APPENDIX F: Utility Analysis Supporting Documentation

Domestic Water Demand Calculations and Pipe Sizing – Hotel

Domestic Water Demand Calculations and Pipe Sizing – Residential and Retail

Stormwater Report

Summary of Stormwater Collection and Treatment Options – Memo December 28, 2017

Design Consultants, Inc.
120 Middlesex Avenue, Suite 20
Somerville, MA 02145

4/17/2018

DOMESTIC WATER DEMAND
CALCULATIONS AND PIPE SIZING

LOCATION: Assembly Edge Hotel — Design Consultants, Inc.

DESCRIPTION OF FACILITY: Hotel (180 Units) & Hotel Functions — Calc by: MFC

Architectural Reference Plans: — Date: 4/16/2018

UNITS	DESCRIPTION (DCI Job#: 2016-)	FACTOR	HOT	COLD
0	BATHTUBS (W/WO SHOWERHEAD)	2	190	190
0	DRINKING FOUNTAIN	1	N/A	0
0	DISHWASHER (COMERCIAL)	6	3	3
0	KITCHEN SINKS (RESIDENTIAL)	2	0	0
0	KITCHEN SINKS (COMMERCIAL)	6	3	3
0	BATHROOM SINK	1	190	190
0	WASHING MACHINE/LAUNDRY TRAY	6	10	10
0	URINALS (FLUSH VALVE TYPE)	6	N/A	5
0	TOILET (TANK TYPE)	1	N/A	200
0	TOILET (FLUSH VALVE TYPE)	12	N/A	0
0	HOSE FAUCET/SILL COCK/HOSE BIBBS	2	N/A	0
0	OTHER	0	0	0

adding HOT & COLD values yields… FIXTURE UNITS: 997 = 396 + 601

SELECT PROPER DEMAND FACTOR FROM TBL 2 (SEE BELOW) 0.70

MULTIPLY TOTAL x DEMAND FACTOR (FROM TABLE 2) 997 x 0.70 = 697.9

A CAPACITY VALUE OF 697.9 WOULD REQUIRE A WATER SERVICE SIZE OF **4"**

(SEE TABLE 3 BELOW)

TABLE 2

OCCUPANCY USE		DEMAND FACTOR
RES.	1 OR 2 FAMILY	0.50
	MULTI-RESIDENTIAL	0.35
	HOTEL	0.70
BUS.	GENERAL	0.25
	RESTAURANT/CAFÉ	0.70

TABLE 3

SERVICE PIPE SIZE	CAPACITY VALUE
3/4 "	NOT RECOMMENDED
1 "	9.1 TO 16.5
1 1/2 "	16.6 TO 55.0
2 "	55.1 TO 107.499
4 "	107.5 TO 700

Note: Calculations based upon Mass. Plumbing Codes (248 CMR 10.14)

Note: Calculations are preliminary, to be confirmed by Registered MEP Engineer.

Design Consultants, Inc.
265 Medford Street
Somerville, MA 02143

4/17/2018

DOMESTIC WATER DEMAND CALCULATIONS AND PIPE SIZING

LOCATION: Assmblyy Edge — Design Consultants, Inc.

DESCRIPTION OF FACILITY: Residential and Retail — Calc by: MFC

Architectural Reference Plans: — Date:

UNITS	DESCRIPTION (DCI Job#: 2007-xxx)	FACTOR	HOT	COLD
0	BATHTUBS (W/WO SHOWERHEAD)	2	267	267
0	DRINKING FOUNTAIN	1	N/A	0
0	DISHWASHER (DOMESTIC)	2	210	210
0	KITCHEN SINKS (RESIDENTIAL)	2	210	210
0	KITCHEN SINKS (COMMERCIAL)	6	2	2
0	LAVATORIES	1	268	268
0	WASHING MACHINE/LAUNDRY TRAY	2	212	212
0	URINALS (FLUSH VALVE TYPE)	6	N/A	1
0	WATER CLOSETS (TANK TYPE)	1	N/A	278
0	WATER CLOSETS (FLUSH VALVE TYPE)	12	N/A	0
0	HOSE FAUCET/SILL COCK/HOSE BIBBS	2	N/A	0
0	OTHER	0	0	0

adding HOT & COLD values yields… FIXTURE UNITS: 2617 = 1169 + 1448

SELECT PROPER DEMAND FACTOR FROM TBL 2 (SEE BELOW) 0.35

MULTIPLY TOTAL x DEMAND FACTOR (FROM TABLE 2) 2617 x 0.35 = 916.0

A CAPACITY VALUE OF 916.0 WOULD REQUIRE A WATER SERVICE SIZE OF 5" Use 6"

(SEE TABLE 3 BELOW)

TABLE 2

OCCUPANCY USE		DEMAND FACTOR
RES.	1 OR 2 FAMILY	0.50
	MULTI-RESIDENTIAL	0.35
	HOTEL	0.70
BUS.	GENERAL	0.25
	RESTAURANT/CAFÉ	0.70

TABLE 3

SERVICE PIPE SIZE	CAPACITY VALUE
3/4 "	NOT RECOMMENDED
1 "	9.1 TO 16.5
1 1/2 "	16.6 TO 55.0
2 "	55.1 TO 107.5
4 "	107.5 TO 700

Note: Calculations based upon Mass. Plumbing Codes (248 CMR 2.14)

Note: Calculations are preliminary, to be confirmed by Registered MEP Engineer.

STORMWATER MANAGEMENT REPORT

FOR

ASSEMBLY EDGE
845 MCGRATH HIGHWAY
SOMERVILLE, MA

Prepared for:
Kems Corporation
35 Doty Avenue
Danvers, MA 01923

Prepared by:
Design Consultants, Inc.
120 Middlesex Avenue, Suite 20
Somerville, Massachusetts 02145

Project 2016-059
April 18, 2018

Design Consultants Inc.
Somerville - Quincy - Newburyport
www.dci-ma.com

Table of Contents

Appendix

INTRODUCTION

Kems Corporation proposes to demolish the existing commercial structure located at 845 McGrath Highway and construct a new, 2-tower, mixed use building with below-grade, at-grade, and above-grade garage parking for the proposed hotel, residential, and retail areas on-site.

STORMWATER MANAGEMENT POLICY

Section 5.4.6.4 of the City of Somerville's Zoning Ordinance, Version June 25, 2009, describes the management standards that control stormwater quality and quantity, and also groundwater recharge. The following report explains how the stormwater management system designed for this project meets the specific standards set forth in the ordinance.

EXISTING CONDITION

The property at 845 McGrath Highway includes two parcels and has an area of approximately 37,075 square feet. One parcel is currently vacant, and has an area of approximately 23,841 square feet that is covered completely with bituminous concrete. The other parcel includes a one-story brick building and a parking area, currently being used for retail. The brick retail building covers approximately 3,760 square feet of the property. The rest of the property is bituminous concrete, except for the 892 square feet of landscape area. Part of this project also includes utilizing the Lot owned by the City of Somerville across Kensington Avenue, which has approximately 6,546 square feet of landscape area, and is an accessible route to Assembly Edge.

The existing site has minimal stormwater management. Stormwater runoff from the site is captured by catch basins in Middlesex Avenue, Kensington Avenue, and McGrath Highway, which are connected the City's drainage system. Stormwater runoff from the Dunkin' Donuts parking lot is collected by two catch basins and routed to the City's drainage system as well.

According to FEMA Flood Insurance Rate Map Number 25017C0439E, with an effective date of June 4, 2010, the site is located in the "0.2% Annual Chance Flood Hazard" Zone. See firmette in the Appendix B.

SOILS

Boring logs were performed on-site to properly assess the soil conditions. The site is mapped as map unit 602(Urban Land). There is no NRCS hydrologic soil group (HSG) classification for this soil. For hydrologic calculation purposes, we have classified the receiving soils on site as a Sandy Loam, which is a HSG B soil, with an infiltration rate of 1.02 inches per hour.

PROPOSED CONDITION

The current development program is to demolish the existing 1-story commercial structure and construct a 21-story, 405-unit, mixed-use building with below-grade, at-grade, and above-grade parking for the hotel, residential and retail areas on-site. The building has two towers, one is the hotel section of the property, which is 18 stories high, and the other tower is a residential and retail area proposed to be 21 stories high. Between these two towers is a courtyard that provides outdoor seating for residents and visitors of the retail area and hotel. Kensington Avenue is going to be abandoned and replaced with permeable pavers, giving

access to the park area located at the southeastern side of the property. The park area will have permeable pavers and landscape areas. These landscape areas will have a concrete berm about a foot high surrounding it, so that the stormwater can be collected and infiltrated into the ground, producing no runoff off-site. The sidewalk areas that surround the site have many different bioretention areas and tree filters that collect and treat stormwater runoff. Some stormwater is infiltrated into the ground, while the rest is collected in an overflow pipe, and discharged into the City's drainage system. The runoff from the roof area is also connected directly into the City's drainage system. Overall, impervious area on site is reduced through the use of landscaping areas, bioretention areas, as well as utilizing permeable pavers in the park area.

The City of Somerville assesses a fee for increased sewage flows resulting from a redevelopment project. Calculations have been prepared that show the proposed development will increase sewage flow inside the sewer main in McGrath Highway from 16,395 gallons per day, to about 86,200 gallons per day, increasing the flow by 69,805 gallons per day. 86,200 gallons per day is approximately 0.1333 cubic feet per second of flow, which is well under the calculated full capacity of the 8" sewer pipe in McGrath Highway. The calculated full capacity of the sewer pipe was found to be 1.95 cubic feet per second, and can be seen in the attached nomograph. In total the sewage flow for the proposed system is 71,075 gallons per day, which does not meet the City's requirement of having less than 2000 gallons per day for new sanitary sewer connections. See Sewer Calculations in Appendix E.

HYDROLOGIC MODEL

The hydrologic model used for this analysis is based upon the SCS Method. Both existing and proposed conditions are modeled for the 2-year, 10-year, 25-year, and 100-year storm events. The SCS Method allows for variable rainfall intensity throughout the storm duration. A Type III rainfall distribution has been selected for this analysis. Calculated times of concentration (Tc) were below the acceptable minimum of six minutes, subcatchment Tc's are assumed to be six minutes for this site. Hydrologic analysis for the site was performed using HydroCad® software. Output from the storm events analyzed are included in the appendix.

Calculations show that the on-site stormwater management system and increase in site perviousness has reduced overall off-site flow and volume for all storm events. See Table 1 below for the hydrologic calculation summary.

Table 1: Hydrologic Calculation Summary

Description	Existing Conditions		Proposed Conditions	
Drainage Area	2.010+/- Acres		2.010+/- Acres	
Storm Event (Years)	Offsite Peak Runoff (CFS)	Offsite Runoff Volume (CF)	Offsite Peak Runoff (CFS)	Offsite Runoff Volume (CF)
2	5.62	19,603	4.71	13,174
10	8.72	30,761	7.24	21,867
25	11.17	39,617	9.23	29,149
100	16.26	58,024	13.82	44,486

CONCLUSION

Based on DCI's analysis of the existing and proposed conditions, the proposed site condition meets the criteria set forth by the City of Somerville. Design Point runoff volume and peak flow rate for the 2, 10, 25 and 100-year storm events is decreased. DCI concludes that the proposed redevelopment at 845 McGrath Highway, Somerville, MA adheres to all applicable stormwater management policies.

Appendix A

EXISTING CONDITIONS

LEGEND

IMPERVIOUS

PERVIOUS

20 0 20 40 60 80 FEET

10 0 10 20 METERS

SPSR-A APPLICATION

DCi Design Consultants Inc.
Somerville - Quincy - Newburyport
www.dci-ma.com

ASSEMBLY'S EDGE
845 MCGRATH HIGHWAY
SOMERVILLE, MA

DEVELOPER:
KEMS CORPORATION
35 DOTY AVENUE
DANVERS, MA 01923

ARCHITECT:
KHALSA DESIGN INC.
17 IVALOO STREET SUITE 400
SOMERVILLE, MA 02143
617-591-8682

VERDANT LANDSCAPE ARCHITECTURE
318 HARVARD ST, SUITE 25
BROOKLINE, MA 02446
(617)-735-1180

DESIGN CONSULTANTS, INC
120 MIDDLESEX AVE #20
SOMERVILLE, MA 02145
(617)-766-3350

ALLIED CONSULTING ENGINEERING SERVICES, INC
151 LAVAN ST
WARWICK, RHODE ISLAND 02888
(401)-461-7888

WSP USA
88 BLACK FALCON AVENUE, SUITE 210
BOSTON, MA 02210
(617)-210-1600

VANASSE HANGEN BRUSTLIN INC.
99 HIGH STREET, #10
BOSTON, MA 02210
(617)-728-7777

MCDERMOTT, QUILTY & MILLER LLP
28 STATE ST, SUITE 802
BOSTON, MA 02109
(617)-946-4600

PROJECT INFO

REV	DESCRIPTION	DATE

STAMP:

EXISTING CATCHMENT AREA

SHEET NAME:

FIG-1

SHT NO:

DR BY: MSK
CHK BY: EXISTING
PROJ NO: 2016-059
DATE: APR 18, 2018
SCALE: N.T.S.

P:\2016 Projects\2016-059 845 McGrath Hwy Somerville\Dwgs_ENGINEERING\16-059 C5-C7 DET.dwg

THIS PLAN IS FORMATTED TO PLOT AT SIZE ARCH D (24"X36")

EXISTING CONDITIONS

LEGEND

IMPERVIOUS

PERVIOUS

PERMEABLE PAVERS

20 0 20 40 60 80 FEET

10 0 10 20 METERS

SPSR-A APPLICATION

DCi Design Consultants Inc.
Somerville - Quincy - Newburyport
www.dci-ma.com

ASSEMBLY'S EDGE
845 MCGRATH HIGHWAY
SOMERVILLE, MA

DEVELOPER:
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28 STATE ST, SUITE 802
BOSTON, MA 02109
(617)-946-4600

PROJECT INFO

REV	DESCRIPTION	DATE

STAMP:

PROPOSED CATCHMENT AREA

SHEET NAME:

FIG-1

SHT NO:

DR BY: MSK
CHK BY: EXISTING
PROJ NO: 2016-059
DATE: APR 18, 2018
SCALE: N.T.S.

P:\2016 Projects\2016-059 845 McGrath Hwy Somerville\Dwg_ENGINEERING\16-059 C5-C7 DET.dwg

THIS PLAN IS FORMATTED TO PLOT AT SIZE ARCH D (24"X36")

Appendix B

National Flood Hazard Layer FIRMette

FEMA

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth
- Regulatory Floodway *Zone AE, AO, AH, VE, AR*

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The base map shown complies with FEMA's base map accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 4/16/2018 at 4:35:44 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: base map imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Appendix C

BORING LOG

Project:	ASSEMBLY EDGE (SOMERVILLE)
Location:	845 MCGRATH HIGHWAY
Client:	KEMS CORPORATION
Driller:	SOIL EXPLORATION CORP
Drilling Methods:	HSA/D&W 20'+
Weather:	50's, CLOUDY, LT. RAIN
Performed By:	PJS Date: 6/5/17
Checked By:	MFC Date: 6/15/17

DESIGN CONSULTANTS, INC.

Boring No:	B-1
Location:	See Plan
Approx. Ground Elevation:	15±
Approx. Groundwater Elevation:	6.5±
Date/Time of Groundwater Elevation:	8:00 AM
Datum:	SOMERVILLE SEWER BASE
Project No.	2016-059

Depth (feet)	Sample No.	Blows per 6-inch	Pen./ Rec.	Soil Description	Stratum Change Depth (feet)	Stratum	Note No.
1	S-1	2 3 3 1	24"/8"	S-1, SAND, Some Silt, Some Gravel, Dry, Brown/Black, Loose (FILL)	.5'	GRAVEL	
2						FILL	
3							
4							
5	S-2	1 2 2 2	24'/7"	S-2, Similar to S-1, Trace Glass			
6							
7							
8							(1)
9							
10	S-3	3 3 4 6	24"/9"	S-3, Top 3", Medium SAND, Some Silt, Brown, Wet, Loose Bottom 6" Fine to Medium SAND, Little Silt, Tan, Wet, Loose		SAND	
11							
12							
13					13.5'		
14						ORGANIC SILT	
15	S-4	WOH/24"	24"/24"	S-4, SILT, Little Sand, Trace Seashells, Flakes of Organics, Grey, Wet, Soft			(2)
16							
17							
18							
19							
20					20'		

NOTES:

(1) Water 8.5-feet below ground surface

(2) Faint peat-like odor in sample S-4

LEGEND

S - Split Spoon Sample	O/A - Sample Collected Off the Augers	
UT - Undisturbed Tube Sample		
Trace - Approximately 0 to 10%	Some - Approximately 20 to 35%	
Little - Approximately 10 to 20%	And - Approximately 35 to 50%	
0-10 Coarse Soil N Value - Loose	30-50 Coarse Soil N Value - Dense	
10-30 Coarse Soil N Value - Medium Dense	>50 Coarse Soil N Value - Very Dense	
0-4 Fine Soil N Value - Soft	8-15 Fine Soil N Value - Stiff	>30 Fine Soil N Value - Hard
4-8 Fine Soil N Value - Medium Stiff	15-30 Fine Soil N Value - Very Stiff	

BORING LOG

Project:	ASSEMBLY EDGE (SOMERVILLE)	Boring No:	B-1
Location:	845 MCGRATH HIGHWAY	Location:	See Plan
Client:	KEMS CORPORATION	Approx. Ground Elevation:	15±
Driller:	SOIL EXPLORATION CORP	Approx. Groundwater Elevation:	6.5±
Drilling Methods:	HSA/D&W 20'+	Date/Time of Groundwater Elevation:	8:00 AM
Weather:	50's, CLOUDY, LT. RAIN	Datum:	SOMERVILLE SEWER BASE
Performed By: PJS	Date: 6/5/17	Project No.	2016-059
Checked By: MFC	Date: 6/15/17		

DESIGN CONSULTANTS, INC.

Depth (feet)	Sample No.	Blows per 6-inch	Pen./ Rec.	Soil Description	Stratum Change Depth (feet)	Stratum	Note No.
21	S-5	3 6 11 9	24"/20"	S-5, SAND And Silt, Trace Organics, Faint Peat-like odor, Grey, Wet, Medium Dense		SAND	
22							
23							
24							
25	S-6	6 9 15 20	24"/24"	S-6, Top 11" Medium SAND, Little Silt, Grey, Wet, Medium Dense (Blow-In) Bottom 13", CLAY, Trace Sand, Tan, Wet, Very Stiff	26'	CLAY	(3)
26							
27							
28							
29							
30	S-7	1 3 3 4	24"/24"	S-7, CLAY, Trace Sand, Wet, Medium Stiff 1/4" Sand seam 22" into sample			(4)
31							
32							
33							
34							
35	S-8	1 2 3 3	24"/24"	S-8, Similar to S-7			(5)
36							
37							
38							
39							
40							

NOTES:

(3) 2.0 Tons/SF on Pocket Pentrometer

(4) 0.375 Tons/SF on Pocket Pentrometer

(5) 0.5 Tons/SF on Pocket Pentrometer

LEGEND

S - Split Spoon Sample	O/A - Sample Collected Off the Augers	
UT - Undisturbed Tube Sample		
Trace - Approximately 0 to 10%	Some - Approximately 20 to 35%	
Little - Approximately 10 to 20%	And - Approximately 35 to 50%	
0-10 Coarse Soil N Value - Loose	30-50 Coarse Soil N Value - Dense	
10-30 Coarse Soil N Value - Medium Dense	>50 Coarse Soil N Value - Very Dense	
0-4 Fine Soil N Value - Soft	8-15 Fine Soil N Value - Stiff	>30 Fine Soil N Value - Hard
4-8 Fine Soil N Value - Medium Stiff	15-30 Fine Soil N Value - Very Stiff	

BORING LOG

Project:	ASSEMBLY EDGE (SOMERVILLE)	Boring No:	B-1
Location:	845 MCGRATH HIGHWAY	Location:	See Plan
Client:	KEMS CORPORATION	Approx. Ground Elevation:	15±
Driller:	SOIL EXPLORATION CORP	Approx. Groundwater Elevation:	6.5±
Drilling Methods:	HSA/D&W 20'+	Date/Time of Groundwater Elevation:	8:00 AM
Weather:	50's, CLOUDY, LT. RAIN	Datum:	SOMERVILLE SEWER BASE
Performed By: PJS	Date: 6/5/17	Project No.	2016-059
Checked By: MFC	Date: 6/15/17		

DESIGN CONSULTANTS, INC.

Depth (feet)	Sample No.	Blows per 6-inch	Pen./ Rec.	Soil Description	Stratum Change Depth (feet)	Stratum	Note No.
41	S-9	WOH/12" 2 3	24"/24"	S-9, Similar to S-8, Soft			(6)
42							
43							
44							
45	S-10	WOH/12" 3 4	24"/24"	S-10, Similar to S-9			(7)
46							
47							
48							
49							
50	S-11	WOH/6" 3 4 5	24"/24"	S-11, Similar to S-10, Medium Stiff		CLAY	(8)
51							
52							
53							
54							
55	S-12	WOH/12" 3 4	24"/24"	S-12, Similar to S-11, Trace Gravel, Soft			(9)
56							
57							
58							
59							
60							

NOTES:

(6) 0.25 Tons/SF on Pocket Pentrometer

(7) 0.5 Tons/SF on Pocket Pentrometer

(8) 0.75 Tons/SF on Pocket Pentrometer

(9) 0.5 Tons/SF on Pocket Pentrometer

LEGEND

S - Split Spoon Sample	O/A - Sample Collected Off the Augers	
UT - Undisturbed Tube Sample		
Trace - Approximately 0 to 10%	Some - Approximately 20 to 35%	
Little - Approximately 10 to 20%	And - Approximately 35 to 50%	
0-10 Coarse Soil N Value - Loose	30-50 Coarse Soil N Value - Dense	
10-30 Coarse Soil N Value - Medium Dense	>50 Coarse Soil N Value - Very Dense	
0-4 Fine Soil N Value - Soft	8-15 Fine Soil N Value - Stiff	>30 Fine Soil N Value - Hard
4-8 Fine Soil N Value - Medium Stiff	15-30 Fine Soil N Value - Very Stiff	

BORING LOG

Project:	**ASSEMBLY EDGE (SOMERVILLE)**
Location:	**845 MCGRATH HIGHWAY**
Client:	**KEMS CORPORATION**
Driller:	**SOIL EXPLORATION CORP**
Drilling Methods:	**HSA/D&W 20'+**
Weather:	**50's, CLOUDY, LT. RAIN**
Performed By:	**PJS** Date: **6/5/17**
Checked By:	**MFC** Date: **6/15/17**

DESIGN CONSULTANTS, INC.

Boring No:	**B-1**
Location:	**See Plan**
Approx. Ground Elevation:	**15±**
Approx. Groundwater Elevation:	**6.5±**
Date/Time of Groundwater Elevation:	**8:00 AM**
Datum:	**SOMERVILLE SEWER BASE**
Project No.	**2016-059**

Depth (feet)	Sample No.	Blows per 6-inch	Pen./ Rec.	Soil Description	Stratum Change Depth (feet)	Stratum	Note No.
61	S-13	WOH/6" 2 4 7	24"/24"	S-13, Similar to S-12, Medium Stiff		CLAY	(10)
62							
63					63'		
64							
65	S-14	6 10 12 13	24"/24"	S-14, SAND And Gravel And Clay, Grey, Wet, Medium Dense		GLACIAL TILL	
66							
67							
68							
69							
70							
71							
72							
73							
74							
75					75'		(11)
76				BOTTOM OF BORING AT 75' BGS			
77							
78							
79							
80							

NOTES:

(10) 0.5 Tons/SF on Pocket Pentrometer

(11) Driller only brought 50-feet of casing. Rollerbit drilled down to 75-below ground surface, still in the till, unable to sample without hole caving in.

LEGEND

S - Split Spoon Sample	O/A - Sample Collected Off the Augers	
UT - Undisturbed Tube Sample		
Trace - Approximately 0 to 10%	Some - Approximately 20 to 35%	
Little - Approximately 10 to 20%	And - Approximately 35 to 50%	
0-10 Coarse Soil N Value - Loose	30-50 Coarse Soil N Value - Dense	
10-30 Coarse Soil N Value - Medium Dense	>50 Coarse Soil N Value - Very Dense	
0-4 Fine Soil N Value - Soft	8-15 Fine Soil N Value - Stiff	>30 Fine Soil N Value - Hard
4-8 Fine Soil N Value - Medium Stiff	15-30 Fine Soil N Value - Very Stiff	

BORING LOG

Project:	ASSEMBLY EDGE (SOMERVILLE)	Boring No:	B-2
Location:	845 MCGRATH HIGHWAY	Location:	See Plan
Client:	KEMS CORPORATION	Approx. Ground Elevation:	14±
Driller:	SOIL EXPLORATION CORP	Approx. Groundwater Elevation:	6.5±
Drilling Methods:	HSA/D&W 10'+	Date/Time of Groundwater Elevation:	10:00 AM
Weather:	90's, SUNNY	Datum:	SOMERVILLE SEWER BASE
Performed By: PJS	Date: 6/13/17	Project No.	2016-059
Checked By: MFC	Date: 6/15/17		

DESIGN CONSULTANTS, INC.

Depth (feet)	Sample No.	Blows per 6-inch	Pen./ Rec.	Soil Description	Stratum Change Depth (feet)	Stratum	Note No.
					.2'	ASPHALT	(1)
1	S-1	4	24"/9"	S-1, SAND, Some Gravel, Some Silt, Trace Coal, Trace Glass, Brown, Dry, Loose			
2		3					
3		3				FILL	
4		4					
5	S-2	8	24"/4"	S-2, SAND, Little Gravel, Little Silt, Brown, Dry, Medium Dense			
6		10					
7		8			7'		(2)
8		6					
9							
10	S-3	1	24"/22"	S-3, PEAT		PEAT	
11		1/12"					
12		1					
13							
14							
15	S-4	WOH/12"	24"/0"	S-4, No Recovery			
16		1					
17		1					
18							
19							
20							

NOTES:

(1) 2.5" OF ASPHALT

(2) WATER AT 7.5' BELOW GROUND SURFACE

LEGEND

S - Split Spoon Sample	O/A - Sample Collected Off the Augers	
UT - Undisturbed Tube Sample		
Trace - Approximately 0 to 10%	Some - Approximately 20 to 35%	
Little - Approximately 10 to 20%	And - Approximately 35 to 50%	
0-10 Coarse Soil N Value - Loose	30-50 Coarse Soil N Value - Dense	
10-30 Coarse Soil N Value - Medium Dense	>50 Coarse Soil N Value - Very Dense	
0-4 Fine Soil N Value - Soft	8-15 Fine Soil N Value - Stiff	>30 Fine Soil N Value - Hard
4-8 Fine Soil N Value - Medium Stiff	15-30 Fine Soil N Value - Very Stiff	

BORING LOG

Project:	ASSEMBLY EDGE (SOMERVILLE)	Boring No:	B-2
Location:	845 MCGRATH HIGHWAY	Location:	See Plan
Client:	KEMS CORPORATION	Approx. Ground Elevation:	14±
Driller:	SOIL EXPLORATION CORP	Approx. Groundwater Elevation:	6.5±
Drilling Methods:	HSA/D&W 10'+	Date/Time of Groundwater Elevation:	10:00 AM
Weather:	90's, SUNNY	Datum:	SOMERVILLE SEWER BASE
Performed By:	PJS Date: 6/13/17	Project No.	2016-059
Checked By:	MFC Date: 6/15/17		

DESIGN CONSULTANTS, INC.

Depth (feet)	Sample No.	Blows per 6-inch	Pen./ Rec.	Soil Description	Stratum Change Depth (feet)	Stratum	Note No.
21	S-5	WOH/18"	24"/0"	S-5, No Recovery	21.5'	PEAT	
22		8					
23							
24							
25	S-6	4	24"/24"	S-6, Top 2" CLAY and Sand, Grey, Wet, Medium Stiff (Sand Seam)			(3)
26		2		Next 6", CLAY, Grey, Wet, Medium Stiff,			
27		4		Bottom 16", CLAY, Olive, Wet,			
28		4		Medium Stiff			
29							
30	S-7	1	24"/12"	S-7, CLAY, Trace Sand, Grey, Wet, Soft		CLAY	(4)
31		1					
32		1					
33		2					
34							
35	S-8	WOH/12"	24"/14"	S-8, Similar to S-7			(5)
36		2					
37		2					
38							
39							
40							

NOTES:

(3) 2.0 Tons/SF on Pocket Pentrometer

(4) 0.25 Tons/SF on Pocket Pentrometer

(5) 0.25 Tons/SF on Pocket Pentrometer

LEGEND

S - Split Spoon Sample	O/A - Sample Collected Off the Augers	
UT - Undisturbed Tube Sample		
Trace - Approximately 0 to 10%	Some - Approximately 20 to 35%	
Little - Approximately 10 to 20%	And - Approximately 35 to 50%	
0-10 Coarse Soil N Value - Loose	30-50 Coarse Soil N Value - Dense	
10-30 Coarse Soil N Value - Medium Dense	>50 Coarse Soil N Value - Very Dense	
0-4 Fine Soil N Value - Soft	8-15 Fine Soil N Value - Stiff	>30 Fine Soil N Value - Hard
4-8 Fine Soil N Value - Medium Stiff	15-30 Fine Soil N Value - Very Stiff	

BORING LOG

Project:	ASSEMBLY EDGE (SOMERVILLE)
Location:	845 MCGRATH HIGHWAY
Client:	KEMS CORPORATION
Driller:	SOIL EXPLORATION CORP
Drilling Methods:	HSA/D&W 10'+
Weather:	90's, SUNNY
Performed By:	PJS Date: 6/13/17
Checked By:	MFC Date: 6/15/17

DESIGN CONSULTANTS, INC.

Boring No:	B-2
Location:	See Plan
Approx. Ground Elevation:	14±
Approx. Groundwater Elevation:	6.5±
Date/Time of Groundwater Elevation:	10:00 AM
Datum:	SOMERVILLE SEWER BASE
Project No.	2016-059

Depth (feet)	Sample No.	Blows per 6-inch	Pen./ Rec.	Soil Description	Stratum Change Depth (feet)	Stratum	Note No.
41							
42							
43							
44							
45							
46	S-9	WOH/12" 3 3	24"/24"	S-9, CLAY, Grey, Wet, Soft,			(6)
47							
48							
49							
50						CLAY	
51							
52							
53							
54							
55							
56	S-10	2 1 4 6	24"/24"	S-10, CLAY, Trace Gravel Pieces, Grey, Wet, Medium Stiff			(7)
57							
58							
59							
60							

NOTES:

(6) 0.5 Tons/SF on Pocket Pentrometer

(7) 0.5 Tons/ SF on Pocket Pentrometer

LEGEND

S - Split Spoon Sample	O/A - Sample Collected Off the Augers	
UT - Undisturbed Tube Sample		
Trace - Approximately 0 to 10%	Some - Approximately 20 to 35%	
Little - Approximately 10 to 20%	And - Approximately 35 to 50%	
0-10 Coarse Soil N Value - Loose	30-50 Coarse Soil N Value - Dense	
10-30 Coarse Soil N Value - Medium Dense	>50 Coarse Soil N Value - Very Dense	
0-4 Fine Soil N Value - Soft	8-15 Fine Soil N Value - Stiff	>30 Fine Soil N Value - Hard
4-8 Fine Soil N Value - Medium Stiff	15-30 Fine Soil N Value - Very Stiff	

BORING LOG

Project:	**ASSEMBLY EDGE (SOMERVILLE)**
Location:	**845 MCGRATH HIGHWAY**
Client:	**KEMS CORPORATION**
Driller:	**SOIL EXPLORATION CORP**
Drilling Methods:	**HSA/D&W 10'+**
Weather:	**90's, SUNNY**
Performed By:	**PJS** Date: **6/13/17**
Checked By:	**MFC** Date: **6/15/17**

DESIGN CONSULTANTS, INC.

Boring No:	**B-2**
Location:	**See Plan**
Approx. Ground Elevation:	**14±**
Approx. Groundwater Elevation:	**6.5±**
Date/Time of Groundwater Elevation:	**10:00 AM**
Datum:	**SOMERVILLE SEWER BASE**
Project No.	**2016-059**

Depth (feet)	*Sample No.*	*Blows per 6-inch*	*Pen./ Rec.*	*Soil Description*	*Stratum Change Depth (feet)*	*Stratum*	*Note No.*
61							
62							
63							
64							
65							
66						CLAY	
67							
68							
69							
70							
71	S-11	3 4 5 7	24"/3"	S-11, CLAY, Some Gravel, Grey, Wet, Stiff			(8)
72					72'		
73				BOTTOM OF BORING AT 72' BGS			
74							
75							
76							
77							
78							
79							
80							

NOTES:

(8) SAMPLE NOT SOLID ENOUGH TO GET RELIABLE READING FROM POCKET PENTROMETER

LEGEND

S - Split Spoon Sample	O/A - Sample Collected Off the Augers	
UT - Undisturbed Tube Sample		
Trace - Approximately 0 to 10%	Some - Approximately 20 to 35%	
Little - Approximately 10 to 20%	And - Approximately 35 to 50%	
0-10 Coarse Soil N Value - Loose	30-50 Coarse Soil N Value - Dense	
10-30 Coarse Soil N Value - Medium Dense	>50 Coarse Soil N Value - Very Dense	
0-4 Fine Soil N Value - Soft	8-15 Fine Soil N Value - Stiff	>30 Fine Soil N Value - Hard
4-8 Fine Soil N Value - Medium Stiff	15-30 Fine Soil N Value - Very Stiff	

BORING LOG

Project:	ASSEMBLY EDGE (SOMERVILLE)
Location:	845 MCGRATH HIGHWAY
Client:	KEMS CORPORATION
Driller:	SOIL EXPLORATION CORP
Drilling Methods:	HSA/D&W 20'+
Weather:	50's, CLOUDY, LT. RAIN
Performed By:	PJS Date: 6/5/17
Checked By:	MFC Date: 6/15/17

DESIGN CONSULTANTS, INC.

Boring No:	B-3
Location:	See Plan
Approx. Ground Elevation:	14.1±
Approx. Groundwater Elevation:	5.6±
Date/Time of Groundwater Elevation:	2:00 PM
Datum:	SOMERVILLE SEWER BASE
Project No.	2016-059

Depth (feet)	Sample No.	Blows per 6-inch	Pen./ Rec.	Soil Description	Stratum Change Depth (feet)	Stratum	Note No.
					.2'	ASPHALT	(1)
1	S-1	3	24"/11"	S-1, SAND And Silt, Little Gravel, Trace Coal, Trace Ash, Black, Dry, Medium Dense (FILL)			
2		8					
3		11					
4		10					
5	S-2	WOH/18"	24"/6"	S-2, Similar to S-1, Grey, Moist, Loose		FILL	
6		3					
7							
8							(2)
9							
10	S-3	WOH/12"	24"/0"	S-3, ASH, Cobble in Spoon			
11		1					
12		1					
13					13'		
14							
15	S-4	WOH/18"	24"/24"	S-4, PEAT		PEAT	
16		2					
17							
18							
19					19'		
20						CLAY	

NOTES:

(1) 2" OF ASPHALT

(2) WATER AT 8.5' BELOW GROUND SURFACE

BORING MOVED 5-FEET SW TO AVOID UTILITY

LEGEND

S - Split Spoon Sample	O/A - Sample Collected Off the Augers	
UT - Undisturbed Tube Sample		
Trace - Approximately 0 to 10%	Some - Approximately 20 to 35%	
Little - Approximately 10 to 20%	And - Approximately 35 to 50%	
0-10 Coarse Soil N Value - Loose	30-50 Coarse Soil N Value - Dense	
10-30 Coarse Soil N Value - Medium Dense	>50 Coarse Soil N Value - Very Dense	
0-4 Fine Soil N Value - Soft	8-15 Fine Soil N Value - Stiff	>30 Fine Soil N Value - Hard
4-8 Fine Soil N Value - Medium Stiff	15-30 Fine Soil N Value - Very Stiff	

BORING LOG

Project:	ASSEMBLY EDGE (SOMERVILLE)
Location:	845 MCGRATH HIGHWAY
Client:	KEMS CORPORATION
Driller:	SOIL EXPLORATION CORP
Drilling Methods:	HSA/D&W 20'+
Weather:	50's, CLOUDY, LT. RAIN
Performed By:	PJS Date: 6/5/17
Checked By:	MFC Date: 6/15/17

DESIGN CONSULTANTS, INC.

Boring No:	B-3
Location:	See Plan
Approx. Ground Elevation:	14.1±
Approx. Groundwater Elevation:	5.6±
Date/Time of Groundwater Elevation:	2:00 PM
Datum:	SOMERVILLE SEWER BASE
Project No.	2016-059

Depth (feet)	Sample No.	Blows per 6-inch	Pen./ Rec.	Soil Description	Stratum Change Depth (feet)	Stratum	Note No.
21	S-5	3 4 5 8	24"/24"	S-5, CLAY, Trace Sand, Trace Organics, Grey, Wet, Stiff			(4)
22							
23							
24							
25	S-6	4 4 4 5	24"/24"	S-6, CLAY, Trace to Little SAND, Olive, Wet, Stiff			(5)
26							
27							
28							
29							
30	S-7	WOH/12" 2 3	24"/24"	S-7, CLAY, Trace Sand, Grey, Wet, Soft		CLAY	(6)
31							
32							
33							
34							
35	S-8	WOH/12" 2 2	24"/24"	S-8, Similar to S-7			(7)
36							
37							
38							
39							
40							

NOTES:

(4) 1.5 Tons/SF on Pocket Pentrometer

(5) 1.5 Tons/SF on Pocket Pentrometer

(6) 0.5 Tons/SF on Pocket Pentrometer

(7) 0.375 Tons/SF on Pocket Pentrometer

LEGEND

S - Split Spoon Sample	O/A - Sample Collected Off the Augers	
UT - Undisturbed Tube Sample		
Trace - Approximately 0 to 10%	Some - Approximately 20 to 35%	
Little - Approximately 10 to 20%	And - Approximately 35 to 50%	
0-10 Coarse Soil N Value - Loose	30-50 Coarse Soil N Value - Dense	
10-30 Coarse Soil N Value - Medium Dense	>50 Coarse Soil N Value - Very Dense	
0-4 Fine Soil N Value - Soft	8-15 Fine Soil N Value - Stiff	>30 Fine Soil N Value - Hard
4-8 Fine Soil N Value - Medium Stiff	15-30 Fine Soil N Value - Very Stiff	

BORING LOG

Project:	ASSEMBLY EDGE (SOMERVILLE)
Location:	845 MCGRATH HIGHWAY
Client:	KEMS CORPORATION
Driller:	SOIL EXPLORATION CORP
Drilling Methods:	HSA/D&W 20'+
Weather:	50's, CLOUDY, LT. RAIN
Performed By:	PJS Date: 6/6/17
Checked By:	MFC Date: 6/15/17

DESIGN CONSULTANTS, INC.

Boring No:	B-3
Location:	See Plan
Approx. Ground Elevation:	14.1±
Approx. Groundwater Elevation:	5.6±
Date/Time of Groundwater Elevation:	7:00 AM
Datum:	SOMERVILLE SEWER BASE
Project No.	2016-059

Depth (feet)	Sample No.	Blows per 6-inch	Pen./ Rec.	Soil Description	Stratum Change Depth (feet)	Stratum	Note No.
41	S-9	WOH/12" 5 2	24"/24"	S-9, Similar to S-8, Trace Gravel, Medium Stiff			(8)
42							
43							
44							
45	S-10	WOH/12" 1 3	24"/24"	S-10, Similar to S-9, Trace Coarse Sand Flakes			(9)
46							
47							(10)
48							
49							
50	S-11	6 8 8 9	24"/0	S-11, No Recovery		CLAY	
51							
52							
53							
54							
55	S-12	3 3 5 5	24"/0"	S-12, No Recovery			
56							
57							
58							
59							
60							

NOTES:

(8) 0.25 Tons/SF on Pocket Pentrometer

(9) 0.25 Tons/SF on Pocket Pentrometer

(10) Hardness change in clay at 47' below ground surface

LEGEND

S - Split Spoon Sample	O/A - Sample Collected Off the Augers	
UT - Undisturbed Tube Sample		
Trace - Approximately 0 to 10%	Some - Approximately 20 to 35%	
Little - Approximately 10 to 20%	And - Approximately 35 to 50%	
0-10 Coarse Soil N Value - Loose	30-50 Coarse Soil N Value - Dense	
10-30 Coarse Soil N Value - Medium Dense	>50 Coarse Soil N Value - Very Dense	
0-4 Fine Soil N Value - Soft	8-15 Fine Soil N Value - Stiff	>30 Fine Soil N Value - Hard
4-8 Fine Soil N Value - Medium Stiff	15-30 Fine Soil N Value - Very Stiff	

BORING LOG

Project:	**ASSEMBLY EDGE (SOMERVILLE)**
Location:	**845 MCGRATH HIGHWAY**
Client:	**KEMS CORPORATION**
Driller:	**SOIL EXPLORATION CORP**
Drilling Methods:	**HSA/D&W 20'+**
Weather:	**50's, CLOUDY, LT. RAIN**
Performed By:	**PJS** Date: **6/6/17**
Checked By:	**MFC** Date: **6/15/17**

DESIGN CONSULTANTS, INC.

Boring No:	**B-3**
Location:	**See Plan**
Approx. Ground Elevation:	**14.1±**
Approx. Groundwater Elevation:	**5.6±**
Date/Time of Groundwater Elevation:	**7:00 AM**
Datum:	**SOMERVILLE SEWER BASE**
Project No.	**2016-059**

Depth (feet)	Sample No.	Blows per 6-inch	Pen./ Rec.	Soil Description	Stratum Change Depth (feet)	Stratum	Note No.
61	S-13	3 3 5 6	24"/24"	S-13, CLAY, Trace Coarse Sand pieces, Grey, Wet, Stiff		CLAY	(11)
62							
63							
64							
65	S-14	WOH/6" 3 4 8	24"/24"	S-14, Similar to S-13			(12)
66							
67							
68							
69					69'		(13)
70				CASING REFUSAL AT 69' BGS ROLLERBIT REFUSAL AT 69' BGS BOTTOM OF BORING AT 69' BGS			
71							
72							
73							
74							
75							
76							
77							
78							
79							
80							

NOTES:

(11) 0.6 Tons/SF on Pocket Pentrometer

(12) 0.5 Tons/SF on Pocket Pentrometer

(13) Bouncing rod at 69' below ground surface

LEGEND

S - Split Spoon Sample	O/A - Sample Collected Off the Augers	
UT - Undisturbed Tube Sample		
Trace - Approximately 0 to 10%	Some - Approximately 20 to 35%	
Little - Approximately 10 to 20%	And - Approximately 35 to 50%	
0-10 Coarse Soil N Value - Loose	30-50 Coarse Soil N Value - Dense	
10-30 Coarse Soil N Value - Medium Dense	>50 Coarse Soil N Value - Very Dense	
0-4 Fine Soil N Value - Soft	8-15 Fine Soil N Value - Stiff	>30 Fine Soil N Value - Hard
4-8 Fine Soil N Value - Medium Stiff	15-30 Fine Soil N Value - Very Stiff	

BORING LOG

Project:	ASSEMBLY EDGE (SOMERVILLE)
Location:	845 MCGRATH HIGHWAY
Client:	KEMS CORPORATION
Driller:	SOIL EXPLORATION CORP
Drilling Methods:	HSA/D&W 20'+
Weather:	50's, CLOUDY, LT. RAIN
Performed By:	PJS Date: 6/7/27
Checked By:	MFC Date: 6/15/17

DESIGN CONSULTANTS, INC.

Boring No:	B-4
Location:	See Plan
Approx. Ground Elevation:	14.1±
Approx. Groundwater Elevation:	6.6±
Date/Time of Groundwater Elevation:	7:00 AM
Datum:	SOMERVILLE SEWER BASE
Project No.	2016-059

Depth (feet)	Sample No.	Blows per 6-inch	Pen./ Rec.	Soil Description	Stratum Change Depth (feet)	Stratum	Note No.
1	S-1	5 9 10 10	24"/13"	S-1, Top 2", Topsoil Bottom 9" SAND, Little Silt, Little Gravel, Brown, Dry, Medium Dense	.2'	TOPSOIL	
2							
3							
4							
5	S-2	3 2 4 2	24"/0"	S-2, No Recovery, Loose		FILL	
6							
7							(1)
8							
9							
10	S-3	1 1 1 1	24"/24"	S-3, Top 3" Similar to S-1, Trace Brick, Trace Coal, Grey, Wet, Loose Bottom 21", PEAT	10'	PEAT	
11							
12							
13							
14							
15	S-4	WOH/12" 1 1	24"/22"	S-4, PEAT			
16							
17							
18							
19							
20							

NOTES:

(1) Water at 7.5' below ground surface

LEGEND

S - Split Spoon Sample	O/A - Sample Collected Off the Augers	
UT - Undisturbed Tube Sample		
Trace - Approximately 0 to 10%	Some - Approximately 20 to 35%	
Little - Approximately 10 to 20%	And - Approximately 35 to 50%	
0-10 Coarse Soil N Value - Loose	30-50 Coarse Soil N Value - Dense	
10-30 Coarse Soil N Value - Medium Dense	>50 Coarse Soil N Value - Very Dense	
0-4 Fine Soil N Value - Soft	8-15 Fine Soil N Value - Stiff	>30 Fine Soil N Value - Hard
4-8 Fine Soil N Value - Medium Stiff	15-30 Fine Soil N Value - Very Stiff	

BORING LOG

Project:	ASSEMBLY EDGE (SOMERVILLE)		
Location:	845 MCGRATH HIGHWAY		
Client:	KEMS CORPORATION		
Driller:	SOIL EXPLORATION CORP		
Drilling Methods:	HSA/D&W 20'+		
Weather:	50's, CLOUDY, LT. RAIN		
Performed By:	PJS	Date:	6/7/27
Checked By:	MFC	Date:	6/15/17

DESIGN CONSULTANTS, INC.

Boring No:	B-4
Location:	See Plan
Approx. Ground Elevation:	14.1±
Approx. Groundwater Elevation:	6.6±
Date/Time of Groundwater Elevation:	7:00 AM
Datum:	SOMERVILLE SEWER BASE
Project No.	2016-059

Depth (feet)	Sample No.	Blows per 6-inch	Pen./ Rec.	Soil Description	Stratum Change Depth (feet)	Stratum	Note No.
21	S-5	WHO/6" 2 3 5	24"/15"	S-5, Top 7" PEAT, Soft Bottom 8" SILT, Some Sand, Little Organics, Grey, Wet, Medium Stiff	21'	PEAT	
22							
23						ORGANIC SILT	
24							
25					25.5'		
26	S-6	2 3 4 4	24"/24"	S-6, Top 6" Similar to Bottom of S-5, Bottom 18", CLAY, Little Sand, Olive, Wet, Medium Stiff			(2)
27							
28	S-7	5 4 6 5	24"/24"	S-7, CLAY, Trace Sand, Grey, Wet, Stiff			(3)
29							
30	U-1	2" DIA. SHELBY TUBE	24"/24"				
31				VANE SHEAR TEST @ 31' BGS 2.5" Diameter vane shear in 3" casing, >600 inch-lbs, 1/8 turn of vane shear, 6" long blades		CLAY	
32							
33							
34							
35							
36	S-8	WOH/18"	24"/24"	S-8, CLAY, Trace Sand, Grey, Wet, Soft			(4)
37		2					
38							
39							
40							

NOTES:

LEGEND

S - Split Spoon Sample	O/A - Sample Collected Off the Augers
UT - Undisturbed Tube Sample	
Trace - Approximately 0 to 10%	Some - Approximately 20 to 35%
Little - Approximately 10 to 20%	And - Approximately 35 to 50%
0-10 Coarse Soil N Value - Loose	30-50 Coarse Soil N Value - Dense
10-30 Coarse Soil N Value - Medium Dense	>50 Coarse Soil N Value - Very Dense
0-4 Fine Soil N Value - Soft	8-15 Fine Soil N Value - Stiff
4-8 Fine Soil N Value - Medium Stiff	15-30 Fine Soil N Value - Very Stiff

>30 Fine Soil N Value - Hard

BORING LOG

Project:	ASSEMBLY EDGE (SOMERVILLE)	Boring No:	B-4
Location:	845 MCGRATH HIGHWAY	Location:	See Plan
Client:	KEMS CORPORATION	Approx. Ground Elevation:	14.1±
Driller:	SOIL EXPLORATION CORP	Approx. Groundwater Elevation:	6.6±
Drilling Methods:	HSA/D&W 20'+	Date/Time of Groundwater Elevation:	7:00 AM
Weather:	50's, CLOUDY, LT. RAIN	Datum:	SOMERVILLE SEWER BASE
Performed By: PJS	Date: 6/7/27	Project No.	2016-059
Checked By: MFC	Date: 6/15/17		

DESIGN CONSULTANTS, INC.

Depth (feet)	Sample No.	Blows per 6-inch	Pen./ Rec.	Soil Description	Stratum Change Depth (feet)	Stratum	Note No.
41	S-9	WOH/12" 2 2	24"/24"	S-9, CLAY, Grey, Wet, Soft			(5)
42							
43	U-2	2" DIA. SHELBY TUBE	24"/24"				
44							
45							(6)
46							
47							
48				VANE SHEAR TEST AT 49' BGS 550 inch-lbs to break in 1st 1/4 turn, 300 inch-lbs for remaining rotation, 2.5" diameter vane shear in 3" casing 6" vane shear blades			
49							
50		WOH/6" 2 3 4				CLAY	
51	S-10		24"/24"	S-10, Similar to S-9, Medium Stiff			
52							
53							
54	U-3a	2" DIA. SHELBY TUBE	24"/0"	U-3a, No Recovery in Shelby Tube			
55							
56	U-3b	2" DIA. SHELBY TUBE	24"/24"				
57							
58	S-11	WOH/12" 3 5	24"/24"	S-11, Similar to S-10, Trace Gravel pieces, Soft			(7)
59							
60							

NOTES:

(5) 0.5 Tons/SF on Pocket Pentrometer

(6) 18.5" long vane shear

(7) 0.5 Tons/SF on Pocket Pentrometer

LEGEND

S - Split Spoon Sample	O/A - Sample Collected Off the Augers	
UT - Undisturbed Tube Sample		
Trace - Approximately 0 to 10%	Some - Approximately 20 to 35%	
Little - Approximately 10 to 20%	And - Approximately 35 to 50%	
0-10 Coarse Soil N Value - Loose	30-50 Coarse Soil N Value - Dense	
10-30 Coarse Soil N Value - Medium Dense	>50 Coarse Soil N Value - Very Dense	
0-4 Fine Soil N Value - Soft	8-15 Fine Soil N Value - Stiff	>30 Fine Soil N Value - Hard
4-8 Fine Soil N Value - Medium Stiff	15-30 Fine Soil N Value - Very Stiff	

BORING LOG

Project:	ASSEMBLY EDGE (SOMERVILLE)	Boring No:	B-4
Location:	845 MCGRATH HIGHWAY	Location:	See Plan
Client:	KEMS CORPORATION	Approx. Ground Elevation:	14.1±
Driller:	SOIL EXPLORATION CORP	Approx. Groundwater Elevation:	6.6±
Drilling Methods:	HSA/D&W 20'+	Date/Time of Groundwater Elevation:	7:00 AM
Weather:	SUNNY, 90's	Datum:	SOMERVILLE SEWER BASE
Performed By: PJS	Date: 6/12/17	Project No.	2016-059
Checked By: MFC	Date: 6/15/17		

DESIGN CONSULTANTS, INC.

Depth (feet)	Sample No.	Blows per 6-inch	Pen./ Rec.	Soil Description	Stratum Change Depth (feet)	Stratum	Note No.
61	S-12	WOH/6" 3 3 5	24"/0"	S-12, No Recovery			
62							
63							
64							
65	S-13	WOH/6" 3 5 4	24"/16"	S-13, Similar to S-11			(8)
66							
67							
68							
69							
70	S-14	15 7 7 8	24"/9"	S-14, CLAY, Some Gravel, Little Sand, Grey, Wet, Stiff		CLAY	(9)
71							
72							
73							
74							
75	S-15	3 4 6 8	24"/24"	S-15, CLAY, Grey, Wet, Stiff			(10)
76							
77							
78							
79							
80							

NOTES:

(8) 0.5 Tons/SF on Pocket Pentrometer

(9) 0.5 Tons/SF on Pocket Pentrometer

(10) 0.75 Tons/SF on Pocket Pentrometer

LEGEND

S - Split Spoon Sample	O/A - Sample Collected Off the Augers
UT - Undisturbed Tube Sample	
Trace - Approximately 0 to 10%	Some - Approximately 20 to 35%
Little - Approximately 10 to 20%	And - Approximately 35 to 50%
0-10 Coarse Soil N Value - Loose	30-50 Coarse Soil N Value - Dense
10-30 Coarse Soil N Value - Medium Dense	>50 Coarse Soil N Value - Very Dense
0-4 Fine Soil N Value - Soft	8-15 Fine Soil N Value - Stiff
4-8 Fine Soil N Value - Medium Stiff	15-30 Fine Soil N Value - Very Stiff

>30 Fine Soil N Value - Hard

BORING LOG

Project:	**ASSEMBLY EDGE (SOMERVILLE)**
Location:	**845 MCGRATH HIGHWAY**
Client:	**KEMS CORPORATION**
Driller:	**SOIL EXPLORATION CORP**
Drilling Methods:	**HSA/D&W 20'+**
Weather:	**SUNNY, 90's**
Performed By:	**PJS** Date: **6/12/17**
Checked By:	**MFC** Date: **6/15/17**

DESIGN CONSULTANTS, INC.

Boring No:	**B-4**
Location:	**See Plan**
Approx. Ground Elevation:	**14.1±**
Approx. Groundwater Elevation:	**6.6±**
Date/Time of Groundwater Elevation:	**7:00 AM**
Datum:	**SOMERVILLE SEWER BASE**
Project No.	**2016-059**

Depth (feet)	Sample No.	Blows per 6-inch	Pen./ Rec.	Soil Description	Stratum Change Depth (feet)	Stratum	Note No.
81	S-16	WOH/6" 5 6 8	24"/24"	S-16, CLAY, Grey, Wet, Stiff			(11)
82						CLAY	
83							
84					84'		
85		10 11 16 14					
86	S-17		24"/16"	S-17, CLAY, Some Gravel, Little Sand, Grey, Wet, Very Stiff			(12)
87							
88							
89							
90		23 26 20 26					
91	S-18		24"/16"	S-18, SAND and Gravel, Some Clay, Grey, Wet, Dense		GLACIAL TILL	
92							
93							
94							
95		21 35 29 60					
96	S-19		24"/3"	S-19, SAND and Gravel, Grey, Wet, Very Dense			
97					97'		
98				BOTTOM OF BORING AT 97' BGS			
99							
100							

NOTES:

(11) 0.625 Tons/ SF on Pocket Pentrometer

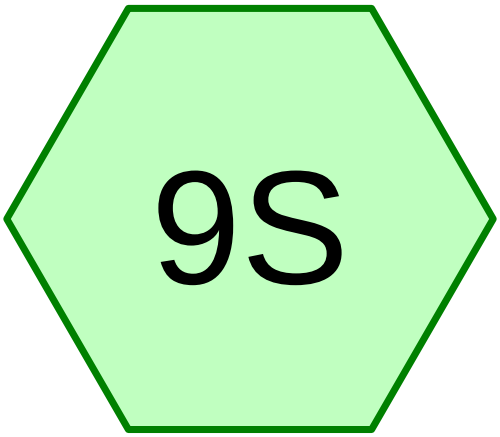
(12) 2.5 Tons/ SF on Pocket Pentrometer

LEGEND

S - Split Spoon Sample	O/A - Sample Collected Off the Augers
UT - Undisturbed Tube Sample	
Trace - Approximately 0 to 10%	Some - Approximately 20 to 35%
Little - Approximately 10 to 20%	And - Approximately 35 to 50%
0-10 Coarse Soil N Value - Loose	30-50 Coarse Soil N Value - Dense
10-30 Coarse Soil N Value - Medium Dense	>50 Coarse Soil N Value - Very Dense
0-4 Fine Soil N Value - Soft	8-15 Fine Soil N Value - Stiff
4-8 Fine Soil N Value - Medium Stiff	15-30 Fine Soil N Value - Very Stiff

>30 Fine Soil N Value - Hard

Appendix D



Existing

Subcat Reach Pond Link

Routing Diagram for 16-059 Mcgrath Highway Proposed
Prepared by Design Consultants, Inc., Printed 4/17/2018

Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
8,506	61	>75% Grass cover, Good, HSG B (9S)
79,108	98	Paved parking, HSG B (9S)
87,614	**94**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
87,614	HSG B	9S
0	HSG C	
0	HSG D	
0	Other	
87,614		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatch Numbers
0	8,506	0	0	0	8,506	>75% Grass cover, Good	
0	79,108	0	0	0	79,108	Paved parking	
0	**87,614**	**0**	**0**	**0**	**87,614**	**TOTAL AREA**	

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 9S: Existing Runoff Area=87,614 sf 90.29% Impervious Runoff Depth=2.68"
Flow Length=207' Tc=6.0 min CN=WQ Runoff=5.62 cfs 19,603 cf

Total Runoff Area = 87,614 sf Runoff Volume = 19,603 cf Average Runoff Depth = 2.68"
9.71% Pervious = 8,506 sf 90.29% Impervious = 79,108 sf

Summary for Subcatchment 9S: Existing

Runoff = 5.62 cfs @ 12.08 hrs, Volume= 19,603 cf, Depth= 2.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.16"

Area (sf)	CN	Description
8,506	61	>75% Grass cover, Good, HSG B
79,108	98	Paved parking, HSG B
87,614		Weighted Average
8,506		9.71% Pervious Area
79,108		90.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	207		0.57		**Direct Entry,**

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 9S: Existing Runoff Area=87,614 sf 90.29% Impervious Runoff Depth=4.21"
Flow Length=207' Tc=6.0 min CN=WQ Runoff=8.72 cfs 30,761 cf

Total Runoff Area = 87,614 sf Runoff Volume = 30,761 cf Average Runoff Depth = 4.21"
9.71% Pervious = 8,506 sf 90.29% Impervious = 79,108 sf

Summary for Subcatchment 9S: Existing

Runoff = 8.72 cfs @ 12.08 hrs, Volume= 30,761 cf, Depth= 4.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.77"

Area (sf)	CN	Description
8,506	61	>75% Grass cover, Good, HSG B
79,108	98	Paved parking, HSG B
87,614		Weighted Average
8,506		9.71% Pervious Area
79,108		90.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	207		0.57		**Direct Entry,**

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 9S: Existing Runoff Area=87,614 sf 90.29% Impervious Runoff Depth=5.43"
Flow Length=207' Tc=6.0 min CN=WQ Runoff=11.17 cfs 39,617 cf

Total Runoff Area = 87,614 sf Runoff Volume = 39,617 cf Average Runoff Depth = 5.43"
9.71% Pervious = 8,506 sf 90.29% Impervious = 79,108 sf

Summary for Subcatchment 9S: Existing

Runoff = 11.17 cfs @ 12.08 hrs, Volume= 39,617 cf, Depth= 5.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.03"

Area (sf)	CN	Description
8,506	61	>75% Grass cover, Good, HSG B
79,108	98	Paved parking, HSG B
87,614		Weighted Average
8,506		9.71% Pervious Area
79,108		90.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	207		0.57		**Direct Entry,**

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 9S: Existing Runoff Area=87,614 sf 90.29% Impervious Runoff Depth=7.95"
Flow Length=207' Tc=6.0 min CN=WQ Runoff=16.26 cfs 58,024 cf

Total Runoff Area = 87,614 sf Runoff Volume = 58,024 cf Average Runoff Depth = 7.95"
9.71% Pervious = 8,506 sf 90.29% Impervious = 79,108 sf

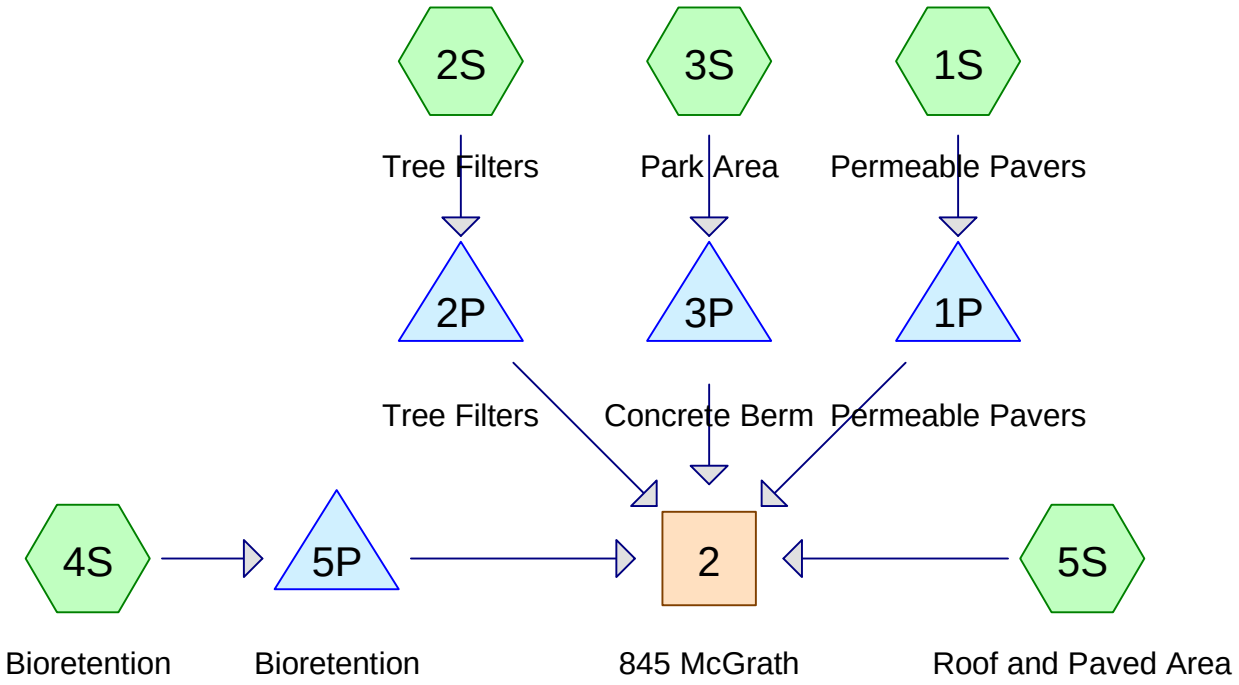
Summary for Subcatchment 9S: Existing

Runoff = 16.26 cfs @ 12.08 hrs, Volume= 58,024 cf, Depth= 7.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.62"

Area (sf)	CN	Description
8,506	61	>75% Grass cover, Good, HSG B
79,108	98	Paved parking, HSG B
87,614		Weighted Average
8,506		9.71% Pervious Area
79,108		90.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	207		0.57		**Direct Entry,**



Subcat Reach Pond Link

Routing Diagram for 16-059 Mcgrath Highway Proposed
Prepared by Design Consultants, Inc., Printed 4/17/2018

Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
10,715	61	>75% Grass cover, Good, HSG B (2S, 3S, 4S)
42,447	98	Paved parking, HSG B (2S, 4S, 5S)
27,290	98	Roofs, HSG B (5S)
6,705	98	Unconnected pavement, HSG A (1S)
457	98	Unconnected pavement, HSG B (2S, 4S)
87,614	**93**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
6,705	HSG A	1S
80,909	HSG B	2S, 3S, 4S, 5S
0	HSG C	
0	HSG D	
0	Other	
87,614		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatch Numbers
0	10,715	0	0	0	10,715	>75% Grass cover, Good	
0	42,447	0	0	0	42,447	Paved parking	
0	27,290	0	0	0	27,290	Roofs	
6,705	457	0	0	0	7,162	Unconnected pavement	
6,705	**80,909**	**0**	**0**	**0**	**87,614**	**TOTAL AREA**	

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Permeable Pavers Runoff Area=6,705 sf 100.00% Impervious Runoff Depth=2.93"
Tc=6.0 min CN=98 Runoff=0.47 cfs 1,636 cf

Subcatchment 2S: Tree Filters Runoff Area=32,790 sf 92.77% Impervious Runoff Depth=2.75"
Tc=6.0 min CN=WQ Runoff=2.16 cfs 7,506 cf

Subcatchment 3S: Park Area Runoff Area=7,514 sf 0.00% Impervious Runoff Depth=0.43"
Flow Length=121' Tc=6.0 min CN=61 Runoff=0.05 cfs 268 cf

Subcatchment 4S: Bioretention Runoff Area=3,306 sf 74.86% Impervious Runoff Depth=2.30"
Tc=6.0 min CN=WQ Runoff=0.18 cfs 633 cf

Subcatchment 5S: Roof and Paved Area Runoff Area=37,299 sf 100.00% Impervious Runoff Depth=2.93"
Tc=6.0 min CN=WQ Runoff=2.63 cfs 9,100 cf

Reach 2: 845 McGrath Inflow=4.71 cfs 13,174 cf
Outflow=4.71 cfs 13,174 cf

Pond 1P: Permeable Pavers Peak Elev=12.10' Storage=263 cf Inflow=0.47 cfs 1,636 cf
Discarded=0.16 cfs 1,636 cf Primary=0.00 cfs 0 cf Outflow=0.16 cfs 1,636 cf

Pond 2P: Tree Filters Peak Elev=13.79' Storage=1,248 cf Inflow=2.16 cfs 7,506 cf
Discarded=0.05 cfs 3,431 cf Primary=2.09 cfs 4,075 cf Outflow=2.14 cfs 7,506 cf

Pond 3P: Concrete Berm Peak Elev=14.00' Storage=17 cf Inflow=0.05 cfs 268 cf
Discarded=0.04 cfs 268 cf Primary=0.00 cfs 0 cf Outflow=0.04 cfs 268 cf

Pond 5P: Bioretention Peak Elev=14.11' Storage=304 cf Inflow=0.18 cfs 633 cf
Discarded=0.01 cfs 633 cf Primary=0.00 cfs 0 cf Outflow=0.01 cfs 633 cf

Total Runoff Area = 87,614 sf Runoff Volume = 19,143 cf Average Runoff Depth = 2.62"
12.23% Pervious = 10,715 sf 87.77% Impervious = 76,899 sf

Summary for Subcatchment 1S: Permeable Pavers

Runoff = 0.47 cfs @ 12.08 hrs, Volume= 1,636 cf, Depth= 2.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.16"

Area (sf)	CN	Description
6,705	98	Unconnected pavement, HSG A
6,705		100.00% Impervious Area
6,705		100.00% Unconnected

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

Summary for Subcatchment 2S: Tree Filters

Runoff = 2.16 cfs @ 12.08 hrs, Volume= 7,506 cf, Depth= 2.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.16"

Area (sf)	CN	Description
2,370	61	>75% Grass cover, Good, HSG B
30,295	98	Paved parking, HSG B
125	98	Unconnected pavement, HSG B
32,790		Weighted Average
2,370		7.23% Pervious Area
30,420		92.77% Impervious Area
125		0.41% Unconnected

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

Summary for Subcatchment 3S: Park Area

Runoff = 0.05 cfs @ 12.12 hrs, Volume= 268 cf, Depth= 0.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.16"

Area (sf)	CN	Description
7,514	61	>75% Grass cover, Good, HSG B
7,514		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	121		0.34		**Direct Entry,**

Summary for Subcatchment 4S: Bioretention

Runoff = 0.18 cfs @ 12.08 hrs, Volume= 633 cf, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.16"

Area (sf)	CN	Description
332	98	Unconnected pavement, HSG B
2,143	98	Paved parking, HSG B
831	61	>75% Grass cover, Good, HSG B
3,306		Weighted Average
831		25.14% Pervious Area
2,475		74.86% Impervious Area
332		13.41% Unconnected

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

Summary for Subcatchment 5S: Roof and Paved Area

Runoff = 2.63 cfs @ 12.08 hrs, Volume= 9,100 cf, Depth= 2.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.16"

Area (sf)	CN	Description
10,009	98	Paved parking, HSG B
27,290	98	Roofs, HSG B
37,299		Weighted Average
37,299		100.00% Impervious Area

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

Summary for Reach 2: 845 McGrath

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 87,614 sf, 87.77% Impervious, Inflow Depth = 1.80" for 2-Year event
Inflow = 4.71 cfs @ 12.09 hrs, Volume= 13,174 cf
Outflow = 4.71 cfs @ 12.09 hrs, Volume= 13,174 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: Permeable Pavers

Inflow Area = 6,705 sf,100.00% Impervious, Inflow Depth = 2.93" for 2-Year event
Inflow = 0.47 cfs @ 12.08 hrs, Volume= 1,636 cf
Outflow = 0.16 cfs @ 11.93 hrs, Volume= 1,636 cf, Atten= 66%, Lag= 0.0 min
Discarded = 0.16 cfs @ 11.93 hrs, Volume= 1,636 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 12.10' @ 12.36 hrs Surf.Area= 6,705 sf Storage= 263 cf

Plug-Flow detention time= 10.7 min calculated for 1,636 cf (100% of inflow)
Center-of-Mass det. time= 10.7 min (767.3 - 756.7)

Volume	Invert	Avail.Storage	Storage Description
#1	12.00'	5,364 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 13,410 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
12.00	6,705	0	0
14.00	6,705	13,410	13,410

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	13.90'	**4.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.16 cfs @ 11.93 hrs HW=12.02' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.16 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=12.00' (Free Discharge)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 2P: Tree Filters

Inflow Area = 32,790 sf, 92.77% Impervious, Inflow Depth = 2.75" for 2-Year event
Inflow = 2.16 cfs @ 12.08 hrs, Volume= 7,506 cf
Outflow = 2.14 cfs @ 12.09 hrs, Volume= 7,506 cf, Atten= 1%, Lag= 0.6 min
Discarded = 0.05 cfs @ 12.09 hrs, Volume= 3,431 cf
Primary = 2.09 cfs @ 12.09 hrs, Volume= 4,075 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 13.79' @ 12.09 hrs Surf.Area= 1,672 sf Storage= 1,248 cf

Plug-Flow detention time= 169.3 min calculated for 7,505 cf (100% of inflow)

Center-of-Mass det. time= 169.4 min (927.8 - 758.5)

Volume	Invert	Avail.Storage	Storage Description
#1	10.50'	1,003 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
			2,508 cf Overall x 40.0% Voids
#2	13.50'	418 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		1,421 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
10.50	836	0	0
13.50	836	2,508	2,508

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
13.50	836	0	0
14.00	836	418	418

Device	Routing	Invert	Outlet Devices
#1	Discarded	10.50'	**1.020 in/hr Exfiltration over Surface area**
			Conductivity to Groundwater Elevation = 0.01'
#2	Primary	13.65'	**9.0" Horiz. Overflow X 5.00** C= 0.600
			Limited to weir flow at low heads

Discarded OutFlow Max=0.05 cfs @ 12.09 hrs HW=13.79' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.05 cfs)

Primary OutFlow Max=2.08 cfs @ 12.09 hrs HW=13.79' (Free Discharge)
↑—**2=Overflow** (Weir Controls 2.08 cfs @ 1.24 fps)

Summary for Pond 3P: Concrete Berm

Inflow Area = 7,514 sf, 0.00% Impervious, Inflow Depth = 0.43" for 2-Year event
Inflow = 0.05 cfs @ 12.12 hrs, Volume= 268 cf
Outflow = 0.04 cfs @ 12.30 hrs, Volume= 268 cf, Atten= 26%, Lag= 10.8 min
Discarded = 0.04 cfs @ 12.30 hrs, Volume= 268 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 14.00' @ 12.30 hrs Surf.Area= 7,514 sf Storage= 17 cf

Plug-Flow detention time= 7.1 min calculated for 268 cf (100% of inflow)
Center-of-Mass det. time= 7.1 min (923.5 - 916.4)

Volume	Invert	Avail.Storage	Storage Description
#1	14.00'	7,514 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
14.00	7,514	0	0
15.00	7,514	7,514	7,514

Device	Routing	Invert	Outlet Devices
#1	Discarded	14.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	14.99'	**1.0' long x 0.5' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00
			Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.18 cfs @ 12.30 hrs HW=14.00' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.18 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=14.00' (Free Discharge)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 5P: Bioretention

Inflow Area = 3,306 sf, 74.86% Impervious, Inflow Depth = 2.30" for 2-Year event
Inflow = 0.18 cfs @ 12.08 hrs, Volume= 633 cf
Outflow = 0.01 cfs @ 9.97 hrs, Volume= 633 cf, Atten= 96%, Lag= 0.0 min
Discarded = 0.01 cfs @ 9.97 hrs, Volume= 633 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 14.11' @ 14.95 hrs Surf.Area= 332 sf Storage= 304 cf

Plug-Flow detention time= 331.8 min calculated for 633 cf (100% of inflow)
Center-of-Mass det. time= 331.8 min (1,095.9 - 764.1)

Volume	Invert	Avail.Storage	Storage Description
#1	11.99'	599 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
11.99	332	0.0	0	0
12.00	332	40.0	1	1
14.00	332	40.0	266	267
15.00	332	100.0	332	599

Device	Routing	Invert	Outlet Devices
#1	Discarded	11.99'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	14.99'	**20.0' long x 1.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00
			Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.01 cfs @ 9.97 hrs HW=12.00' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=11.99' (Free Discharge)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Permeable Pavers Runoff Area=6,705 sf 100.00% Impervious Runoff Depth=4.53"
Tc=6.0 min CN=98 Runoff=0.72 cfs 2,533 cf

Subcatchment 2S: Tree Filters Runoff Area=32,790 sf 92.77% Impervious Runoff Depth=4.29"
Tc=6.0 min CN=WQ Runoff=3.33 cfs 11,736 cf

Subcatchment 3S: Park Area Runoff Area=7,514 sf 0.00% Impervious Runoff Depth=1.23"
Flow Length=121' Tc=6.0 min CN=61 Runoff=0.22 cfs 772 cf

Subcatchment 4S: Bioretention Runoff Area=3,306 sf 74.86% Impervious Runoff Depth=3.70"
Tc=6.0 min CN=WQ Runoff=0.29 cfs 1,020 cf

Subcatchment 5S: Roof and Paved Area Runoff Area=37,299 sf 100.00% Impervious Runoff Depth=4.53"
Tc=6.0 min CN=WQ Runoff=3.99 cfs 14,091 cf

Reach 2: 845 McGrath Inflow=7.24 cfs 21,867 cf
Outflow=7.24 cfs 21,867 cf

Pond 1P: Permeable Pavers Peak Elev=12.21' Storage=568 cf Inflow=0.72 cfs 2,533 cf
Discarded=0.16 cfs 2,533 cf Primary=0.00 cfs 0 cf Outflow=0.16 cfs 2,533 cf

Pond 2P: Tree Filters Peak Elev=13.84' Storage=1,289 cf Inflow=3.33 cfs 11,736 cf
Discarded=0.05 cfs 3,960 cf Primary=3.26 cfs 7,776 cf Outflow=3.31 cfs 11,736 cf

Pond 3P: Concrete Berm Peak Elev=14.01' Storage=68 cf Inflow=0.22 cfs 772 cf
Discarded=0.16 cfs 772 cf Primary=0.00 cfs 0 cf Outflow=0.16 cfs 772 cf

Pond 5P: Bioretention Peak Elev=14.97' Storage=591 cf Inflow=0.29 cfs 1,020 cf
Discarded=0.01 cfs 1,020 cf Primary=0.00 cfs 0 cf Outflow=0.01 cfs 1,020 cf

Total Runoff Area = 87,614 sf Runoff Volume = 30,153 cf Average Runoff Depth = 4.13"
12.23% Pervious = 10,715 sf 87.77% Impervious = 76,899 sf

Summary for Subcatchment 1S: Permeable Pavers

Runoff = 0.72 cfs @ 12.08 hrs, Volume= 2,533 cf, Depth= 4.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.77"

Area (sf)	CN	Description
6,705	98	Unconnected pavement, HSG A
6,705		100.00% Impervious Area
6,705		100.00% Unconnected

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

Summary for Subcatchment 2S: Tree Filters

Runoff = 3.33 cfs @ 12.08 hrs, Volume= 11,736 cf, Depth= 4.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.77"

Area (sf)	CN	Description
2,370	61	>75% Grass cover, Good, HSG B
30,295	98	Paved parking, HSG B
125	98	Unconnected pavement, HSG B
32,790		Weighted Average
2,370		7.23% Pervious Area
30,420		92.77% Impervious Area
125		0.41% Unconnected

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

Summary for Subcatchment 3S: Park Area

Runoff = 0.22 cfs @ 12.10 hrs, Volume= 772 cf, Depth= 1.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.77"

Area (sf)	CN	Description
7,514	61	>75% Grass cover, Good, HSG B
7,514		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	121		0.34		**Direct Entry,**

Summary for Subcatchment 4S: Bioretention

Runoff = 0.29 cfs @ 12.08 hrs, Volume= 1,020 cf, Depth= 3.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.77"

Area (sf)	CN	Description
332	98	Unconnected pavement, HSG B
2,143	98	Paved parking, HSG B
831	61	>75% Grass cover, Good, HSG B
3,306		Weighted Average
831		25.14% Pervious Area
2,475		74.86% Impervious Area
332		13.41% Unconnected

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

Summary for Subcatchment 5S: Roof and Paved Area

Runoff = 3.99 cfs @ 12.08 hrs, Volume= 14,091 cf, Depth= 4.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.77"

Area (sf)	CN	Description
10,009	98	Paved parking, HSG B
27,290	98	Roofs, HSG B
37,299		Weighted Average
37,299		100.00% Impervious Area

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

Summary for Reach 2: 845 McGrath

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 87,614 sf, 87.77% Impervious, Inflow Depth = 2.99" for 10-Year event
Inflow = 7.24 cfs @ 12.09 hrs, Volume= 21,867 cf
Outflow = 7.24 cfs @ 12.09 hrs, Volume= 21,867 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: Permeable Pavers

Inflow Area = 6,705 sf,100.00% Impervious, Inflow Depth = 4.53" for 10-Year event
Inflow = 0.72 cfs @ 12.08 hrs, Volume= 2,533 cf
Outflow = 0.16 cfs @ 11.79 hrs, Volume= 2,533 cf, Atten= 78%, Lag= 0.0 min
Discarded = 0.16 cfs @ 11.79 hrs, Volume= 2,533 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 12.21' @ 12.48 hrs Surf.Area= 6,705 sf Storage= 568 cf

Plug-Flow detention time= 20.3 min calculated for 2,533 cf (100% of inflow)
Center-of-Mass det. time= 20.3 min (769.1 - 748.8)

Volume	Invert	Avail.Storage	Storage Description
#1	12.00'	5,364 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 13,410 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
12.00	6,705	0	0
14.00	6,705	13,410	13,410

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	13.90'	**4.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.16 cfs @ 11.79 hrs HW=12.02' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.16 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=12.00' (Free Discharge)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 2P: Tree Filters

Inflow Area = 32,790 sf, 92.77% Impervious, Inflow Depth = 4.29" for 10-Year event
Inflow = 3.33 cfs @ 12.08 hrs, Volume= 11,736 cf
Outflow = 3.31 cfs @ 12.09 hrs, Volume= 11,736 cf, Atten= 1%, Lag= 0.6 min
Discarded = 0.05 cfs @ 12.09 hrs, Volume= 3,960 cf
Primary = 3.26 cfs @ 12.09 hrs, Volume= 7,776 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 13.84' @ 12.09 hrs Surf.Area= 1,672 sf Storage= 1,289 cf

Plug-Flow detention time= 123.4 min calculated for 11,734 cf (100% of inflow)

Center-of-Mass det. time= 123.5 min (874.9 - 751.4)

Volume	Invert	Avail.Storage	Storage Description
#1	10.50'	1,003 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 2,508 cf Overall x 40.0% Voids
#2	13.50'	418 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		1,421 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
10.50	836	0	0
13.50	836	2,508	2,508

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
13.50	836	0	0
14.00	836	418	418

Device	Routing	Invert	Outlet Devices
#1	Discarded	10.50'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.01'
#2	Primary	13.65'	**9.0" Horiz. Overflow X 5.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.05 cfs @ 12.09 hrs HW=13.84' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.05 cfs)

Primary OutFlow Max=3.24 cfs @ 12.09 hrs HW=13.84' (Free Discharge)
↑—**2=Overflow** (Weir Controls 3.24 cfs @ 1.43 fps)

Summary for Pond 3P: Concrete Berm

Inflow Area = 7,514 sf, 0.00% Impervious, Inflow Depth = 1.23" for 10-Year event
Inflow = 0.22 cfs @ 12.10 hrs, Volume= 772 cf
Outflow = 0.16 cfs @ 12.18 hrs, Volume= 772 cf, Atten= 28%, Lag= 5.1 min
Discarded = 0.16 cfs @ 12.18 hrs, Volume= 772 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 14.01' @ 12.18 hrs Surf.Area= 7,514 sf Storage= 68 cf

Plug-Flow detention time= 7.1 min calculated for 772 cf (100% of inflow)
Center-of-Mass det. time= 7.1 min (882.9 - 875.8)

Volume	Invert	Avail.Storage	Storage Description
#1	14.00'	7,514 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
14.00	7,514	0	0
15.00	7,514	7,514	7,514

Device	Routing	Invert	Outlet Devices
#1	Discarded	14.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	14.99'	**1.0' long x 0.5' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00
			Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.18 cfs @ 12.18 hrs HW=14.01' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.18 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=14.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 5P: Bioretention

Inflow Area = 3,306 sf, 74.86% Impervious, Inflow Depth = 3.70" for 10-Year event
Inflow = 0.29 cfs @ 12.08 hrs, Volume= 1,020 cf
Outflow = 0.01 cfs @ 8.57 hrs, Volume= 1,020 cf, Atten= 97%, Lag= 0.0 min
Discarded = 0.01 cfs @ 8.57 hrs, Volume= 1,020 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 14.97' @ 16.42 hrs Surf.Area= 332 sf Storage= 591 cf

Plug-Flow detention time= 654.2 min calculated for 1,020 cf (100% of inflow)
Center-of-Mass det. time= 654.2 min (1,413.6 - 759.4)

Volume	Invert	Avail.Storage	Storage Description
#1	11.99'	599 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
11.99	332	0.0	0	0
12.00	332	40.0	1	1
14.00	332	40.0	266	267
15.00	332	100.0	332	599

Device	Routing	Invert	Outlet Devices
#1	Discarded	11.99'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	14.99'	**20.0' long x 1.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00
			Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.01 cfs @ 8.57 hrs HW=12.00' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=11.99' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Permeable Pavers Runoff Area=6,705 sf 100.00% Impervious Runoff Depth=5.79"
Tc=6.0 min CN=98 Runoff=0.91 cfs 3,236 cf

Subcatchment 2S: Tree Filters Runoff Area=32,790 sf 92.77% Impervious Runoff Depth=5.52"
Tc=6.0 min CN=WQ Runoff=4.25 cfs 15,082 cf

Subcatchment 3S: Park Area Runoff Area=7,514 sf 0.00% Impervious Runoff Depth=2.03"
Flow Length=121' Tc=6.0 min CN=61 Runoff=0.39 cfs 1,268 cf

Subcatchment 4S: Bioretention Runoff Area=3,306 sf 74.86% Impervious Runoff Depth=4.85"
Tc=6.0 min CN=WQ Runoff=0.38 cfs 1,335 cf

Subcatchment 5S: Roof and Paved Area Runoff Area=37,299 sf 100.00% Impervious Runoff Depth=5.79"
Tc=6.0 min CN=WQ Runoff=5.06 cfs 18,002 cf

Reach 2: 845 McGrath Inflow=9.23 cfs 29,149 cf
Outflow=9.23 cfs 29,149 cf

Pond 1P: Permeable Pavers Peak Elev=12.31' Storage=835 cf Inflow=0.91 cfs 3,236 cf
Discarded=0.16 cfs 3,236 cf Primary=0.00 cfs 0 cf Outflow=0.16 cfs 3,236 cf

Pond 2P: Tree Filters Peak Elev=13.88' Storage=1,319 cf Inflow=4.25 cfs 15,082 cf
Discarded=0.05 cfs 4,185 cf Primary=4.18 cfs 10,898 cf Outflow=4.23 cfs 15,082 cf

Pond 3P: Concrete Berm Peak Elev=14.02' Storage=174 cf Inflow=0.39 cfs 1,268 cf
Discarded=0.18 cfs 1,268 cf Primary=0.00 cfs 0 cf Outflow=0.18 cfs 1,268 cf

Pond 5P: Bioretention Peak Elev=15.01' Storage=599 cf Inflow=0.38 cfs 1,335 cf
Discarded=0.01 cfs 1,086 cf Primary=0.13 cfs 249 cf Outflow=0.14 cfs 1,335 cf

Total Runoff Area = 87,614 sf Runoff Volume = 38,924 cf Average Runoff Depth = 5.33"
12.23% Pervious = 10,715 sf 87.77% Impervious = 76,899 sf

Summary for Subcatchment 1S: Permeable Pavers

Runoff = 0.91 cfs @ 12.08 hrs, Volume= 3,236 cf, Depth= 5.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.03"

Area (sf)	CN	Description
6,705	98	Unconnected pavement, HSG A
6,705		100.00% Impervious Area
6,705		100.00% Unconnected

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

Summary for Subcatchment 2S: Tree Filters

Runoff = 4.25 cfs @ 12.08 hrs, Volume= 15,082 cf, Depth= 5.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.03"

Area (sf)	CN	Description
2,370	61	>75% Grass cover, Good, HSG B
30,295	98	Paved parking, HSG B
125	98	Unconnected pavement, HSG B
32,790		Weighted Average
2,370		7.23% Pervious Area
30,420		92.77% Impervious Area
125		0.41% Unconnected

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

Summary for Subcatchment 3S: Park Area

Runoff = 0.39 cfs @ 12.10 hrs, Volume= 1,268 cf, Depth= 2.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.03"

Area (sf)	CN	Description
7,514	61	>75% Grass cover, Good, HSG B
7,514		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	121		0.34		**Direct Entry,**

Summary for Subcatchment 4S: Bioretention

Runoff = 0.38 cfs @ 12.08 hrs, Volume= 1,335 cf, Depth= 4.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.03"

Area (sf)	CN	Description
332	98	Unconnected pavement, HSG B
2,143	98	Paved parking, HSG B
831	61	>75% Grass cover, Good, HSG B
3,306		Weighted Average
831		25.14% Pervious Area
2,475		74.86% Impervious Area
332		13.41% Unconnected

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

Summary for Subcatchment 5S: Roof and Paved Area

Runoff = 5.06 cfs @ 12.08 hrs, Volume= 18,002 cf, Depth= 5.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.03"

Area (sf)	CN	Description
10,009	98	Paved parking, HSG B
27,290	98	Roofs, HSG B
37,299		Weighted Average
37,299		100.00% Impervious Area

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

Summary for Reach 2: 845 McGrath

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 87,614 sf, 87.77% Impervious, Inflow Depth = 3.99" for 25-Year event
Inflow = 9.23 cfs @ 12.09 hrs, Volume= 29,149 cf
Outflow = 9.23 cfs @ 12.09 hrs, Volume= 29,149 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: Permeable Pavers

Inflow Area = 6,705 sf,100.00% Impervious, Inflow Depth = 5.79" for 25-Year event
Inflow = 0.91 cfs @ 12.08 hrs, Volume= 3,236 cf
Outflow = 0.16 cfs @ 11.73 hrs, Volume= 3,236 cf, Atten= 83%, Lag= 0.0 min
Discarded = 0.16 cfs @ 11.73 hrs, Volume= 3,236 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 12.31' @ 12.54 hrs Surf.Area= 6,705 sf Storage= 835 cf

Plug-Flow detention time= 30.4 min calculated for 3,236 cf (100% of inflow)
Center-of-Mass det. time= 30.4 min (775.4 - 745.1)

Volume	Invert	Avail.Storage	Storage Description
#1	12.00'	5,364 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 13,410 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
12.00	6,705	0	0
14.00	6,705	13,410	13,410

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	13.90'	**4.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.16 cfs @ 11.73 hrs HW=12.02' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.16 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=12.00' (Free Discharge)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 2P: Tree Filters

Inflow Area = 32,790 sf, 92.77% Impervious, Inflow Depth = 5.52" for 25-Year event
Inflow = 4.25 cfs @ 12.08 hrs, Volume= 15,082 cf
Outflow = 4.23 cfs @ 12.09 hrs, Volume= 15,082 cf, Atten= 1%, Lag= 0.5 min
Discarded = 0.05 cfs @ 12.09 hrs, Volume= 4,185 cf
Primary = 4.18 cfs @ 12.09 hrs, Volume= 10,898 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 13.88' @ 12.09 hrs Surf.Area= 1,672 sf Storage= 1,319 cf

Plug-Flow detention time= 104.1 min calculated for 15,080 cf (100% of inflow)

Center-of-Mass det. time= 104.2 min (852.3 - 748.1)

Volume	Invert	Avail.Storage	Storage Description
#1	10.50'	1,003 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 2,508 cf Overall x 40.0% Voids
#2	13.50'	418 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		1,421 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
10.50	836	0	0
13.50	836	2,508	2,508

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
13.50	836	0	0
14.00	836	418	418

Device	Routing	Invert	Outlet Devices
#1	Discarded	10.50'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.01'
#2	Primary	13.65'	**9.0" Horiz. Overflow X 5.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.05 cfs @ 12.09 hrs HW=13.88' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.05 cfs)

Primary OutFlow Max=4.17 cfs @ 12.09 hrs HW=13.88' (Free Discharge)
↑—**2=Overflow** (Weir Controls 4.17 cfs @ 1.56 fps)

Summary for Pond 3P: Concrete Berm

Inflow Area = 7,514 sf, 0.00% Impervious, Inflow Depth = 2.03" for 25-Year event
Inflow = 0.39 cfs @ 12.10 hrs, Volume= 1,268 cf
Outflow = 0.18 cfs @ 12.06 hrs, Volume= 1,268 cf, Atten= 55%, Lag= 0.0 min
Discarded = 0.18 cfs @ 12.06 hrs, Volume= 1,268 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 14.02' @ 12.34 hrs Surf.Area= 7,514 sf Storage= 174 cf

Plug-Flow detention time= 9.1 min calculated for 1,268 cf (100% of inflow)
Center-of-Mass det. time= 9.1 min (869.0 - 859.9)

Volume	Invert	Avail.Storage	Storage Description
#1	14.00'	7,514 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
14.00	7,514	0	0
15.00	7,514	7,514	7,514

Device	Routing	Invert	Outlet Devices
#1	Discarded	14.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	14.99'	**1.0' long x 0.5' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00
			Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.18 cfs @ 12.06 hrs HW=14.01' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.18 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=14.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 5P: Bioretention

[93] Warning: Storage range exceeded by 0.01'
[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=6)

Inflow Area =	3,306 sf,	74.86% Impervious,	Inflow Depth =	4.85"	for 25-Year event
Inflow =	0.38 cfs @	12.08 hrs,	Volume=	1,335 cf	
Outflow =	0.14 cfs @	12.39 hrs,	Volume=	1,335 cf,	Atten= 63%, Lag= 18.3 min
Discarded =	0.01 cfs @	7.80 hrs,	Volume=	1,086 cf	
Primary =	0.13 cfs @	12.39 hrs,	Volume=	249 cf	

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 15.01' @ 12.39 hrs Surf.Area= 332 sf Storage= 599 cf

Plug-Flow detention time= 552.0 min calculated for 1,335 cf (100% of inflow)
Center-of-Mass det. time= 552.0 min (1,309.2 - 757.1)

Volume	Invert	Avail.Storage	Storage Description
#1	11.99'	599 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
11.99	332	0.0	0	0
12.00	332	40.0	1	1
14.00	332	40.0	266	267
15.00	332	100.0	332	599

Device	Routing	Invert	Outlet Devices
#1	Discarded	11.99'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	14.99'	**20.0' long x 1.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00
			Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.01 cfs @ 7.80 hrs HW=12.00' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.11 cfs @ 12.39 hrs HW=15.01' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 0.11 cfs @ 0.34 fps)

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Permeable Pavers Runoff Area=6,705 sf 100.00% Impervious Runoff Depth=8.38"
Tc=6.0 min CN=98 Runoff=1.30 cfs 4,682 cf

Subcatchment 2S: Tree Filters Runoff Area=32,790 sf 92.77% Impervious Runoff Depth=8.06"
Tc=6.0 min CN=WQ Runoff=6.16 cfs 22,018 cf

Subcatchment 3S: Park Area Runoff Area=7,514 sf 0.00% Impervious Runoff Depth=3.92"
Flow Length=121' Tc=6.0 min CN=61 Runoff=0.79 cfs 2,457 cf

Subcatchment 4S: Bioretention Runoff Area=3,306 sf 74.86% Impervious Runoff Depth=7.26"
Tc=6.0 min CN=WQ Runoff=0.57 cfs 2,000 cf

Subcatchment 5S: Roof and Paved Area Runoff Area=37,299 sf 100.00% Impervious Runoff Depth=8.38"
Tc=6.0 min CN=WQ Runoff=7.25 cfs 26,047 cf

Reach 2: 845 McGrath Inflow=13.82 cfs 44,486 cf
Outflow=13.82 cfs 44,486 cf

Pond 1P: Permeable Pavers Peak Elev=12.53' Storage=1,419 cf Inflow=1.30 cfs 4,682 cf
Discarded=0.16 cfs 4,682 cf Primary=0.00 cfs 0 cf Outflow=0.16 cfs 4,682 cf

Pond 2P: Tree Filters Peak Elev=13.97' Storage=1,392 cf Inflow=6.16 cfs 22,018 cf
Discarded=0.05 cfs 4,405 cf Primary=5.97 cfs 17,613 cf Outflow=6.02 cfs 22,018 cf

Pond 3P: Concrete Berm Peak Elev=14.08' Storage=618 cf Inflow=0.79 cfs 2,457 cf
Discarded=0.18 cfs 2,457 cf Primary=0.00 cfs 0 cf Outflow=0.18 cfs 2,457 cf

Pond 5P: Bioretention Peak Elev=15.04' Storage=599 cf Inflow=0.57 cfs 2,000 cf
Discarded=0.01 cfs 1,174 cf Primary=0.66 cfs 826 cf Outflow=0.67 cfs 2,000 cf

Total Runoff Area = 87,614 sf Runoff Volume = 57,204 cf Average Runoff Depth = 7.83"
12.23% Pervious = 10,715 sf 87.77% Impervious = 76,899 sf

Summary for Subcatchment 1S: Permeable Pavers

Runoff = 1.30 cfs @ 12.08 hrs, Volume= 4,682 cf, Depth= 8.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.62"

Area (sf)	CN	Description
6,705	98	Unconnected pavement, HSG A
6,705		100.00% Impervious Area
6,705		100.00% Unconnected

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

Summary for Subcatchment 2S: Tree Filters

Runoff = 6.16 cfs @ 12.08 hrs, Volume= 22,018 cf, Depth= 8.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.62"

Area (sf)	CN	Description
2,370	61	>75% Grass cover, Good, HSG B
30,295	98	Paved parking, HSG B
125	98	Unconnected pavement, HSG B
32,790		Weighted Average
2,370		7.23% Pervious Area
30,420		92.77% Impervious Area
125		0.41% Unconnected

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

Summary for Subcatchment 3S: Park Area

Runoff = 0.79 cfs @ 12.09 hrs, Volume= 2,457 cf, Depth= 3.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.62"

Area (sf)	CN	Description
7,514	61	>75% Grass cover, Good, HSG B
7,514		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	121		0.34		**Direct Entry,**

Summary for Subcatchment 4S: Bioretention

Runoff = 0.57 cfs @ 12.08 hrs, Volume= 2,000 cf, Depth= 7.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.62"

Area (sf)	CN	Description
332	98	Unconnected pavement, HSG B
2,143	98	Paved parking, HSG B
831	61	>75% Grass cover, Good, HSG B
3,306		Weighted Average
831		25.14% Pervious Area
2,475		74.86% Impervious Area
332		13.41% Unconnected

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

Summary for Subcatchment 5S: Roof and Paved Area

Runoff = 7.25 cfs @ 12.08 hrs, Volume= 26,047 cf, Depth= 8.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.62"

Area (sf)	CN	Description
10,009	98	Paved parking, HSG B
27,290	98	Roofs, HSG B
37,299		Weighted Average
37,299		100.00% Impervious Area

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

Summary for Reach 2: 845 McGrath

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 87,614 sf, 87.77% Impervious, Inflow Depth = 6.09" for 100-Year event
Inflow = 13.82 cfs @ 12.09 hrs, Volume= 44,486 cf
Outflow = 13.82 cfs @ 12.09 hrs, Volume= 44,486 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: Permeable Pavers

Inflow Area = 6,705 sf,100.00% Impervious, Inflow Depth = 8.38" for 100-Year event
Inflow = 1.30 cfs @ 12.08 hrs, Volume= 4,682 cf
Outflow = 0.16 cfs @ 11.62 hrs, Volume= 4,682 cf, Atten= 88%, Lag= 0.0 min
Discarded = 0.16 cfs @ 11.62 hrs, Volume= 4,682 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 12.53' @ 12.64 hrs Surf.Area= 6,705 sf Storage= 1,419 cf

Plug-Flow detention time= 56.2 min calculated for 4,682 cf (100% of inflow)
Center-of-Mass det. time= 56.2 min (796.5 - 740.3)

Volume	Invert	Avail.Storage	Storage Description
#1	12.00'	5,364 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 13,410 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
12.00	6,705	0	0
14.00	6,705	13,410	13,410

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	13.90'	**4.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.16 cfs @ 11.62 hrs HW=12.02' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.16 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=12.00' (Free Discharge)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 2P: Tree Filters

Inflow Area = 32,790 sf, 92.77% Impervious, Inflow Depth = 8.06" for 100-Year event
Inflow = 6.16 cfs @ 12.08 hrs, Volume= 22,018 cf
Outflow = 6.02 cfs @ 12.10 hrs, Volume= 22,018 cf, Atten= 2%, Lag= 1.0 min
Discarded = 0.05 cfs @ 12.10 hrs, Volume= 4,405 cf
Primary = 5.97 cfs @ 12.10 hrs, Volume= 17,613 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 13.97' @ 12.10 hrs Surf.Area= 1,672 sf Storage= 1,392 cf

Plug-Flow detention time= 77.4 min calculated for 22,015 cf (100% of inflow)

Center-of-Mass det. time= 77.5 min (821.3 - 743.8)

Volume	Invert	Avail.Storage	Storage Description
#1	10.50'	1,003 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
			2,508 cf Overall x 40.0% Voids
#2	13.50'	418 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		1,421 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
10.50	836	0	0
13.50	836	2,508	2,508

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
13.50	836	0	0
14.00	836	418	418

Device	Routing	Invert	Outlet Devices
#1	Discarded	10.50'	**1.020 in/hr Exfiltration over Surface area**
			Conductivity to Groundwater Elevation = 0.01'
#2	Primary	13.65'	**9.0" Horiz. Overflow X 5.00** C= 0.600
			Limited to weir flow at low heads

Discarded OutFlow Max=0.05 cfs @ 12.10 hrs HW=13.97' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.05 cfs)

Primary OutFlow Max=5.97 cfs @ 12.10 hrs HW=13.97' (Free Discharge)
↑—**2=Overflow** (Orifice Controls 5.97 cfs @ 2.70 fps)

Summary for Pond 3P: Concrete Berm

Inflow Area = 7,514 sf, 0.00% Impervious, Inflow Depth = 3.92" for 100-Year event
Inflow = 0.79 cfs @ 12.09 hrs, Volume= 2,457 cf
Outflow = 0.18 cfs @ 11.92 hrs, Volume= 2,457 cf, Atten= 77%, Lag= 0.0 min
Discarded = 0.18 cfs @ 11.92 hrs, Volume= 2,457 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 14.08' @ 12.53 hrs Surf.Area= 7,514 sf Storage= 618 cf

Plug-Flow detention time= 23.6 min calculated for 2,457 cf (100% of inflow)
Center-of-Mass det. time= 23.6 min (863.8 - 840.1)

Volume	Invert	Avail.Storage	Storage Description
#1	14.00'	7,514 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
14.00	7,514	0	0
15.00	7,514	7,514	7,514

Device	Routing	Invert	Outlet Devices
#1	Discarded	14.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	14.99'	**1.0' long x 0.5' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00
			Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.18 cfs @ 11.92 hrs HW=14.01' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.18 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=14.00' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 5P: Bioretention

[93] Warning: Storage range exceeded by 0.04'
[88] Warning: Qout>Qin may require smaller dt or Finer Routing
[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=32)

Inflow Area =	3,306 sf,	74.86% Impervious,	Inflow Depth =	7.26"	for 100-Year event
Inflow =	0.57 cfs @	12.08 hrs,	Volume=	2,000 cf	
Outflow =	0.67 cfs @	12.09 hrs,	Volume=	2,000 cf,	Atten= 0%, Lag= 0.3 min
Discarded =	0.01 cfs @	6.33 hrs,	Volume=	1,174 cf	
Primary =	0.66 cfs @	12.09 hrs,	Volume=	826 cf	

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 15.04' @ 12.09 hrs Surf.Area= 332 sf Storage= 599 cf

Plug-Flow detention time= 408.2 min calculated for 2,000 cf (100% of inflow)
Center-of-Mass det. time= 408.4 min (1,162.2 - 753.9)

Volume	Invert	Avail.Storage	Storage Description
#1	11.99'	599 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
11.99	332	0.0	0	0
12.00	332	40.0	1	1
14.00	332	40.0	266	267
15.00	332	100.0	332	599

Device	Routing	Invert	Outlet Devices
#1	Discarded	11.99'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	14.99'	**20.0' long x 1.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00
			Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.01 cfs @ 6.33 hrs HW=12.00' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.64 cfs @ 12.09 hrs HW=15.04' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 0.64 cfs @ 0.61 fps)

Appendix E

I. INTRODUCTION

The following sewerage calculations are based upon 310 CMR 15.203, 314 CMR 7.15, architectural floor plans provided by Khalsa Design, Inc., and Yearly Water Consumption. (see attached Table)

II. CALCULATIONS

Proposed Sewage Flow

Proposed Flow in Main	0.133389 CFS
Peaking Factor	5.5
Total Peak Flow (CFS) (Qmax)	0.734 CFS
Slope	0.02
Size of Main in Street	8”

Existing Sewage Flow (Service Station)

Existing Flow in Main(CFS)	.025367 CFS
Proposed Flow in Main(CFS)	.133389 CFS
Change in Sewer Flow (CFS)	.108 CFS

Change in Sewer Flow(GPD)	+69,800 GPD

III. DESIGN

Vitrified Clay Pipe (Manning’s roughness coefficient = 0.011) at the calculated slope and diameter is adequate for flows of 1.95 CFS and less (see attached nomograph). The proposed design falls within acceptable limits.

IV. CONCLUSION

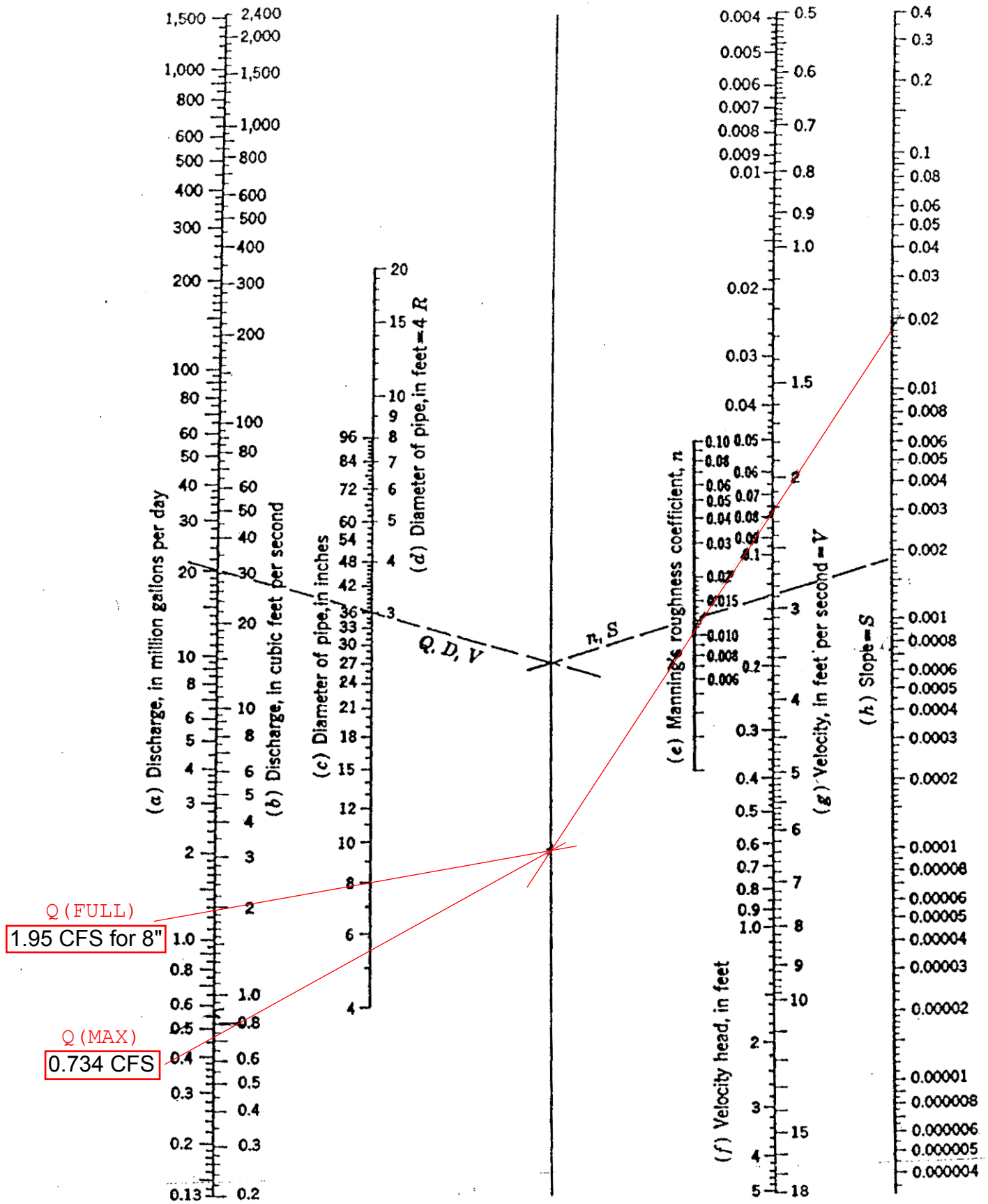
Eight-inch (8”) VCP Main in street has enough capacity to handle proposed additional sewer flow.

McGrath Highway Sewer Flows From Annual Water Usage					
Address	Account Number	Billing Units (BU)	Rate (ft^3/BU)	Flow(ft^3/year)	Flow(ft^3/sec)
50 Middlesex Ave	144056001	583.39	100	58339	0.001849918
76 Middlesex Ave	144055001	356.5	100	35650	0.001130454
76A Middlesex Ave	144055011	264.3	100	26430	0.00083809
175 Fellsway West	144051001	285.5	100	28550	0.000905315
120 Middlesex Ave	144051011	63.77	100	6377	0.000202213
25 Cummings Street	661025021	5087	100	508700	0.016130771
132 Middlesex Ave	144052001	67.35	100	6735	0.000213565
96 Middlesex Ave	144048001	1292	100	129200	0.004096905
PROPOSED					0.109990795
				Existing Flow(ft^3/sec) =	0.025367231
				Proposed Flow(ft^3/sec) =	0.133389482
				Proposed Flow(MGD) =	0.086205887

Notes:

1. PROPOSED was calculated to be 71,075 GPD using the Title 5 Method, then converted to ft^3/sec for calculation purposes.

845 McGrath Highway



Appendix F

Operation & Maintenance Plan (Permanent BMPs)

FOR

845 MCGRATH HIGHWAY

Date: April 18, 2018

The following Stormwater Management Operation and Maintenance (O&M) Plan has been prepared to operate and maintain the stormwater management system for 845 McGrath Highway, Somerville, MA. The systems consists of landscaping and bioretention areas, roof drains, and permeable pavers.

Owner/Operator: Kems Corporation
35 Doty Avenue
Danvers, MA 01923

Inspection and Maintenance Schedule

Facility personnel will inspect the stormwater management system on a routine basis not less than once per month for the first six (6) months of operation and annually thereafter. Refer to plans for landscaped area locations. Inspection and maintenance shall be performed as follows:

1. Landscaped & Bioretention Areas:

Landscaped areas shall be inspected and maintained on a regular basis. Areas that may be subject to erosion will be stabilized and reseeded immediately. Inspect soil and repair eroded areas monthly. Re-plant void areas as needed. Remove litter and debris monthly. Remove and replace dead vegetation twice per year in spring and fall. Replace soil media if ponding is witnessed more than 48 hours after rainfall event.

2. Roof Drains:

Inspections: The downspout inlets on the roof of the building will need periodic maintenance to ensure proper function. The required interval for this maintenance will vary by season; however, downspout inlets should be inspected for debris before the rainy season. When trees and other deciduous vegetation shed leaves that drop into the gutters, this will inhibit the flow of water and possibly clog downspouts. The leaves and/or debris must be removed in order for the system to work as designed.

Maintenance: Debris, such as leaves and trash, shall be removed by hand. Sediments shall be swept and collected or vacuumed.

3. Permeable Pavers:

Inspection: Inspect parking area after precipitation events at a minimum of four times per year to ensure proper drainage. Inspection should preferably occur during extended precipitation events, high-intensity rainfall, and/or rain-on-snow events. If standing water remains on surface of pavers more than 30 minutes after rainfall has ended, cleaning of porous pavers is recommended.

Cleaning: In Clogged areas power wash aggregate between joints to a minimum of 1" below paver surface. Refill joints with clean ASTM NO. 8 aggregate material.

Winter Maintenance: Salting of the permeable paver sidewalk and driveway is permitted. No winter sanding shall be allowed on the permeable paver area, as sand will clog the porous pavement surface. To prevent aesthetic damage to the paver surface (e.g. scaring), consider plowing with rubber skids or raised blades; however, aesthetic damage from plow blades does not affect the integrity of the paver structure.

Stormwater System Inspection Report

General Information			
Location: 845 McGrath Highway			
Date of Inspection		Start/End Time	
Inspector's Name(s)			
Inspector's Title(s)			
Inspector's Contact Information			
Purpose of Inspection			
Weather Information			
Has it rained since the last inspection? ❑Yes ❑No			
Weather at time of this inspection?			

Site-Specific Stormwater Devices

	Description	Installed and Operating Properly?	Corrective Action Needed	Date for Corrective Action/Responsible Person
1		❑Yes ❑No		
2		❑Yes ❑No		
3		❑Yes ❑No		
4		❑Yes ❑No		
5		❑Yes ❑No		
6		❑Yes ❑No		
7		❑Yes ❑No		
8		❑Yes ❑No		

Overall Site Issues

	Description		Corrective Action	Date for Corrective Action/Responsible Person
1	Are all slopes properly stabilized?	❑Yes ❑No		
2	Are natural resource areas (e.g., streams, wetlands, etc.) being subjected to erosion?	❑Yes ❑No		
3	Are discharge points free of sediment deposits?	❑Yes ❑No		

Certification Statement:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Print name:

Signature:

Date:

Design Consultants, Inc.

Civil Engineering
Transportation/Traffic
Water/Wastewater
Geotechnical
Land Surveying
Environmental
Planning

December 28, 2017

George Proakis
Director of Planning
Somerville City Hall
93 Highland Ave.
Somerville, MA 02143

Re: Assembly Edge Site Development
845 McGrath Highway, Somerville, MA
Sustainable Stormwater Design
DCi Project No. 2017-059

Dear Mr. Proakis:

The purpose of this letter is to provide a summary of stormwater collection and treatment options presented in the design of the above referenced project. Design Consultants, Inc. (DCi), the project's civil engineer, has developed a stormwater program that utilizes Low Impact Development (LID) and Green Infrastructure Best Management Practices (BMPs) that reduce peak flows and total volumes of runoff from the project. The following provides a description of the selected BMPS, and their ultimate impact on both the quantity and quality for stormwater runoff from the project.

The existing site consists of a building site with a restaurant (Dunkin Donuts) with a parking lot, and an open lot that is approximately 75 percent paved. The proposed building site consists of two multi-story towers with below grade parking under the entire site. There is a courtyard that bisects the building site. In addition, the project will include improvements in the right of way and in the neighboring urban park. Table 1 presents a summary of the impervious surfaces over the project area. Figure 1 presents a Site Plan of the existing project area, and defines the Project Site, Right-of-Way and Urban Park Areas.

Table 1
Summary of Pervious and Impervious Areas
Assembly Edge Project

Area	Existing Conditions		Proposed Conditions	
	Impervious	Pervious	Impervious	Pervious
Site	32,798 SF 88%	4,277 SF 12%	35,843 SF 97%	1,232 SF 3%
Right-of-Way	35,733 SF 97%	1,234 SF 3%	33,448 SF 90%	3,519 SF 10%
Urban Park	1,490 SF 18%	6,856 SF 82%	0 SF 0%	8,346 SF 100%
Total	70,021 SF 85%	12,367 SF 15%	69,291 SF 84%	13,097 SF 16%

DCi utilized both Green Infrastructure strategies; planning practices and BMPs[1]. Planning strategies include reducing impervious surfaces, disconnecting impervious surface, conserving natural resources, using cluster/consolidated development, and using water conservation practices. Green Infrastructure BMPs include vegetated filter strips, bioretention, constructed stormwater wetlands, tree box filters, green roofs, and permeable pavement.

In planning the project, DCi reviewed the project area and focused on reducing impervious surface, as the other Green Infrastructure planning strategies where not applicable to this urban redevelopment. An overall reduction of 1% in impervious area is proposed for the Project Area.

Green Infrastructure BMPs included in the project include bioretention, tree box filters and permeable pavements. Figure 2 presents the proposed development and the locations of the BMPs which are proposed. These BMPs utilize biofiltration and infiltration to treat stormwater runoff, and infiltration to reduce runoff volumes. Utilizing the EPA's National Stormwater Calculator[2], infiltration in the project area will increase by 27 percent, resulting in an additional 77,800 cubic feet (582,000 gallons of water) infiltrated on an annual basis, reducing stormwater discharges to the Mystic River by similar amounts.

The receiving water for the runoff from the project is the Mystic River, which is impacted by nutrients and pathogens[3]. The addition of the Green Infrastructure BMPs to the stormwater system at the Project Site will reduce the amount of Total Suspended Solids discharged to the Mystic River by 3,258 pounds. Total Phosphorus will be reduced by 8.01 pounds and Total Nitrogen by 32.9 pounds[4]. Green Infrastructure BMPs have also been shown to remove 80% of pathogens from stormwater.

In summary, the quantity of stormwater at the site will be significantly reduced, and significant improvement in stormwater quality will result from the utilization of Green Infrastructure at the Project Area.

We trust that the contents of the letter satisfies your present needs should you have any questions please do not hesitate to contact me at (617) 776-3350 x323 or mclark@dci-ma.com.

Sincerely,
Design Consultants Inc.

Michael F. Clark, P.E.
Associate

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[1] US EPA and National Estuary Program, "Coastal Stormwater Management Through Green Infrastructure, A Handbook for Municipalities, EPA 842-R-14-04", December 2014.
[2] US EPA National Stormwater Calculator – Release 1.2.0.0
[3] MA DEP, "Mystic River Water Quality Assessment Reports"
[4] The Simple Method to Calculate Urban Stormwater Loads

LEGEND

- URBAN PARK AREA
- RIGHT-OF-WAY AREA
- PAVED AREA

FIGURE 1

SITE PLAN

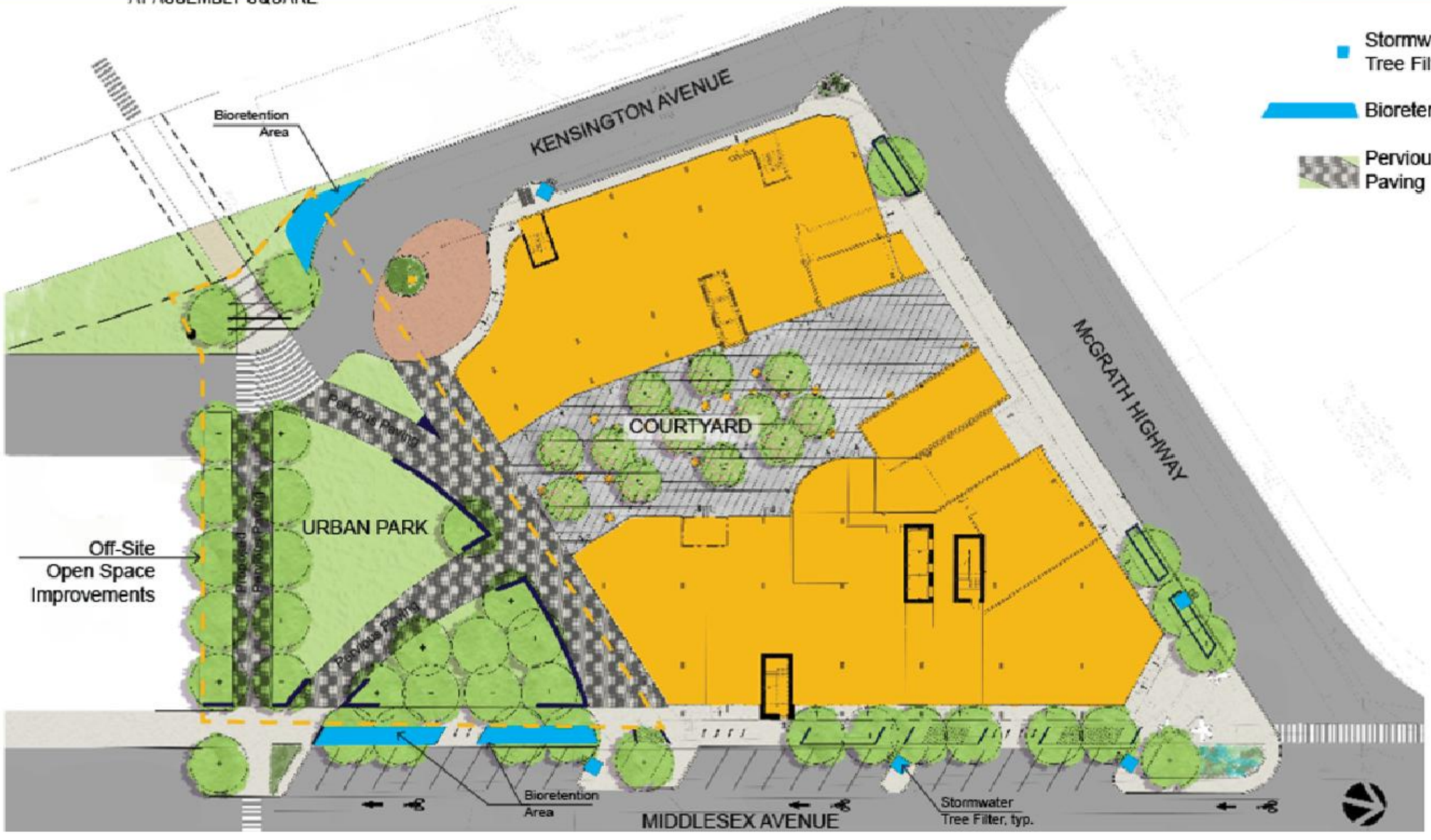
845 MCGRATH HIGHWAY
SOMERVILLE, MA

Design Consultants, Inc.
CIVIL ENGINEERS and LAND SURVEYORS
SOMERVILLE - NEWBURYPORT - QUINCY
PHONE: 617-776-3350 WEBSITE: WWW.DCI-MA.COM

ASSEMBLY'S EDGE

AT ASSEMBLY SQUARE

SPSR-A



DRAWING IS NOT TO SCALE

FIGURE 2

PROPOSED CONDITIONS

845 MCGRATH HIGHWAY

SOMERVILLE, MA

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