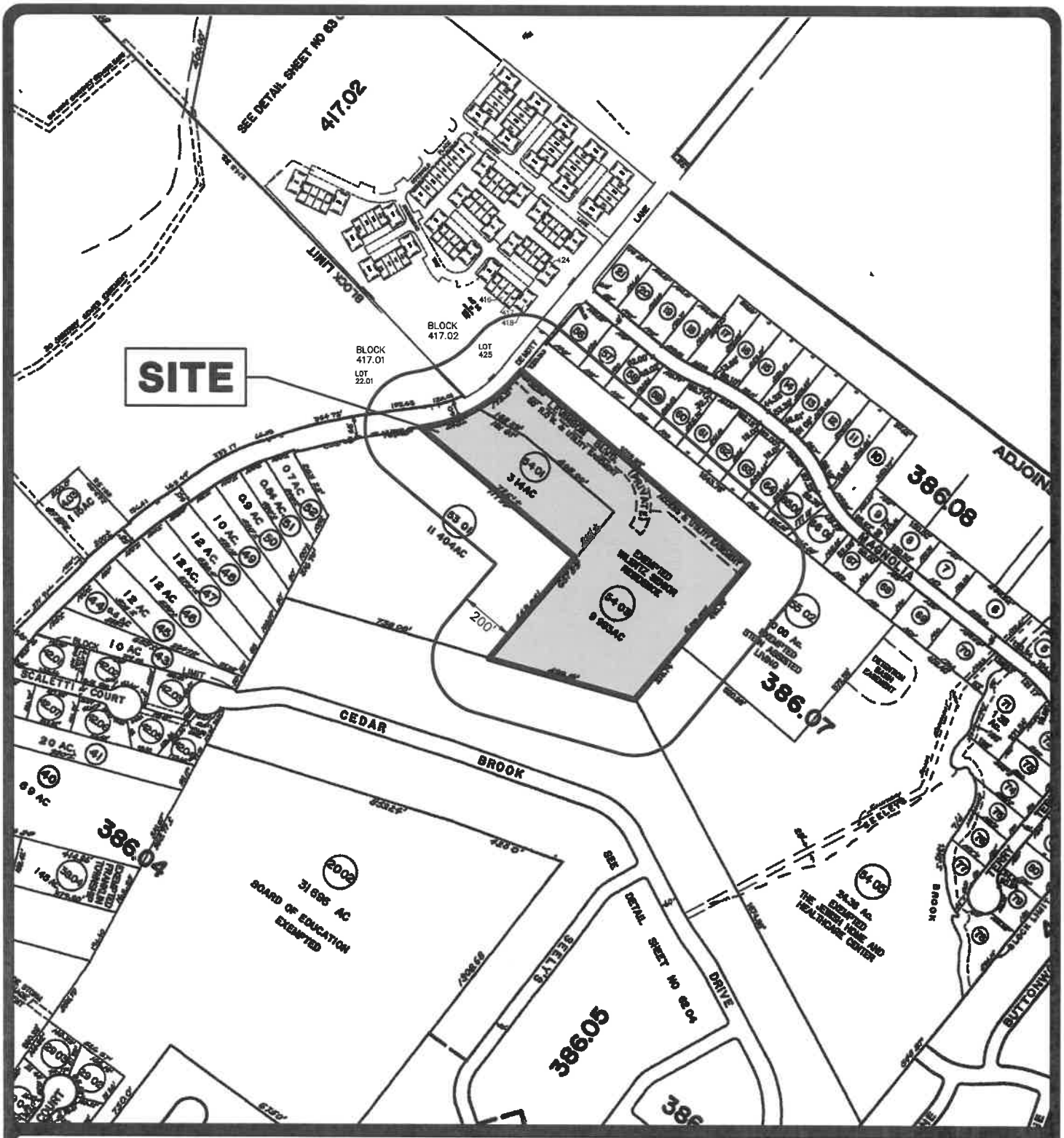
It is the intent of this report to aid and assist Engineers at the Municipal, County, and State levels in evaluating the drainage calculations and considerations incorporated in the design, as shown on the plans submitted. This office will readily respond to questions and requests for additional calculations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

CRITERIA

In the hydraulic designs involved in this project, the drainage areas have been determined by a topographic survey prepared by Robert J. Monson, PLS and field observations. The Soil Conservation Service Soil Survey maps are used for hydrological soil group classification and utilized with the Rational Method in the design calculations for basin routing. Existing and proposed conditions are calculated for the 100, 25, 10 and 2-year flows. The existing detention basin has been analyzed by using a critical duration analysis for both the existing and proposed routings. 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 13.02-acre tract of land situated in the Township of Franklin, Somerset County, New Jersey. The applicant is proposing to further develop the existing Senior Apartment Complex tract of land by installing solar panels, known as Oscar and Ella Wilf Campus for Senior Living Solar Field. The lot is located between the Regency Jewish Heritage Nursing and Levinson Boulevard along DeMott Lane. The property is currently utilized as a Senior Apartment Complex and as it exists today, contains open space, woods, pavement and a 6-Story Senior Apartment Building. Access to the site has been provided by an emergency access driveway through the Existing Nursing Home Complex.



TAX MAP

Sheet Number: 62
Township of Franklin
Somerset County

BLOCK	LOTS
386.07	54.01 & 54.03

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

0 125' 250' 375' 500'

Scale: 1"=500± ft *Job # 2012.033.02*

PJ

ROAD MAP

Township of Franklin
Somerset County

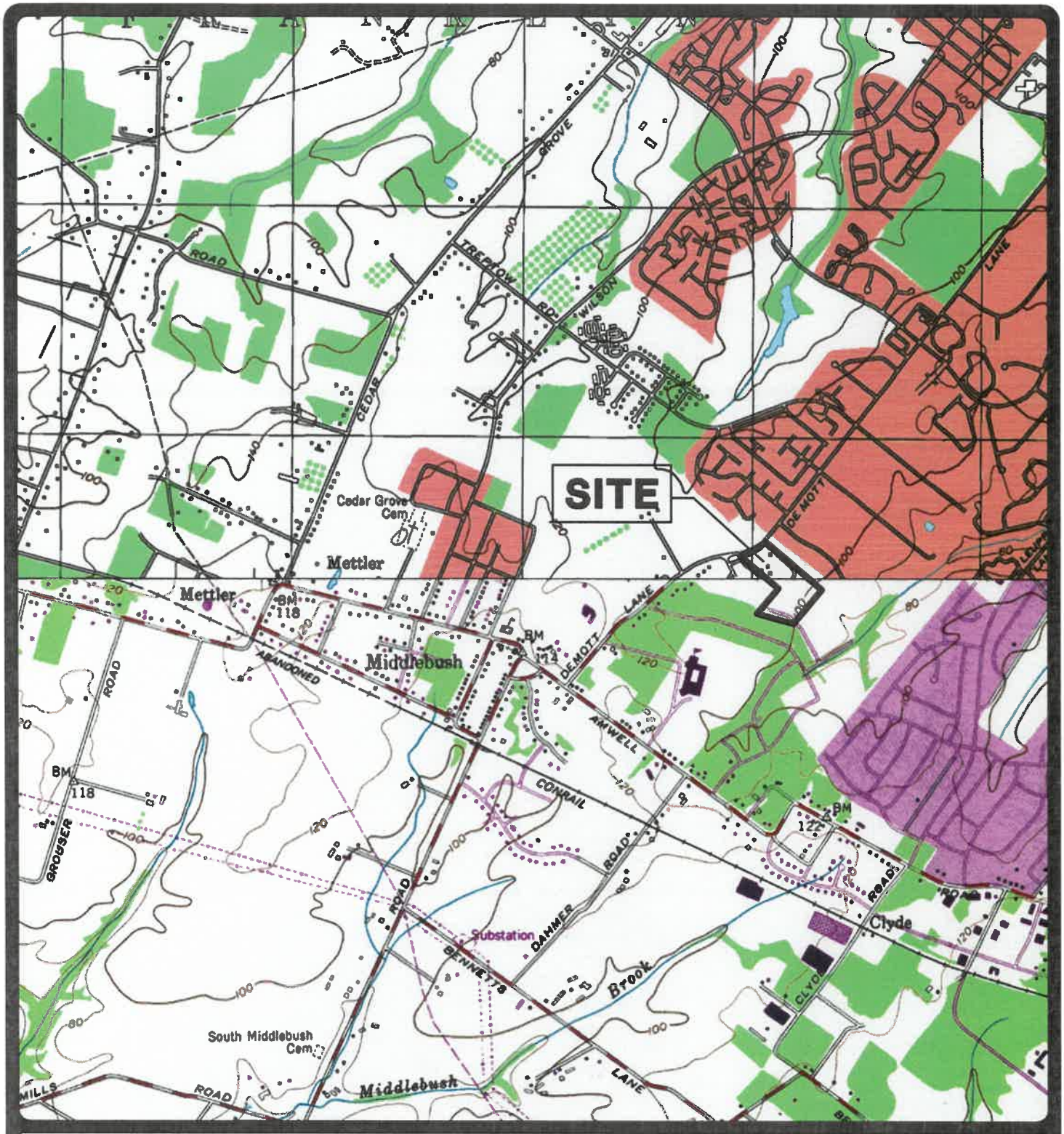
BLOCK	LOTS
386.07	54.01 & 54.03

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

0 300' 600'
150' 450'

Scale: 1"=600± ft *Job # 2012.033.02*

PJ



U.S.G.S. MAP

Quad Name: Monmouth Junction/Boundbrook
Township of Franklin
Somerset County

N

BLOCK
386.07

LOTS
54.01 & 54.03

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

State Plane Coordinates:
N: 607,116.78 ft.
E: 488,132.63 ft.

0 1,000' 2,000'
500' 1,500'

Scale: 1"=2,000±ft *Job # 2012.033.02*

PJ

STORMWATER MANAGEMENT PLAN & DESIGN

The guidelines for hydraulic design, as prepared by the Soil Conservation District, the Township of Franklin, Somerset County, and the New Jersey Department of Environmental Protection, have been utilized for the stormwater design of this project. The purpose of the stormwater design is for the post-development peak drainage flow pattern to continue as it exists today. The location and modification of the existing detention basin will allow the post-development peak flows from the site to be attenuated to meet all applicable reductions from the pre-development condition.

Summary of the Runoff Analysis

The existing drainage areas can be divided into three separate subareas. Subarea EDA-1 drains towards the Demott lane. Subarea EDA-2 drains towards the south direction and discharges overland into the existing wetlands that also receives runoff from the existing basin. Subarea EDA-3 drains towards the south-east direction and flows into the existing storm sewer system and finally flows into the existing detention basin. The detention basin retains the excess runoff prior to discharging downstream to a delineated wetland. For post-development conditions, the drainage area has been similarly divided into three separate subareas, named as PDA-1, PDA-2 and PDA-3. Each area drains towards and discharges to the same area as its existing condition (See drainage area maps).

In accordance with N.J.A.C. 7:8-5.4(a)3, the stormwater management system for the proposed development has been designed to control stormwater runoff quantity impacts. The post-construction peak runoff rates for the 100, 10 and 2-year storm events are 80, 75 and 50 percent, respectively, of the pre-construction peak runoff rates. Refer to Appendix A and B for supporting documentation.

No new storm sewer will be proposed for this improvement. The runoff generated from the site will be conveyed by the existing storm sewer systems. Since the flow pattern of post-development conditions is same as the pre-development conditions. Only the affected storm sewer lines will be examined with the 25-year storm event. Refer to Appendix D for supporting documentation.

Summary of the Water Quality Analysis

Since no additional impervious surface will be proposed in this development, in accordance with N.J.A.C. 7:5-5, the water quality control requirement is not applicable to this improvement.

Summary of the Groundwater Recharge Analysis

The following tables summarizes the groundwater recharge rates:

Pre-Developed Condition		Post Development Conditions	
Total Annual Recharge (cf) =	155,688	Annual Recharge Requirements (cf) =	156,010
		Annual Recharge Deficit (cf) =	-322

No new impervious surface area has been proposed for the development, and approximately 0.09 acres of existing impervious surface area will be removed. Therefore, the structural infiltration

BMP is not required. Refer to Appendix D for supporting calculation (Groundwater Recharge Spreadsheet).
The following tables summarize the reduction of runoff for the 100, 25, 10 and 2-year storm events:

(1) Drainage Areas Draining towards the Basin Direction

EXISTING CONDITIONS INTO BASIN

FREQUENCY	(1) EXISTING OVERLAND FROM BASIN (CFS)	(2) EXISTING UNDISTURBED INTO BASIN (82%) (CFS)	(3) EXISTING DISTURBED INTO BASIN (18%) (CFS)	REDUCTIONS ON EXISTING DISTURBED INTO BASIN (%)	(4) EXISTING DISTURBED INTO BASIN WITH REDUCTIONS (CFS)
100	18.92	15.51	3.41	80	2.72
25	14.25	11.69	2.57	------	------
10	11.64	9.54	2.10	75	1.57
2	7.30	5.99	1.31	50	0.66

OVERALL EXISTING CONDITIONS

FREQUENCY	(2+4) MAXIMUM ALLOWABLE FROM BASIN (CFS)	(5) EXISTING OVERLAND UNDETAINED (EDA-2) (CFS)	REDUCTIONS ON EXISTING OVERLAND CONDITIONS (%)	(6) EXISTING OVERLAND W/ REDUCTIONS (CFS)	(2+4+6) MAXIMUM OVERALL ALLOWABLE (CFS)
100	18.23	1.86	80	1.49	19.72
25	------	1.51	------	------	------
10	11.11	1.29	75	0.97	12.08
2	6.65	0.95	50	0.48	7.13

OVERALL PROPOSED CONDITIONS

FREQUENCY	(7) PROPOSED OVERLAND (CFS)	(8) BASIN OUTFLOW (CFS)	(7+8) TOTAL PROPOSED (CFS)	(2+4+6) - (7+8) FLOW REDUCTION FROM MAXIMUM OVERALL ALLOWABLE (CFS)
100	3.16	15.82	18.98	0.74
25	2.59	11.78	14.37	------
10	2.23	9.38	11.61	0.47
2	1.63	5.46	7.09	0.04

EXISTING DETENTION BASIN CONDITIONS

FREQUENCY	DEPTH (FEET)	ELEVATION	STORAGE (CF)	BASIN OUTFLOW (CFS)
100	3.03	96.88	34,106	18.92
25	2.77	96.62	28,778	14.25
10	2.62	96.47	25,503	11.64
2	2.31	96.16	19,039	7.30

PROPOSED DETENTION BASIN CONDITIONS

FREQUENCY	DEPTH (FEET)	ELEVATION	STORAGE (CF)	BASIN OUTFLOW (CFS)
100	3.14	96.99	45,012	15.82
25	2.85	96.70	38,130	11.78
10	2.66	96.51	33,614	9.38
2	2.29	96.14	24,771	5.46

(2) Drainage Areas Draining towards Demott Lane

FREQUENCY	(1) EXISTING OVERLAND CONDITIONS (EDA-1) (CFS)	(2) PROPOSED OVERLAND CONDITIONS (PDA-1) (CFS)	(1)-(2) FLOW REDUCTION (CFS)
100	1.16	0.47	0.69
25	0.95	0.39	------
10	0.82	0.33	0.49
2	0.60	0.25	0.35

APPENDIX A
(Existing Conditions)

PRE-DEVELOPMENT DRAINAGE CONDITION

OVERLAND

EDA-1 EXISTING OVERLAND TO DEMOTT LANE

I. Total Drainage Area: 0.44 Acres

II. Soil Groups/Types:

		Type
KkoB	-Klinesville	C

III. Time of Concentration: 20 Minutes

IV Rainfall Intensity:

Storm	Rainfall(in/hr)
100-YR	5.80
25-YR	4.75
10-YR	4.10
2-YR	3.00
1-YR	2.20

V. Weighted 'c' Calulation:

Land Use	Area		% of Cover	C Value	Total
Impervious	0.001	Acres	0.00	0.99	0.00
Gravel	0.000	Acres	0.00	0.88	0.00
Grass	0.000	Acres	0.00	0.51	0.00
Woods	0.441	Acres	1.00	0.45	0.45
				Weighted 'c':	0.45

VI. $Q=ciA$

Q=	c	I	A		=	Q	Reduction	QAllowed
Q_{100}=	0.45	5.80		0.44	=	1.16	20%	0.92
Q_{25}=	0.45	4.75		0.44	=	0.95	------	------
Q_{10}=	0.45	4.10		0.44	=	0.82	25%	0.61
Q_{2}=	0.45	3.00		0.44	=	0.60	50%	0.30

Time of Concentration for EDA-1

The calculation of time of concentration was based on the TR-55 method.

EDA-1: TO Demott Lane	Length (ft)	Slope (ft/ft)	Manning's n	P_2 (in)	Velocity (ft/sec)	Time (min)
Sheet Flow	100	0.0280	0.40	3.3	---	18.5
Shallow Concentrated Flow	134	0.0090			1.5	1.5
Channel Flow						
					Total =	**20.0** **(min)**

PRE-DEVELOPMENT DRAINAGE CONDITION

OVERLAND

EDA-2 Existing Overland Undetained

I. Total Drainage Area: 0.76 Acres

II. Soil Groups/Types:

		Type
KkoB	-Klinesville	C

III. Time of Concentration: 26 Minutes

IV Rainfall Intensity:

Storm	Rainfall(in/hr)
100-YR	5.17
25-YR	4.20
10-YR	3.58
2-YR	2.65
1-YR	1.91

V. Weighted 'c' Calulation:

Land Use	Area		% of Cover	C Value	Total
Impervious	0.028	Acres	0.04	0.99	0.04
Gravel	0.000	Acres	0.00	0.88	0.00
Grass	0.000	Acres	0.00	0.51	0.00
Woods	0.737	Acres	0.96	0.45	0.43
				Weighted 'c':	0.47

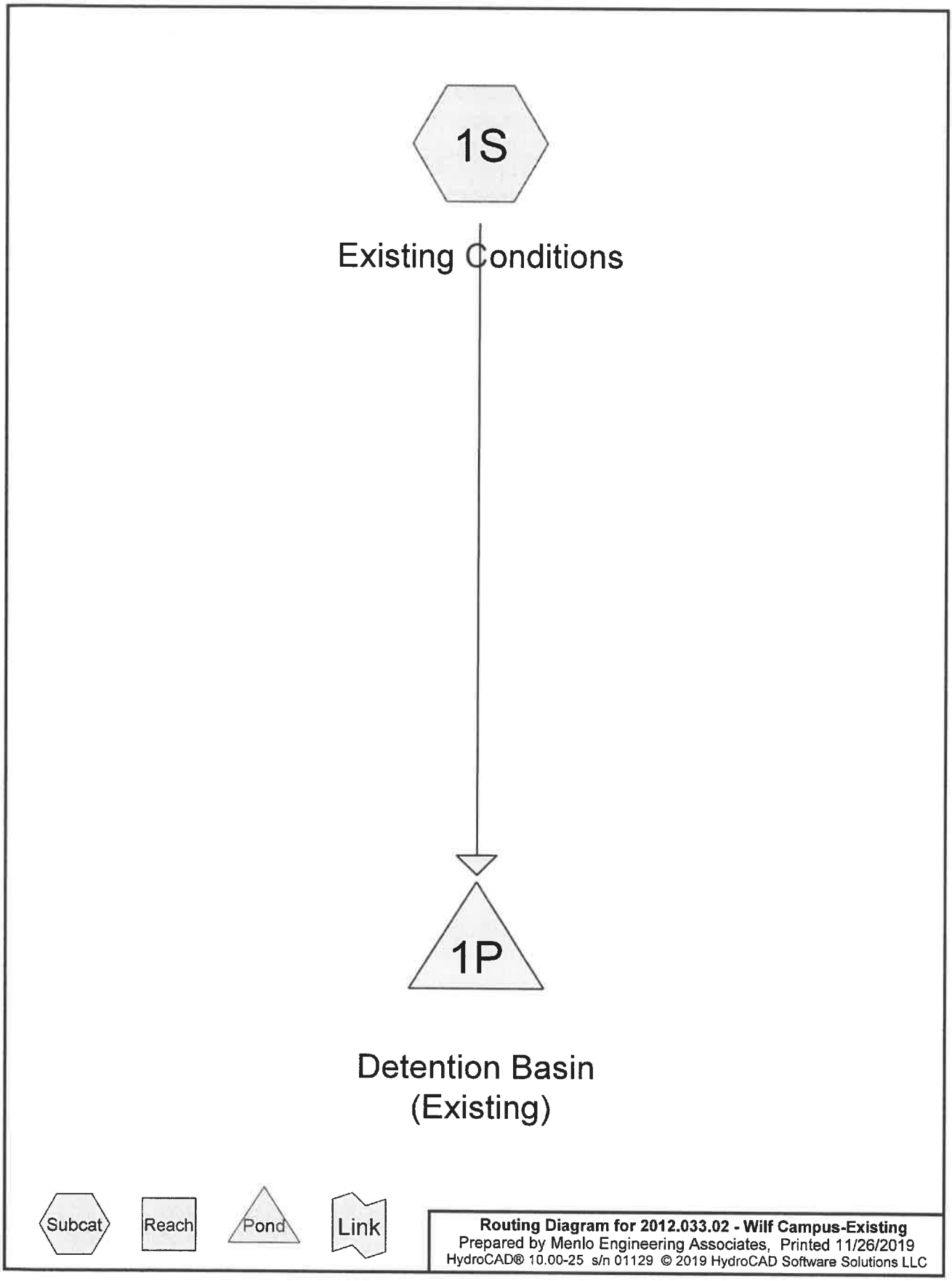
VI. $Q=ciA$

	c	I	A	=	Q	Reduction	QAllowed
Q_{100}=	0.47	5.17	0.76	=	1.86	20%	1.49
Q_{25}=	0.47	4.20	0.76	=	1.51	------	------
Q_{10}=	0.47	3.58	0.76	=	1.29	25%	0.97
Q_{2}=	0.47	2.65	0.76	=	0.95	50%	0.48

Time of Concentration for EDA-2

The calculation of time of concentration was based on the TR-55 method.

EDA-2: Undetained	Length (ft)	Slope (ft/ft)	Manning's n	P_2 (in)	Velocity (ft/sec)	Time (min)
Sheet Flow	100	0.0147	0.40	3.3	---	23.9
Shallow Concentrated Flow	392	0.0248			2.6	2.5
Channel Flow						
					Total =	**26.4** **(min)**



Routing Diagram for 2012.033.02 - Wilf Campus-Existing
Prepared by Menlo Engineering Associates, Printed 11/26/2019
HydroCAD® 10.00-25 s/n 01129 © 2019 HydroCAD Software Solutions LLC

100-YEAR STORM

Area Listing (all nodes)

Area (acres)	C	Description (subcatchment-numbers)
2.750	0.99	Impervious Surface (1S)
3.180	0.51	Pervious Surface (1S)
3.170	0.45	Woods (1S)
9.100	**0.63**	**TOTAL AREA**

Time span=0.00-4.00 hrs, dt=0.01 hrs, 401 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: Existing Conditions Runoff Area=9.100 ac 30.22% Impervious Runoff Depth=2.07"
Flow Length=1,002' Tc=27.2 min Frequency Adjusted C=0.79 Runoff=27.84 cfs 1.572 af

Total Runoff Area = 9.100 ac Runoff Volume = 1.572 af Average Runoff Depth = 2.07"
69.78% Pervious = 6.350 ac 30.22% Impervious = 2.750 ac

Summary for Subcatchment 1S: Existing Conditions

Runoff = 27.84 cfs @ 0.46 hrs, Volume= 1.572 af, Depth= 2.07"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
NJ-DEP 100-Year Duration=41 min, Inten=3.83 in/hr, Cf=1.25

Area (ac)	C	Adj	Description
2.750	0.99		Impervious Surface
3.180	0.51		Pervious Surface
3.170	0.45		Woods
9.100	0.63	0.79	Weighted Average, Frequency Adjusted
6.350			69.78% Pervious Area
2.750			30.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.7	100	0.0167	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
2.8	452	0.0286	2.72		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	110	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.8	340	0.0139	7.01	12.38	**Pipe Channel, RCP_Round 18"** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
27.2	1,002	Total			

TIME OF CONCENTRATION

Summary for Pond 1P: Detention Basin (Existing)

Inflow Area = 9.100 ac, 30.22% Impervious, Inflow Depth = 2.07" for 100-Year event
Inflow = 27.84 cfs @ 0.46 hrs, Volume= 1.572 af
Outflow = 18.92 cfs @ 0.83 hrs, Volume= 1.572 af, Atten= 32%, Lag= 22.1 min
Primary = 18.92 cfs @ 0.83 hrs, Volume= 1.572 af

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 96.88' @ 0.83 hrs Surf.Area= 23,009 sf Storage= 34,106 cf

Plug-Flow detention time= 34.3 min calculated for 1.572 af (100% of inflow)
Center-of-Mass det. time= 34.3 min (68.4 - 34.1)

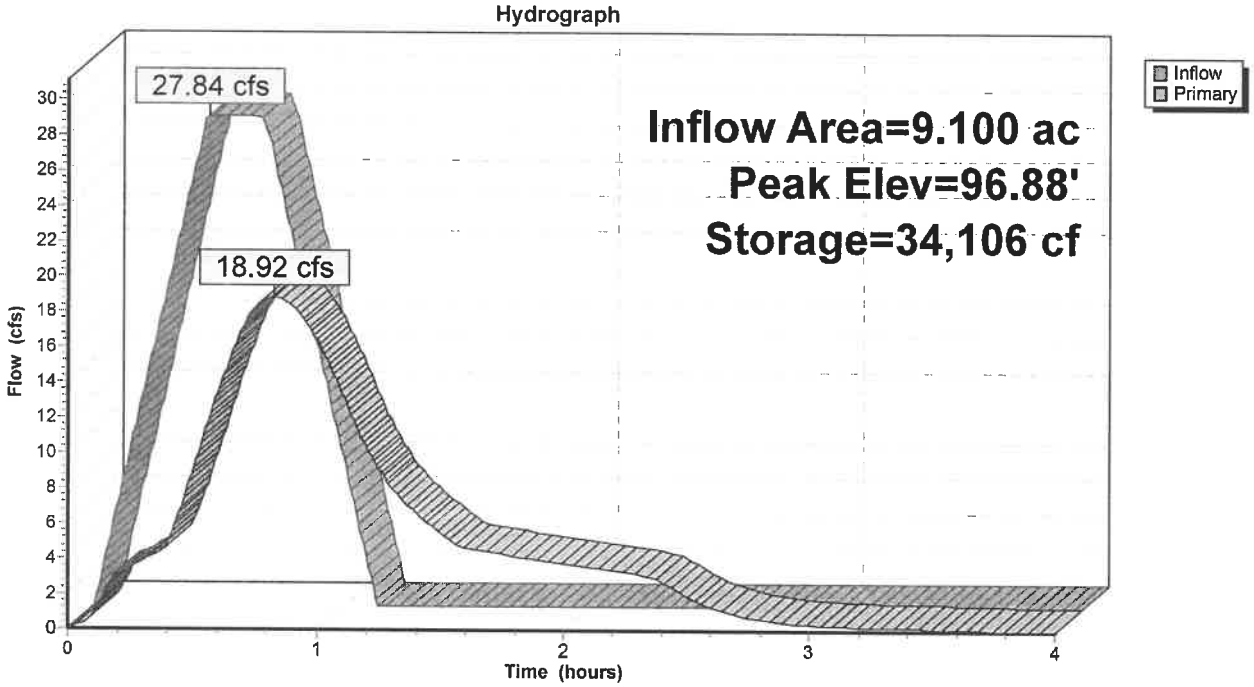
Volume	Invert	Avail.Storage	Storage Description
#1	93.85'	62,459 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
93.85	0	0	0
94.00	50	4	4
95.00	6,520	3,285	3,289
96.00	18,310	12,415	15,704
97.00	23,670	20,990	36,694
98.00	27,860	25,765	62,459

Device	Routing	Invert	Outlet Devices
#1	Primary	93.85'	**12.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	95.85'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=18.92 cfs @ 0.83 hrs HW=96.88' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 6.01 cfs @ 7.65 fps)
└—**2=Sharp-Crested Rectangular Weir** (Weir Controls 12.91 cfs @ 3.31 fps)

Pond 1P: Detention Basin (Existing)



25-YEAR STORM

Area Listing (all nodes)

Area (acres)	C	Description (subcatchment-numbers)
2.750	0.99	Impervious Surface (1S)
3.180	0.51	Pervious Surface (1S)
3.170	0.45	Woods (1S)
9.100	**0.63**	**TOTAL AREA**

Time span=0.00-4.00 hrs, dt=0.01 hrs, 401 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

Subcatchment1S: Existing Conditions Runoff Area=9.100 ac 30.22% Impervious Runoff Depth=1.70"
Flow Length=1,002' Tc=27.2 min Frequency Adjusted C=0.79 Runoff=21.74 cfs 1.288 af

Total Runoff Area = 9.100 ac Runoff Volume = 1.288 af Average Runoff Depth = 1.70"
69.78% Pervious = 6.350 ac 30.22% Impervious = 2.750 ac

Summary for Subcatchment 1S: Existing Conditions

Runoff = 21.74 cfs @ 0.46 hrs, Volume= 1.288 af, Depth= 1.70"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
NJ-DEP 25-Year Duration=43 min, Inten=2.99 in/hr, Cf=1.25

Area (ac)	C	Adj	Description
2.750	0.99		Impervious Surface
3.180	0.51		Pervious Surface
3.170	0.45		Woods
9.100	0.63	0.79	Weighted Average, Frequency Adjusted
6.350			69.78% Pervious Area
2.750			30.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.7	100	0.0167	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
2.8	452	0.0286	2.72		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	110	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.8	340	0.0139	7.01	12.38	**Pipe Channel, RCP_Round 18"** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
27.2	1,002	Total			

TIME OF CONCENTRATION

Time span=0.00-4.00 hrs, dt=0.01 hrs, 401 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

Pond 1P: Detention Basin (Existing) Peak Elev=96.62' Storage=28,778 cf Inflow=21.74 cfs 1.288 af
Outflow=14.25 cfs 1.288 af

Summary for Pond 1P: Detention Basin (Existing)

Inflow Area = 9.100 ac, 30.22% Impervious, Inflow Depth = 1.70" for 25-Year event
Inflow = 21.74 cfs @ 0.46 hrs, Volume= 1.288 af
Outflow = 14.25 cfs @ 0.87 hrs, Volume= 1.288 af, Atten= 34%, Lag= 24.8 min
Primary = 14.25 cfs @ 0.87 hrs, Volume= 1.288 af

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 96.62' @ 0.87 hrs Surf.Area= 21,649 sf Storage= 28,778 cf

Plug-Flow detention time= 36.2 min calculated for 1.288 af (100% of inflow)
Center-of-Mass det. time= 36.1 min (71.3 - 35.1)

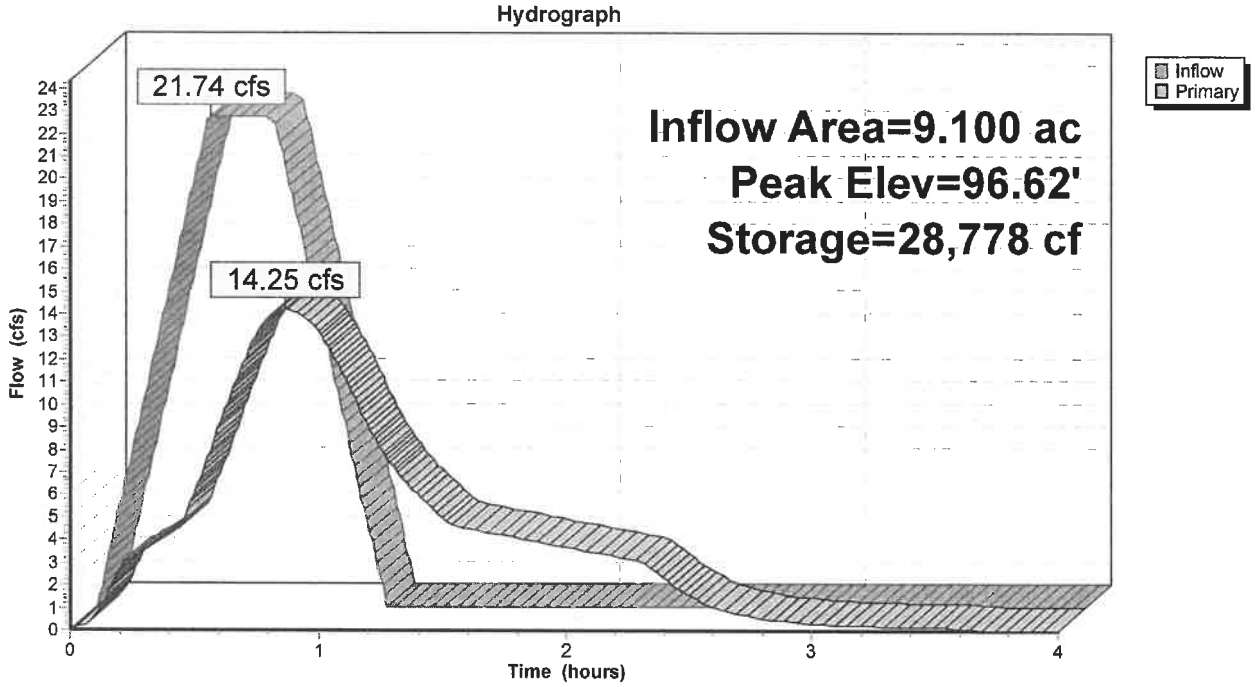
Volume	Invert	Avail.Storage	Storage Description
#1	93.85'	62,459 cf	**Custom Stage Data (Prismatic)**Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
93.85	0	0	0
94.00	50	4	4
95.00	6,520	3,285	3,289
96.00	18,310	12,415	15,704
97.00	23,670	20,990	36,694
98.00	27,860	25,765	62,459

Device	Routing	Invert	Outlet Devices
#1	Primary	93.85'	**12.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	95.85'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=14.24 cfs @ 0.87 hrs HW=96.62' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 5.70 cfs @ 7.26 fps)
└—**2=Sharp-Crested Rectangular Weir** (Weir Controls 8.54 cfs @ 2.87 fps)

Pond 1P: Detention Basin (Existing)



10-YEAR STORM

Area Listing (all nodes)

Area (acres)	C	Description (subcatchment-numbers)
2.750	0.99	Impervious Surface (1S)
3.180	0.51	Pervious Surface (1S)
3.170	0.45	Woods (1S)
9.100	**0.63**	**TOTAL AREA**

Time span=0.00-4.00 hrs, dt=0.01 hrs, 401 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

Subcatchment1S: Existing Conditions Runoff Area=9.100 ac 30.22% Impervious Runoff Depth=1.49"
Flow Length=1,002' Tc=27.2 min Frequency Adjusted C=0.79 Runoff=18.18 cfs 1.127 af

Total Runoff Area = 9.100 ac Runoff Volume = 1.127 af Average Runoff Depth = 1.49"
69.78% Pervious = 6.350 ac 30.22% Impervious = 2.750 ac

Summary for Subcatchment 1S: Existing Conditions

Runoff = 18.18 cfs @ 0.46 hrs, Volume= 1.127 af, Depth= 1.49"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
NJ-DEP 10-Year Duration=45 min, Inten=2.50 in/hr, Cf=1.25

Area (ac)	C	Adj	Description
2.750	0.99		Impervious Surface
3.180	0.51		Pervious Surface
3.170	0.45		Woods
9.100	0.63	0.79	Weighted Average, Frequency Adjusted
6.350			69.78% Pervious Area
2.750			30.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.7	100	0.0167	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
2.8	452	0.0286	2.72		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	110	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.8	340	0.0139	7.01	12.38	**Pipe Channel, RCP_Round 18"** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
27.2	1,002	Total			

Time span=0.00-4.00 hrs, dt=0.01 hrs, 401 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

Pond 1P: Detention Basin (Existing) Peak Elev=96.47' Storage=25,503 cf Inflow=18.18 cfs 1.127 af
Outflow=11.64 cfs 1.127 af

Summary for Pond 1P: Detention Basin (Existing)

Inflow Area = 9.100 ac, 30.22% Impervious, Inflow Depth = 1.49" for 10-Year event
Inflow = 18.18 cfs @ 0.46 hrs, Volume= 1.127 af
Outflow = 11.64 cfs @ 0.91 hrs, Volume= 1.127 af, Atten= 36%, Lag= 27.2 min
Primary = 11.64 cfs @ 0.91 hrs, Volume= 1.127 af

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 96.47' @ 0.91 hrs Surf.Area= 20,812 sf Storage= 25,503 cf

Plug-Flow detention time= 36.9 min calculated for 1.124 af (100% of inflow)
Center-of-Mass det. time= 37.2 min (73.3 - 36.1)

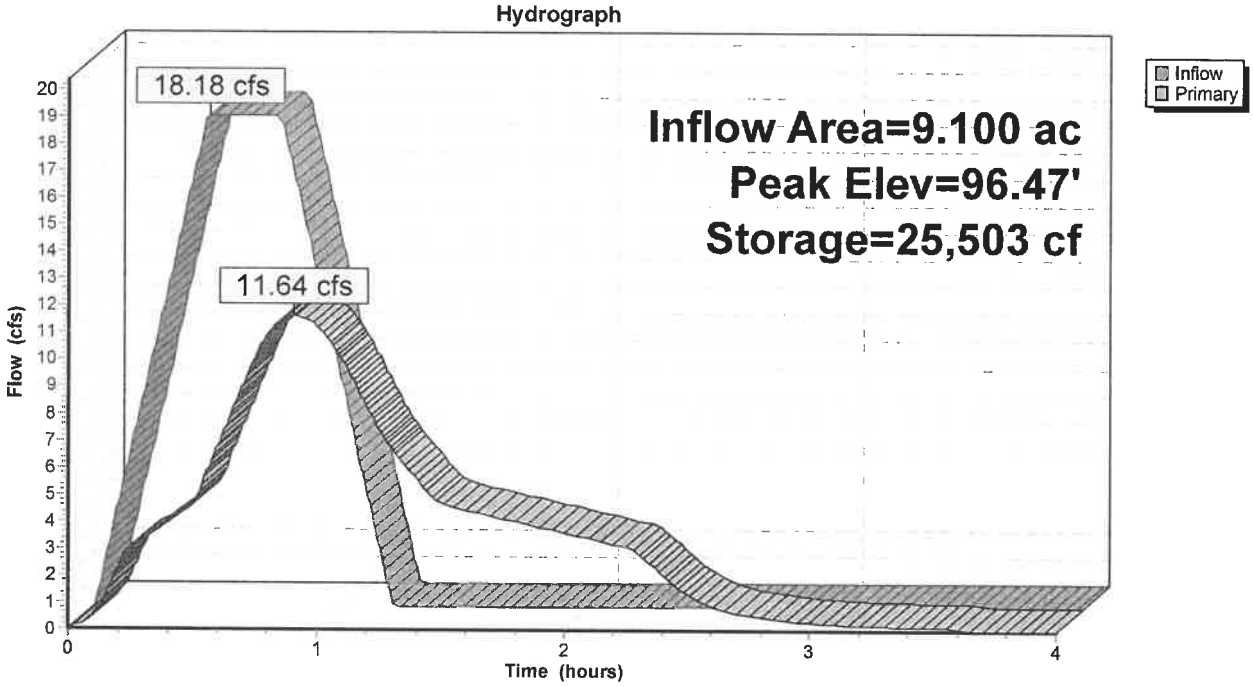
Volume	Invert	Avail.Storage	Storage Description
#1	93.85'	62,459 cf	**Custom Stage Data (Prismatic)**Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
93.85	0	0	0
94.00	50	4	4
95.00	6,520	3,285	3,289
96.00	18,310	12,415	15,704
97.00	23,670	20,990	36,694
98.00	27,860	25,765	62,459

Device	Routing	Invert	Outlet Devices
#1	Primary	93.85'	**12.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	95.85'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=11.64 cfs @ 0.91 hrs HW=96.47' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 5.50 cfs @ 7.01 fps)
└—**2=Sharp-Crested Rectangular Weir** (Weir Controls 6.14 cfs @ 2.57 fps)

Pond 1P: Detention Basin (Existing)



2-YEAR STORM

Area Listing (all nodes)

Area (acres)	C	Description (subcatchment-numbers)
2.750	0.99	Impervious Surface (1S)
3.180	0.51	Pervious Surface (1S)
3.170	0.45	Woods (1S)
9.100	**0.63**	**TOTAL AREA**

Time span=0.00-4.00 hrs, dt=0.01 hrs, 401 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

Subcatchment1S: Existing Conditions Runoff Area=9.100 ac 30.22% Impervious Runoff Depth=1.06"
Flow Length=1,002' Tc=27.2 min Frequency Adjusted C=0.79 Runoff=13.52 cfs 0.801 af

Total Runoff Area = 9.100 ac Runoff Volume = 0.801 af Average Runoff Depth = 1.06"
69.78% Pervious = 6.350 ac 30.22% Impervious = 2.750 ac

Summary for Subcatchment 1S: Existing Conditions

Runoff = 13.52 cfs @ 0.46 hrs, Volume= 0.801 af, Depth= 1.06"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
NJ-DEP 2-Year Duration=43 min, Inten=1.86 in/hr, Cf=1.25

Area (ac)	C	Adj	Description
2.750	0.99		Impervious Surface
3.180	0.51		Pervious Surface
3.170	0.45		Woods
9.100	0.63	0.79	Weighted Average, Frequency Adjusted
6.350			69.78% Pervious Area
2.750			30.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.7	100	0.0167	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
2.8	452	0.0286	2.72		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	110	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.8	340	0.0139	7.01	12.38	**Pipe Channel, RCP_Round 18"** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
27.2	1,002	Total			

Time span=0.00-4.00 hrs, dt=0.01 hrs, 401 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

Pond 1P: Detention Basin (Existing) Peak Elev=96.16' Storage=19,039 cf Inflow=13.52 cfs 0.801 af
Outflow=7.30 cfs 0.801 af

Summary for Pond 1P: Detention Basin (Existing)

Inflow Area = 9.100 ac, 30.22% Impervious, Inflow Depth = 1.06" for 2-Year event
Inflow = 13.52 cfs @ 0.46 hrs, Volume= 0.801 af
Outflow = 7.30 cfs @ 0.93 hrs, Volume= 0.801 af, Atten= 46%, Lag= 27.9 min
Primary = 7.30 cfs @ 0.93 hrs, Volume= 0.801 af

Routing by Stor-Ind method, Time Span= 0.00-4.00 hrs, dt= 0.01 hrs
Peak Elev= 96.16' @ 0.93 hrs Surf.Area= 19,162 sf Storage= 19,039 cf

Plug-Flow detention time= 37.5 min calculated for 0.799 af (100% of inflow)
Center-of-Mass det. time= 37.7 min (72.8 - 35.1)

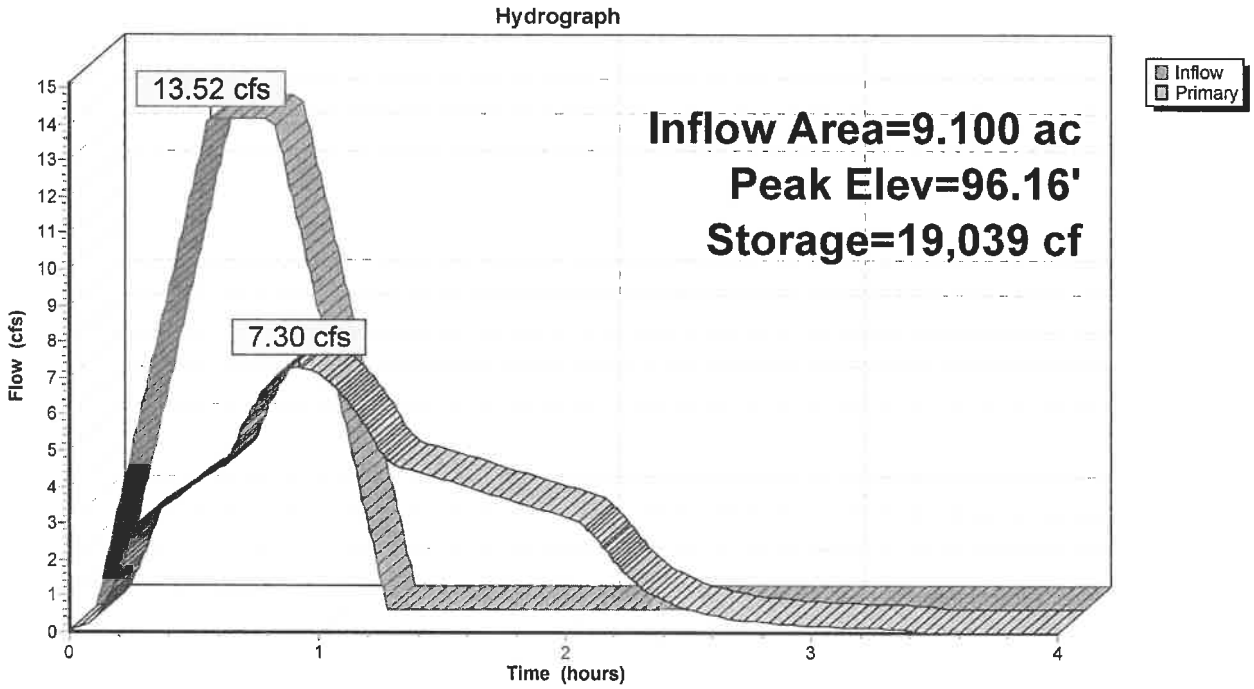
Volume	Invert	Avail.Storage	Storage Description
#1	93.85'	62,459 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
93.85	0	0	0
94.00	50	4	4
95.00	6,520	3,285	3,289
96.00	18,310	12,415	15,704
97.00	23,670	20,990	36,694
98.00	27,860	25,765	62,459

Device	Routing	Invert	Outlet Devices
#1	Primary	93.85'	**12.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	95.85'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=7.30 cfs @ 0.93 hrs HW=96.16' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 5.09 cfs @ 6.48 fps)
└—**2=Sharp-Crested Rectangular Weir** (Weir Controls 2.21 cfs @ 1.82 fps)

Pond 1P: Detention Basin (Existing)



APPENDIX B
(Proposed Conditions and Basin Routing)

POST-DEVELOPMENT RUNOFF CONDITION

OVERLAND

PDA-1 PROPOSED OVERLAND TO DEMOTT LANE

I. Total Drainage Area: 0.14 Acres

II. Soil Groups/Types:			Type
	KkoB	-Klinesville	C

III. Time of Concentration: 17 Minutes

IV Rainfall Intensity:

Storm	Rainfall(in/hr)
100-YR	6.56
25-YR	5.47
10-YR	4.71
2-YR	3.46
1-YR	2.50

V. Weighted 'c' Calulation:

Land Use	Area		% of Cover	C Value	Total
Impervious	0.000	Acres	0.00	0.99	0.00
Gravel	0.000	Acres	0.00	0.88	0.00
Grass	0.139	Acres	1.00	0.51	0.51
Woods	0.000	Acres	0.00	0.45	0.00
				Weighted 'c':	0.51

VI. $Q=ciA$

Q=	c	I	A	=	Q
Q_{100}=	0.51	6.56	0.14	=	0.47
Q_{25}=	0.51	5.47	0.14	=	0.39
Q_{10}=	0.51	4.71	0.14	=	0.33
Q_{2}=	0.51	3.46	0.14	=	0.25

Time of Concentration for PDA-1

The calculation of time of concentration was based on the TR-55 method.

PDA-1: TO Demott Lane	Length (ft)	Slope (ft/ft)	Manning's n	P_2 (in)	Velocity (ft/sec)	Time (min)
Sheet Flow (Grass)	78	0.0256	0.24	3.3	---	10.4
Sheet Flow (Wood)	22	0.0227	0.40	3.3		6.0
Shallow Concentrated Flow	49	0.0102			1.6	0.5
Channel Flow						
					Total =	**16.9** **(min)**

POST-DEVELOPMENT RUNOFF CONDITION

OVERLAND

PDA-2 Proposed Overland Undetained

I. Total Drainage Area: 1.07 Acres

II. Soil Groups/Types:			Type
	KkoB	-Klinesville	C

III. Time of Concentration: 21 Minutes

IV Rainfall Intensity:

Storm	Rainfall(in/hr)
100-YR	5.80
25-YR	4.75
10-YR	4.10
2-YR	3.00
1-YR	2.20

V. Weighted 'c' Calulation:

Land Use	Area		% of Cover	C Value	Total
Impervious	0.000	Acres	0.00	0.99	0.00
Gravel	0.000	Acres	0.00	0.88	0.00
Grass	1.068	Acres	1.00	0.51	0.51
Woods	0.000	Acres	0.00	0.45	0.00
				Weighted 'c':	0.51

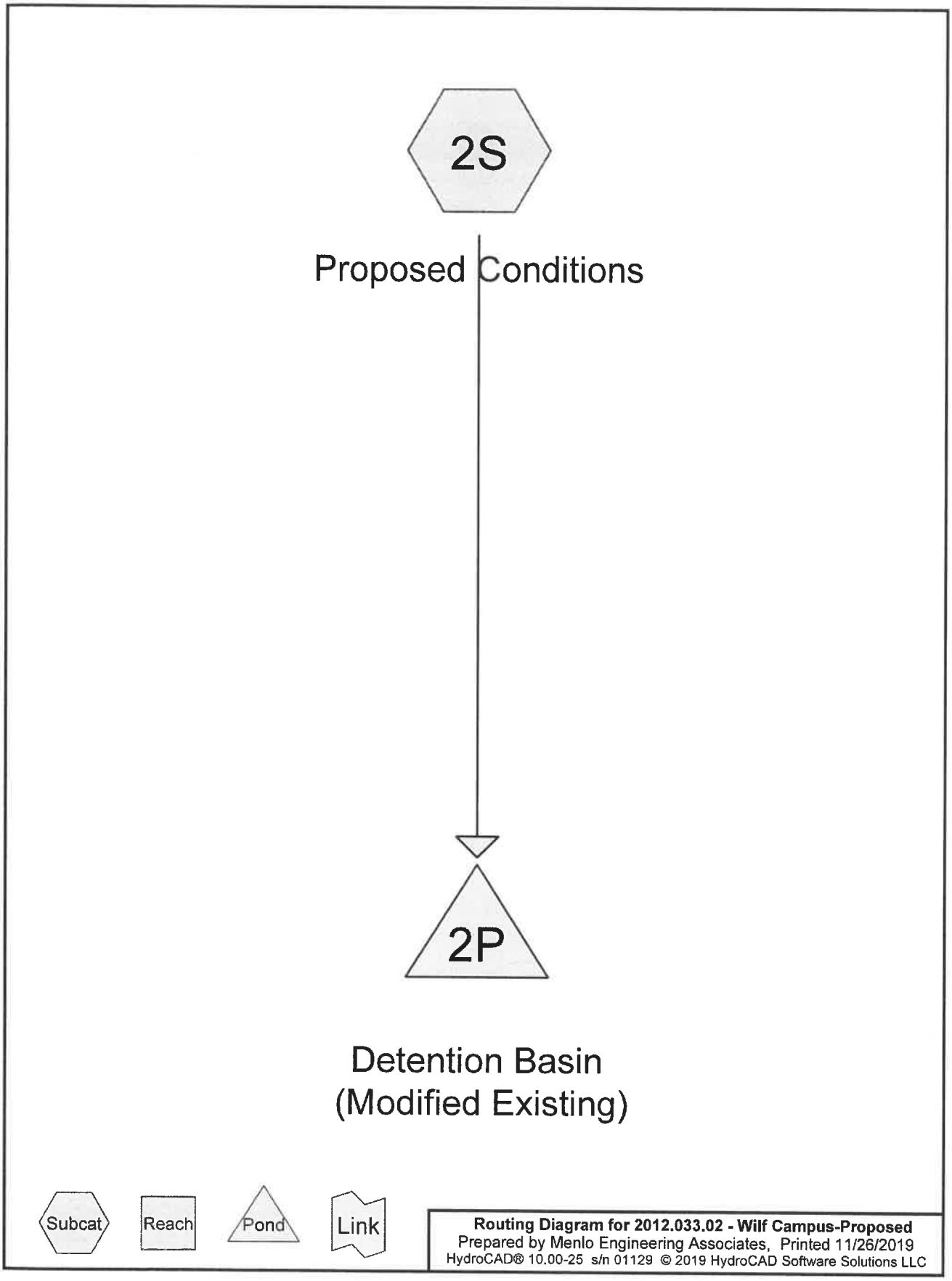
VI. $Q=ciA$

Q=	c	I	A	=	Q
Q_{100}=	0.51	5.80	1.07	=	3.16
Q_{25}=	0.51	4.75	1.07	=	2.59
Q_{10}=	0.51	4.10	1.07	=	2.23
Q_{2}=	0.51	3.00	1.07	=	1.63

Time of Concentration for PDA-2

The calculation of time of concentration was based on the TR-55 method.

PDA-2: Undetained	Length (ft)	Slope (ft/ft)	Manning's n	P_2 (in)	Velocity (ft/sec)	Time (min)
Sheet Flow	100	0.0100	0.24	3.3	---	18.5
Shallow Concentrated Flow	430	0.0237			2.6	2.8
Channel Flow						
					Total =	**21.3** **(min)**


2S
Proposed Conditions
2P
Detention Basin
(Modified Existing)
Subcat
Reach
Pond
Link
Routing Diagram for 2012.033.02 - Wilf Campus-Proposed
Prepared by Menlo Engineering Associates, Printed 11/26/2019
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100-YEAR STORM

Area Listing (all nodes)

Area (acres)	C	Description (subcatchment-numbers)
2.750	0.99	Impervious Surface (2S)
4.780	0.51	Pervious Surface (2S)
1.570	0.45	Woods (2S)
9.100	**0.64**	**TOTAL AREA**

Time span=0.00-6.00 hrs, dt=0.01 hrs, 601 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 2S: Proposed Conditions Runoff Area=9.100 ac 30.22% Impervious Runoff Depth=2.22"
Flow Length=1,002' Tc=19.6 min Frequency Adjusted C=0.81 Runoff=25.46 cfs 1.683 af

Total Runoff Area = 9.100 ac Runoff Volume = 1.683 af Average Runoff Depth = 2.22"
69.78% Pervious = 6.350 ac 30.22% Impervious = 2.750 ac

Summary for Subcatchment 2S: Proposed Conditions

Runoff = 25.46 cfs @ 0.33 hrs, Volume= 1.683 af, Depth= 2.22"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
NJ-DEP 100-Year Duration=48 min, Inten=3.44 in/hr, Cf=1.25

Area (ac)	C	Adj	Description
2.750	0.99		Impervious Surface
4.780	0.51		Pervious Surface
1.570	0.45		Woods
9.100	0.64	0.81	Weighted Average, Frequency Adjusted
6.350			69.78% Pervious Area
2.750			30.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	100	0.0167	0.11		**Sheet Flow,** n= 0.240 P2= 3.30"
2.8	452	0.0286	2.72		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	110	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.8	340	0.0139	7.01	12.38	**Pipe Channel, RCP_Round 18"** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
19.6	1,002	Total			

TIME OF CONCENTRATION

Time span=0.00-6.00 hrs, dt=0.01 hrs, 601 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

Pond 2P: Detention Basin (Modified Peak Elev=96.99' Storage=45,012 cf Inflow=25.46 cfs 1.683 af
Outflow=15.82 cfs 1.683 af

Summary for Pond 2P: Detention Basin (Modified Existing)

Inflow Area = 9.100 ac, 30.22% Impervious, Inflow Depth = 2.22" for 100-Year event
Inflow = 25.46 cfs @ 0.33 hrs, Volume= 1.683 af
Outflow = 15.82 cfs @ 0.92 hrs, Volume= 1.683 af, Atten= 38%, Lag= 35.6 min
Primary = 15.82 cfs @ 0.92 hrs, Volume= 1.683 af

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
Peak Elev= 96.99' @ 0.92 hrs Surf.Area= 25,134 sf Storage= 45,012 cf

Plug-Flow detention time= 57.7 min calculated for 1.680 af (100% of inflow)
Center-of-Mass det. time= 58.1 min (91.9 - 33.8)

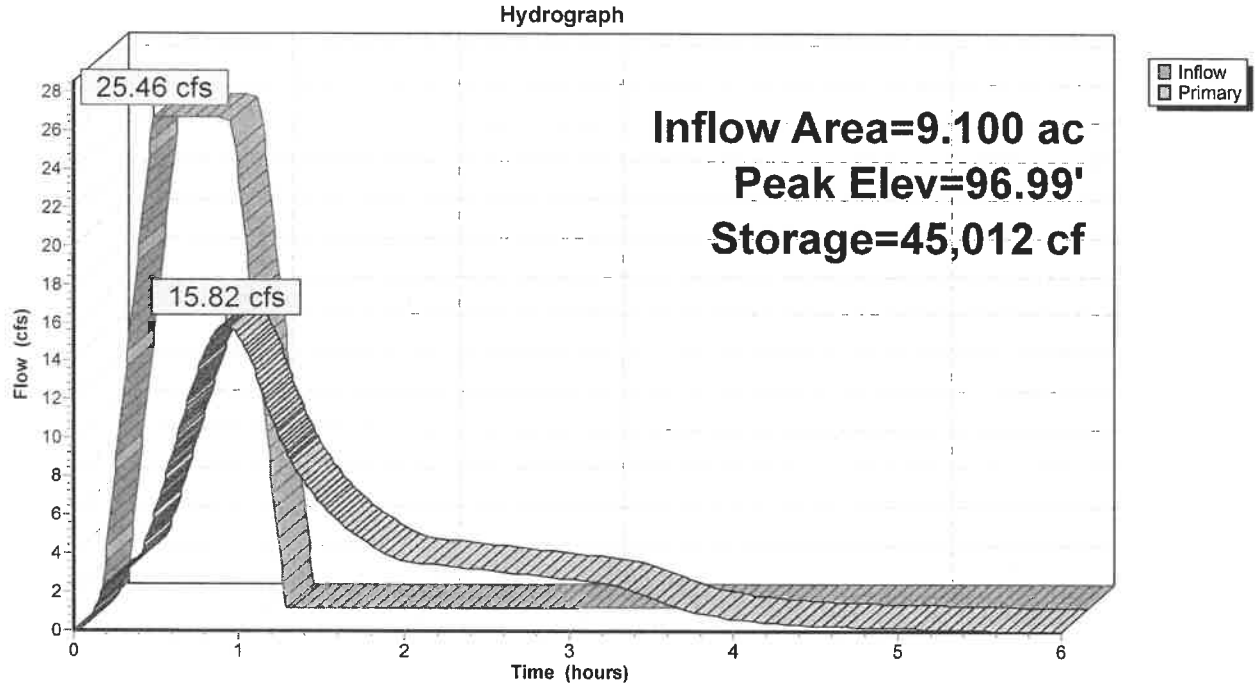
Volume	Invert	Avail.Storage	Storage Description
#1	93.85'	71,794 cf	**Custom Stage Data (Prismatic)**Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
93.85	0	0	0
94.00	50	4	4
95.00	10,159	5,105	5,108
96.00	22,443	16,301	21,409
97.00	25,157	23,800	45,209
98.00	28,013	26,585	71,794

Device	Routing	Invert	Outlet Devices
#1	Primary	93.85'	**10.5" Vert. Orifice/Grate** C= 0.600
#2	Primary	95.85'	**3.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=15.82 cfs @ 0.92 hrs HW=96.99' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 4.76 cfs @ 7.92 fps)
└—**2=Sharp-Crested Rectangular Weir** (Weir Controls 11.05 cfs @ 3.49 fps)

Pond 2P: Detention Basin (Modified Existing)



25-YEAR STORM

Area Listing (all nodes)

Area (acres)	C	Description (subcatchment-numbers)
2.750	0.99	Impervious Surface (2S)
4.780	0.51	Pervious Surface (2S)
1.570	0.45	Woods (2S)
9.100	**0.64**	**TOTAL AREA**

Time span=0.00-6.00 hrs, dt=0.01 hrs, 601 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 2S: Proposed Conditions Runoff Area=9.100 ac 30.22% Impervious Runoff Depth=1.91"
Flow Length=1,002' Tc=19.6 min Frequency Adjusted C=0.81 Runoff=18.15 cfs 1.450 af

Total Runoff Area = 9.100 ac Runoff Volume = 1.450 af Average Runoff Depth = 1.91"
69.78% Pervious = 6.350 ac 30.22% Impervious = 2.750 ac

Summary for Subcatchment 2S: Proposed Conditions

Runoff = 18.15 cfs @ 0.33 hrs, Volume= 1.450 af, Depth= 1.91"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
NJ-DEP 25-Year Duration=58 min, Inten=2.45 in/hr, Cf=1.25

Area (ac)	C	Adj	Description
2.750	0.99		Impervious Surface
4.780	0.51		Pervious Surface
1.570	0.45		Woods
9.100	0.64	0.81	Weighted Average, Frequency Adjusted
6.350			69.78% Pervious Area
2.750			30.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	100	0.0167	0.11		**Sheet Flow,** n= 0.240 P2= 3.30"
2.8	452	0.0286	2.72		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	110	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.8	340	0.0139	7.01	12.38	**Pipe Channel, RCP_Round 18"** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
19.6	1,002	Total			

TIME OF CONCENTRATION

Time span=0.00-6.00 hrs, dt=0.01 hrs, 601 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

Pond 2P: Detention Basin (Modified Peak Elev=96.70' Storage=38,130 cf Inflow=18.15 cfs 1.450 af
Outflow=11.78 cfs 1.450 af

Summary for Pond 2P: Detention Basin (Modified Existing)

Inflow Area = 9.100 ac, 30.22% Impervious, Inflow Depth = 1.91" for 25-Year event
Inflow = 18.15 cfs @ 0.33 hrs, Volume= 1.450 af
Outflow = 11.78 cfs @ 1.08 hrs, Volume= 1.450 af, Atten= 35%, Lag= 45.1 min
Primary = 11.78 cfs @ 1.08 hrs, Volume= 1.450 af

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
Peak Elev= 96.70' @ 1.08 hrs Surf.Area= 24,350 sf Storage= 38,130 cf

Plug-Flow detention time= 61.6 min calculated for 1.450 af (100% of inflow)
Center-of-Mass det. time= 61.6 min (100.4 - 38.8)

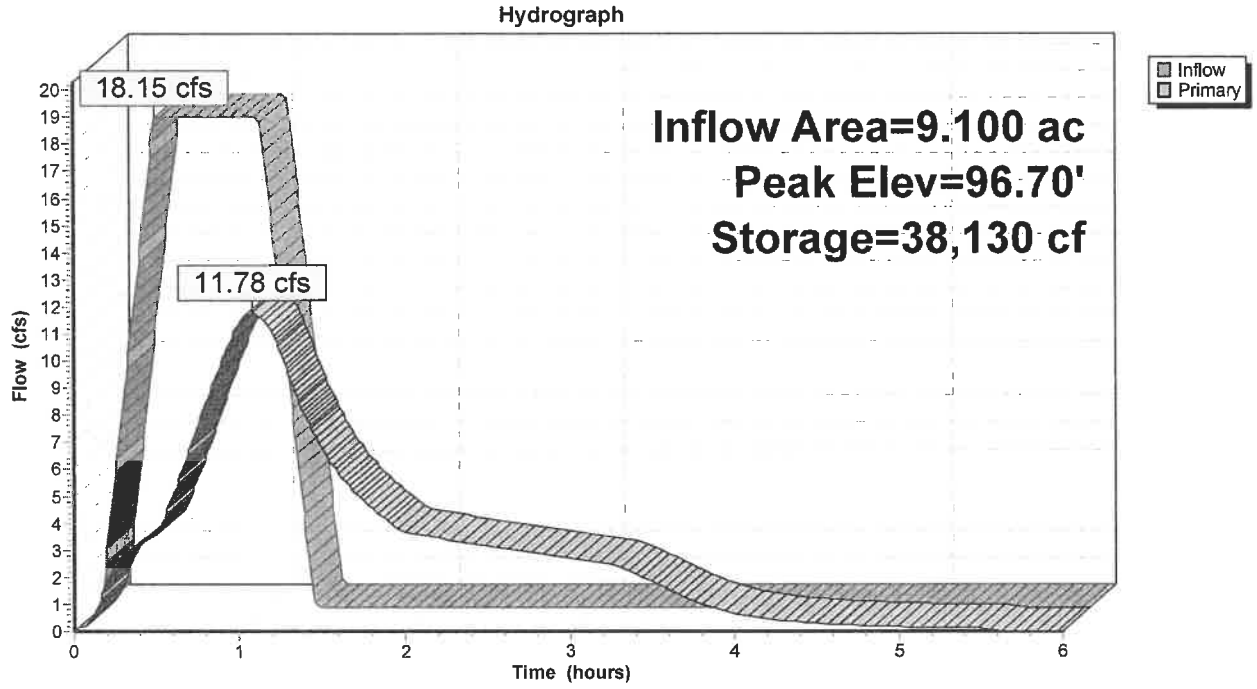
Volume	Invert	Avail.Storage	Storage Description
#1	93.85'	71,794 cf	**Custom Stage Data (Prismatic)**Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
93.85	0	0	0
94.00	50	4	4
95.00	10,159	5,105	5,108
96.00	22,443	16,301	21,409
97.00	25,157	23,800	45,209
98.00	28,013	26,585	71,794

Device	Routing	Invert	Outlet Devices
#1	Primary	93.85'	**10.5" Vert. Orifice/Grate** C= 0.600
#2	Primary	95.85'	**3.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=11.78 cfs @ 1.08 hrs HW=96.70' (Free Discharge)
↑ **1=Orifice/Grate** (Orifice Controls 4.50 cfs @ 7.48 fps)
└ **2=Sharp-Crested Rectangular Weir** (Weir Controls 7.28 cfs @ 3.02 fps)

Pond 2P: Detention Basin (Modified Existing)



10-YEAR STORM

Area Listing (all nodes)

Area (acres)	C	Description (subcatchment-numbers)
2.750	0.99	Impervious Surface (2S)
4.780	0.51	Pervious Surface (2S)
1.570	0.45	Woods (2S)
9.100	**0.64**	**TOTAL AREA**

Time span=0.00-6.00 hrs, dt=0.01 hrs, 601 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 2S: Proposed Conditions Runoff Area=9.100 ac 30.22% Impervious Runoff Depth=1.63"
Flow Length=1,002' Tc=19.6 min Frequency Adjusted C=0.81 Runoff=15.70 cfs 1.233 af

Total Runoff Area = 9.100 ac Runoff Volume = 1.233 af Average Runoff Depth = 1.63"
69.78% Pervious = 6.350 ac 30.22% Impervious = 2.750 ac

Summary for Subcatchment 2S: Proposed Conditions

Runoff = 15.70 cfs @ 0.33 hrs, Volume= 1.233 af, Depth= 1.63"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
NJ-DEP 10-Year Duration=57 min, Inten=2.12 in/hr, Cf=1.25

Area (ac)	C	Adj	Description
2.750	0.99		Impervious Surface
4.780	0.51		Pervious Surface
1.570	0.45		Woods
9.100	0.64	0.81	Weighted Average, Frequency Adjusted
6.350			69.78% Pervious Area
2.750			30.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	100	0.0167	0.11		**Sheet Flow,** n= 0.240 P2= 3.30"
2.8	452	0.0286	2.72		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	110	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.8	340	0.0139	7.01	12.38	**Pipe Channel, RCP_Round 18"** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
19.6	1,002	Total			

Time span=0.00-6.00 hrs, dt=0.01 hrs, 601 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

Pond 2P: Detention Basin (Modified Peak Elev=96.51' Storage=33,614 cf Inflow=15.70 cfs 1.233 af
Outflow=9.38 cfs 1.233 af

Summary for Pond 2P: Detention Basin (Modified Existing)

Inflow Area = 9.100 ac, 30.22% Impervious, Inflow Depth = 1.63" for 10-Year event
Inflow = 15.70 cfs @ 0.33 hrs, Volume= 1.233 af
Outflow = 9.38 cfs @ 1.08 hrs, Volume= 1.233 af, Atten= 40%, Lag= 45.1 min
Primary = 9.38 cfs @ 1.08 hrs, Volume= 1.233 af

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
Peak Elev= 96.51' @ 1.08 hrs Surf.Area= 23,835 sf Storage= 33,614 cf

Plug-Flow detention time= 63.4 min calculated for 1.231 af (100% of inflow)
Center-of-Mass det. time= 63.7 min (102.0 - 38.3)

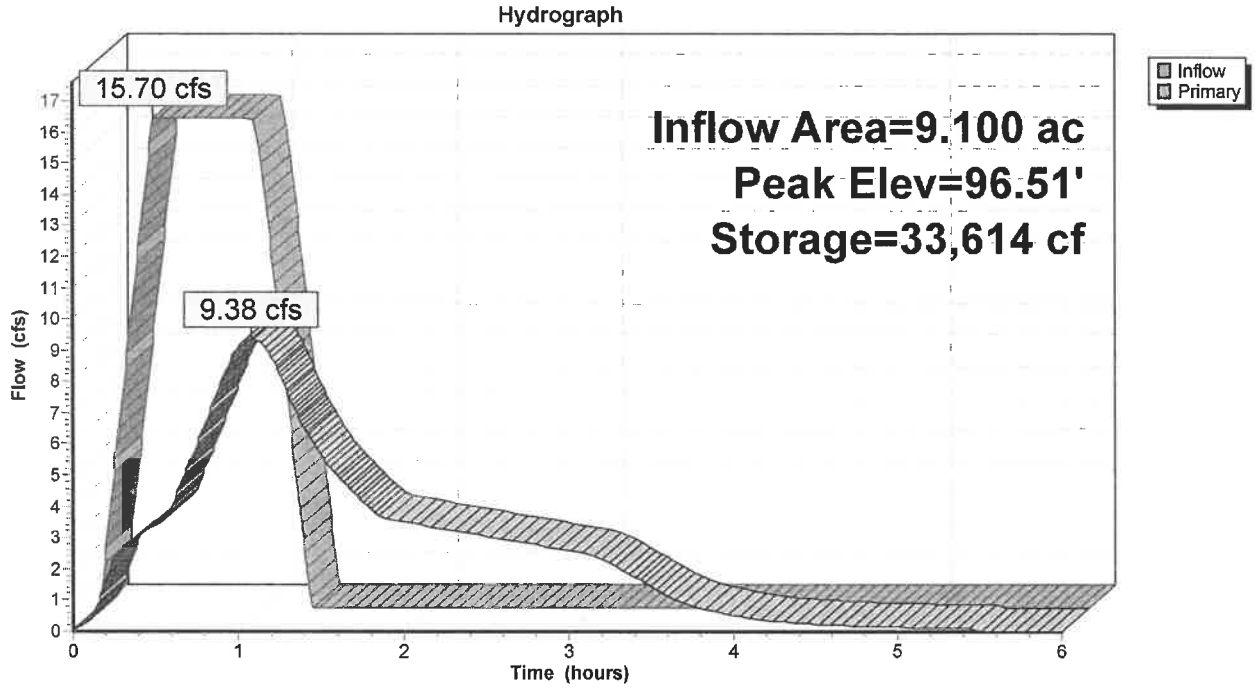
Volume	Invert	Avail.Storage	Storage Description
#1	93.85'	71,794 cf	**Custom Stage Data (Prismatic)**Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
93.85	0	0	0
94.00	50	4	4
95.00	10,159	5,105	5,108
96.00	22,443	16,301	21,409
97.00	25,157	23,800	45,209
98.00	28,013	26,585	71,794

Device	Routing	Invert	Outlet Devices
#1	Primary	93.85'	**10.5" Vert. Orifice/Grate** C= 0.600
#2	Primary	95.85'	**3.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=9.38 cfs @ 1.08 hrs HW=96.51' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 4.32 cfs @ 7.18 fps)
└—**2=Sharp-Crested Rectangular Weir** (Weir Controls 5.06 cfs @ 2.66 fps)

Pond 2P: Detention Basin (Modified Existing)



2-YEAR STORM

Area Listing (all nodes)

Area (acres)	C	Description (subcatchment-numbers)
2.750	0.99	Impervious Surface (2S)
4.780	0.51	Pervious Surface (2S)
1.570	0.45	Woods (2S)
9.100	**0.64**	**TOTAL AREA**

Time span=0.00-6.00 hrs, dt=0.01 hrs, 601 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 2S: Proposed Conditions Runoff Area=9.100 ac 30.22% Impervious Runoff Depth=1.12"
Flow Length=1,002' Tc=19.6 min Frequency Adjusted C=0.81 Runoff=12.12 cfs 0.851 af

Total Runoff Area = 9.100 ac Runoff Volume = 0.851 af Average Runoff Depth = 1.12"
69.78% Pervious = 6.350 ac 30.22% Impervious = 2.750 ac

Summary for Subcatchment 2S: Proposed Conditions

Runoff = 12.12 cfs @ 0.33 hrs, Volume= 0.851 af, Depth= 1.12"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
NJ-DEP 2-Year Duration=51 min, Inten=1.64 in/hr, Cf=1.25

Area (ac)	C	Adj	Description
2.750	0.99		Impervious Surface
4.780	0.51		Pervious Surface
1.570	0.45		Woods
9.100	0.64	0.81	Weighted Average, Frequency Adjusted
6.350			69.78% Pervious Area
2.750			30.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	100	0.0167	0.11		**Sheet Flow,** n= 0.240 P2= 3.30"
2.8	452	0.0286	2.72		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	110	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.8	340	0.0139	7.01	12.38	**Pipe Channel, RCP_Round 18"** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
19.6	1,002	Total			

Time span=0.00-6.00 hrs, dt=0.01 hrs, 601 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

Pond 2P: Detention Basin (Modified Peak Elev=96.14' Storage=24,771 cf Inflow=12.12 cfs 0.851 af
Outflow=5.46 cfs 0.851 af

Summary for Pond 2P: Detention Basin (Modified Existing)

Inflow Area = 9.100 ac, 30.22% Impervious, Inflow Depth = 1.12" for 2-Year event
Inflow = 12.12 cfs @ 0.33 hrs, Volume= 0.851 af
Outflow = 5.46 cfs @ 1.03 hrs, Volume= 0.851 af, Atten= 55%, Lag= 42.0 min
Primary = 5.46 cfs @ 1.03 hrs, Volume= 0.851 af

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
Peak Elev= 96.14' @ 1.03 hrs Surf.Area= 22,826 sf Storage= 24,771 cf

Plug-Flow detention time= 64.2 min calculated for 0.850 af (100% of inflow)
Center-of-Mass det. time= 64.4 min (99.7 - 35.3)

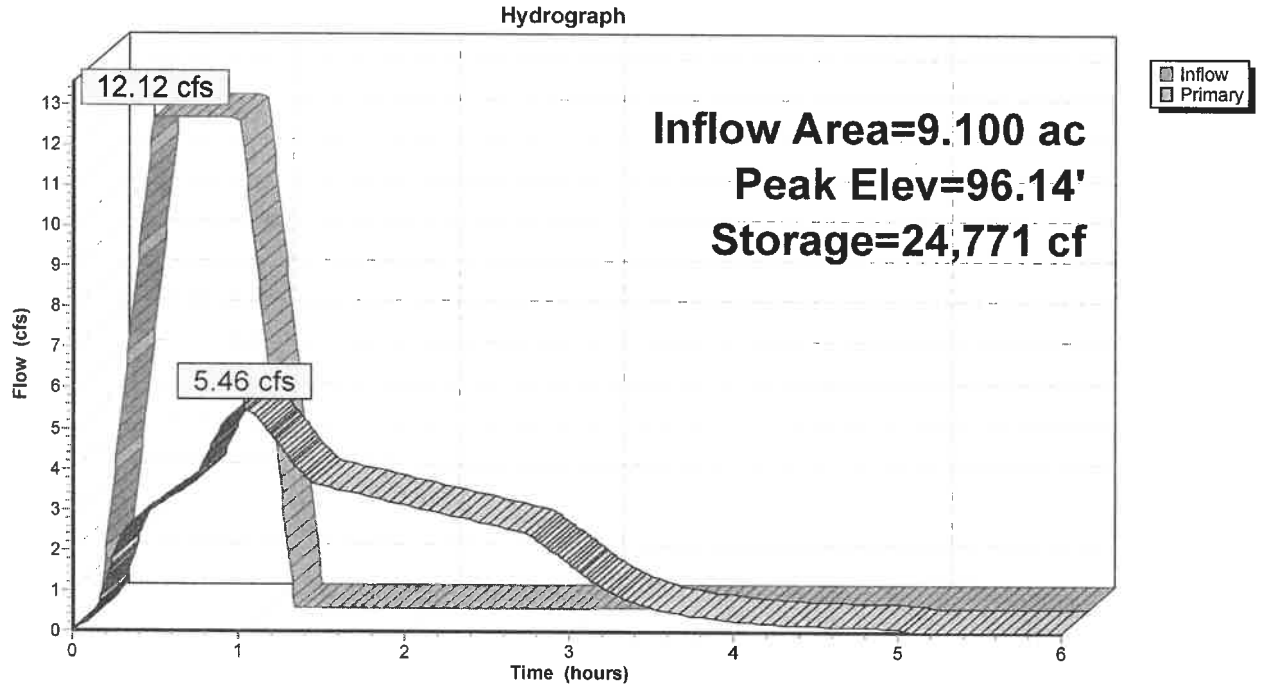
Volume	Invert	Avail.Storage	Storage Description
#1	93.85'	71,794 cf	**Custom Stage Data (Prismatic)**Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
93.85	0	0	0
94.00	50	4	4
95.00	10,159	5,105	5,108
96.00	22,443	16,301	21,409
97.00	25,157	23,800	45,209
98.00	28,013	26,585	71,794

Device	Routing	Invert	Outlet Devices
#1	Primary	93.85'	**10.5" Vert. Orifice/Grate** C= 0.600
#2	Primary	95.85'	**3.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=5.45 cfs @ 1.03 hrs HW=96.14' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 3.94 cfs @ 6.56 fps)
└—**2=Sharp-Crested Rectangular Weir** (Weir Controls 1.51 cfs @ 1.76 fps)

Pond 2P: Detention Basin (Modified Existing)



WATER QUALITY STORM

Summary for Pond 2P: Detention Basin (Modified Existing)

Inflow Area = 9.100 ac, 30.22% Impervious, Inflow Depth = 1.00" for Quality event
Inflow = 4.58 cfs @ 0.33 hrs, Volume= 0.758 af
Outflow = 3.23 cfs @ 2.10 hrs, Volume= 0.758 af, Atten= 29%, Lag= 106.0 min
Primary = 3.23 cfs @ 2.10 hrs, Volume= 0.758 af

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
Peak Elev= 95.53' @ 2.10 hrs Surf.Area= 16,719 sf Storage= 13,813 cf

Plug-Flow detention time= 51.4 min calculated for 0.758 af (100% of inflow)
Center-of-Mass det. time= 51.4 min (121.2 - 69.8)

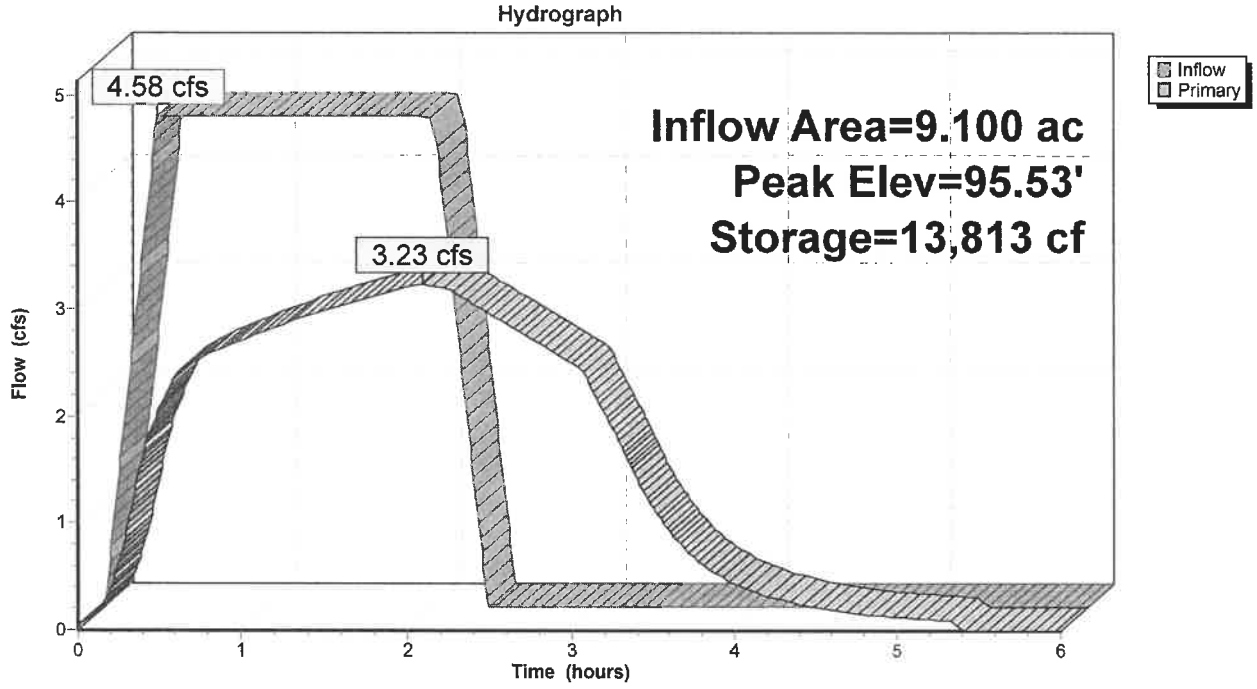
Volume	Invert	Avail.Storage	Storage Description
#1	93.85'	71,794 cf	**Custom Stage Data (Prismatic)**Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
93.85	0	0	0
94.00	50	4	4
95.00	10,159	5,105	5,108
96.00	22,443	16,301	21,409
97.00	25,157	23,800	45,209
98.00	28,013	26,585	71,794

Device	Routing	Invert	Outlet Devices
#1	Primary	93.85'	**10.5" Vert. Orifice/Grate** C= 0.600
#2	Primary	95.85'	**3.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=3.23 cfs @ 2.10 hrs HW=95.53' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 3.23 cfs @ 5.38 fps)
└—**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Detention Basin (Modified Existing)



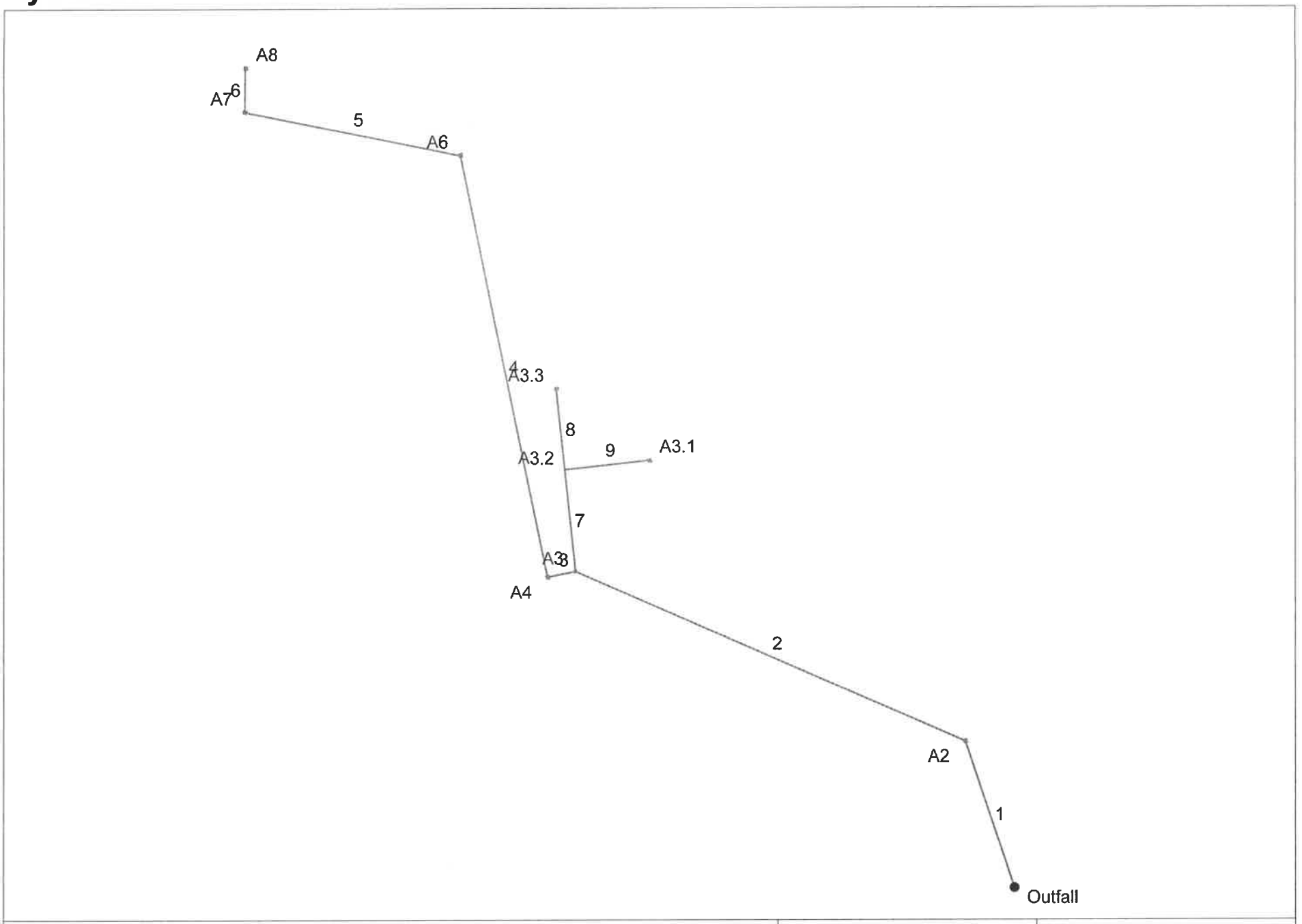
APPENDIX C
(Pipe & Spillway Calculations)

Oscar and Ella Wilf Campus Office Building - WEIGHTED 'C' VALUES

SOIL TYPE(S) : Klinesville

STRUCTURE	TOTAL AREA (acres)	IMPERVIOUS		'C' =	0.99	GRASS		'C' =	0.51	WOODS		'C' =	0.45	TOTAL WEIGHTED 'C' (F+J+N)
		AREA (acres)	%	'C'	IMPERV 'C'	AREA (acres)	%	'C'	GRASS 'C'	AREA (acres)	%	'C'	WOODS 'C'	
B1	FES													0.00
B2	MH													0.00
B3	MH													0.00
B3.1	0.26	0.24	91%	0.99	0.90	0.02	9%	0.51	0.05		0%	0.45	0.00	0.95
B3	0.12	0.12	100%	0.99	0.99		0%	0.51	0.00		0%	0.45	0.00	0.99
B4	0.11	0.09	85%	0.99	0.84	0.02	15%	0.51	0.08		0%	0.45	0.00	0.92
A8	1.42	0.40	28%	0.99	0.28	0.02	1%	0.51	0.01	1.00	70%	0.45	0.32	0.60
A7	0.53	0.19	36%	0.99	0.35	0.34	64%	0.51	0.33		0%	0.45	0.00	0.68
A6	0.00	0.00				0.00				0.00				0.00
A4	2.08	0.14	7%	0.99	0.07	0.41	20%	0.51	0.10	1.53	74%	0.45	0.33	0.50
A3	0.04	0.03	75%	0.99	0.74	0.01	25%	0.51	0.13		0%	0.45	0.00	0.87
A3.3	0.08	0.04	50%	0.99	0.50	0.04	50%	0.51	0.26		0%	0.45	0.00	0.75
A3.1	0.10	0.03	30%	0.99	0.30	0.07	70%	0.51	0.36		0%	0.45	0.00	0.65
A2	3.21	1.39	43%	0.99	0.43	0.62	19%	0.51	0.10	1.20	37%	0.45	0.17	0.70
A1	FES													
TOTALS	7.95	2.67	34%	0.99	0.33	1.55	19%	0.51	0.10	3.73	47%	0.45	0.21	

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



Project File: Line-A.stm	Number of lines: 9	Date: 11/26/2019

Storm Sewers v2019.20

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	P15	98.48	83.649	3.21	0.70	20.9	4.66	10.48	7.46	20.9	4.66	21.73	0.00	21.73	26.12	24	0.79	7.77	95.08	94.42	0.010
2	A3	P14	101.95	229.650	0.04	0.87	10.0	6.73	0.23	4.25	18.9	4.92	11.87	0.00	11.87	16.29	18	1.42	7.66	98.85	95.58	0.010
3	A4	P3.	101.96	15.457	2.08	0.50	18.9	4.92	5.12	4.03	18.9	4.92	11.09	0.00	11.09	10.24	15	1.49	9.04	99.16	98.93	0.010
4	A6	P6	105.38	230.400	0.00	0.00	10.0	0.00	0.00	1.95	10.4	6.62	8.02	0.00	8.02	8.99	15	1.15	6.54	101.80	99.16	0.010
5	A7	P7	107.28	119.120	0.53	0.68	10.0	6.73	2.43	1.95	10.1	6.71	8.13	0.00	8.13	10.88	15	1.68	6.63	104.00	102.00	0.010
6	A8	P8	107.49	23.854	1.42	0.60	10.0	6.73	5.73	1.42	10.0	6.73	5.73	0.00	5.73	12.15	15	2.10	4.67	104.50	104.00	0.010
7	A3.2	P17 (2)	103.87	55.150	0.00	0.00	10.0	0.00	0.00	0.18	12.2	6.14	0.77	0.00	0.77	5.98	15	0.51	0.67	99.13	98.85	0.010
8	A3.3	P17	101.30	43.449	0.08	0.75	10.0	6.73	0.40	0.08	10.0	6.73	0.40	0.00	0.40	5.97	15	0.51	1.36	99.35	99.13	0.010
9	A3.1	P18	101.30	46.050	0.10	0.65	10.0	6.73	0.44	0.10	10.0	6.73	0.44	0.00	0.44	5.93	15	0.50	1.41	99.36	99.13	0.010

Project File: Line-A.stm | Number of lines: 9 | Date: 11/26/2019

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

Summary for Pond 2P: Detention Basin (Modified Existing)

Inflow Area = 9.100 ac, 30.22% Impervious, Inflow Depth = 2.19" for 100-Year event
Inflow = 26.22 cfs @ 0.33 hrs, Volume= 1.661 af
Outflow = 23.36 cfs @ 0.80 hrs, Volume= 0.623 af, Atten= 11%, Lag= 28.4 min
Primary = 23.36 cfs @ 0.80 hrs, Volume= 0.623 af

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
Peak Elev= 97.24' @ 0.80 hrs Surf.Area= 25,847 sf Storage= 51,637 cf

Plug-Flow detention time= 36.4 min calculated for 0.623 af (38% of inflow)
Center-of-Mass det. time= 21.0 min (53.8 - 32.8)

Volume	Invert	Avail.Storage	Storage Description
#1	93.85'	71,794 cf	**Custom Stage Data (Prismatic)**Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
93.85	0	0	0
94.00	50	4	4
95.00	10,159	5,105	5,108
96.00	22,443	16,301	21,409
97.00	25,157	23,800	45,209
98.00	28,013	26,585	71,794

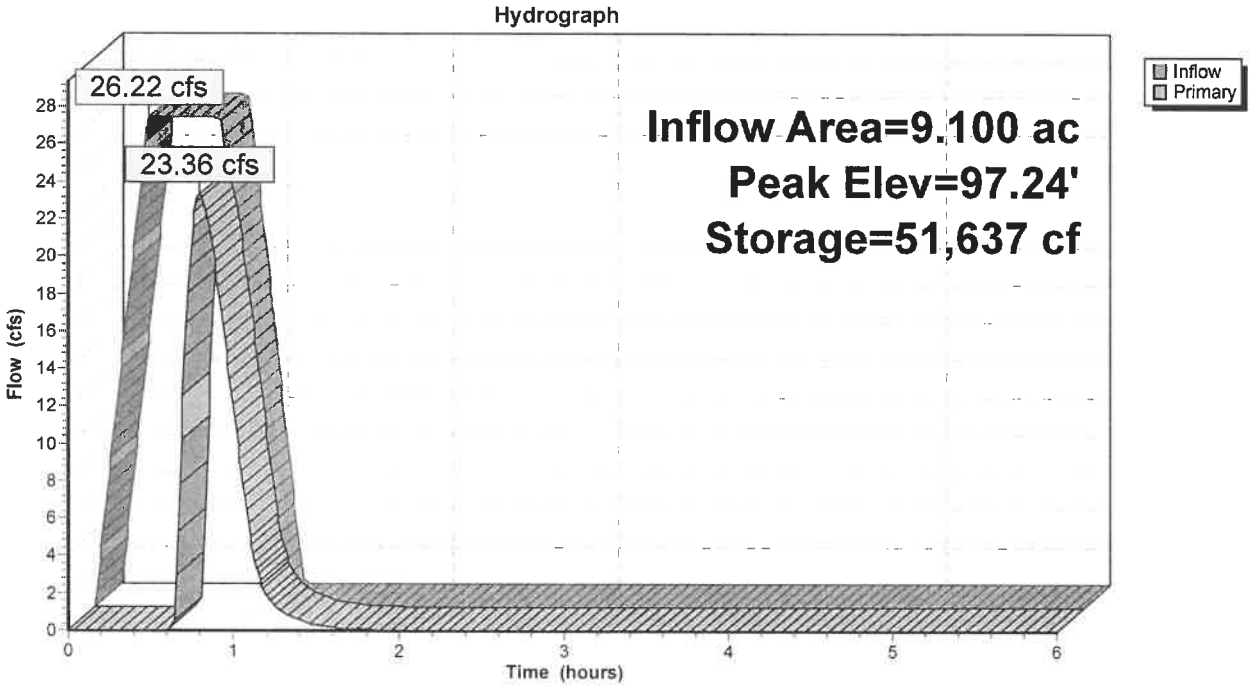
Device	Routing	Invert	Outlet Devices
* #1	Primary	97.00'	**60.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=23.29 cfs @ 0.80 hrs HW=97.24' (Free Discharge)
↑—**1=Sharp-Crested Rectangular Weir** (Weir Controls 23.29 cfs @ 1.61 fps)

* EXISTING EMERGENCY SPILLWAY

1.61 FPS < 2.0 FPS (SCS TABLE 18-1)

Pond 2P: Detention Basin (Modified Existing)



APPENDIX D
(Annual Groundwater Recharge Analysis)

New Jersey Groundwater Recharge Spreadsheet Version 2.0 November 2003

Annual Groundwater Recharge Analysis (based on GSR-32)

Select Township ↓	Average Annual P (in)	Climatic Factor
SOMERSET CO., FRANKLIN TWP	45.7	1.48

Project Name:	**Oscar & Ella Wilf Campus**
Description:	**Wilf Campus Solar Field**
Analysis Date:	**11/07/19**

Pre-Developed Conditions

Land Segment	Area (acres)	TR-55 Land Cover	Soil	Annual Recharge (in)	Annual Recharge (cu.ft)
1	2.93	Woods	Klinesville	14.6	155,688
2	0.119	Impervious areas	Klinesville	0.0	-
3	0				
4	0				
5	0				
6	0				
7	0				
8	0				
9	0				
10	0				
11	0				
12	0				
13	0				
14	0				
15	0				
Total =	3.0			Total Annual Recharge (in)	Total Annual Recharge (cu-ft)
				14.1	155,688

Post-Developed Conditions

Land Segment	Area (acres)	TR-55 Land Cover	Soil	Annual Recharge (in)	Annual Recharge (cu.ft)
1	0.282	Woods	Klinesville	14.6	14,984
2	2.738	Open space	Klinesville	14.2	141,026
3	0.029	Impervious areas	Klinesville	0.0	-
4	0				
5	0				
6	0				
7	0				
8	0				
9	0				
10	0				
11	0				
12	0				
13	0				
14	0				
15	0				
Total =	3.0			Total Annual Recharge (in)	Total Annual Recharge (cu.ft)
				14.1	156,010

Annual Recharge Requirements Calculation ↓

% of Pre-Developed Annual Recharge to Preserve =	100%	Total Impervious Area (sq.ft) 1,263
Post-Development Annual Recharge Deficit=	-322	(cubic feet)

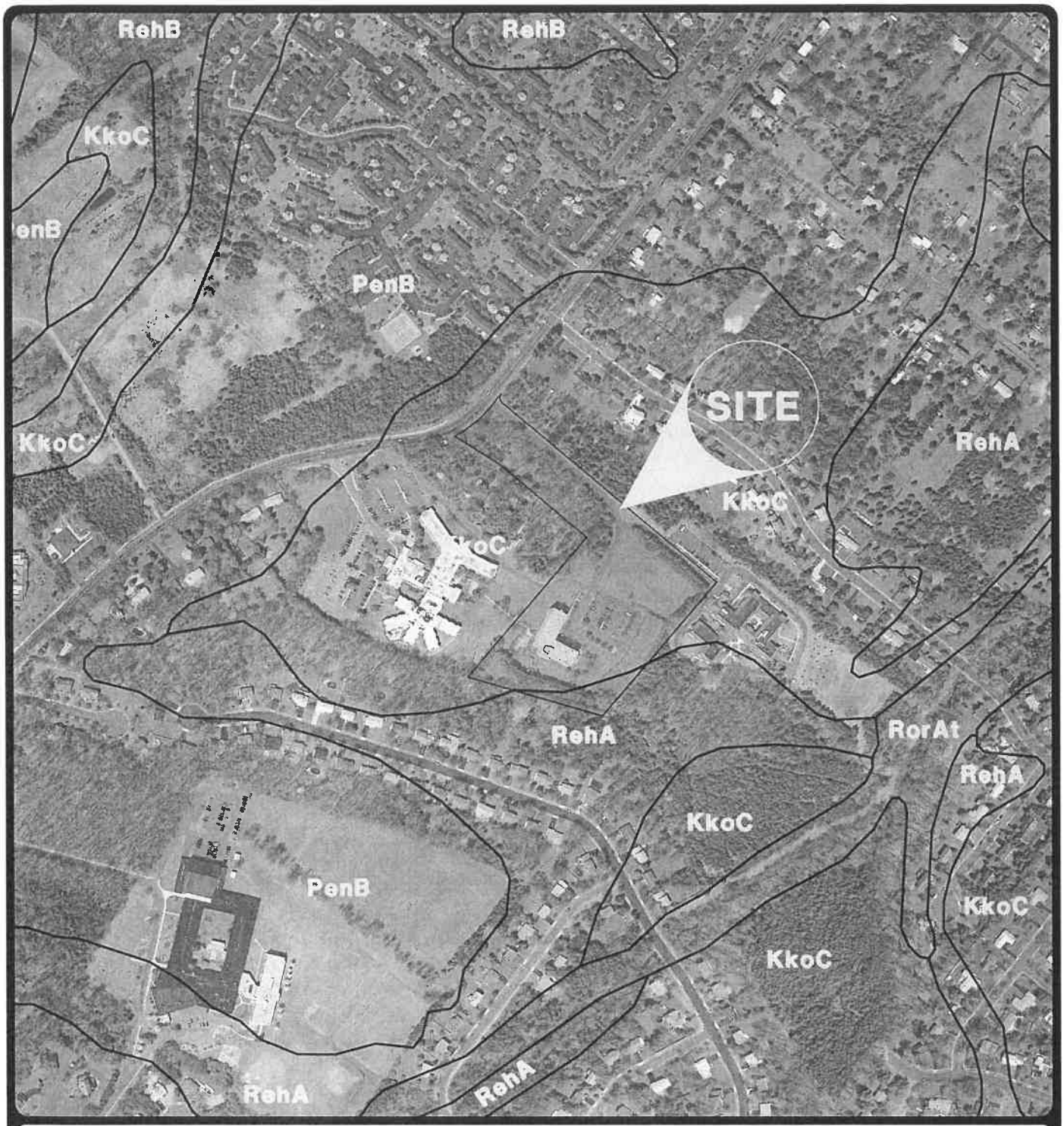
Recharge Efficiency Parameters Calculations (area averages)

RWC= 1.14	(in)	DRWC= 0.00	(in)
ERWC = 0.30	(in)	EDRWC= 0.00	(in)

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.

APPENDIX E
(Soils Information)



SOILS MAP

Soil Type: Kkoc Klinesville Channery Loam
RehA Reaville Silt Loam
Franklin Township
Somerset County

N

BLOCK
386.07

LOT
54.03

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

0 250' 500'
125' 375'

Scale: 1"=500±ft

Job # 2012.033

KMR

Map Unit Text

Somerset County, New Jersey

[Only those mapunits that have entries for the selected text kinds and categories are included in this report]

Map unit: KkoC - Klinesville channery loam, 6 to 12 percent slopes

Text kind/Category: Nontechnical description/SOI-5

The Klinesville series consists of shallow, somewhat excessively soils on uplands. They formed in material weathered from shale, siltstone, and sandstone. Typically these soils have a dark reddish brown very channery silt loam surface layer 5 inches thick. The subsoil from 5 to 15 inches is reddish brown very channery silt loam. The substratum from 15 to 19 inches is weak red weathered shale fragments. Bedrock is at 19 inches. Slopes range from 0 to 80 percent.

Map unit: RehA - Reaville silt loam, 0 to 2 percent slopes

Text kind/Category: Nontechnical description/SOI-5

The Reaville series consists of moderately deep, moderately well, and somewhat poorly drained soils on uplands. They formed in material weathered from interbedded triassic red shale and siltstone. Typically, these soils have a reddish brown, channery silt loam surface layer 9 inches thick. The mottled subsoil from 9 to 15 inches is reddish brown channery silt loam. The mottled substratum from 15 to 25 inches is dusky red, very channery silt loam. Bedrock is at 25 inches. Slopes range from 0 to 15 percent.

Table NJ 2-1-NJ1

Soil Series	Hydrologic Soil Group
Howell	C
Ingleside	B
Jade Run	B/D
Keansburg	D
Keyport	C
Klej	B
Klinesville	D
Knickerbocker	A
Kresson	C
Lackawanna	C
Lakehurst	A
Lakewood	A
Lamington	D
Lansdale	B
Lansdowne	C
Lawrenceville	C
Legore	B
Lehigh	C
Lenni	C/D
Lenoir	D
Livingston	D
Lordstown	C
Lyons	D
Manahawkin	D
Manlius	C
Mannington	D
Marlton	C
Matapeake	B
Matawan	C
Mattapex	C
Meckesville	C
Middlebury	B
Minoa	C
Mispillion	D
Mount Lucas	C
Mullica	D
Muttontown	B
Nanticoke	D
Nassau	D
Natchaug	B/D
Neshaminy	B
Netcong	B
Nixon	B
Norton	C
Norwich	D
Oquaga	C
Othello	C/D
Otisville	A
Palms	A/D
Palmyra	B
Parker	B
Parsippany	D
Pascack	C
Passaic	D
Pattenburg	B
Pawcatuck	D
Paxton	C
Peckmantown	C
Pedricktown	D
Pemberton	B
Penn	C
Phalanx	B
Plummer	D
Pompton	B/D
Pope	B
Portsmouth variant	B/D
Preakness	D
Quakerbridge	A
Quakertown	C
Raritan	C
Readington	C
Reaville	C
Ridgebury	C
Rikers	A
Riverhead	B
Rockaway	C
Rowland	C
Royce	C
Sassafras	B
Scio	C
Sharptown	C
Shrewsbury	C/D
Steinsburg	C
Swainton	B
Swartswood	C
Swedesboro	B
Tinton	A
Tioga	B
Transquaking	D
Trussum	C/D
Tunkhannock	A
Turbotville	C
Unadilla	B
Venango	D
Wallkill	D
Wallpack	B
Washington	B

DRAINAGE AREA MAPS