Drainage Report
For
181-197 Washington Street
Somerville, MA

January 16, 2014

Prepared for:
Cathartes Development Inc.
Somerville Community Corp
DCI Project #2011-081

COMMONWEALTH OF MASSACHUSETTS
STEPHEN B. SAWYER
No. 38900
REGISTERED PROFESSIONAL ENGINEER
JAN. 16, 2014

Table of Contents

ATTACHMENTS

INTRODUCTION

The Somerville Community Corp. proposes the development of the property at 181-197 Washington Street in Somerville, MA. The site is zoned Corridor Commercial District (CCD) and is located at the intersection of Washington Street and Boston Street. The existing parcel covers 49,876 square feet (1.145 acres). The developer is proposing the construction of two, four-story mixed-use buildings, with retail space on the ground floor and residential units above.

EXISTING CONDITION

The existing site is comprised of four lots, identified by the Somerville Assessors Department as Map 81; Block A, Lots 12, 13, 14 and 16. The lots are currently occupied by multiple buildings, including three attached brick buildings and a wood frame building used as a funeral home. There is a paved parking area associated with each building. The existing site is approximately 77% impervious.

The site is located on the south side of Prospect Hill. The previous development of the site included many retaining walls, both between the uphill abutting properties as well as between the lots themselves.

The easterly portion of the site is graded much flatter than the westerly portion. The easterly portion is nearly entirely impervious and has an existing drainage system, comprised of catch basins and roof drains, that minimizes surface runoff offsite. There are two existing connections that tie into a 12" combined sewer in Boston Street, one from a catch basin and one from a building. There are two additional connections from the easterly portion that tie into the 15" combined sewer in Washington Street, one from a catch basin and one from a building.

The westerly portion of the site more closely follows the natural slope of Prospect Hill and is approximately 60% impervious. The building sits at the high side of the site and the front yard slopes down to Washington Street at approximately 11% grade. There is a paved parking lot, accessed by Washington Street, with 18+/- spaces on the extreme westerly end of the site. There is no existing drainage system on the westerly portion of the site.

Existing subcatchment areas are defined in Figure 1, attached.

SOILS

The NRCS Web Soil Survey characterizes the soil at the site as predominantly Urban Land and does not specify a Hydrologic Soil Group. A Geotechnical Engineering Review has been provided by Geotechnical Partnership, Inc. and site soils are generally described as consisting of glacial till. More specifically, the soils are basal till, which contains a larger percentage of fines as compared with ablation till. Therefore, for calculation purposes, an infiltration rate of 0.27 in/hr has been used in the hydrologic model, per Massachusetts Stormwater Handbook, Table 2.3.3 1982 Rawls Rates.

There are two monitoring wells on the site. Proposed sub-surface storm water storage is located close to Well #2. As reported in the geotechnical report, the lowest observed depth to groundwater in Well #2 is -6.8ft (elevation 18.7'). This elevation was used for the design of the proposed storage system.

PROPOSED CONDITION

The proposed development includes the demolition of the existing buildings and the construction of two, four-story, mixed-use buildings, with retail space on the ground floor and residential units above. Parking will be provided at grade with access off of Washington Street. The proposed condition will be approximately 82% impervious.

Drainage calculations were conducted to evaluate peak discharges from the project site under the pre-development and post-development conditions. As required under the City of Somerville's Stormwater Management Policy, peak discharges under post development condition will be less than the pre-development conditions. Also, the 4:1 Inflow/Infiltration requirement is far exceeded. Calculations are attached.

The proposed stormwater management system includes collection, detention, and infiltration of storm water to achieve reduction of offsite flows. Runoff from exterior paved areas will be collected and treated by HydroGuard water quality units prior to being routed to a detention system. A restricted outlet in the detention system will reduce peak discharge rates. Runoff volume reduction will also be provided by infiltration that occurs within the detention system prior to discharging through an existing 8-inch connection to the 15-inch combined sewer in Washington Street. Rainfall on the roof will be collected with roof drains and plumbed internally and directed to the infiltration chambers.

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, peaking near the middle of the Type III, 24-hour storm. The drainage area's time of concentration (t_c), assumed to be six minutes for this site.

The designed on-site stormwater management system collects, detains, and infiltrates site stormwater to reduce off-site flows for all storm events.

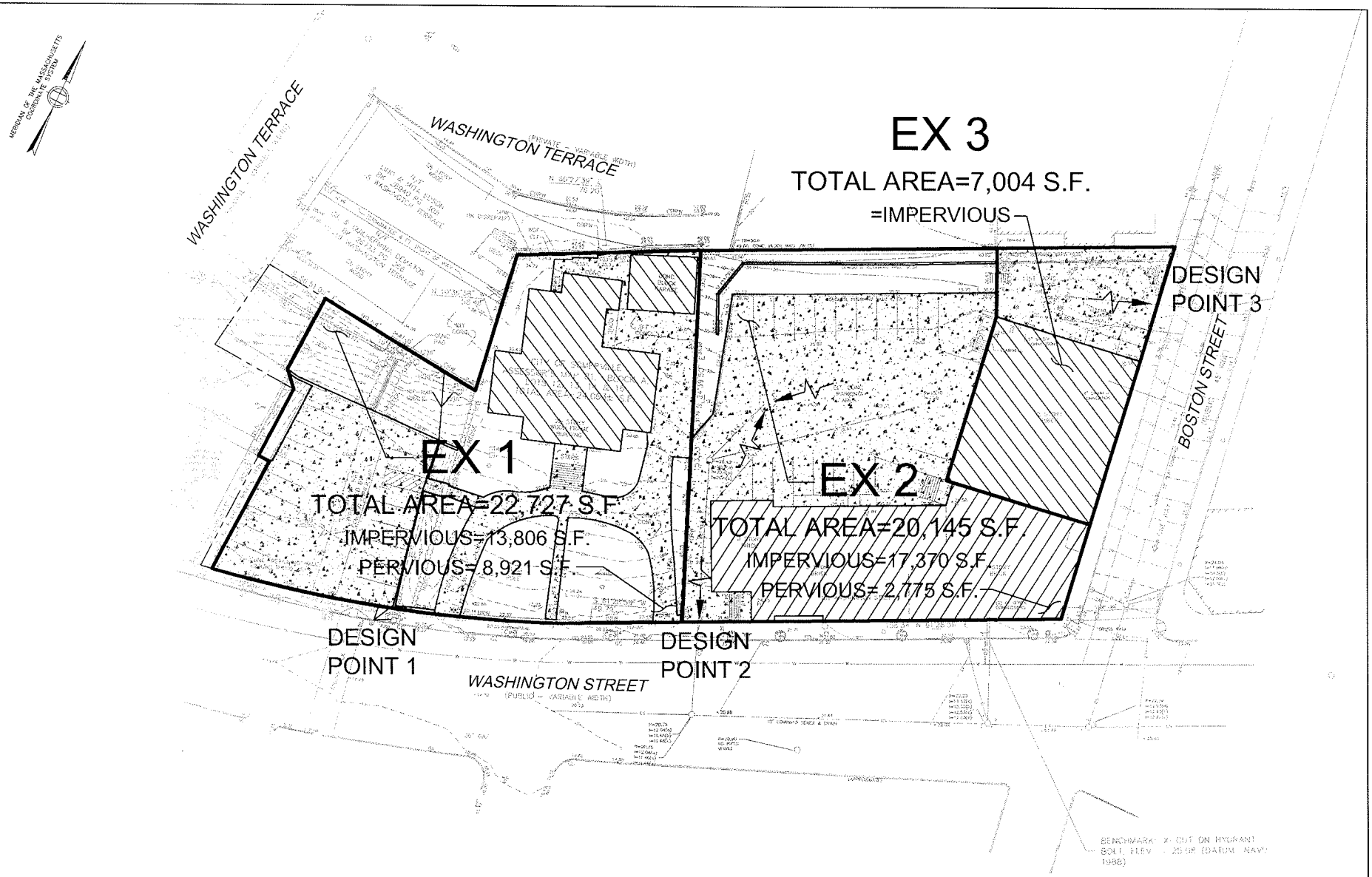
Table 1

Description	Existing Conditions		Proposed Conditions	
Drainage Area	1.145 Acres		1.145 Acres	
Weighted Runoff Coefficient, C	93		93	
Time of Concentration	6 minutes		6 minutes	
Storm Event (Years)	Offsite Peak Runoff (CFS)	Offsite Runoff Volume (CF)	Offsite Peak Runoff (CFS)	Offsite Runoff Volume (CF)
2	3.14	10,442	2.69	9,871
10	4.63	15,692	3.95	15,431
25	5.54	18,955	4.66	18,654
100	6.89	23,875	5.76	23,526

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. Off-site runoff volume and peak flow rate for the 2, 10, 25 and 100-year storm events is decreased. No new storm drain connections to the combined sewer are proposed. The 4:1 I/I requirement will easily be met by significantly reducing peak stormwater runoff rates. DCI concludes that the proposed development at 181-197 Washington Street, Somerville, MA adheres to all applicable stormwater management policy.

APPENDIX A



P:\2011 Projects\2011-081 181 Washington St Somerville\Dwg_ENGINEERING\11-081 SP.dwg

Design Consultants, Inc.
Consulting Engineers and Surveyors
120 MIDDLESEX AVENUE
SOMERVILLE, MA 02145
617-776-3350
66 PLEASANT STREET
NEWBURYPORT, MA 01950
978-358-7173

SCALE:
HORIZ: N.T.S.
VERT: ——

NO.	DATE	BY	REVISIONS

DESIGNED: RLB
DRAFTED: RLB/SSW
CHECKED: SBS
APPROVED: SBS

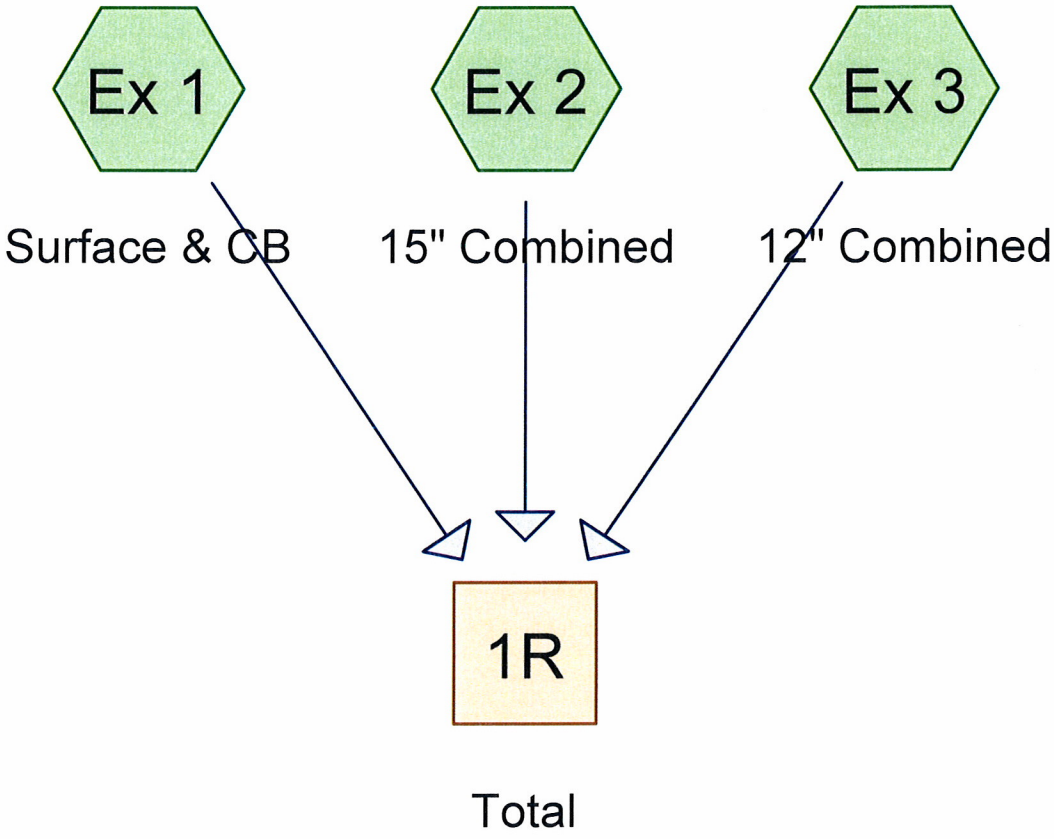
EXISTING DRAINAGE AREAS

UNION SQUARE HOUSING
WASHINGTON STREET

PLAN OF LAND IN
SOMERVILLE, MASSACHUSETTS
PREPARED FOR
SOMERVILLE CDC

PROJECT NO. 2011-081
DATE: APR. 8, 2013

FIGURE 1



Subcat Reach Pond Link

Drainage Diagram for 11-081 EX
Prepared by DESIGN CONSULTANTS, INC, Printed 4/4/2013

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
11,696	79	50-75% Grass cover, Fair, HSG C (Ex 1, Ex 2)
38,180	98	Paved parking, HSG C (Ex 1, Ex 2, Ex 3)

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment Ex 1: Surface & CB Runoff Area=22,727 sf 60.75% Impervious Runoff Depth>2.16"
Tc=6.0 min CN=91 Runoff=1.28 cfs 4,096 cf

Subcatchment Ex 2: 15" Combined Runoff Area=20,145 sf 86.22% Impervious Runoff Depth>2.55"
Tc=6.0 min CN=95 Runoff=1.28 cfs 4,273 cf

Subcatchment Ex 3: 12" Combined Runoff Area=7,004 sf 100.00% Impervious Runoff Depth>2.87"
Tc=6.0 min CN=98 Runoff=0.47 cfs 1,673 cf

Reach 1R: Total Inflow=3.03 cfs 10,042 cf
Outflow=3.03 cfs 10,042 cf

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment Ex 1: Surface & CB Runoff Area=22,727 sf 60.75% Impervious Runoff Depth>3.50"
Tc=6.0 min CN=91 Runoff=2.02 cfs 6,620 cf

Subcatchment Ex 2: 15" Combined Runoff Area=20,145 sf 86.22% Impervious Runoff Depth>3.92"
Tc=6.0 min CN=95 Runoff=1.92 cfs 6,584 cf

Subcatchment Ex 3: 12" Combined Runoff Area=7,004 sf 100.00% Impervious Runoff Depth>4.26"
Tc=6.0 min CN=98 Runoff=0.69 cfs 2,487 cf

Reach 1R: Total Inflow=4.63 cfs 15,692 cf
Outflow=4.63 cfs 15,692 cf

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment Ex 1: Surface & CB Runoff Area=22,727 sf 60.75% Impervious Runoff Depth>4.27"
Tc=6.0 min CN=91 Runoff=2.44 cfs 8,088 cf

Subcatchment Ex 2: 15" Combined Runoff Area=20,145 sf 86.22% Impervious Runoff Depth>4.71"
Tc=6.0 min CN=95 Runoff=2.29 cfs 7,913 cf

Subcatchment Ex 3: 12" Combined Runoff Area=7,004 sf 100.00% Impervious Runoff Depth>5.06"
Tc=6.0 min CN=98 Runoff=0.81 cfs 2,953 cf

Reach 1R: Total Inflow=5.54 cfs 18,955 cf
Outflow=5.54 cfs 18,955 cf

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

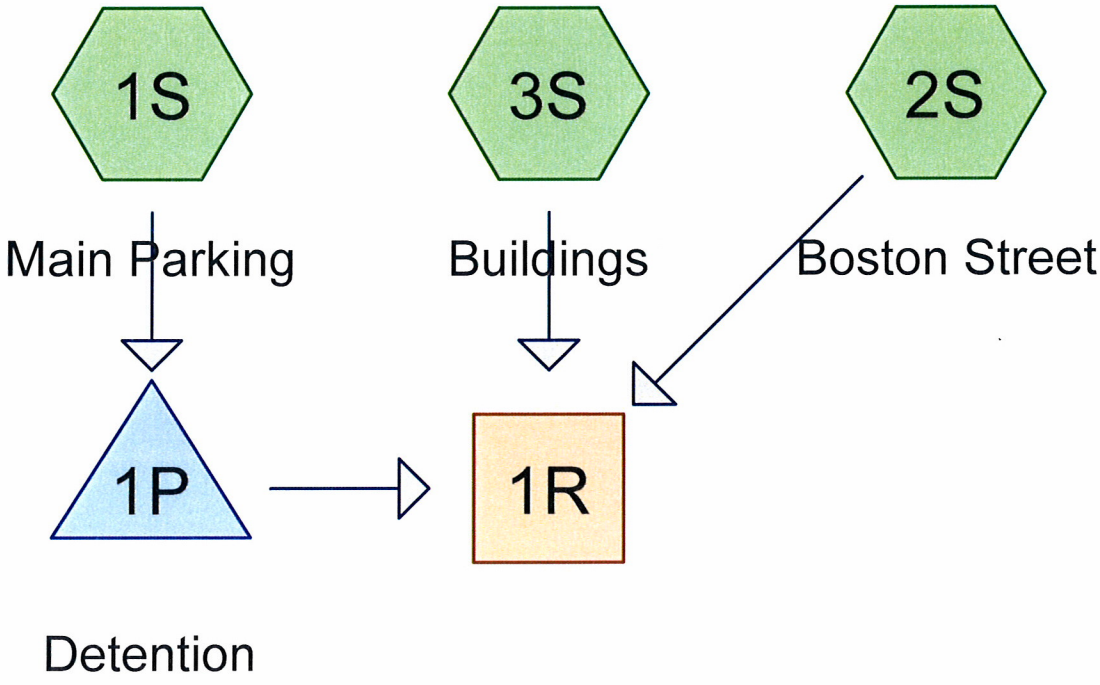
Subcatchment Ex 1: Surface & CB Runoff Area=22,727 sf 60.75% Impervious Runoff Depth>5.44"
Tc=6.0 min CN=91 Runoff=3.06 cfs 10,310 cf

Subcatchment Ex 2: 15" Combined Runoff Area=20,145 sf 86.22% Impervious Runoff Depth>5.90"
Tc=6.0 min CN=95 Runoff=2.83 cfs 9,913 cf

Subcatchment Ex 3: 12" Combined Runoff Area=7,004 sf 100.00% Impervious Runoff Depth>6.26"
Tc=6.0 min CN=98 Runoff=1.00 cfs 3,652 cf

Reach 1R: Total Inflow=6.89 cfs 23,875 cf
Outflow=6.89 cfs 23,875 cf

APPENDIX B



Subcat Reach Pond Link

Drainage Diagram for 11-081 PR riv 1-14-14
Prepared by Microsoft, Printed 1/16/2014

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
9,340	74	>75% Grass cover, Good, HSG C (1S, 2S)
16,121	98	Paved parking, HSG C (1S)
840	98	Roofs, HSG A (2S)
23,575	98	Unconnected roofs, HSG C (3S)
49,876		**TOTAL AREA**

Summary for Subcatchment 1S: Main Parking

Runoff = 1.26 cfs @ 12.09 hrs, Volume= 4,061 cf, Depth> 2.25"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
16,121	98	Paved parking, HSG C
5,500	74	>75% Grass cover, Good, HSG C
21,621	92	Weighted Average
5,500		25.44% Pervious Area
16,121		74.56% Impervious Area

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

Summary for Subcatchment 2S: Boston Street

Runoff = 0.15 cfs @ 12.10 hrs, Volume= 468 cf, Depth> 1.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
840	98	Roofs, HSG A
3,840	74	>75% Grass cover, Good, HSG C
4,680	78	Weighted Average
3,840		82.05% Pervious Area
840		17.95% Impervious Area

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

Summary for Subcatchment 3S: Buildings

Runoff = 1.59 cfs @ 12.09 hrs, Volume= 5,631 cf, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
23,575	98	Unconnected roofs, HSG C
23,575		100.00% Impervious Area
23,575		100.00% Unconnected

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

Summary for Reach 1R:

Inflow Area = 49,876 sf, 81.27% Impervious, Inflow Depth > 2.37" for 2-Year event
Inflow = 2.69 cfs @ 12.10 hrs, Volume= 9,871 cf
Outflow = 2.69 cfs @ 12.10 hrs, Volume= 9,871 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Summary for Pond 1P: Detention

Inflow Area = 21,621 sf, 74.56% Impervious, Inflow Depth > 2.25" for 2-Year event
Inflow = 1.26 cfs @ 12.09 hrs, Volume= 4,061 cf
Outflow = 1.03 cfs @ 12.15 hrs, Volume= 4,047 cf, Atten= 18%, Lag= 3.6 min
Discarded = 0.00 cfs @ 8.10 hrs, Volume= 274 cf
Primary = 1.02 cfs @ 12.15 hrs, Volume= 3,773 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 15.37' @ 12.15 hrs Surf.Area= 714 sf Storage= 269 cf

Plug-Flow detention time= 8.4 min calculated for 4,047 cf (100% of inflow)
Center-of-Mass det. time= 6.2 min (804.6 - 798.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	14.67'	525 cf	**8.17'W x 87.44'L x 2.33'H Field A** 1,666 cf Overall - 354 cf Embedded = 1,312 cf x 40.0% Voids
#2A	15.17'	354 cf	**StormTech SC-310** x 24 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap
#3	14.67'	101 cf	**4.00'D x 4.03'H CB** x 2 -Impervious
		980 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	14.67'	**8.0" Round Culvert** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 14.67' / 13.67' S= 0.0200 '/' Cc= 0.900 n= 0.010 PVC, smooth interior
#2	Discarded	14.67'	**0.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.00 cfs @ 8.10 hrs HW=14.71' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=1.02 cfs @ 12.15 hrs HW=15.37' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 1.02 cfs @ 2.93 fps)

Summary for Subcatchment 1S: Main Parking

Runoff = 1.96 cfs @ 12.09 hrs, Volume= 6,485 cf, Depth> 3.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
16,121	98	Paved parking, HSG C
5,500	74	>75% Grass cover, Good, HSG C
21,621	92	Weighted Average
5,500		25.44% Pervious Area
16,121		74.56% Impervious Area

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

Summary for Subcatchment 2S: Boston Street

Runoff = 0.28 cfs @ 12.09 hrs, Volume= 893 cf, Depth> 2.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
840	98	Roofs, HSG A
3,840	74	>75% Grass cover, Good, HSG C
4,680	78	Weighted Average
3,840		82.05% Pervious Area
840		17.95% Impervious Area

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

Summary for Subcatchment 3S: Buildings

Runoff = 2.32 cfs @ 12.09 hrs, Volume= 8,372 cf, Depth> 4.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
23,575	98	Unconnected roofs, HSG C
23,575		100.00% Impervious Area
23,575		100.00% Unconnected

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

Summary for Reach 1R:

Inflow Area = 49,876 sf, 81.27% Impervious, Inflow Depth > 3.71" for 10-Year event
Inflow = 3.95 cfs @ 12.10 hrs, Volume= 15,431 cf
Outflow = 3.95 cfs @ 12.10 hrs, Volume= 15,431 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Summary for Pond 1P: Detention

Inflow Area = 21,621 sf, 74.56% Impervious, Inflow Depth > 3.60" for 10-Year event
Inflow = 1.96 cfs @ 12.09 hrs, Volume= 6,485 cf
Outflow = 1.48 cfs @ 12.16 hrs, Volume= 6,466 cf, Atten= 24%, Lag= 4.4 min
Discarded = 0.00 cfs @ 6.50 hrs, Volume= 300 cf
Primary = 1.48 cfs @ 12.16 hrs, Volume= 6,166 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 15.78' @ 12.16 hrs Surf.Area= 714 sf Storage= 481 cf

Plug-Flow detention time= 7.6 min calculated for 6,466 cf (100% of inflow)
Center-of-Mass det. time= 5.7 min (791.4 - 785.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	14.67'	525 cf	**8.17'W x 87.44'L x 2.33'H Field A** 1,666 cf Overall - 354 cf Embedded = 1,312 cf x 40.0% Voids
#2A	15.17'	354 cf	**StormTech SC-310** x 24 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap
#3	14.67'	101 cf	**4.00'D x 4.03'H CB** x 2 -Impervious
		980 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	14.67'	**8.0" Round Culvert** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 14.67' / 13.67' S= 0.0200 '/' Cc= 0.900 n= 0.010 PVC, smooth interior
#2	Discarded	14.67'	**0.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.00 cfs @ 6.50 hrs HW=14.71' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=1.47 cfs @ 12.16 hrs HW=15.77' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 1.47 cfs @ 4.20 fps)

Summary for Subcatchment 1S: Main Parking

Runoff = 2.36 cfs @ 12.09 hrs, Volume= 7,891 cf, Depth> 4.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Description
16,121	98	Paved parking, HSG C
5,500	74	>75% Grass cover, Good, HSG C
21,621	92	Weighted Average
5,500		25.44% Pervious Area
16,121		74.56% Impervious Area

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

Summary for Subcatchment 2S: Boston Street

Runoff = 0.37 cfs @ 12.09 hrs, Volume= 1,157 cf, Depth> 2.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Description
840	98	Roofs, HSG A
3,840	74	>75% Grass cover, Good, HSG C
4,680	78	Weighted Average
3,840		82.05% Pervious Area
840		17.95% Impervious Area

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

Summary for Subcatchment 3S: Buildings

Runoff = 2.74 cfs @ 12.09 hrs, Volume= 9,940 cf, Depth> 5.06"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Description
23,575	98	Unconnected roofs, HSG C
23,575		100.00% Impervious Area
23,575		100.00% Unconnected

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

Summary for Reach 1R:

Inflow Area = 49,876 sf, 81.27% Impervious, Inflow Depth > 4.49" for 25-Year event
Inflow = 4.66 cfs @ 12.10 hrs, Volume= 18,654 cf
Outflow = 4.66 cfs @ 12.10 hrs, Volume= 18,654 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Summary for Pond 1P: Detention

Inflow Area = 21,621 sf, 74.56% Impervious, Inflow Depth > 4.38" for 25-Year event
Inflow = 2.36 cfs @ 12.09 hrs, Volume= 7,891 cf
Outflow = 1.74 cfs @ 12.17 hrs, Volume= 7,869 cf, Atten= 26%, Lag= 4.6 min
Discarded = 0.00 cfs @ 5.65 hrs, Volume= 312 cf
Primary = 1.74 cfs @ 12.17 hrs, Volume= 7,558 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 16.07' @ 12.16 hrs Surf.Area= 714 sf Storage= 620 cf

Plug-Flow detention time= 7.4 min calculated for 7,853 cf (100% of inflow)
Center-of-Mass det. time= 5.6 min (786.0 - 780.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	14.67'	525 cf	**8.17'W x 87.44'L x 2.33'H Field A** 1,666 cf Overall - 354 cf Embedded = 1,312 cf x 40.0% Voids
#2A	15.17'	354 cf	**StormTech SC-310** x 24 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap
#3	14.67'	101 cf	**4.00'D x 4.03'H CB** x 2 -Impervious
		980 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	14.67'	**8.0" Round Culvert** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 14.67' / 13.67' S= 0.0200 '/' Cc= 0.900 n= 0.010 PVC, smooth interior
#2	Discarded	14.67'	**0.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.00 cfs @ 5.65 hrs HW=14.71' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=1.72 cfs @ 12.17 hrs HW=16.05' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 1.72 cfs @ 4.92 fps)

Summary for Subcatchment 1S: Main Parking

Runoff = 2.95 cfs @ 12.09 hrs, Volume= 10,014 cf, Depth> 5.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
16,121	98	Paved parking, HSG C
5,500	74	>75% Grass cover, Good, HSG C
21,621	92	Weighted Average
5,500		25.44% Pervious Area
16,121		74.56% Impervious Area

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

Summary for Subcatchment 2S: Boston Street

Runoff = 0.49 cfs @ 12.09 hrs, Volume= 1,568 cf, Depth> 4.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
840	98	Roofs, HSG A
3,840	74	>75% Grass cover, Good, HSG C
4,680	78	Weighted Average
3,840		82.05% Pervious Area
840		17.95% Impervious Area

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

Summary for Subcatchment 3S: Buildings

Runoff = 3.37 cfs @ 12.09 hrs, Volume= 12,294 cf, Depth> 6.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
23,575	98	Unconnected roofs, HSG C
23,575		100.00% Impervious Area
23,575		100.00% Unconnected

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

Summary for Reach 1R:

Inflow Area = 49,876 sf, 81.27% Impervious, Inflow Depth > 5.66" for 100-Year event
Inflow = 5.76 cfs @ 12.10 hrs, Volume= 23,526 cf
Outflow = 5.76 cfs @ 12.10 hrs, Volume= 23,526 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Summary for Pond 1P: Detention

Inflow Area = 21,621 sf, 74.56% Impervious, Inflow Depth > 5.56" for 100-Year event
Inflow = 2.95 cfs @ 12.09 hrs, Volume= 10,014 cf
Outflow = 2.17 cfs @ 12.17 hrs, Volume= 9,989 cf, Atten= 26%, Lag= 4.7 min
Discarded = 0.00 cfs @ 4.70 hrs, Volume= 324 cf
Primary = 2.16 cfs @ 12.17 hrs, Volume= 9,665 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 16.66' @ 12.17 hrs Surf.Area= 714 sf Storage= 830 cf

Plug-Flow detention time= 7.1 min calculated for 9,989 cf (100% of inflow)
Center-of-Mass det. time= 5.5 min (779.8 - 774.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	14.67'	525 cf	**8.17'W x 87.44'L x 2.33'H Field A** 1,666 cf Overall - 354 cf Embedded = 1,312 cf x 40.0% Voids
#2A	15.17'	354 cf	**StormTech SC-310** x 24 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap
#3	14.67'	101 cf	**4.00'D x 4.03'H CB** x 2 -Impervious
		980 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	14.67'	**8.0" Round Culvert** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 14.67' / 13.67' S= 0.0200 '/' Cc= 0.900 n= 0.010 PVC, smooth interior
#2	Discarded	14.67'	**0.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.00 cfs @ 4.70 hrs HW=14.71' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=2.13 cfs @ 12.17 hrs HW=16.62' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 2.13 cfs @ 6.12 fps)

APPENDIX C

INFILTRATION/INFLOW REMOVAL CALCULATIONS

I. INTRODUCTION

The following infiltration/inflow removal calculations are based upon 310 CMR 15.203, the sewer calculations presented above, and the storm drainage calculations summarized in Table I. The City of Somerville requires that infiltration/inflow removal of four times the proposed additional average daily sewer flow must be provided by the project.

II. CALCULATIONS

Existing Average Daily Sewer Flow	5,540 gal/day
Proposed Average Daily Sewer Flow	23,605 gal/day
Additional Average Daily Flow	18,065 gal/day
Four Times Additional Average Daily Flow	72,260 gal/ day = 0.11 cfs

III. REMOVAL

The required 0.11 cfs of infiltration/ inflow will be removed from the combined sewer system by peak flow reduction in the storm drainage from the site. Subtraction of the proposed flow rates from the existing flow rates given in Table 1 gives flow reductions of 0.45 cfs, 0.68 cfs, 0.88 cfs, and 1.13 cfs for the 2 yr., 10yr., 25 yr., and 100 yr. Storms respectively. All of these flow reductions exceed the required removal of 0.11 cfs.

IV. CONCLUSION

Because the storm drainage flow reductions provided by the project exceed the required infiltration/inflow removal rate we conclude that the proposed design meets and exceeds the requirement for infiltration/inflow removal.