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Drainage Calculations
For
220 Summer Street

Prepared for;
City Point Capital
300 A Street
Boston, MA 02210

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Purpose

The purpose of this report is to review the proposed development at 220 Summer Street and determine the impact of the proposed development on the abutting lot and the system on Route 3A and treat the runoff from the proposed impervious surfaces on the lot in accordance with the stormwater standards.

Method

The calculation will be based upon the SCS TR-20 Model using HYDRO-CAD 10.0 software to conduct the calculations.

Assumptions

Minimum Tc 6 minutes

CN Assumptions	A	B	D
Impervious	98		
Meadow grass	30	58	80
Woodland-grass mix	32	58	79
Lawn/shoulder	39	61	

Project Description

The proposed development of the lot at 220 Summer Street will be a single-family dwelling which will be accessed from an existing cart path opening in the stonewall along Kilby Street. Overall, the proposed development will be:

- 3,681 sq. ft. dwelling
- 2,280 sq. ft. driveway,
- 1282 sq. ft. existing barn
- 1,367 sq. ft. existing driveway
- 500 sq. ft. brick patio area.

The primary goal of the design will be to reduce the surface water runoff towards the abutter to the north to the maximum extent possible and redirect these flows towards the existing municipal storm water collection system in Kilby Street. In order to assist with this goal, we are proposing to extend the municipal storm water collection system in Kilby Street up to the proposed driveway entrance.

The lot at 220 Summer Street is 54,648± square feet in size. The lot has frontage on both Summer Street and Kilby Street. There is a masonry retaining wall which ranges in height from 4-5 feet along the entirety of the frontage along Summer Street which maintains the grades on Summer Street. A stonewall also exists along the frontage along Kilby Street but does not retain grades in the right of way. Access onto the lot currently comes from Kilby Street at an opening in the stonewall at the northerly limits of the Kilby Street frontage. This opening is the start of a cart path that runs across the lot to the abutting residence at 156 East Street. The site is primarily an open field with a 15-20’ wide wooded edge along Kilby Street and a wooded area at the rear northerly corner of the parcel. The lot is dominated by a stone filled subdrain that runs down the middle of the lot. This drain discharges at the northerly property line and flows primarily into a catch basin on Kilby Street. This subdrain intercepts both runoff and groundwater flow across the lot. The grades on the lot are well below the surrounding grades on Kilby Street and Summer

Street. As previously noted, there is a 4-5' high retaining wall supporting Summer Street. The elevation along the swale, is 5' below Summer Street at the start and runs generally 4-5' lower than the grades along Kilby Street. Soils on the parcel are unique. All soils east of the swale are an HSG A sandy soil with a percolation rate less than 2 minutes per inch. In and around the swale, groundwater levels are so high that the soils are being considered HSG D. Between the swale and Kilby Street, NRCS WSS results indicate that these soils are shallow to bedrock and are HSG B. Tests in this area confirmed these results and revealed bedrock at 2-6'. A second sub drain is located along the westerly edge of the parcel and directs groundwater flow to the swale near the rear of the lot. However, this subdrain has been so severely damaged during construction that we are assuming it no longer functions.

The proposed development will be a 4-bedroom single-family dwelling which will be located close to the 50' front yard setback along Summer Street. The top of the foundation of the proposed dwelling will be set at Elevation 47.0 along the front of the house and Elevation 44.0 around the remainder of the dwelling. Almost all the area between the house and the masonry retaining wall along Summer Street will be filled and graded to drain west towards Kilby Street except at the southeast corner of the lot where 2 significant trees will be maintained. The driveway access to the garage will be 2,530 square feet of pavement which starts at the cart path opening on Kilby Street and runs straight into the garage which is faced perpendicular to Kilby Street. The driveway will be graded to flow towards a catch basin on the southerly edge of the driveway. A second catch basin will be placed at the entrance which will collect runoff from the Kilby Street Right of way and directs these flows down to an existing catch basin 150' north of the entrance.

Proposed drainage improvements will be designed specifically to reduce flows to the abutting parcel to the north. Runoff from the proposed impervious surfaces will be directed to an infiltration basin. The basin will be located to the left of the barn behind the house. The site will be graded so that runoff from a portion of the existing house, the westerly half of the barn and a portion of the existing driveway will flow overland into the basin.

In order to save the existing trees along Summer Street, a depression along the stonewall in front of the proposed house will be maintained. In order to drain this depression, a 6" outlet will be provided to pass whatever flows from Summer Street and from the lot into the depression created by the stonewall. Testing of surface water collected in the area just below the stonewall indicates that there is residual chlorine and fluorides in the water. Accordingly, the source has to be the municipal water supply system. Based upon the traffic noise and the amount of water moving past this point in the distribution system we were unable to locate the leak. The proposed 6" drain will effectively pass whatever flows from Summer Street and the lot area around the house across the lot.

The Kilby Street improvements will be made to assist the abutting parcel and eliminate the flow onto the lot from the pavement at the corner of Kilby and Summer Streets. The proposed grading of the lot will direct some of the runoff from the lot onto the shoulder of Kilby Street. A catch basin will be provided on the south side of the driveway entrance. The rim will be set lower than the Kilby Street Pavement to accept flow from the pavement as well as the flows in the shoulder. The outlet from this basin will connect with an existing catch basin in Kilby street 148' north of the entrance. The flow from this basin enters the State system on the opposite side of Kilby Street where it flows through a culvert beneath Route 3A. In order to assess the capability o the existing stormwater collection system in Kilby Street we will analyze the entire watershed tributary to the catch basin. Based upon satellite imagery, there is a pool in the backyard of the abutter to the east

which acts as a watershed divide. Accordingly, we will have analyzed the entire watershed tributary to the catch basin in Kilby Street just north of the site.

Existing Conditions

Existing conditions analysis will match the proposed development watershed area and include all of the watershed on site that flows towards the existing catch basins on Kilby Street. The drainage area on the lots will be divided into two parts. The edge of the lawn for the existing dwelling will act as the divide between the two watersheds

1S Development Area

Drainage Area- 54,931 sq. ft.
2.21 acres

	Land Use Use	Area (s.f.)	CN
	House roof	1,340	98
Abutter	House roof	528	98
	Barn	1,280	98
	Driveway	2,625	98
	Cart path	980	92
HSG A	Lawn	32,367	39
	Woods-grass combo	6,090	32

Tc

Sheet flow	50’ s=0.018 grass, dense
Shallow concentrated flow	30’ s=0.020 paved
Shallow Concentrated Flow	70’, s=0.10 grass
Shallow Concentrated flow	66, s=0.0850 grass
Shallow Concentrated flow	105’,s=0.01 pipe

2S west side of development Area

Drainage Area- 39,517 sq. ft.
2.21 acres

	Land Use Use	Area (s.f.)	CN
	Existing Kilby street pavement	2,912	98
	Cart path	1,335	92
HSG B	Woods-grass	3;109	58

	Meadow	7,213	61
	Shoulder	2,467	61
HSG D	Meadow	19,696	80
	Woods-grass	2,785	79

Tc

Sheet flow	50’ s=0.02 grass, dense
Shallow concentrated flow	98’ s=0.033 grass
Shallow Concentrated Flow	257’, s=0.012 pipe

6S CB No. 2 off lot

Drainage Area- 13,730 sq. ft.
1.28 acres

Land Use

Use	Area (s.f.)	CN
Pavement	3,587	98
Shoulder-HSG B	3,568	61
Woods-HSG D	6,575	77

Tc

Sheet flow	50’ s=0.05 woods dense
Shallow Concentrated Flow	75’ s=0.05 woods dense

7S CB No. 3

Drainage Area- 3,064 sq. ft.
1.28 acres

Land Use

Use	Area (s.f.)	CN
Pavement	1,730	98
Shoulder-HSG B	1,334	61

Tc

Use 6 minutes as a minimum

Total watershed area

1S	54,931
2S	39,517
6S	13,730
7S	3,064
Total	111,242 sq. ft.

Proposed Conditions

To Summer Street depression (2S)

Drainage Area- 14,800 sq. ft.

Weighted CN

Use	Area (s.f.)	CN
Roof	1,002	98
Lawn HSG A	9,320	39
Lawn HSG B	1,106	61
Lawn HSG D	3,372	80

Tc

Sheet flow	50’ s=0.028 grass, dense
Shallow Concentrated Flow	85’ s=0.06 grass dense

Depression remaining

Storage

El.	Area	Volume
38.0	815	
39.0	1109	962
40.0	1480	2257
41.0	1750	3872

Outlet

6” Culvert l=40’ s=0.01 Inv. = 38.00

Overland Flow To the Basin (3S)

Drainage Area- 28,909 sq. ft.

Weighted CN

	Use	Area (s.f.)	CN
	Barn	644	98
	Ex. House	550	98
	Ex. Patio	1,750	98
	Ex. Driveway	1,378	98
HSG A	Lawn	17,866	39
HSG D	Lawn	4,751	80

Tc

Sheet flow	50' s=0.018 grass, dense
Shallow Concentrated Flow	41' s=0.03 grass dense

Proposed impervious To the Basin (8S)

Drainage Area- 5,735 sq. ft.

Weighted CN

Use	Area (s.f.)	CN
Pavement	1,837	98
House	3,681	98
Porch	217	98

Tc

Use 6 minutes as a minimum

Size stone at outlet end using Bur. Rec Method

From calculations, 100-year peak flow rate is 0.90 cfs
Velocity in 8" culvert = 2.49 ft/sec
Where: $D_{50} = 0.01222\ V^{2.06}$
$= 0.01222\ (2.49^{2.06})$
$= 0.01222(9.22) = 0.08' = 1.0"$
Rip rap used is 4" stone-ok

Basin (Pond 4P)

Storage

El.	Area	Volume
36.8	114	0
37.0	1468	158
38.0	2540	2162
39.0	4920	5892

Outlet

8" Culvert	Inv. El. 37.20
	Length = 38' s=0.018
Spillway	length = 10'
	Crest El. 38.20

Water Quality Volume
Volume = 0.5" of runoff from impervious surfaces
Impervious surfaces

Existing	4,322 s.f.

Proposed 5,735 s.f.
Total 11,057 s.f.
WQV = 0.5(11057)/12 = 460.7 cu. ft.
Static Storage Provided 473 cu. ft. ok

Forbay sizing requirements
Storage required = 0.1" of impervious surfaces
= 0.1(11057)/12 = 92 cu. ft.
Storage provided = 121 cu. ft. ok

DMH 3 (Pond 3P)

Manhole has no storage. Qin = Qout
Outlet
8" culvert Inv. El. 34.18
Length = 34.0', s= 0.02

Stone sizing calculations:
For 8" outlet from the basin,
100 yr. peak flow 1.47 cfs
Peak vel. = 4.22 ft/sec
Size stone at outlet end using Bur. Rec Method
Where: D_{50} = $0.01222\ V^{2.06}$
= $0.01222\ (4.22^{2.06})$
= 0.01222(19.4) = 0.237' = 2.84"
Rip-rap used is 4" stone-ok

To Kilby Street inlet (4S)

Drainage Area- 13,941 sq. ft.

Weighted CN

	Use	Area (s.f.)	CN
	Ex. pavement	2912	98
HSG B	Woods-grass	2671	58
	Lawn	4393	61
	Shoulder	1228	61
HSG D	Lawn	2043	80

Tc

Sheet flow	50' s=0.025 grass, dense
Shallow Concentrated Flow	98' s=0.023 grass dense

Direct to CB No. 2 from lot area (5S)

Drainage Area-35,179 sq. ft.

Weighted CN

	Use	Area (s.f.)	CN
	Pavement	1,118	98
	Roof	640	98
Abutter	Roof	528	98
HSG A	woods-grass	10060	32
	Lawn	6448	39
Abutter	Lawn	6521	39
HSG B	Lawn	1885	61
	Woods	1008	55
HSG D	Woods	2173	61
	Lawn	4798	80

Tc

Sheet flow	50’ s=0.03 grass, dense
Shallow concentrated flow	130’ s=0.030 grass
Shallow Concentrated Flow	135’, s=0.047 wooded

6S CB No. 2 off lot

Drainage Area- 13,730 sq. ft.
1.28 acres

Land Use

Use	Area (s.f.)	CN
Pavement	3,587	98
Shoulder-HSG B	3,568	61
Woods-HSG D	6,575	77

Tc

Sheet flow	50’ s=0.05 woods dense
Shallow Concentrated Flow	76’ s=0.05 woods dense

7S CB No. 3

Drainage Area- 3,064 sq. ft.
1.28 acres

Land Use

Use	Area (s.f.)	CN
Pavement	1,730	98
Shoulder-HSG B	1,334	61

Tc

Use 6 minutes as a minimum

Total watershed area

2S	14,800	
3S	28,909	
8S	5,735	
4S	14,267	
5S	30,734	
6S	13,730	
7S	3,064	
Total	111,229 sq. ft.	ok areas within 13 sq. ft. existing

Storm Water Standards

Standard No. 1, Untreated Discharges

The proposed storm water system will collect and treat the runoff from nearly all the proposed impervious surfaces in the development. Approximately 694 square feet of the driveway pavement is too close to the existing pavement in Kilby Street to be collected and routed to the basin. This area will be partially treated by the new catch basin. 190 square feet of the new driveway pavement to this catch basin is in the right of way. We are collecting runoff from a portion of the existing driveway. The pavement will be removed and at this time it will not be reset. In addition, we are collecting the runoff from 640 square feet of roof from the barn in the basin. Either of these existing impervious surfaces will offset the issue with the 504 square feet of proposed driveway especially since the driveway runoff will be treated to a greater degree than the existing impervious surfaces.

Standard No. 2, Peak Discharge Rates

The development of the lot did not modify the land use of the lot significantly enough to change the peak flow rates emanating from the site. The specific intent of the design was to reduce the flow on to the abutting lot and route the runoff from the lot into the municipal system as quickly as possible. Accordingly, the peak flow rates off the entire lot into the municipal system are as follows:

Site Total	Existing	Proposed	Difference
2 Year Storm	1.64 cfs	1.01 cfs	-39.4%
10 Year Storm	3.06 cfs	2.33 cfs	-23.8%
25 Year storm	4.25 cfs	3.37 cfs	-20.7%
100 Year Storm	6.82 cfs	5.44 cfs	-20.2%

By directing the flows towards the municipal system, the abutter to the north benefits significantly. The watershed at the headwall beneath route 3A is approximately 14.5 acres and has a flow path well in excess of 2,200 linear feet which originates from the houses at the top of Windjammer Way. The peak flow rate at this headwall will lag well behind the contribution from this lot. Although we are reducing the peak flow rates off this lot area, peak flow rates at the headwall will remain unaffected by this reduction. The only significant pipe issue will be the connection from the first basin north of the entrance across the street. In the model, this structure is identified as CB 3 and based upon the calculations, the pipe as sized and sloped will adequately pass the peak of the 10-year storm. Therefore, if we look only at the more significant issue of flows onto the abutting lot to the north, the results are:

Site Total	Existing	Proposed	Difference
2 Year Storm	1.08 cfs	0.27 cfs	-75.0%
10 Year Storm	2.09 cfs	0.91 cfs	-56.5%
25 Year Storm	3.01 cfs	1.41 cfs	-53.2%
100 Year Storm	5.07 cfs	2.49 cfs	-50.8%

Thus, as can be seen, in comparing the proposed conditions with existing conditions peak flow rates on to the abutting lot have been reduced by 75% for the 2-year storm and over 50 % for the 100-year storm.

Standard No. 3, Recharge

The static storage provided in the basin will be enough to meet the requirements of this standard. Since the site is a combination of HSG A, B & D, we will use a recharge volume equal to the water quality volume of 0.5". This will nearly match the requirements for HSG A although all of the impervious surfaces for the proposed development are in HSG B & D areas. Accordingly, this volume is:

Static Storage Provided	473 cu. ft.
Required infiltration	0.5"
Impervious area	
Proposed	6,212 sq. ft.
Existing	2,572 sq. ft.
Total	8,784 sq. ft.

Infiltration volume required		366.0 cu. ft.
Directed to the basin	8,090 sq. ft.	
Weighted volume	8784/8090 (366.0)	
		397.4 cu. ft. ok< 473

Standard No. 4, Water Quality

Into the basin, the driveway will be pre-treated by a deep sump catch basin and sediment trap which will provide the 44% TSS pretreatment required for the proposed driveway. All runoff will be directed through the basin so all will receive 80% treatment.

Pretreatment

BMP	TSS Removal Rate	Actual Rate	Remainder
Deep sump catch basin	25%	25%	75%
Sediment trap	25%	18.75%	56.25 %
Total		43.75%	

BMP	TSS removal rate	Actual removal rate	Remainder
Forebay	25%	25%	75%
Infiltration basin	80%	60%	15%
Total		85%	

The only bypass of new impervious surfaces will be 694 square feet of driveway pavement which will be directed through the new inlet on Kilby Street. In accordance with DEP Guidelines, this surface area will be considered de minimus.

Infiltration Basin	5,518 sq. ft. (85%)
Inlet	694 sq. ft. (25%)
Weighted average	$\frac{4690.3 + 173.5}{6212} = 80.3\%$

Standard No. 5, Land Use with Higher Potential Pollution Loads

This standard is not applicable to a residential lot

Standard No. 6, Critical Areas

This standard is not applicable to this site

Standard No. 7, Redevelopment

This standard is applicable to this site. 2,572 square feet of existing impervious surfaces will be collected and treated by the proposed infiltration basin. Runoff from the pavement area will flow over a minimum of 100' of grass prior to entering the basin. Which will provide the pretreatment required.

Standard No. 8, Construction Period Pollution Control

The site does not qualify under the NPDES CGP. Accordingly, a Storm Water Pollution Prevention Plan is not required. 12" mulch logs will be placed along the lower edge of the development area to prevent sediment transport on to the abutting lot.

Standard No. 9, Operation and Maintenance

The O & M manual for the lot is attached hereto

Standard No. 10, Illicit Discharge statement

I do hereby certify that there are no illicit discharges proposed on site.

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Gary D. James, P.E.

Existing Conditions
Hydro-Cad Printout

Proposed Conditions
Hydro-CAD printout