STORMWATER REPORT
Hampton Court Apartments
1223 Beacon Street
Brookline, Massachusetts

Submitted to:

Brookline Zoning Board of Appeals
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HAMPTON COURT APARTMENTS
1223 BEACON STREET
BROOKLINE, MASSACHUSETTS

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I. Executive Summary

Project Description

The Hampton Court Beacon LLC is proposing to renovate the existing Hampton Court Apartments at 1223 Beacon Street in Brookline, MA. The project will consist of renovating the existing four-story apartment building and constructing a seven story addition with a two level parking facility. (one level at grade with the driveway and one level below grade). The development will consist of 123 apartment units with associated parking, drainage, utilities, landscaping, and other site development features on the property.

The existing developed property contains the Hampton Court Apartments and the associated surface parking lot. Vehicular access is provided via a fifteen foot (15') wide passageway from St. Paul Street and pedestrian access is provided via the main building entryway on Beacon Street. The main entrance and existing building façade on Beacon Street are to remain unaltered in the proposed condition. Vehicular access will be provided via two entry ramps from the fifteen foot (15') passageway: one to access the upper parking level and a second to access the lower parking level.

Site Characteristics

The proposed site is located to the south of Beacon Street, to the east of St. Paul Street, and to the north of the fifteen foot (15') access passageway. Abutting properties to the east are fully developed with retail stores and multi-family housing units.

Stormwater runoff from the site drains to an underground drainage network consisting of roof drains, catch basins, and drain lines. Ultimately, all stormwater runoff from the site is discharged to the Town of Brookline's municipal system located in St. Paul Street and Beacon Street. Stormwater from the parking lot is captured by catch basins that direct the stormwater to a sump pump that discharges to the drainage system.. Stormwater from the easterly portion of the building is captured by roof drains and directed to the existing sump pump. Stormwater from other portions of the property flow overland toward catch basins in St. Paul Street and are directed to the municipal system.

Stormwater Management

The proposed buildings, parking areas, walkways, and green roof terrace will decrease the amount of impervious area on the site. The project has been designed to incorporate subsurface detention/infiltration basin to mitigate the rate of runoff from the site, reducing flow rates to below pre-development rates. The project will also incorporate best management practices that will promote stormwater recharge and result in Total Suspend Solids (TSS) removal. The project has been designed in accordance with the Massachusetts Stormwater Management Standards.

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II. Project Type

The Hampton Court Beacon LLC proposes a **redevelopment** project in accordance with MassDEP Stormwater Handbook Standard 7 (see Section 7, Standard 7: Redevelopment). The project includes redevelopment of a previously developed site. The project is in compliance with the Stormwater Management Standards.

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III. LID Measures

Key features of Low Impact Development (LID) stormwater management systems include implementing practices to maintain a site's existing hydrology. This is achieved using decentralized practices to manage stormwater close to the source of generation and maximizing onsite infiltration. This reduces runoff and landscape watering requirements. The project will implement low-impact development methods and strategies for treating and mitigating stormwater runoff.

The following LID techniques are Best Management Practices according to MassDEP and are specified in the proposed development program.

LID Techniques Implemented:

- No disturbance to any Wetland Resource Areas
- Subsurface Detention/Infiltration Basins
- Proprietary water quality device

Additionally, efforts will be made to protect existing trees during the construction period to the maximum feasible extent. Major trees and valued vegetation occurring outside the limit of work will be clearly marked for protection and monitored during the construction process.

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1.0 Standard 1: No New Untreated Discharges

Stormwater Management Standard 1 States:

> *"No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth."*

The project does not have direct discharge of stormwater to waters or wetlands. Standard 1 is therefore met.

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2.0 Standard 2: Peak Rate Attenuation

Stormwater Management Standard 2 States:

> *"Stormwater management systems shall be designed so that the post-development peak discharge rates do not exceed pre-development peak discharge rates."*

2.1 SUMMARY

Per the requirement of the Massachusetts Stormwater Handbook, Standard 2, we evaluated the pre-development (existing condition) and post-development (proposed condition) peak discharge rates for the 2-, 10- and 100-year storm events. The peak discharge rates were calculated at one discharge (design) point. (See Figure 4, Existing Watershed Plan and Figure 5, Proposed Watershed Plan following this section). Below are the results from the analysis.

Table 2.1 – Peak Discharge Rates

Discharge Points	Design Storms					
	2-Year (3.20"		10-Year (4.60")		100-Year (6.70")	
	Pre-Dev. Peak Discharge Rate (cfs)	Post-Dev. Peak Discharge Rate (cfs)	Pre-Dev. Peak Discharge Rate (cfs)	Post-Dev. Peak Discharge Rate (cfs)	Pre-Dev. Peak Discharge Rate (cfs)	Post-Dev. Peak Discharge Rate (cfs)
Municipal Drainage System	2.03	1.56	3.08	2.75	4.64	3.89

The post-development peak discharge rates do not exceed pre-development peak discharge rates. Stormwater Management Standard 2 is met.

This section describes the pre- and post-development conditions and outlines the procedure for determining the peak discharge rates.

2.2 ANALYSIS

2.2.1 Soil Conditions

The Natural Resources Conservation Service (NRCS) shows "Urban Land" within the development area and does not designate a hydrologic soil group for the proposed project area with the exception of the southeast corner of the site, which is classified as Newport-Urban land complex.

Initial Subsurface Investigation

Geotechnical Services Inc. (GSI) performed subsurface explorations on site between May 30, 2018 and May 31, 2018 to provide generalized subsurface conditions for the redevelopment of the site. Two (2) test borings were drilled, and soil samples were collected and classified in accordance with the USDA classification procedures. Information provided by GSI with respect to soil classifications was utilized in the design of the stormwater management system.

Hydrologic Soil Group

The standard requires a determination of the Hydrologic Soil Group within the proposed project site. The NRCS Hydrologic Soil Group maps were consulted to determine what soils would likely be encountered at the site, but the proposed redevelopment site was classified as “Urban Land” which has no associated hydrologic soil group designation.

A review of the soils classifications as prepared by GSI was performed to estimate the hydrologic soil groups at the project site utilizing National Engineering Handbook, Part 630, “Hydrology”, Chapter 7, “Hydrologic Soil Groups.

Soil classifications of the two soil samples taken from the test borings correlate, based on USDA textural classifications and associated Rawl’s Rate (see Massachusetts Stormwater Handbook Chapter 7, Page 22) as either hydrologic soil group “A” or “B”. Based on the observations of this area of the site and NRCS mapping for the surrounding area, an average hydrologic soil group “A” is assumed for the purpose of generating hyrdrographs (TR-55 and TR-20 methodologies, see Appendix D) and for water quality and groundwater recharge calculations.

Soil Infiltration Rates

For the purpose of required recharge volume and drawdown calculations, the Rawl’s rate utilized at each site specific location is based on the assumed Hydrologic Group A soils, and corresponding infiltration rate of 2.41 in/hr. The most conservative Rawl’s rate for all available soil samples was assumed.

Table 2.2 –Soils at Recharge Systems

Proposed Stormwater BMP	Bottom Elevation of Basin	USDA Soil Classification at Depth	Boring/Monitoring Well	Assumed Rawl’s Rate at Depth (in/hr)
Subsurface Recharge Chambers (ST-01)	4.60	Fill (Loose, medium sand)	B-2	2.41

2.2.2 Discharge Points

The project site was analyzed as a single subcatchment area for the pre-development conditions, with the subcatchment area contributing to one specific discharge point (See Figure 4). The peak discharge rate for the pre-and post-development conditions were analyzed for this discharge point.

Results of the analysis are found in Table 2.1.

2.2.3 Pre-Development Conditions

The subcatchment area analyzed for the existing conditions is summarized below:

Subcatchment X-1: To Municipal Drainage System

Subcatchment area EX-1 includes the entire development property which is fully developed with the existing building, pavement and other impervious area, and landscaped area. Stormwater runoff from EX-1 is captured by catch basins, either on the site or within the abutting streets, which all discharge to the Town of Brookline municipal drain line in Beacon Street.

Subcatchment Area Summary

Table 2.3 summarizes the pre-development conditions drainage areas and includes information used for the hydraulic analysis (Appendix C, Existing Conditions HydroCAD Calculations).

Table 2.3 – Pre-Development Conditions Drainage Area Summary

Drainage Area	Area (s.f.)	Curve Number	Time of Concentration (min.)[1]
EX-1	31,857	93	6

2.2.4 Post-Development Conditions

For the proposed conditions, three (3) subcatchment areas were analyzed. Each subcatchment ultimately discharges to the existing Town of Brookline municipal drainage system in Beacon Street.

A summary of each of the subcatchments, is provided below:

Subcatchment PR-1A

Subcatchment PR-1A includes the existing and roof areas, the concrete entryway via Beacon Street, and pervious area along both Beacon Street and St. Paul Street. Stormwater from the roof will be captured by roof drains and directed towards the municipal drainage system in St. Paul

[1] Section 2.3.3

Street. Surface runoff from both the impervious and pervious areas along Beacon Street and St. Paul Street will be captured by catch basins in roadways as in the existing condition.

Subcatchment PR-1B

Subcatchment PR-1B is comprised of the green roof terrace above the proposed parking facility. Runoff from the green roof terrace will be collected through a series of area drains and conveyed through an eight inch (8") HDPE pipe run along the ceiling of the parking facility and directed to a water quality unit before discharging to a subsurface recharge system (ST-01). The overflow from ST-01 is directed to a pump station manhole that will pump stormwater to the existing municipal drainage system in St. Paul Street.

Subcatchment PR-1C

Subcatchment PR-1C includes the proposed access ramp and the concrete dumpster pad area. Runoff from the access ramp and dumpster pad area will be captured by a series of catch basins and trench drains and directed to a water quality unit before discharging to a subsurface recharge system (ST-01). The overflow from ST-01 is directed to a pump station manhole that will pump stormwater to the existing municipal drainage system in St. Paul Street.

Drainage Area Summary

Table 2.4 summarizes the post-development conditions drainage areas and includes information used for the hydrologic analysis (Appendix D, Proposed Conditions HydroCAD Calculations).

Table 2.4 – Post-Development Conditions Drainage Area Summary

Drainage Area	Area (s.f.)	Curve Number	Time of Concentration (min.)[2]
PR-1A	23,760	94	6
PR-1B	4,673	85	6
PR-1C	3,424	91	6

2.3 METHODOLOGY AND DESIGN CRITERIA

2.3.1 Hydrologic Modeling

The peak discharge rates and stormwater runoff volumes were calculated using the Soil Conservation Service (SCS) TR-55 and TR-20 methodologies and the computer program HydroCAD 10.00 by HydroCAD Software Solutions, LLC.

[2] Section 2.3.3

2.3.2 Design Storms

The analysis was performed on the 2-, 10-, and 100-year frequency rainfall events. The events were based on the 24-hour, type-III duration storm (See Appendix E, Massachusetts Rainfall Data Maps).

2.3.3 Time of Concentration

The time of concentration (T_c) for each watershed was determined by finding the time necessary for runoff to travel from the hydraulically most distant point in the watershed to the point of concentration. The travel path was drawn based on the topography and the time was calculated using the HydroCAD. A minimum T_c of 6.0 minutes was used to account for the initial storm fluctuation and depression storage.

2.3.4 Curve Numbers

Curve numbers were developed for each of the different use categories and hydrologic soil group types within each sub-area. The curve numbers were based on the SCS TR-55 methodology and are included in the HydroCAD input and output found in Appendix C and Appendix D.

2.3.5 Rainfall Depth

Rainfall depths were acquired from Technical Paper 40, “The Rainfall Frequency Atlas of the United States”. Rainfall events for the 2-, 10-, and 100-year storms were analyzed.

The following rainfall depths were used in the calculations:

Storm Event	Rainfall Depth
2-Year	3.20 inches
10-Year	4.60 inches
100-Year	6.70 inches

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3.0 Standard 3: Recharge

Stormwater Management Standard 3 States:

> *"The annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type."*
>
> *"Infiltration structures must be able to drain fully within 72 hours."*
>
> *"There must be at least a two-foot separation between the bottom of the infiltration structure and the seasonal high groundwater."*

For the project,

- The annual recharge from the post-development condition will exceed the annual recharge from the pre-development condition with the reduction of impervious area and inclusion of a detention/infiltration basin. In the pre-development condition, there are no infiltration measures other than limited landscaped areas surrounding the existing building. The inclusion of a green roof terrace will reduce the impervious area discharging to the municipal drainage system and the implementation of a subsurface infiltration facility will increase recharge capacity. Recharge volume has been provided to the Maximum Extent Practicable as a Redevelopment project and therefore the standard is met.
- The recharge volumes comprised of a subsurface detention/infiltration basin is able to drain fully within 72 hours.
- There is greater than a two-foot separation between the bottom of the detention/infiltration basin and the seasonal high groundwater table based on observation of borings drilled by Geotechnical Services, Inc. on May 30, 2018. Refer to Appendix B for the full Geotechnical Report prepared by Geotechnical Services, Inc.

Stormwater Management Standard 3 is met.

This section describes the procedures for determining compliancy with Stormwater Management Standard 3.

3.1 RECHARGE REQUIREMENT

3.1.1 Summary

The proposed stormwater management system will consist of one detention/infiltration basin. The recharge area for the project provides a recharge volume less than what is required based on the observed soils onsite, but compliance with this standard has been provided to the Maximum Extent Practicable as a Redevelopment project.

The proposed project involves a net reduction of impervious area and that reduction along with the provision of the proposed subsurface detention/infiltration basin will increase recharge in post-development conditions.

Recharge volume is provided at elevations below the weir in the outlet control structure for the Stormtank detention / infiltration system. This system will capture runoff from the green roof terrace, access ramp, and dumpster pad area and direct it to the system to provide recharge volume. Area for the proposed system is limited by nearby lot lines and the proposed lower level parking garage, but the Stormtank system encompasses the entire available area to provide compliance to the Maximum Extent Practicable as allowed for a Redevelopment project.

Table 3.1 summarizes the recharge required and provided for the project before providing a capture area adjustment for the recharge requirement.

Table 3.1 – Recharge Summary

Storage Provided	Recharge Volume Required (cf)	Recharge Volume Provided (cf)
Subsurface Detention/Infiltration Basin	1,191	343

As previously discussed, since there is only limited area available that does not contain the existing building footprint and proposed lower level parking facility, the size of the proposed subsurface detention / infiltration system is also limited. There is not enough volume available to recharge stormwater from all impervious areas on the site, and some impervious area will be directed directly to the municipal system instead of the Stormtank detention / infiltration system so the subsurface system does not overtop with stormwater and back up into the roof drains and trench drains. If the capture area adjustment is applied to the required recharge volume, 10,258 c.f. of recharge volume is required.

See Appendix F, Recharge Volume Calculations and Sections 3.1.2 and 3.1.3 for supporting calculations and analysis.

3.1.2 Determining the Recharge Requirement

For Hydrologic Soil Group A soils, the required recharge volume equals 0.60” of runoff multiplied by the total impervious area at the post development condition. Since a portion of the impervious area does not discharge to the recharge system, the required recharge volume was increased by applying a capture area adjustment as required by the Stormwater Management Standards. This results in an initial required recharge volume of 10,258 cf (Appendix F, Recharge Volume Calculations). This is summarized in Table 3.2 below.

Table 3.2 – Required Recharge Volume

Hydrologic Soil Group	Impervious Area (sf)	Target Depth*	Volume Required (cf)
A	23,822	0.60	1,191

Required Recharge Volume with Capture Area Adjustment:	***10,258***

*The Target depth is from the Massachusetts Stormwater Handbook

During post-development conditions, 11.6% of the project area's impervious cover is routed through the subsurface detention/infiltration basin. This is less than the minimum required 65 percent from the Stormwater Handbook, but as previously discussed it is not possible to route all stormwater runoff through the subsurface system due to elevation limitations. Additionally, in the existing condition there are no infiltration measurements on site. The proposed infiltration facility will increase the amount of recharge provided on site. As a redevelopment project, the system was designed to provide recharge to the maximum practicable.

A capture area adjustment is applied to the initial required recharge volume. The capture area adjustment is calculated by dividing the amount of impervious cover on the site (23,822 s.f.) by the amount of impervious area routed through the subsurface detention/infiltration basins (2,766 sf). This results in a capture area adjustment ratio of 8.61. This is multiplied by the initial required recharge volume of 1,191 cf resulting in a ***required recharge volume of 10,258 cf.***

3.1.3 Sizing the Recharge Volume

To accommodate the required recharge volume, the proposed stormwater management system will include a subsurface detention/infiltration basin. The recharge volume was designed and sized using the "Static" method as described in the Massachusetts Stormwater Handbook, Volume 3, Chapter 1. The "Static" method was used to produce a larger storage volume resulting in a conservative approach. Hydrologic modeling (HydroCAD 10.00) was used to determine the size of the subsurface basin. See Appendix D. When designing the basins, the following was taken into consideration:

The basin is designed to accommodate the site characteristics of the ground surface, underlying soil types and subsurface conditions (seasonal high groundwater table, depth to bedrock, hydrologic conductivity rate and type of receiving soil layers). See Section 2.2.1.

Additionally, the basin is sized to provide a recharge volume of **343 cubic feet**. This is less than the requirement, but this is the maximum extent practicable for a Redevelopment project.

3.2 DRAWDOWN WITHIN 72 HOURS

The required drawdown time for the proposed recharge volumes shall be less than or equal to 72 hours. The drawdown time is calculated by dividing the storage volume by the permeability rate times the bottom area of the recharge volume.

Exhibit 3.1 – Drawdown Equation

$$Time_{drawdown} = \frac{Rv}{(K)(Bottom\ Area)}$$

where:

Rv = Required Storage Volume

K = Saturated Hydraulic Conductivity For "Static" and "Simple Dynamic" Methods, use Rawls Rate (Table 2.3.3, Massachusetts Stormwater Handbook). For "Dynamic Field" Method, use 50% of the in-situ saturated hydraulic conductivity.

Bottom Area = Bottom Area of Recharge Structure

The Storage Volume (Rv) for the subsurface basin and the Bottom Area was derived from HydroCAD (Appendix D). For the purpose of this drawdown calculation, the required recharge volume is the volume provided in the proposed detention/infiltration system. The Rawls Rate (K) used for the analysis was 2.41 in/hr (Section 2.2.1). Supporting calculations are included in Appendix F. Table 3.3 summarizes the drawdown time for the recharge volume.

Table 3.3 – Summary of Drawdown Time

Subsurface Basin	Maximum Drawdown Time (hours)	Drawdown Time Provided (hours)
ST-01	72	3.81

The drawdown times for the recharge volume is less than the required drawdown time of 72 hours from Standard 3.

3.3 SEPARATION FROM SEASONAL HIGH GROUNDWATER

The Massachusetts Stormwater Handbook requires at least a two-foot separation between the bottom of the infiltration structure and the seasonal high groundwater table. During the subsurface investigations conducted by Geotechnical Services Inc., groundwater was observed at varying depths: 9.4 feet in boring B-1 and 10 feet in boring B-2. These depths correspond to elevation 6.6 and elevation 2, respectively. As a result, it is assumed that the seasonal high water table follows the gradient of the existing ground surface. Based on this assumption, elevation 2 was used at the seasonal high groundwater table.

The recharge volume provides the required separation from the seasonal high groundwater table per Standard 3. The system maintains 3.4' separation to groundwater.

4.0 Standard 4: Water Quality

Stormwater Management Standard 4 states:

> *"Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This standard is met when:*
>
> *a. Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained.*
>
> *b. Structural stormwater best management practices are sized to capture the required water quality volume as determined in accordance with the Massachusetts Stormwater Handbook.*
>
> *c. Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.*

For the project,

- Pollution prevention practices are identified and a long term pollution prevention plan is implemented and maintained.
- The structural stormwater best management practices are sized to capture the required water quality volume as determined in accordance with the Massachusetts Stormwater Handbook
- Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.

Stormwater Management Standard 4 is met.

This section describes the procedures for determining compliancy with Stormwater Management Standard 4.

4.1 LONG – TERM POLLUTION PREVENTION PLAN

The complete long-term pollution prevention plan for the project site is included as part of the Operation and Maintenance Plan (Section 9.2). A long term pollution prevention plan that fully meets the requirements of Standard 4 will be implemented and maintained.

- The pollution prevention plan includes: management of deicing chemicals; proper management of fertilizers, herbicides, and pesticides; and management of spills of hazardous materials.

- The new development design provides treatment for runoff from proposed impervious surfaces within the project area to achieve 80% TSS removal. A proprietary water quality device will be installed to provide TSS removal and water quality for paved areas and impervious landscaping features.

- The contributing flow to the subsurface basin includes runoff from the roof of the proposed building and access ramp. Since this roof will be non-metal its runoff is considered to be "clean" and will not require TSS removal.

- The following pollution prevention measures have been considered:

    - Deicing materials will only be used to the extent needed to make the drive aisle and walkways safe.

    - Fertilizers, herbicides, and pesticides will only be used to the extent needed to maintain healthy plant materials and landscaped areas.

    - Landscaping that reduces the need for fertilizer, herbicides, and pesticides.

    - All trench drains will be inspected at least four times per year and cleaned a minimum of at least once per year. Sediment and/or floatable pollutants will be pumped from the trench drain. During colder periods, the trench drain grates will be kept free of snow and ice. During warmer periods, trench drain grates will be kept free of leaves, litter, sand, and debris.

- There are no discharges to impaired waters.

4.2 WATER QUALITY TREATMENT VOLUME

The project area is not located within a critical area therefore "Water Quality Depth" of 0.5-inches is utilized when computing the required water quality treatment. Water quality calculations are included in Appendix H.

4.3 TSS REMOVAL COMPUTATIONS

Standard 4 requires that a minimum of 80% Total Suspended Solids (TSS) removal rate be achieved in the proposed condition. TSS calculations are included in Appendix G of this report.

The following BMPs are proposed:

<u>Proprietary Water Quality Unit</u>
One Contech water quality device is proposed to provide pretreatment before stormwater is directed into the municipal drainage system. The unit has been sized based on the water quality volume (WQV) for runoff from a 1/2" storm event, in accordance with MassDEP guidance policies. WQV calculations are provided in Appendix H. The calculation for the TSS removal

for the proposed water quality unit and TSS removal for the proposed treatment train are provided in Appendix G.

Subsurface Detention/Infiltration Basin

One subsurface detention/infiltration basin (Stormtank ST-24 chambers) are proposed to detain and infiltrate stormwater runoff. As previously discussed, stormwater from these non-metal roof areas do not require pretreatment and the subsurface chambers will provide 80% TSS removal.

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5.0 Standard 5: Land Uses with Higher Potential Pollutant Loads

Stormwater Management Standard 5 states:

> *"For land uses with higher potential pollutant loads (LUHPPL), source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable."*
>
> *Stormwater discharges from LUHPPLs requires the use of a treatment train that provides 80% TSS removal prior to discharge and at least 44% TSS removal prior to discharge to the infiltration BMP."*
>
> *"The infiltration BMP shall be designed to treat 1.0 in. of runoff times the total impervious area at the post development site."*

The project is not considered a LUHPPL. Standard 5 is not applicable.

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6.0 Standard 6: Critical Areas

Stormwater Management Standard 6 states:

> *"Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook."*
>
> *Stormwater discharges from Outstanding Resource Waters requires the use of a treatment train that provides 80% TSS removal prior to discharge and at least 44% TSS removal prior to discharge to the infiltration BMP."*
>
> *"The infiltration BMP shall be designed to treat 1.0 in. of runoff times the total impervious area at the post development site."*

The project is not within a critical area. Standard 6 is not applicable.

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7.0 Standard 7: Redevelopment

Stormwater Management Standard 7 states:

> *"A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions."*
>
> *"A new development project must comply fully with all the Stormwater Management Standards."*

The project is considered **Redevelopment** in accordance with the Stormwater Handbook. The proposed project involves a net reduction of 3,771 ± s.f. of impervious area compared to existing conditions.

The project is in compliance with the Stormwater Management Standards to the Maximum Extent Practicable. Standards 1, 2, and 4 are fully met, Standard 3 is met to the maximum extent practicable, and Standards 5 and 6 do not apply. Therefore, Stormwater Management Standard 7 is met.

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8.0 Standard 8: Construction Period Pollution Prevention and Erosion & Sedimentation Control

Construction period pollution prevention and erosion and sedimentation control measures will be implemented at the project site to control construction related impacts during construction and land disturbance activities. The general contractor for the project will be responsible for implementation of the construction period controls.

8.1 EROSION AND SEDIMENT CONTROL MEASURES

The project will disturb more than one acre of land during the construction process and will require a NPDES Construction General Permit issued by the Environmental Protection Agency. As a result, a stormwater pollution prevention plan (SWPPP) will be required. The SWPPP document will satisfy the requirements of the construction period erosion, sedimentation and pollution prevention plan requirements outlined in Standard 8 of the Massachusetts Stormwater Handbook. A SWPPP has not been prepared for inclusion with this stormwater report; however one will be prepared prior to any construction activities at the site.

Without proper erosion and sediment control measures, grading, filling and installation of structures may cause erosion and sedimentation, resulting in temporarily increased turbidity and suspended solid loads. Runoff from construction sites may also transport sediment to downstream watercourses, where sediment deposition and accumulation will occur as flow velocities decrease.

Erosion and sedimentation controls will be employed to prevent the erosion and transport of sediment into adjacent areas and drainage systems during the earthwork and construction phases of the project. Erosion and sedimentation control measures will be installed prior to site excavation or disturbance and will be maintained throughout the construction period.

Below is a description of some of the erosion and sediment control measures that will be employed at the project and that will be included in the SWPPP.

Catch Basin Inlet Protection

The inlets of existing catch basins will be protected from sediment inflow during the work period through the installation of Siltsacks™. A layer of filter fabric will be installed beneath the grates of the catch basins. The inlets of existing catch basins will be protected by Siltsacks™. These protection measures will be inspected after every storm event and will be routinely maintained until the drainage area tributary to each inlet has been stabilized with vegetation and/or covered by pavement. Any sediment that collects behind the barrier or in the sacks will be removed and will be either reused onsite or disposed of at a suitable off-site location.

Dust Control

Fugitive dust from large areas of unstabilized soil can be a problem during construction. On dry and windy days when dust generation is a concern, a water truck will traverse the site and spray water as necessary to prevent dust from forming. Calcium chloride may also be applied to the ground in granular form to attract atmospheric moisture, dampening the ground and preventing fugitive dust.

Stabilized Construction Entrance

Temporary stabilized construction entrances will be installed at the site. The purpose of the construction entrance is to remove sediment attached to vehicle tires and to minimize sediment transport and deposition onto public road surfaces. The construction entrances will be composed of beds of crushed stone which will be replenished as necessary to maintain their proper function. The stone will be placed over a layer of non-woven filter fabric. The stabilized construction entrances will remain in place until a binder coat of pavement has been established in areas to be paved.

8.2 MATERIAL MANAGEMENT PRACTICES

The following material management practices will be used to reduce the risk of spills or other accidental exposure of materials and substances to stormwater runoff. These include good housekeeping practices and guidelines for the handling of hazardous products. The following good housekeeping practices will be followed on-site during the construction period.

- An effort will be made to store only enough products required to do the job.
- All materials stored on-site will be stored in a neat, orderly manner in their appropriate containers, and (if possible) under a roof or other enclosure.
- Products will be kept in their original containers with the original manufacturer's label.
- Substances will not be mixed with one another unless recommended by the manufacturer.
- Whenever possible, all of a product will be used before disposing of the container.
- Manufacturer's recommendations for proper use and disposal will be followed.
- The site superintendent will inspect the storage area daily to ensure proper use and disposal of materials on-site.

The following practices will reduce the risks associated with hazardous materials (e.g., petroleum products, solvents):

- A copy of all Material Safety Data Sheets (MSDS) for materials or products used during construction will be kept in the office trailer.
- Products will be kept in original containers unless they are not re-sealable.
- Original labels and material safety data (MSD sheets) will be retained; they contain important product information.

- If surplus product must be disposed, manufacturer's or local- and state-recommended methods for proper disposal will be followed.

8.3 PRODUCT SPECIFIC PRACTICES

The following product-specific practices will be followed on-site. Recommendations are provided for petroleum products, fertilizers, solvents, paints, and other hazardous substances.

Petroleum Products

All on-site vehicles will be monitored for leaks and will receive regular preventive maintenance to reduce the chance of leakage. No vehicle maintenance will occur on site. Petroleum products will be stored in tightly sealed containers that are clearly labeled. Any asphalt substances used on-site will be applied according to manufacturer's recommendations.

Fertilizers

Fertilizers will be applied only in the minimum amounts recommended by the manufacturer. Once applied, the fertilizer will be worked into the soil to limit exposure to stormwater. Storage will be in a covered area; and the contents of any partially used bags will be transferred to a sealable, plastic bin to avoid spills.

Solvents, Paints, and other Hazardous Substances

All containers will be tightly sealed and stored when not required for use. Excess materials will not be discharged to the storm sewer system, but will be properly disposed according to manufacturer's instructions or state and local regulations.

Concrete Trucks

Concrete trucks will not be allowed to wash out or discharge surplus concrete or drum wash water into catch basins or drainage systems that are already in place.

8.4 SPILL CONTROL/NOTIFICATION PRACTICES

In addition to the good housekeeping and material management practices discussed above, the following practices will be followed for spill control, notification and cleanup.

- Manufacturer's recommended methods for spill cleanup will be clearly posted and site personnel will be informed of the procedures and the location of the information and cleanup supplies.
- Materials and equipment necessary for spill cleanup will be kept in the material storage area on-site. Equipment and materials will include, but will not be limited to, shovels, wheel barrows, brooms, dust pans, mops, rags, gloves, goggles, kitty litter or Speedi-Dry, sand, sawdust, and plastic and metal trash containers specifically designated for this purpose.

- All spills will be cleaned up immediately after discovery.
- The spill area will be kept well ventilated and personnel will wear protective clothing to prevent injury from contact with a hazardous substance.
- Spills of toxic or hazardous material in excess of reportable quantities, as established in the Massachusetts Contingency Plan (MCP), will be reported to the Massachusetts Department of Environmental Protection Division of Hazardous Waste [(617) 292-5851 or (978) 661-7679].
- The construction superintendent responsible for the daily operations will be the spill prevention and cleanup coordinator. He will designate at least three other site personnel to receive spill prevention and cleanup training. These individuals will each become responsible for a particular phase of prevention and cleanup. The names of the responsible spill personnel will be posted in the material storage area and in the on-site office trailer.

8.5 MAINTENANCE PROGRAM PRACTICES: PRIOR OR DURING CONSTRUCTION

In addition to the maintenance described for each stormwater control, the following practices should be followed:

- Prior to construction, install erosion and sediment control measures as shown on the plan and details.
- The site contractor shall inspect all sediment and erosion control structures after each rainfall event and at the end of the working day.
- All measures shall be maintained in good working order. If repair is necessary, it shall be initiated within 24 hours of inspection.
- Silt shall be removed from the filter bags if depths reach 6-inches or greater and as-needed.
- Sediment shall be contained within the construction site and away from drainage structures.
- Damaged or deteriorated erosion control measures will be repaired immediately after identification.
- The contractor’s site superintendent will be responsible for inspection, maintenance and repair activities.

Erosion control measures shall remain in place until all construction is completed and all disturbed earth is stabilized.

9.0 Standard 9: Operation and Maintenance Plan

The goal of the operation and maintenance plan is not only to protect resources on-site or nearby, but also to protect resources in the region that may be affected by the activities at the site. Water quality treatment measures and the implementation of Best Management Practices (BMP's) for structural controls will result in the treatment of site stormwater and the removal of a minimum of 80 percent of the total suspended solids (TSS) load in runoff prior to discharge from the site, consistent with Massachusetts DEP's TSS removal standard.

The stormwater management system will be owned by the Chestnut Hill Realty. They will be responsible for operation and maintenance. An Operation and Maintenance Log has been prepared for this project and is included in this report as Appendix J.

9.1 STRUCTURAL POLLUTANT CONTROLS

The proposed stormwater management system is designed to protect runoff water quality through the removal of sediment and pollutants. Structural pollutant controls used to separate and capture stormwater pollutants are described below.

Proprietary Water Quality Device

The proprietary water quality device will be inspected and cleaned in strict accordance with the manufacturer's recommendations and requirements. The manufacturer's recommendations and requirements are included in Appendix K.

Roof Drain Leaders

Roof runoff from the proposed building will be directed to underground piped drainage systems. Routine roof inspections will be performed. Roofs will be kept clean and free of debris, and the roof drainage systems will be kept clear. Gutters and downspouts connected to the drainage system will be cleaned at least twice per year, or more frequently as necessary.

Subsurface Detention/Infiltration Basin

The subsurface detention/infiltration basin at the proposed project site will be Stormtank. They are used for infiltration and detention. The basins require maintenance to remain functional.

See Appendix L, Stormtank Maintenance Guidelines for additional information.

Trench Drains

The proper removal of sediments and associated pollutants and trash occurs only when trench drains are cleaned out regularly. The more frequent the cleaning, the less likely sediments will

be re-suspended and subsequently discharged. In addition, frequent cleaning also results in more volume available for future deposition and enhances overall performance.

Trench drains will be cleaned a minimum of four times and inspected monthly for the first year to determine the sediment loading for the site. Any sand, sediment, or debris that collects (when it reaches a depth of more than ½ the sump depth will be removed as needed. After the first year, the frequency of the trench drain cleaning should be reviewed and revised based upon the sediment loading observed in the first year. Any structural damage or other indication of malfunction will be reported to the site manager. During colder periods, the grates will be kept free of snow and ice.

This practice, in coordination with minimal use of sand, and street sweeping comprises a multi-level source control approach that prevents sand/sediments and litter from exiting off-site and/or ultimately into the resource areas.

Vegetated Areas Maintenance

Although not a structural component of the drainage system, the maintenance of vegetated areas may affect the functioning of stormwater management practices. This includes the health/density of vegetative cover and activities such as the application and disposal of lawn and garden care products, disposal of leaves and yard trimmings.

Initial Post-Construction Inspection

During the initial period of vegetation establishment in disturbed areas pruning and weeding are required twice in first year by contractor or owner. Any dead vegetation/plantings found after the first year will be replaced. Proper mulching is mandatory and regular watering may be required initially to ensure proper establishment of new vegetation.

Long-Term Maintenance

Weeds and invasive plant species will be removed by hand. Leaf litter and other detritus shall be removed twice per year. If needed to maintain aesthetic appearance, perennial plantings may be trimmed at the end of the growing season. Trees and shrubs will be inspected twice per year to evaluate health and attended to as necessary. Seeded ground cover or grass areas shall not receive mulching. PH tests of the soils in the planting bed will occur annually. If the pH is below 5.2, limestone will be applied to increase it. If the pH is above 8.0, iron sulfate plus sulfur will be added accordingly.

9.2 LONG TERM POLLUTION PREVENTION PLAN

The following measures will be employed to control potential sources of contamination and prevent pollution at the project site:

Deicing

To prevent increased pollutant concentrations in stormwater discharges, the amount of road salt applied will be controlled. The amount of deicing materials used will be monitored with the goal of using only enough to make the drive aisle and walkways safe.

Fertilizer/Pesticide/Herbicide Application

The facility will require that landscaping maintenance contractors implement a program to test soils at the site annually and to limit the amount of fertilizer, pesticides and herbicides to only what is needed to maintain healthy plant materials and landscaped areas. PH tests of the soils in the planting bed will occur annually. If the pH is below 5.2, limestone will be applied to increase it. If the pH is above 8.0, iron sulfate plus sulfur will be added accordingly.

No pesticides or herbicides are to be used unless a single spot treatment is required for a specific control application.

Fertilizer usage will be avoided. If deemed necessary, slow release fertilizer will be used, and applied only in the minimum amounts recommended by the manufacturer. Once applied, the fertilizer will be worked into the soil to limit exposure to stormwater. Storage will be in a covered area; and the contents of any partially used bags will be transferred to a sealable, plastic bin to avoid spills.

Fertilizer will be used to begin the establishment of vegetation in bare or damaged areas, but will not be applied on a regular basis unless necessary.

Records of soil management, application dates, planting dates, preventive measures, treatments and other appropriate information should be kept. This information will be used as a reference when fertilizer/pesticide/herbicide management decisions in the future.

Materials Management/Housekeeping Practices

The following product-specific practices will be followed on-site. Recommendations are provided for petroleum products, fertilizers, solvents, paints, and other hazardous substances, and concrete.

Petroleum Products - No vehicle maintenance or handling of petroleum products will occur on site. Petroleum products will be stored in tightly sealed containers that are clearly labeled. Any asphalt substances used on-site will be applied according to manufacturer's recommendations.

Solvents, Paints, and other Hazardous Substances - All containers will be tightly sealed and stored indoors when not required for use. Excess materials will not be discharged to the storm sewer system, but will be properly disposed according to

manufacturer's instructions or state and local regulations. Outside storage on the property will be prohibited.

Spill Prevention Practices

The facility will implement a spill prevention program that will include storm water contamination assessment, flow diversion, record keeping, internal reporting, employee training, and preventive maintenance. The following specific practices will be followed for spill control, notification and cleanup.

- Manufacturer's recommended methods for spill cleanup for any chemicals used or stored on site will be clearly posted and site personnel will be informed of the procedures and the location of the information and cleanup supplies.
- Materials and equipment necessary for spill cleanup will be kept in the material storage area on-site. Equipment and materials may include, as appropriate, shovels, wheel barrows, brooms, dust pans, mops, rags, gloves, goggles, kitty litter or Speedi-Dry, sand, sawdust, and plastic and metal trash containers specifically designated for this purpose.
- All spills will be cleaned up immediately after discovery.
- The spill area will be kept well ventilated and personnel will wear protective clothing to prevent injury from contact with a hazardous substance.
- Spills of toxic or hazardous material in excess of reportable quantities, as established in the Massachusetts Contingency Plan (MCP), will be reported to the Massachusetts Department of Environmental Protection Division of Hazardous Waste [(617) 292-5851 or (978) 661-7679].

10.0 Standard 10: Prohibition of Illicit Discharges

Standard 10 of the Massachusetts Stormwater Handbook prohibits illicit discharges to stormwater management systems. As stated in the handbook, “The stormwater management system is the system for conveying, treating, and infiltrating stormwater on-site, including stormwater best management practices and any pipes intended to transport stormwater to the groundwater, a surface water, or municipal separate storm sewer system. Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater.”

It is fully understood that the Storm Water Pollution Prevention Plan (SWPPP) for the project will include procedures to prevent illicit discharges to the stormwater management system during construction.

Standard 10 also states that “The Illicit Discharge Compliance Statement must be accompanied by a site map that is drawn to scale and that identifies the location of any systems for conveying stormwater on the site and shows that these systems do not allow the entry of any illicit discharges into the stormwater management system. The site map shall identify the location of any systems for conveying wastewater and/or groundwater on the site and show that there are no connections between the stormwater and wastewater management systems and the location of any measures taken to prevent the entry of illicit discharges into the stormwater management system.” Included with this report are drawings that display the location of all of the stormwater management components as well as other utilities (existing and proposed) on the project site and conforms to requirements of a “site map” to accompany the Illicit Discharge Compliance Statement.

The Illicit Discharge Compliance Statement for the project is as follows:

Illicit Discharge Compliance Statement

Per the requirements of Standard 10 of the Massachusetts Stormwater Management Standards it shall be stated that No Illicit Discharges are proposed on the project.

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Figures

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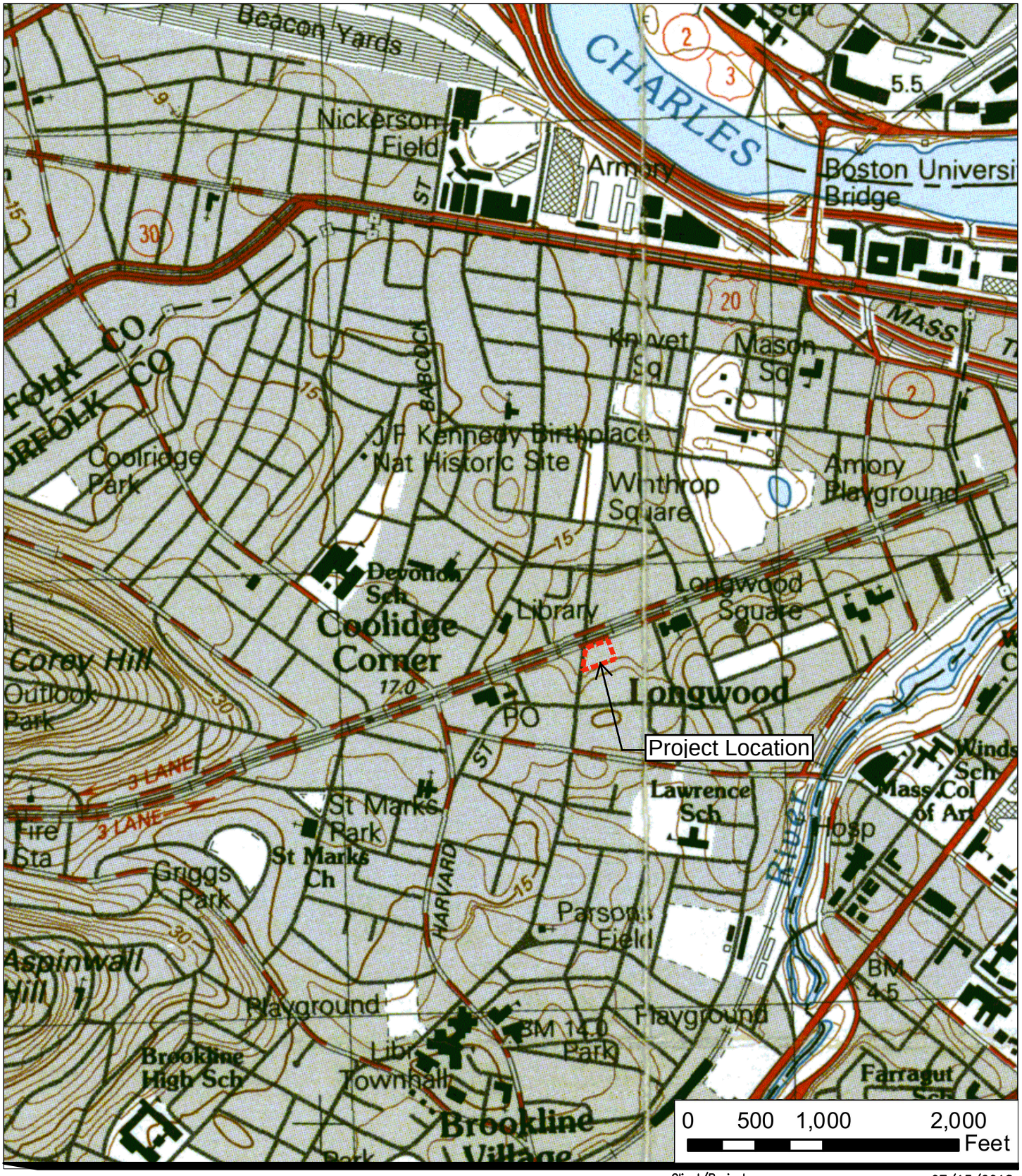
STORMWATER REPORT
HAMPTON COURT APARTMENTS
1223 BEACON STREET
BROOKLINE, MASSACHUSETTS

Figure 1 – USGS Topographic Map



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Client/Project
Hampton Court
Brookline, MA

07/13/2018

Figure No.
FIGURE 1

Title
USGS Topo Map

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Figure 2 – Aerial Photo

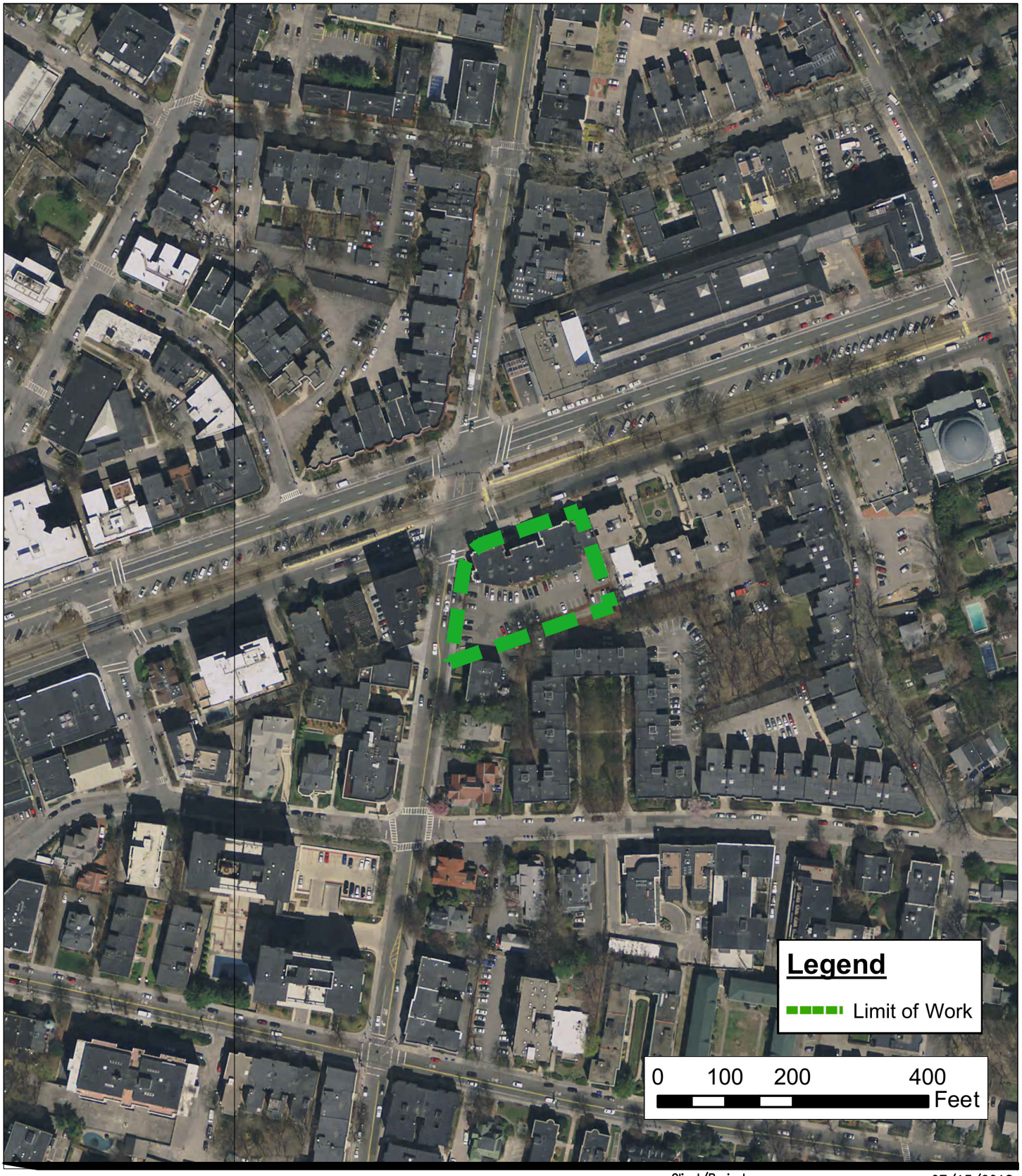

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Figure No.
FIGURE 2

Title
Aerial Photo

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STORMWATER REPORT
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Figure 3 – Soils Map

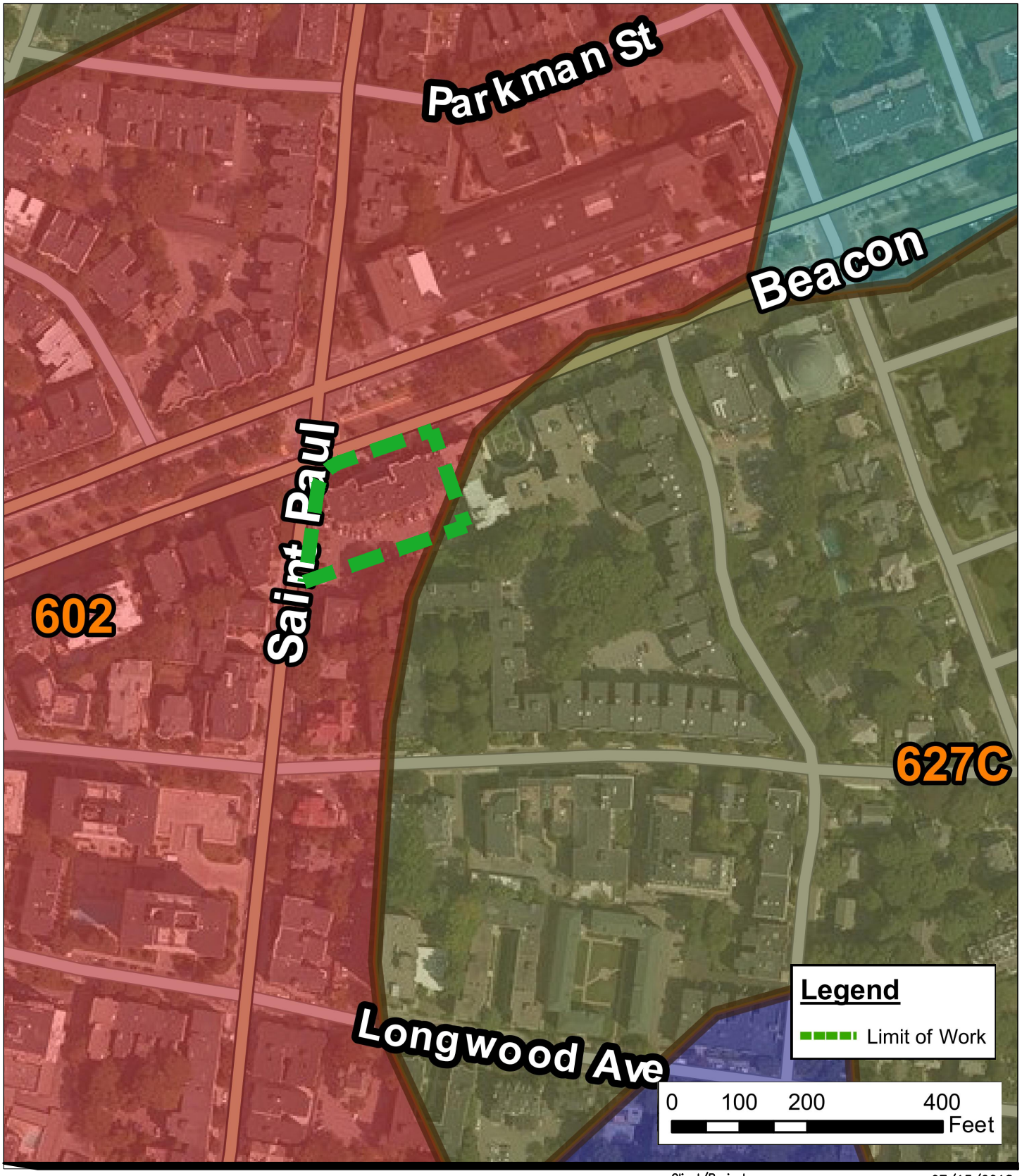

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Figure No.
FIGURE 3

Title
Soils Map

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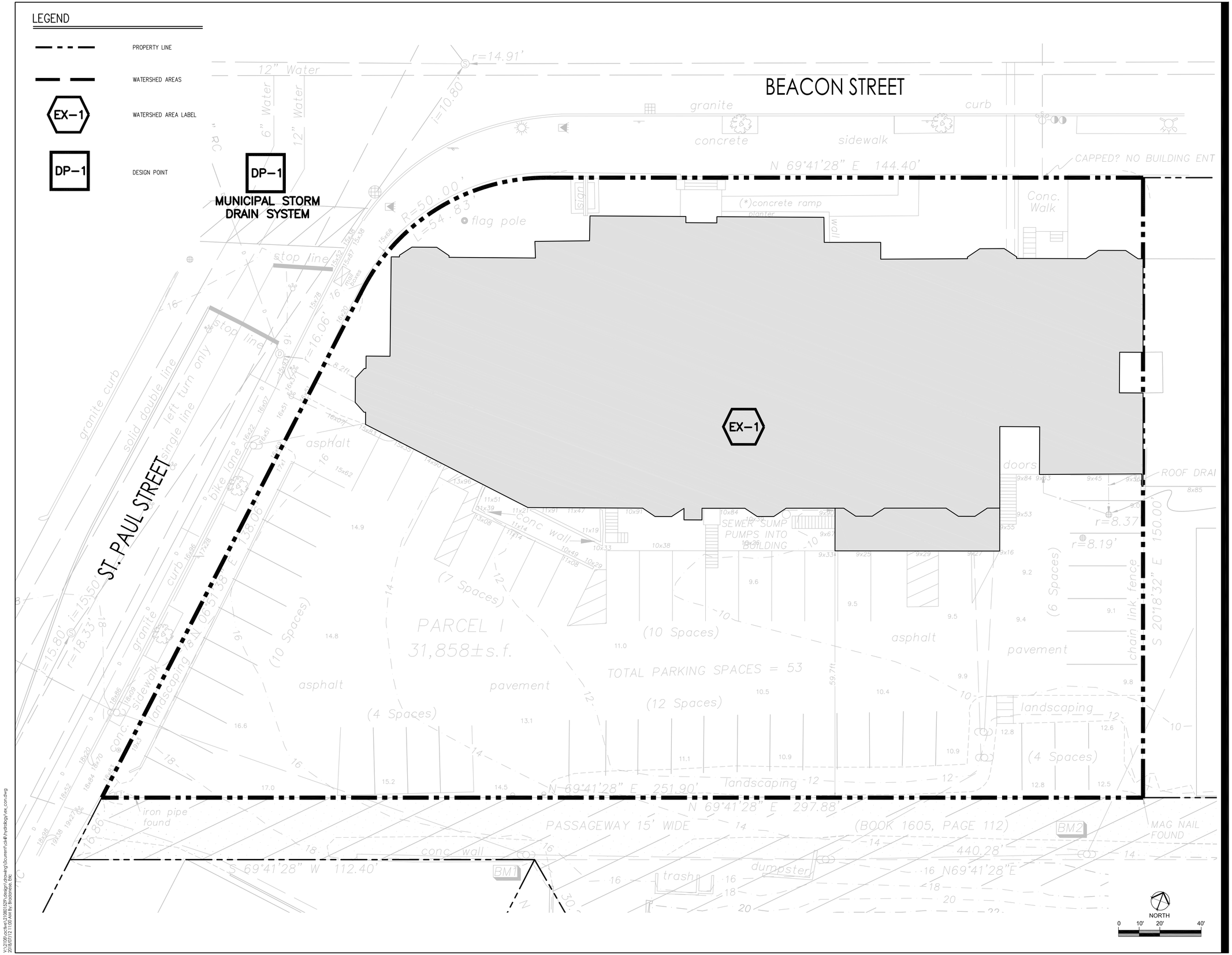
Figure 4 – Existing Watershed Plan



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Notes

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Permit-Seal				

Client/Project
CHESTNUT HILL REALTY

1223 BEACON STREET

BROOKLINE, MA

Title
EXISTING WATERSHED PLAN

Project No. 210801529
Scale AS SHOWN

Sheet
Drawing No.
FIGURE 4.0

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STORMWATER REPORT
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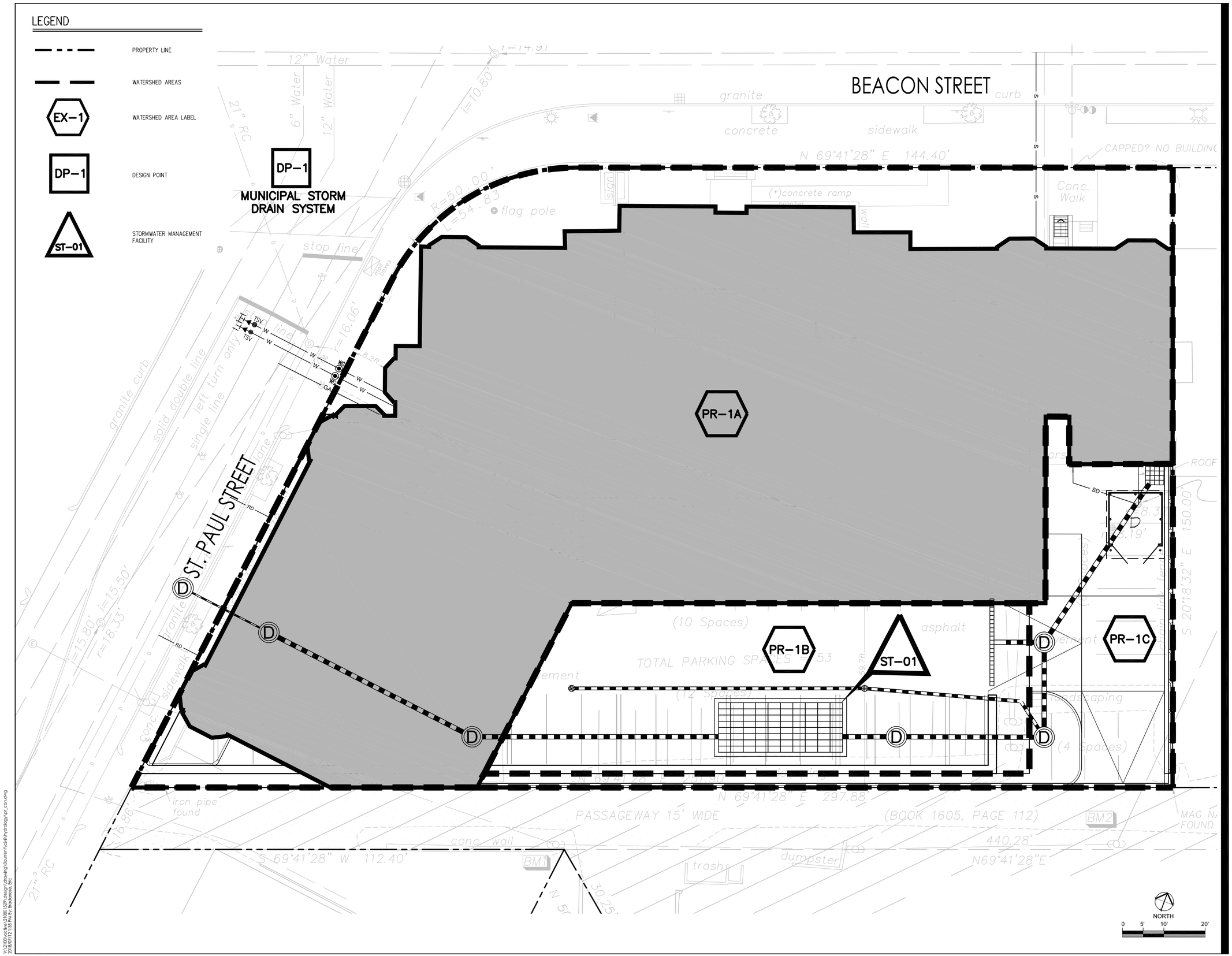
1223 BEACON STREET
BROOKLINE, MASSACHUSETTS

Figure 5 – Proposed Watershed Plan



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Permit-Seal				

Client/Project
CHESTNUT HILL REALTY

1223 BEACON STREET

BROOKLINE, MA

Title
PROPOSED WATERSHED PLAN

Project No. 210801529
Scale AS SHOWN

Sheet
Drawing No.
FIGURE 5.0

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STORMWATER REPORT
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1223 BEACON STREET
BROOKLINE, MASSACHUSETTS

Appendix

STORMWATER REPORT
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BROOKLINE, MASSACHUSETTS

STORMWATER REPORT
HAMPTON COURT APARTMENTS
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BROOKLINE, MASSACHUSETTS

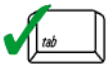
APPENDIX A – MASSACHUSETTS STORMWATER REPORT CHECKLIST AND CERTIFICATION

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature

COMMONWEALTH OF MASSACHUSETTS
FRANK
HOLMES
CIVIL
No. 40203
REGISTERED
PROFESSIONAL ENGINEER

Frank Holmes 7-16-18
Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☐ New development

☒ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☒ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☒ Reduced Impervious Area (Redevelopment Only)
- ☐ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☐ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☐ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☐ Water Quality Swale
- ☐ Grass Channel
- ☐ Green Roof
- ☒ Other (describe): Subsurface detention / infiltration system

Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☐ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☐ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☒ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☐ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

☒ The BMP is sized (and calculations provided) based on:

- ☐ The ½" or 1" Water Quality Volume or
- ☒ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☒ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☐ Critical areas and BMPs are identified in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☒ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☒ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☒ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☒ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☒ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☐ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☐ Description and delineation of public safety features;
- ☐ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☐ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☒ An Illicit Discharge Compliance Statement is attached;

☐ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

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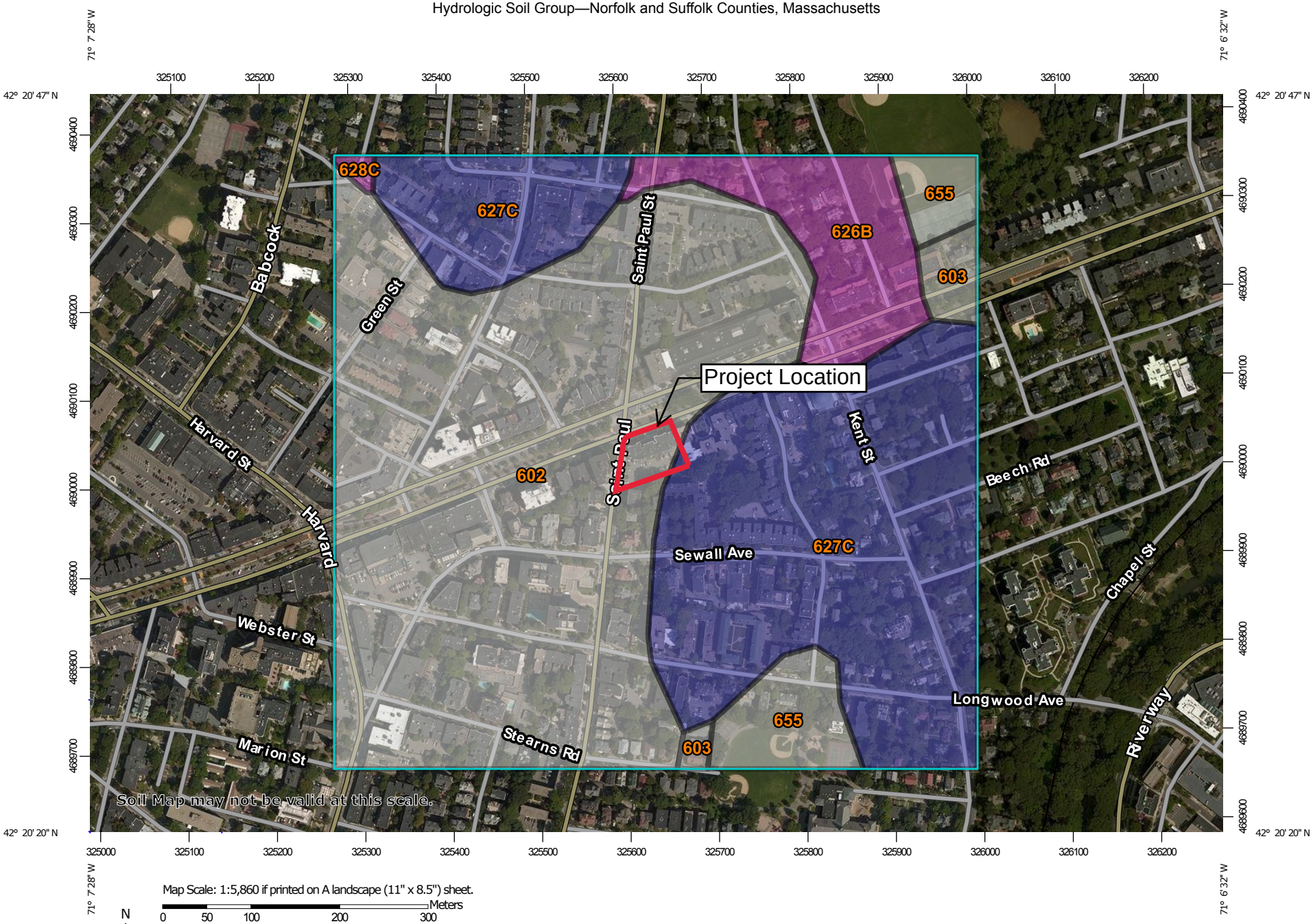
STORMWATER REPORT
HAMPTON COURT APARTMENTS
1223 BEACON STREET
BROOKLINE, MASSACHUSETTS

APPENDIX B – SOILS AND GEOTECHNICAL

- **NRCS WEB SOIL SURVEY MAP**
- **GEOTECHNICAL DATA REPORT (GEOTECHINCAL SERVICES INC.)**

Hydrologic Soil Group—Norfolk and Suffolk Counties, Massachusetts



Map Scale: 1:5,860 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 13, Oct 6, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 10, 2014—Aug 25, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
602	Urban land, 0 to 15 percent slopes		63.6	51.0%
603	Urban land, wet substratum, 0 to 3 percent slopes		1.9	1.6%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	A	9.3	7.4%
627C	Newport-Urban land complex, 3 to 15 percent slopes	B	43.6	34.9%
628C	Canton-Urban land complex, 3 to 15 percent slopes	A	0.3	0.3%
655	Udorthents, wet substratum		6.1	4.9%
Totals for Area of Interest			**124.9**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

GEOTECHNICAL REPORT

1223 BEACON STREET DEVELOPMENT
BROOKLINE, MASSACHUSETTS

June 28, 2018

GSI Project No. 218155

Prepared for:

Mr. Andrew Martineau
Chestnut Hill Realty
300 Independence Drive
Chestnut Hill MA 02467

Prepared by:

Geotechnical Services, Inc.
55 North Stark Highway
Weare, NH 03281

Geotechnical Services Inc.
Geotechnical Engineering ◣ Environmental Studies ◣ Materials Testing ◣ Construction Monitoring

GEOTECHNICAL SERVICES INC.

Geotechnical Engineering | Environmental Studies | Materials Testing | Construction Monitoring

June 28, 2108

Mr. Andrew Martineau
Chestnut Hill Realty
300 Independence Drive
Chestnut Hill MA 02467

RE: Geotechnical Investigation Report
1223 Beacon Street Development
Brookline, MA
GSI Project No. 218155

Dear Mr. Martineau:

Geotechnical Services, Inc. (GSI) is pleased to submit this geotechnical report on the referenced project. The report includes the subsurface data obtained through an exploration program, a geotechnical engineering evaluation of the subsurface data and the observed surface geology in relation to foundation design for the proposed development. The work was undertaken in accordance with the scope of work stated in our proposal dated May 8, 2018 and your subsequent authorization. The content of this report is subject to the attached **Limitations** (Appendix A).

PROJECT UNDERSTANDING

The project site is located at 1223 Beacon Street in Brookline, MA (See Figure 1, Project Locus). We understand that a building addition is planned within the existing parking lot located along the rear of the existing 4-story building. The addition will include a 4-story addition along the rear of the existing building and a 9 to 10-story addition along St Paul Street. Two levels of parking are planned at grade and one level below grade.

The planned building addition is located within the footprint of an existing parking lot along the rear of the building. The grading of the parking lot slopes from roughly east to west with a high point along St Paul St. Existing grades for the site have not been provided to our office at the time this report was prepared.

SUBSURFACE INVESTIGATION

Two test borings, designated as borings B-1 and B-2, were drilled at the site during the period of May 30 to 31, 2018 by Carr-dee Drilling Corporation of Medford, MA under full-time supervision by a GSI engineer. The borings were drilled using a truck -mounted drill rig (Mobile Drill B-53). The test borings were advanced using 3-in. I.D. steel casing and a roller bit to advance the boreholes. The borings were drilled to depths ranging from 27-ft (B-1) to 72-ft (B-2) below the existing grade. The locations of the test borings are shown on Figure 2.

Standard Penetration Tests (SPTs) were performed and split-spoon soil samples were retrieved (ASTM D 1586) generally at the ground surface and subsequently at 5-ft intervals, unless otherwise indicated on the logs. Each soil sample, upon recovery, was observed by the GSI engineer and classified in accordance with the Burmister Classification system. Representative portions of each sample retrieved were saved in glass jars with identification, and delivered to the GSI Soils Laboratory. The samples were re-examined and field classifications were reviewed. The finalized logs for the test borings are included in Appendix C. The soil samples will be stored at the GSI laboratory during the course of the project design-development, and will be shipped to your designated address or discarded upon your notification.

GROUNDWATER MONITORING WELL

A groundwater monitoring well was installed within boring B-1. The well was installed to a depth of 20-ft below the existing grade with a 10-ft of slotted screen and 9.7-ft of riser pipe. The screen and riser consist of 2-in. I.D. PVC pipe. The well is protected with a 6-in. diameter steel manhole cover installed flush to the ground surface. A monitoring well installation report is provided as Appendix C.

30 Newbury Street, Boston, MA 02116 | 617/455/4248 | FAX 617/745/4308
55 N. Stark Highway, Weare, NH 03281 | 603/529/7766 | FAX 603/529/7080

SUBSURFACE CONDITIONS

The subsurface conditions encountered in the investigation indicate that the site is underlain by the following soil units/deposits, described in order of increasing depth:

Asphalt (Surface Deposits): Asphalt pavement was encountered in borings B-1 and B-2. The thickness of the pavement was 2-in.

Fill: Fill soils were encountered in both test borings. The soil unit is generally described as a loose to medium dense, brown, fine SAND with varying amounts of gravel, silt and trace amounts of construction debris (bricks, and). The thickness of the Fill soils was about 10-ft.

Organic Soils: The Organic Soils were encountered in both borings. The thickness of the Organic Soils is 10-ft and is generally described as soft, dark brown, PEAT.

Marine Deposits: The Marine Deposits were encountered in both test borings. The thickness of the Marine Deposits is 26-ft (Boring B-2). The Marine Deposits are generally described a medium stiff to stiff, gray, CLAY or SILT *or* a loose to medium dense, gray, fine to medium SAND with varying amounts gravel, coarse sand and silt.

Glacial Deposits: The Glacial Deposits were encountered from about 46-ft to 72-ft below grade (B-2). The Glacial Till is generally described as a medium dense to dense, gray, fine to coarse SAND and GRAVEL with varying amounts of Silt. Test boring B-2 was terminated within the Glacial Deposits at 72-ft below grade.

Groundwater Conditions

Groundwater level was measured within the completed boreholes and monitoring well which varied from about 9.4-ft (B-1 MW) to 10-ft (B-2) below grade. Groundwater levels should be expected to vary with season, precipitation, snowmelt, construction activities, and other factors. As a result, groundwater levels encountered during construction may differ from those encountered during the explorations.

PRELIMINARY GEOTECHNICAL DESIGN RECOMMENDATIONS

General

As a general guideline, foundation design and construction must conform to the applicable provisions of the Massachusetts Building Code, 9th Edition (Building Code).

Foundation Support

At the time this report was prepared, the column loads for the planned development were not calculated. However, based on the scale of the planned development, we anticipate that 70 to 100 ton (200 kips) capacity (vertical compression) piles will be required for support of the planned column loads.

Given the urban setting and the residential neighborhood surrounding the project site, GSI recommends using Ductile Iron Piles (DIPs) or mini-piles for this project.

Ductile Iron Piles (DIPs)

DIPs are a pre-fabricated driven pile system utilizing high-strength ductile iron pipes that can be designed for end-bearing or skin friction loading conditions.

DIPs can achieve vertical compression loads of about 40 to 50 tons with adequate penetration into the Glacial Deposits underlying the Marine Clay stratum and can achieve 100 tons or more in end bearing. *The higher end-bearing load capacities will need to be verified with deeper test boring data to determine depth to bedrock.*

Pile lengths on the order of 70-ft (not including the pile cap thickness) should be anticipated for the DIPs to support up to 50-ton loads in skin friction. The DIPs will require end bearing support on bedrock to achieve the 100-ton capacities.

Typically, the design of the DIPs are made by the DIP vendor, as such, we recommend that GSI be given the opportunity to review the vendors final design prior to start of construction. Per Massachusetts State Building Code when the design load exceeds 50-tons, one or more static load tests are recommended. GSI recommends conducting at least one load test to verify that the design loads of the DIPs can be supported by the Glacial Deposits.

The use of the DIPs will be more economical than the more traditional piling systems, such as, pre-stressed concrete piles, or steel H-piles. The length of the piles need for the project will make it difficult the deliver the piles to the site due to the urban environment. The footprint of the site would be tight for the equipment needed to install the piles and to store the piles on-site. The higher construction vibrations generated by these pile systems could be a concern for the surrounding residential neighborhood. The likely need for pile splice is eliminated with the use of DIPs.

Minipiles

Minipiles are small diameter piles, generally less than 12-in. in diameter, that are drilled or driven piles, which are composed of grout and steel reinforcement. Minipiles can have design working loads as high as 100 tons depending on the soil or rock conditions. Minipiles are also commonly referred to as micropiles, pin piles, needle piles or root piles, minipiles offer the alternative to conventional piling techniques needed for this project, due to the anticipated restricted access conditions. However, the cost of the minipiles can be more than the DIPs depending on the finalized load requirements.

For preliminary design, we recommend that a 50-ton design capacity be considered. We anticipate that the minipiles will require a 20-ft minimum bond length within the Glacial Deposits which will require minipiles lengths on the order of 65-ft below the existing grade. We anticipate that the minipiles may need to be post grouted to achieve the design capacity. Higher capacity minipiles could be designed if socketed into bedrock. GSI recommends conducting at least one load test to verify that the design loads of the minipiles can be supported by the Glacial Deposits.

Floor Slab

We recommend that the floor slab consist of a structural slab supported by grade beams and piles.

Design Groundwater Level

Based on the available groundwater level data, groundwater should be anticipated 9-ft below existing grade.

Seismic Design Input

Seismic design parameters for the proposed facilities at the project site have been obtained from Commonwealth of Massachusetts, State Building Code, Eighth Edition, 2010. Ground motion parameters at the project site (i.e., the design earthquake for the subject facility) are represented by S_s, 0.2 sec. (short period) Spectral Acceleration, and S_1, 1.0-second period Spectral Acceleration.

These parameters have been obtained as:

$S_s = 0.211$ g

$S_1 = 0.068$ g

Site Class for the project site has been established as "Stiff soil profile" with the designation **Site Class D**. Site Coefficient for the Short Period has been established as $F_a = 1.6$, and Site Coefficient for the 1-sec Period has been established as $F_v = 2.4$. Parameters F_a, and F_v relate to the potential amplification of the earthquake induced shear stress waves traveling upward through the soil-rock profile underlying the project site. The soils within the project site are not considered liquefaction susceptible.

Foundation Drainage

We recommend that perimeter drainage be provided where the adjacent lowest floor slab is 2-ft or deeper below adjacent exterior finished grade. Such drainage systems should be provided at exterior walls and walls between differing floor levels beneath the buildings.

The perimeter foundation drainage should consist of a free-draining material against the wall and a drainage "pipe" at the wall base to collect and transmit the water. For installation convenience and cost-efficiency, we recommend that a prefabricated drainage board product, such as Amerdrain 200 by the American Wick Drain Company (AWDC), be applied to the exterior walls from the level 2-ft below ground surface down to the drainage "pipe." The drainage board should connect at its base to a "high-profile sheet drain section" (such as Amerdrain Total-Drain System by AWDC) or to a 4-in. diameter continuous perforated PVC or corrugated HDPE perforated drainpipe.

If a drain pipe is used, it should be completely surrounded by a 6-in. (min.) thick zone of drainage fill (1/2-in. sized crushed stone) which in turn is completely surrounded by a non-woven filter fabric to avoid potential clogging due to migration of fine soils into the drainage system. The crushed stone should be placed in contact with the drainage board against the wall in accordance with manufacturer's details. Drainpipe inverts should be between the bottom of footing and 6-in. beneath the elevation of the adjacent building floor. Pipes should be pitched nominally toward the system discharge points (slope 0.25 to 0.10 percent). Perforations in the drainpipe should be positioned downward. Foundation drainage system discharge should be directed to the site storm water collection system.

Determination for the Underslab drainage systems should be evaluated once the ground floor elevation has been established.

Below-grade walls should be damp proofed and insulated in according with the Building Code. Elevator pits and other small depressions below the lowest floors should be water proofed and designed to resist hydrostatic pressures. Vapor barriers are recommended beneath the floor slab. Use of vapor barriers should be coordinated with the Structural Engineer for slab design and construction.

To limit the water infiltration around the proposed structure, it is recommended that the upper twelve inches of backfill within approximately 10-ft of the building in unpaved but landscaped areas should consist of silty topsoil or other soils having a relatively low permeability. In general, the ground surface immediately around buildings should be sloped downward and away from the structures to direct surface runoff.

Lateral Earth Pressures

Building (exterior below grade) walls are restrained and, therefore, should be designed as a **non-yielding** structure. Surcharge loads should be considered where they are located within a horizontal distance equal to 1.5 times the height of the wall.

	Non-yielding
Static Lateral Earth Pressure:	60 pcf
(Native soil or lightly compacted structural fill as an equivalent fluid unit weight)	
Traffic Surcharge:	120 psf
(Distributed uniformly over the height of the wall)	

Seismic Forces: Per Section 1610.2 of the Building Code, exterior foundation walls and retaining walls shall be designed to resist an earthquake force, F_w, for horizontal backfill surface equal to:

$$F_w = 0.100(S_s)(F_a)(\gamma_t)(H)^2$$

where: S_s is the 0.2 sec. (short period) Spectral Acceleration,

F_a is the site coefficient for the Short Period,
γ_t is the total unit weight of the soil (backfill), and
H is the height of the wall measured as the difference in elevation of the finished ground surface or floor in front of and behind the wall.

For design, a soil unit weight (γ_t) of 125 pcf may be used.

Note: H (ft) is the height of the backfilled wall above the top of the footing or from the bottom of wall to the top level of retained soil.

CONSTRUCTION CONSIDERATIONS

General

This section of the report discusses geotechnical construction related issues to provide guidance to those responsible for preparing construction contract documents. Prospective contractors should evaluate construction issues on the

basis of their own experience, similar projects in other localities and by taking into account their own construction methods.

Excavation

Temporary earth cuts should be stable if constructed no steeper than about 1.5H: 1V. Some sloughing and raveling should be anticipated in temporary slopes.

All temporary sloping, benching, excavation support, and excavation activities must conform to the requirements of OSHA and all other applicable local, municipal, state, and federal regulations. The soils at the project site are classified as Type C based on OSHA 29 CFR Part 1926.

Temporary Excavation Support

A temporary earth support system will likely be required to maintain the adjacent sidewalks and roadways. Temporary excavation support is typically designed by the Contractor (Massachusetts, P.E., stamped) and submitted to the Architect/Owner's Representative for review and approval prior to construction. Maintaining the integrity of the existing adjacent structures, including utilities during construction is a requirement for the Contractor. Excavation support design and implementation shall also meet OSHA requirements.

Construction Dewatering

Based on the available subsurface data it is anticipated that during the general site work, dewatering measures may be necessary to conduct the construction "in-the-dry." It is anticipated that some dewatering will be necessary for the excavation and placement of the pile caps due to the anticipated shallow groundwater conditions. In addition, the Contractor should take measures to prevent storm water to enter into excavated areas, and be prepared to remove ponded surface water by means of localized sumps and pumps. A lift of crushed stone at excavation grade may be desired to facilitate dewatering during construction and provide stable subgrades for foundation construction. The Contractor should select whichever dewatering procedures may be effective to maintain dry, stable excavation bottoms.

RECOMMENDATIONS FOR ADDITIONAL SUBSURFACE DATA

The preliminary design recommendations provided in this report are based on limited subsurface information and assumed design load for the building. Higher pile capacities are anticipated within the footprint of the planned 9 to 10-story addition, it may be more economical to conduct additional test borings to determine the depth to bedrock and collect rock cores. GSI recommends that additional deep test borings be conducted at the site once the design loads for the building have been finalized and reviewed by our office.

CLOSURE

GSI appreciates the opportunity for participating in this project, and looks forward to our continuing association during its subsequent phases towards its successful completion. In the mean time, please do not hesitate to contact us, if you have any questions on the content of this report.

Very truly yours,
GEOTECHNICAL SERVICES, INC.

Glen V. Zoladz, P.E.
Project Manager

Harry K. Wetherbee, P.E.
Principal Engineer

Figure 1. Project Locus

Figure 2. Exploration Location Plan

Appendix A Limitations

Appendix B Test Boring Logs

Appendix C Monitoring Well Installation Report

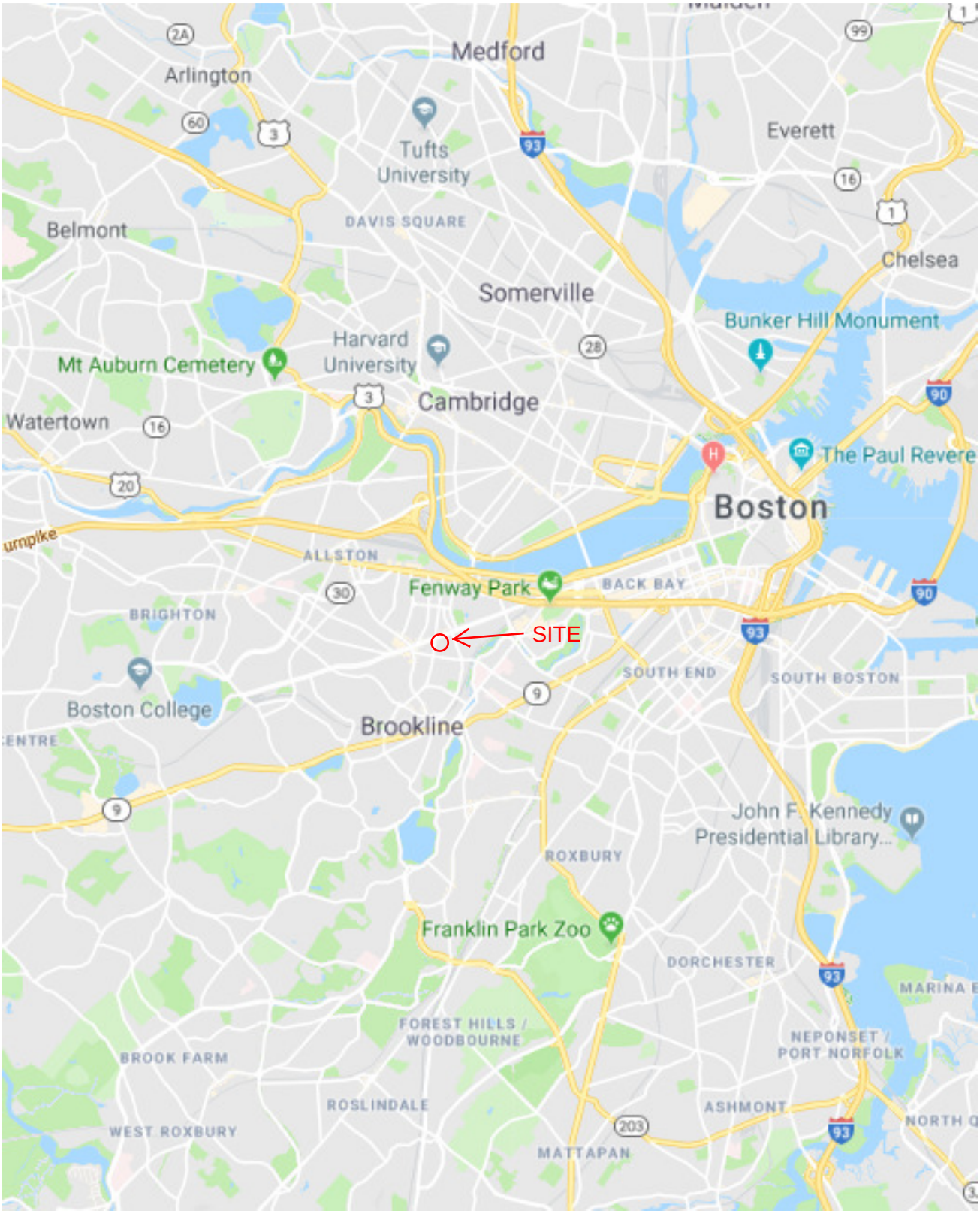
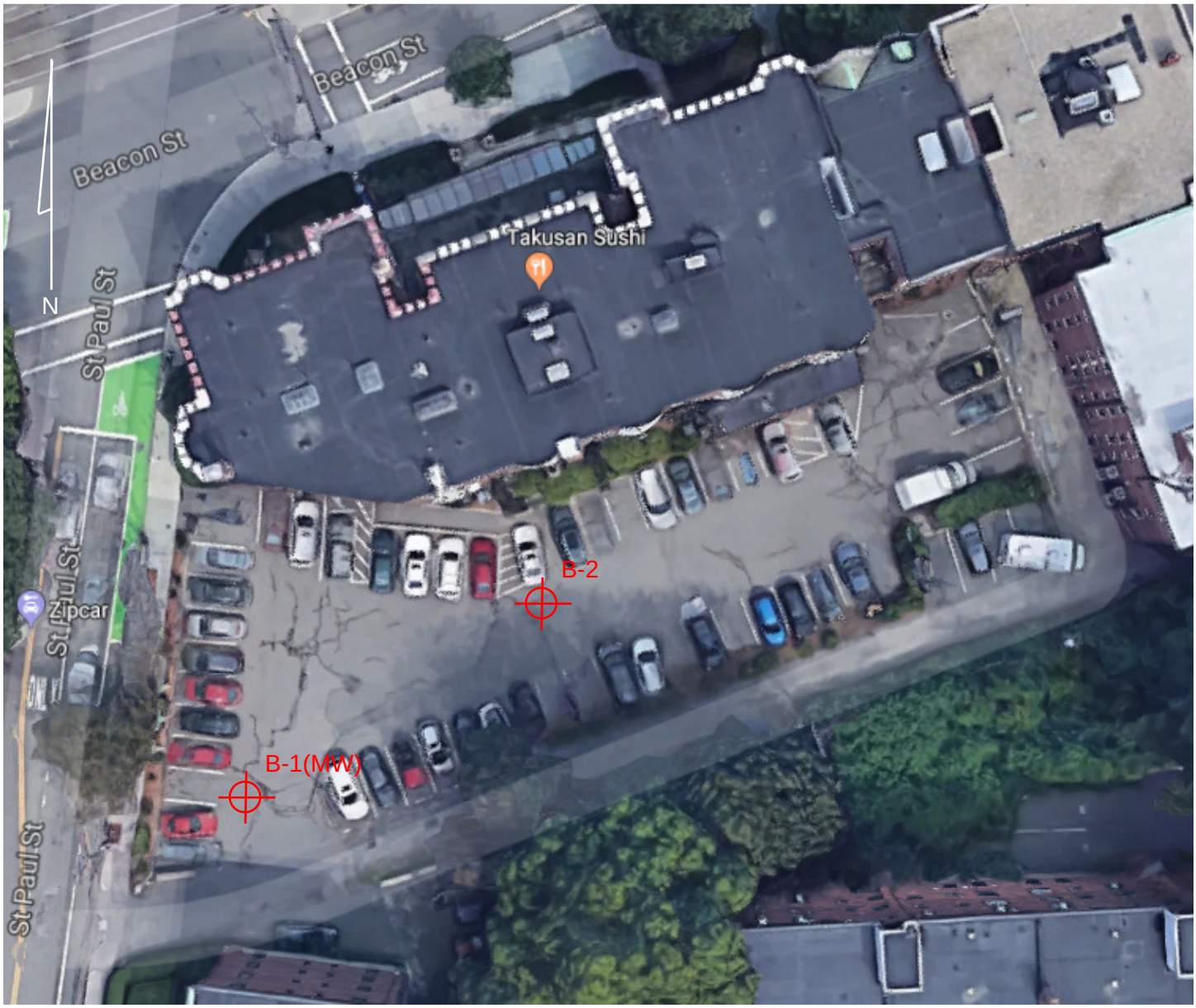


FIGURE 1–PROJECT LOCUS

1223 BEACON STREET
BROOKLINE, MA
GSI PROJECT NO. 218155



SCALE: NOT TO SCALE

B-1(MW)
TEST BORING I.D. AND APPROXIMATE LOCATION

(MW) GROUNDWATER MONITORING WELL INSTALLED IN COMPLETED BOREHOLE

GSI

FIGURE 2–EXPLORATION LOCATION PLAN

1223 BEACON STREET
BROOKLINE, MA
GSI PROJECT NO. 218155

APPENDIX A

LIMITATIONS

LIMITATIONS

Explorations

1. The analyses, recommendations and designs submitted in this report are based in part upon the data obtained from preliminary subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report.

2. The generalized soil profile described in the text is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretation of widely spaced explorations and samples; actual soil transitions are probably more gradual. For specific information, refer to the individual test pit and/or boring logs.

3. Water level readings have been made in the test pits and/or test borings under conditions stated on the logs. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, and other factors differing from the time the measurements were made.

Review

4. It is recommended that this firm be given the opportunity to review final design drawings and specifications to evaluate the appropriate implementation of the recommendations provided herein.

5. In the event that any changes in the nature, design, or location of the proposed areas are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of the report modified or verified in writing by Geotechnical Services, Inc.

Construction

6. It is recommended that this firm be retained to provide geotechnical engineering services during the earthwork phases of the work. This is to observe compliance with the design concepts, specifications, and recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

Use of Report

7. This report has been prepared for the exclusive use of Chestnut Hill Realty in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

8. This report has been prepared for this project by Geotechnical Services, Inc. This report was completed for preliminary design purposes and may be limited in its scope to complete an accurate bid. Contractors wishing a copy of the report may secure it with the understanding that its scope is limited to evaluation considerations only.

APPENDIX B

TEST BORING LOGS

TEST BORING LOG

Boring No. **B-1 (MW)**

Project	1223 Beacon Street	Project No.	218155	Elevation	N/A
Location	Brookline, MA	Inspector	G. Zoladz	Datum	See Plan
Client	Chestnut Hill Realty	Project Manager	G. Zoladz	Start	5/30/2018
Contractor	Carr Dee Drilling	Checked By		Finish	5/30/2018
Driller	S. DeSimmone	Drill Rig	Mobile Drill	Model	B-53

Item:	Auger	Casing	Sampler	Core Barrel
Type	-	NW	S	-
Inside Diameter (in.)	-	3	1.375	-
Hammer Weight (lb)	-	300	140	
Hammer Fall (in.)	-	24	30	

☑ Truck ☐ Skid
☐ Track ☐ ATV
☐ Bomb. ☐ Geophone
☐ Tripod ☐ Other

Hammer Type:
☑ Safety Hammer
☐ Doughnut
☐ Automatic

☐ Winch ☑ Cat Head ☑ Roller Bit ☐ Cutting Head

Depth (ft)	Casing (Blows/ft)	Sample No.	Sample Depth (ft)	Rec. (in.)	SPT (Blows/ 6-in.)	Rock RQD (%)	PID Rdg. (ppm)	Stratum Change (ft)	Soil-Rock Visual Classification and Description (Soils - Burmister System) (Rock - U.S. Corps of Engineers System)
0									1.5-in. Pavement
		S1	0.5-2.5	10	4 6 6 7				M. dense, br., fine SAND, tr. gravel, m-sand
									-FILL-
5		S2	5-7	6	2 2 2 2				Loose, br., fine SAND, little gravel, m-sand
								~10	
10		S3	10-12	10	2 3 1 3				Soft, dark brown, PEAT
									-ORGANIC DEPOSITS-
15		S4	15-17	24	1 1 2 2				Soft, dark brown, PEAT
								~20	
20		S5	20-22	20	8 6 7 7				M. dense, br./gr., fine SAND, little silt
									-MARINE DEPOSITS-
25									

Water Level Data

Date	Time	Depth (ft) to: Bott. of Casing	Bott. of Hole	Water
30-May	-	-	-	~14
31-May	-	Well	Well	~9.4

Sample Identification
O = Open Ended
U = Undisturbed
S = Split Spoon
C = Rock Core
G = Geoprobe

Cohesive Soils N-Value
0 to 2: Very Soft
2 to 4: Soft
4 to 8: Medium Stiff
8 to 15: Stiff
15 to 30 Very Stiff
Over 30: Hard

Granular Soils N- Value
0 to 4: Very Loose
4 to 10: Loose
11 to 30: Medium Dense
31 to 50: Dense
Over 50: Very Dense

Trace (0 to 5%), Little (10 to 20%), Some (20 to 35%), And (35 to 50%)

Notes: Maurice Pump Station Location

B-1 (MW)

Geotechnical Services, Inc. " 55 North Stark Highway Tel. 603.529.7766 Fax. 603.529.7080 " 30 Newbury Street, Boston, MA 02116 Tel. 617.455.4248 Fax. 617.745.4308

TEST BORING LOG

Boring No.
B-1 (MW)

Project	1223 Beacon Street	GSI Project No.	218155	Date Started	05/30/18
Location	Brookline, MA	Inspector	G. Zoladz	Date Finished	05/30/18

Depth (ft)	Casing (Blows/ft)	Sample Data No.	Depth (ft)	Rec (in.)	SPT (Bl./ 6-in.)	Rock RQD (%)	PID Rdg. (ppm)	Stratum Change (ft)	**Soil-Rock Visual Classification and Description** (Soils - Burmister System) (Rock - U.S. Corps of Engineers System)
25		S6	25-27	20	4 4 4 5				M. stiff, gr., SILT
									Bottom of Exploration at 27-ft. Groundwater monitoring well installed in completed borehole.
30									
35									
40									
45									
50									
55									
60									

Notes:

Geotechnical Services, Inc. " 55 North Stark Highway Tel. 603.529.7766 Fax. 603.529.7080 " 30 Newbury Street, Boston, MA 02116 Tel. 617.455.4248 Fax. 617.745.4308

TEST BORING LOG

Boring No. B-2

Project	1223 Beacon Street	Project No.	218155	Elevation	N/A
Location	Brookline, MA	Inspector	G. Zoladz	Datum	See Plan
Client	Chestnut Hill Realty	Project Manager	G. Zoladz	Start	5/30/2018
Contractor	Carr Dee Drilling	Checked By		Finish	5/31/2018
Driller	S. DeSimmone	Drill Rig	Mobile Drill	Model	B-53

Item:	Auger	Casing	Sampler	Core Barrel
Type	-	NW	S	-
Inside Diameter (in.)	-	3	1.375	-
Hammer Weight (lb)	-	300	140	
Hammer Fall (in.)	-	24	30	

☑ Truck ☐ Skid
☐ Track ☐ ATV
☐ Bomb. ☐ Geophone
☐ Tripod ☐ Other

Hammer Type:
☑ Safety Hammer
☐ Doughnut
☐ Automatic

☐ Winch ☑ Cat Head ☑ Roller Bit ☐ Cutting Head

Depth (ft)	Casing (Blows/ft)	Sample No.	Depth (ft)	Rec. (in.)	SPT (Blows/ 6-in.)	Rock RQD (%)	PID Rdg. (ppm)	Stratum Change (ft)	Soil-Rock Visual Classification and Description (Soils - Burmister System) (Rock - U.S. Corps of Engineers System)
0									2-in. Pavement
		S1	0.5-2.5	12	5 4 3 2				Loose, gr./br., silty fine SAND, little gravel, trace concrete bricks
									-FILL-
5		S2	5-7	8	3 3 6 5				Loose, br., silty fine SAND, little gravel, trace m/c sand
								~10	
10		S3	10-12	8	6 3 4 4				M. stiff, br., PEAT
									-ORGANIC DEPOSITS-
15		S4	15-17	6	2 1 2 1				Soft, dark brown, PEAT, little wood fibers
								~20	
20		S5	20-22	3	5 3 6 6				Loose, gr., f/m SAND, little gravel, c-sand, silt
									-MARINE DEPOSITS-
25									

Water Level Data

Date	Time	Depth (ft) to: Bott. of Casing	Bott. of Hole	Water
31-May	-	-	-	~10

Sample Identification
O = Open Ended
U = Undisturbed
S = Split Spoon
C = Rock Core
G = Geoprobe

Cohesive Soils N-Value
0 to 2: Very Soft
2 to 4: Soft
4 to 8: Medium Stiff
8 to 15: Stiff
15 to 30 Very Stiff
Over 30: Hard

Granular Soils N- Value
0 to 4: Very Loose
4 to 10: Loose
11 to 30: Medium Dense
31 to 50: Dense
Over 50: Very Dense

Trace (0 to 5%), Little (10 to 20%), Some (20 to 35%), And (35 to 50%)

Notes: Maurice Pump Station Location

Geotechnical Services, Inc. " 55 North Stark Highway Tel. 603.529.7766 Fax. 603.529.7080 " 30 Newbury Street, Boston, MA 02116 Tel. 617.455.4248 Fax. 617.745.4308

TEST BORING LOG

Boring No. **B-2**

Project	1223 Beacon Street	GSI Project No.	218155	Date Started	05/30/18
Location	Brookline, MA	Inspector	G. Zoladz	Date Finished	05/31/18

Depth (ft)	Casing (Blows/ft)	Sample No.	Sample Depth (ft)	Rec (in.)	SPT (Bl./ 6-in.)	Rock RQD (%)	PID Rdg. (ppm)	Stratum Change (ft)	Soil-Rock Visual Classification and Description (Soils - Burmister System) (Rock - U.S. Corps of Engineers System)
25		S6	25-27	14	14 8 10 11				M. dense, gr., silty, f/m SAND, some coarse sand, little gravel
30		S7	30-32	14	9 8 5 5				Stiff, gr., CLAY
									-MARINE DEPOSITS-
35		S8	35-37	18	9 4 5 10				Stiff, gr., CLAY with layers of fine sand
40		S9	40-42	24	8 8 8 11				M. dense, gr., f/m SAND, occasional seams of clay
45		S10	45-47	12	23 8 9 5				M. dense, gr., silty f/m SAND, little gravel, c-sand
									-GLACIAL DEPOSITS-
50		S11	50-52	12	20 15 19 14				Dense, gr., f/c SAND and GRAVEL, some silt
55									**-GLACIAL DEPOSITS-**
60									

Notes:

Geotechnical Services, Inc. " 55 North Stark Highway Tel. 603.529.7766 Fax. 603.529.7080 " 30 Newbury Street, Boston, MA 02116 Tel. 617.455.4248 Fax. 617.745.4308

TEST BORING LOG

Boring No. **B-2**

Project	1223 Beacon Street	GSI Project No.	218155	Date Started	05/30/18
Location	Brookline, MA	Inspector	G. Zoladz	Date Finished	05/31/18

Depth (ft)	Casing (Blows/ft)	Sample Data No.	Depth (ft)	Rec (in.)	SPT (Bl./ 6-in.)	Rock RQD (%)	PID Rdg. (ppm)	Stratum Change (ft)	**Soil-Rock Visual Classification and Description** (Soils - Burmister System) (Rock - U.S. Corps of Engineers System)
60		S12	60-62	18	20 18 13 12				Dense, br., f/c SAND and GRAVEL, little to tr. silt
65									**-GLACIAL DEPOSITS-**
70		S13	70-72	20	12 11 13 10				M. dense, br., f/c SAND and GRAVEL, little to tr. silt
									Bottom of Exploration at 72-ft.
75									
80									
85									
90									
95									

Notes:

Geotechnical Services, Inc. " 55 North Stark Highway Tel. 603.529.7766 Fax. 603.529.7080 " 30 Newbury Street, Boston, MA 02116 Tel. 617.455.4248 Fax. 617.745.4308

APPENDIX C

MONITORING WELL INSTALLATION REPORT

MONITORING WELL INSTALLATION REPORT

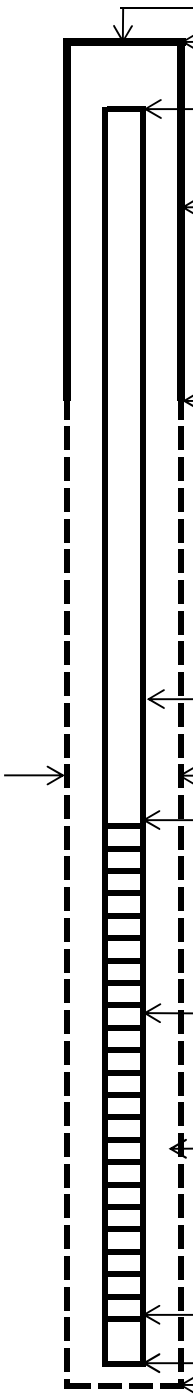
Well No.
B-1 (MW)
Boring No.
B-1 (MW)

Project	1223 Beacon Street	**Project No.**	218155
Location	Brookline, MA	**Project Manager**	G. Zoladz
Client	Chestnut Hill Realty	**Inspector**	G. Zoladz
Contractor	Carr-Dee Corp.	**Date Installed**	5/30/18
Driller	S. DeSimmone	**Water Level**	~14

Ground El.	N/A	**Location** See Plan	☐ Guard Pipe
El. Datum	N/A		☑ Roadway Box

SOIL/ROCK CONDITIONS	BOREHOLE BACKFILL

(Bottom of Exploration)
(Numbers refer to depth below ground surface in feet)



Type of protective cover/lock	Roadway box	
Height/depth of top of riser pipe/ roadway box above/below ground surface	0 (Flush)	ft
Height/depth of top of riser above/below ground surface	~0.3	ft
Type of protective casing:	Steel	
Length:	1	ft
Inside diameter	6	in.
Depth to bottom of guard pipe/ roadway box	1	ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0	0.5
Bentonite Chips	3	1

Type of riser:	PVC	
Inside diameter of riser	2	in.
Type of backfill around riser	Drill cuttings	
Diameter of borehole	4	in.
Depth to top of well screen	10	ft
Type of screen	Slotted PVC	
Screen gauge or size of opening	0.001	in.
Diameter of screen	2	in.
Type of backfill around screen	Filter sand	
Depth to bottom of screen	20	ft
Bottom of silt trap	N/A	ft
Depth to bottom of borehole	27	ft

(Not to Scale)

Comments

Geotechnical Services, Inc. " 55 North Stark Highway Tel. 603.529.7766 Fax. 603.529.7080 " 30 Newbury Street, Boston, MA 02116 Tel. 617.455.4248 Fax. 617.745.4308

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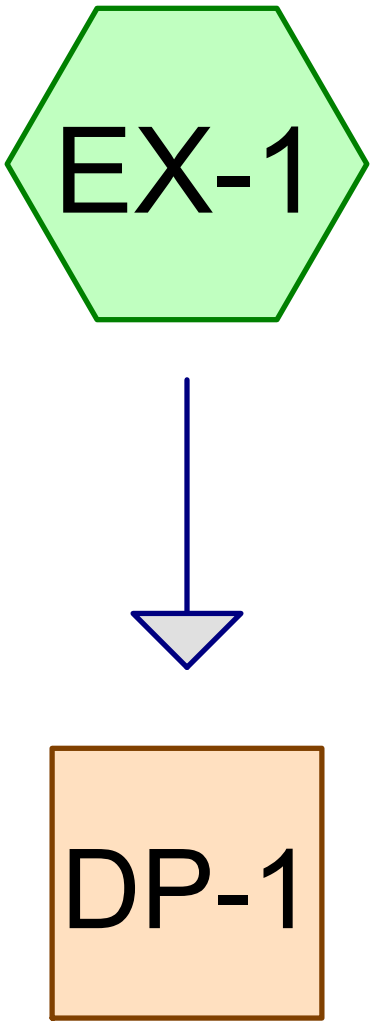
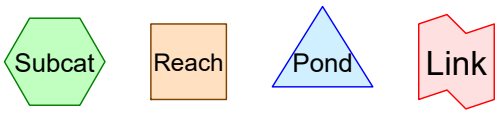
STORMWATER REPORT
HAMPTON COURT APARTMENTS
1223 BEACON STREET
BROOKLINE, MASSACHUSETTS

APPENDIX C – EXISTING CONDITIONS HYDROCAD CALCULATIONS



Municipal Drainage System



Routing Diagram for Existing Hydrologic Analysis
Prepared by Stantec Consulting Ltd., Printed 7/12/2018
HydroCAD® 10.00-20 s/n 02809 © 2017 HydroCAD Software Solutions LLC

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.098	0.000	0.000	0.000	0.098	>75% Grass cover, Good	EX-1
0.000	0.000	0.000	0.000	0.368	0.368	Impervious Area	EX-1
0.000	0.000	0.000	0.000	0.266	0.266	Roof	EX-1
0.000	**0.098**	**0.000**	**0.000**	**0.633**	**0.731**	**TOTAL AREA**	

Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-1: Runoff Area=31,857 sf 86.62% Impervious Runoff Depth>2.44"
Tc=6.0 min CN=93 Runoff=2.03 cfs 0.149 af

Reach DP-1: Municipal Drainage System Inflow=2.03 cfs 0.149 af
Outflow=2.03 cfs 0.149 af

Total Runoff Area = 0.731 ac Runoff Volume = 0.149 af Average Runoff Depth = 2.44"
13.38% Pervious = 0.098 ac 86.62% Impervious = 0.633 ac

Summary for Subcatchment EX-1:

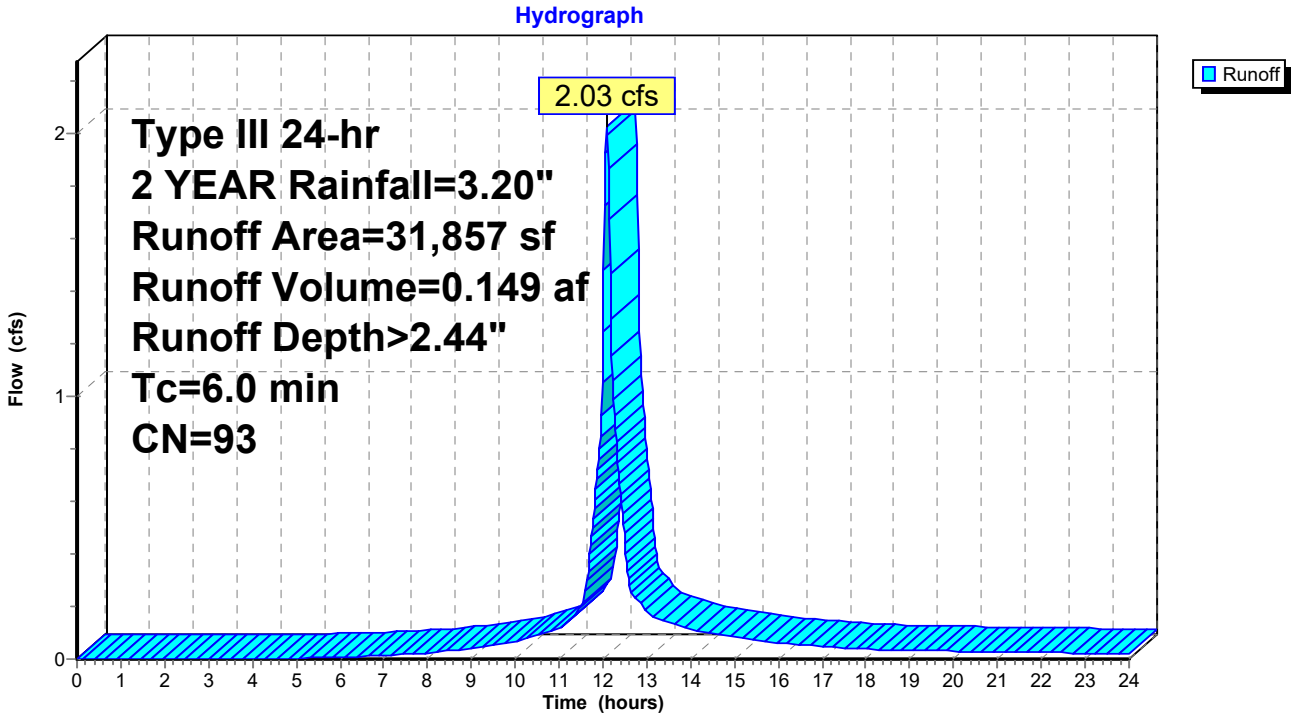
Runoff = 2.03 cfs @ 12.09 hrs, Volume= 0.149 af, Depth> 2.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YEAR Rainfall=3.20"

	Area (sf)	CN	Description
	4,264	61	>75% Grass cover, Good, HSG B
*	16,010	98	Impervious Area
*	11,583	98	Roof
	31,857	93	Weighted Average
	4,264		13.38% Pervious Area
	27,593		86.62% Impervious Area

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

Subcatchment EX-1:

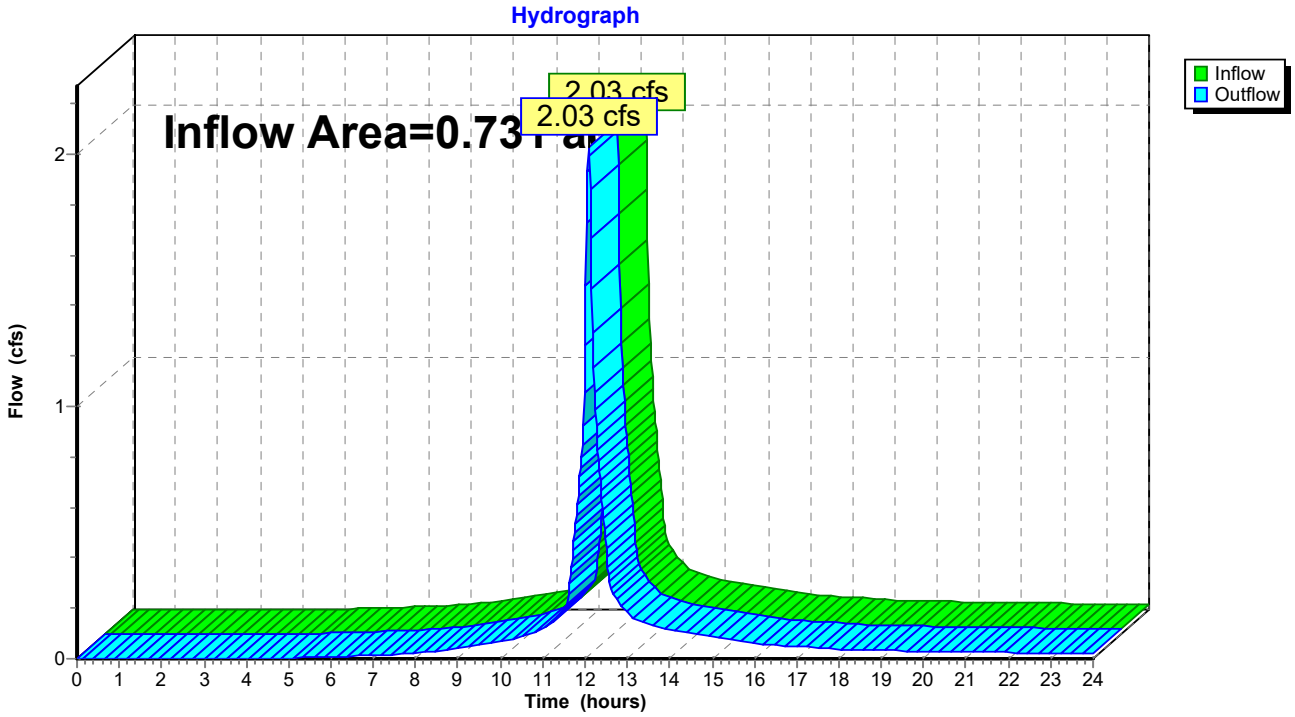


Summary for Reach DP-1: Municipal Drainage System

Inflow Area = 0.731 ac, 86.62% Impervious, Inflow Depth > 2.44" for 2 YEAR event
Inflow = 2.03 cfs @ 12.09 hrs, Volume= 0.149 af
Outflow = 2.03 cfs @ 12.09 hrs, Volume= 0.149 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach DP-1: Municipal Drainage System



Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-1: Runoff Area=31,857 sf 86.62% Impervious Runoff Depth>3.80"
Tc=6.0 min CN=93 Runoff=3.08 cfs 0.232 af

Reach DP-1: Municipal Drainage System Inflow=3.08 cfs 0.232 af
Outflow=3.08 cfs 0.232 af

Total Runoff Area = 0.731 ac Runoff Volume = 0.232 af Average Runoff Depth = 3.80"
13.38% Pervious = 0.098 ac 86.62% Impervious = 0.633 ac

Summary for Subcatchment EX-1:

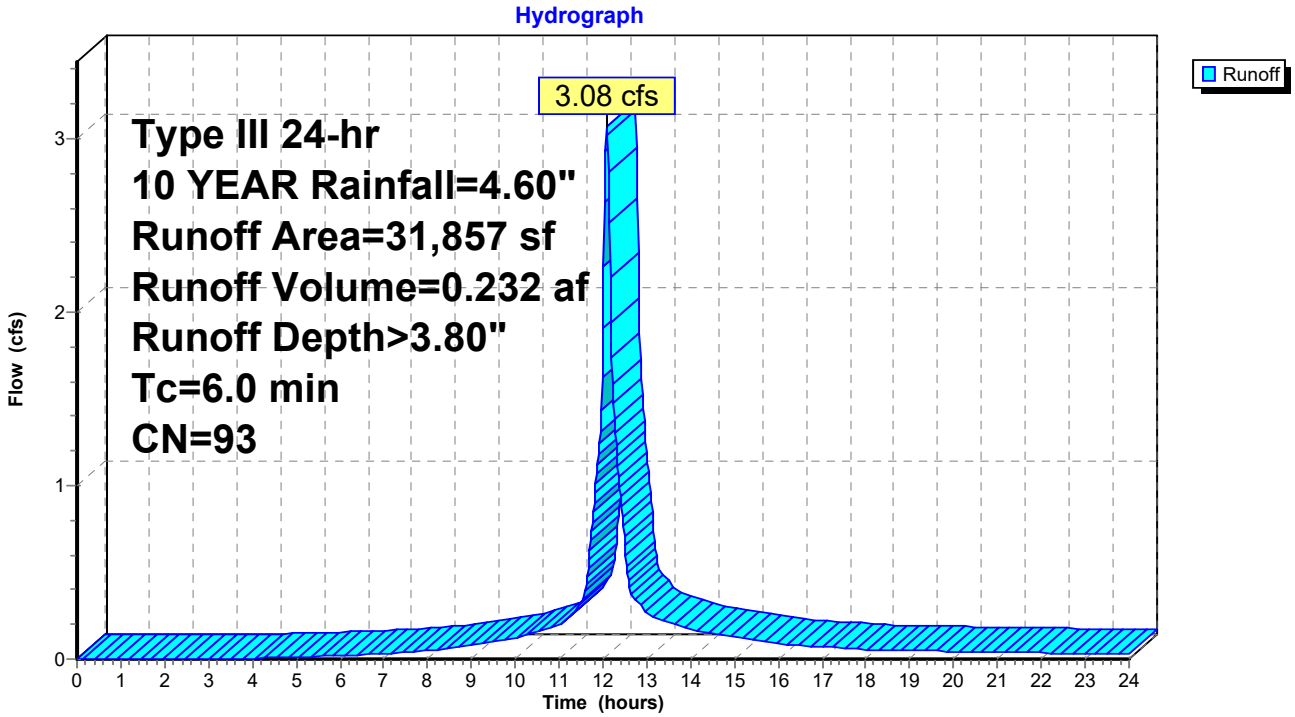
Runoff = 3.08 cfs @ 12.08 hrs, Volume= 0.232 af, Depth> 3.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YEAR Rainfall=4.60"

	Area (sf)	CN	Description
	4,264	61	>75% Grass cover, Good, HSG B
*	16,010	98	Impervious Area
*	11,583	98	Roof
	31,857	93	Weighted Average
	4,264		13.38% Pervious Area
	27,593		86.62% Impervious Area

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

Subcatchment EX-1:

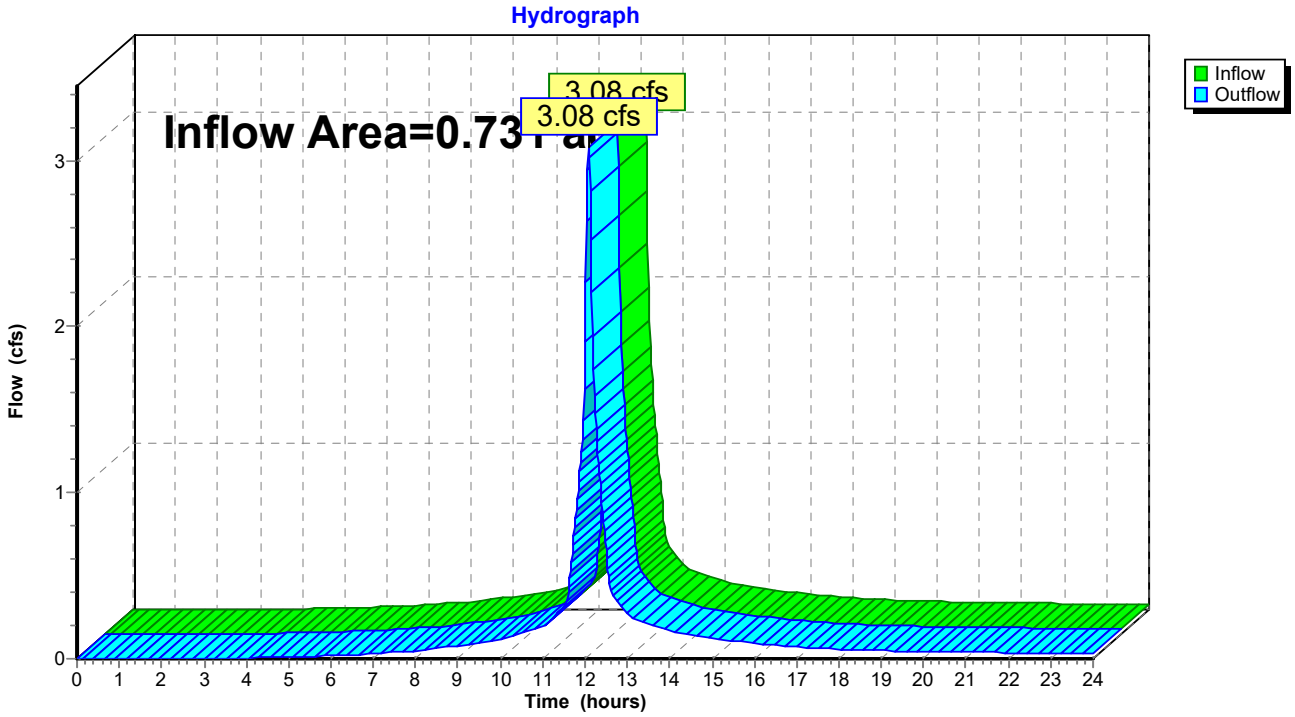


Summary for Reach DP-1: Municipal Drainage System

Inflow Area = 0.731 ac, 86.62% Impervious, Inflow Depth > 3.80" for 10 YEAR event
Inflow = 3.08 cfs @ 12.08 hrs, Volume= 0.232 af
Outflow = 3.08 cfs @ 12.08 hrs, Volume= 0.232 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach DP-1: Municipal Drainage System



Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-1: Runoff Area=31,857 sf 86.62% Impervious Runoff Depth>5.87"
Tc=6.0 min CN=93 Runoff=4.64 cfs 0.358 af

Reach DP-1: Municipal Drainage System Inflow=4.64 cfs 0.358 af
Outflow=4.64 cfs 0.358 af

Total Runoff Area = 0.731 ac Runoff Volume = 0.358 af Average Runoff Depth = 5.87"
13.38% Pervious = 0.098 ac 86.62% Impervious = 0.633 ac

Summary for Subcatchment EX-1:

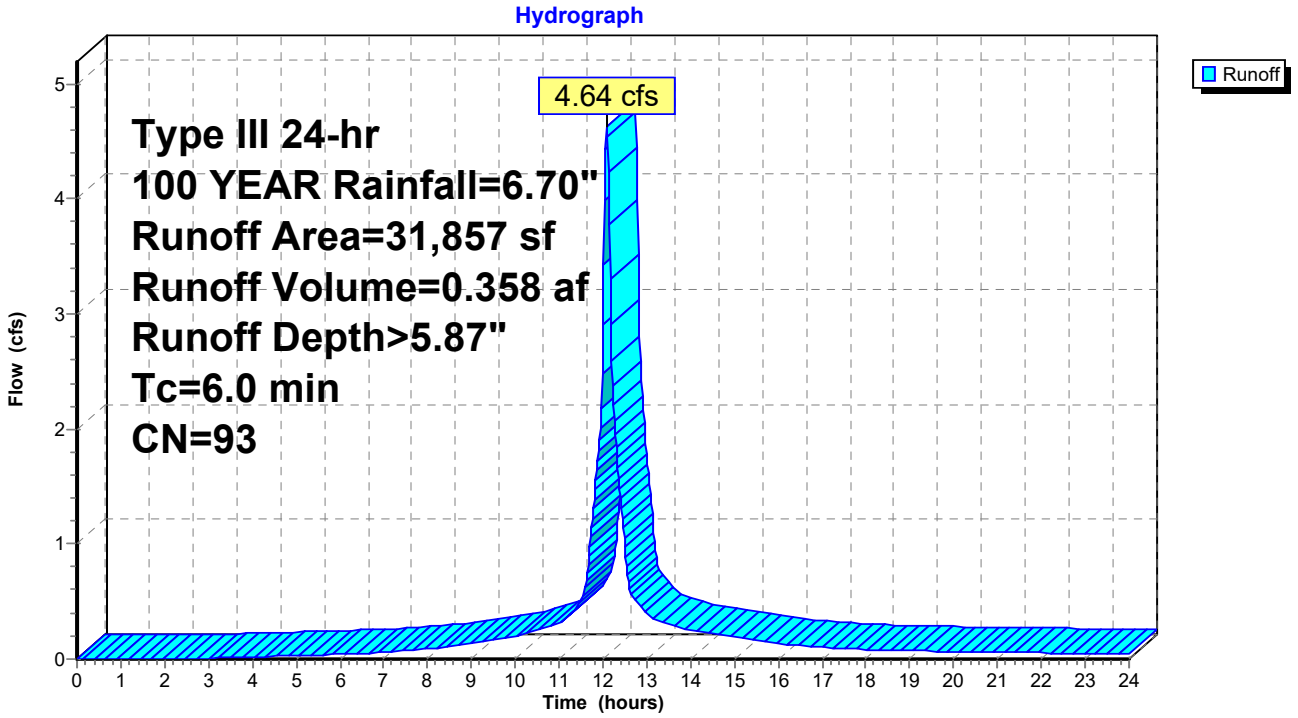
Runoff = 4.64 cfs @ 12.08 hrs, Volume= 0.358 af, Depth> 5.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YEAR Rainfall=6.70"

	Area (sf)	CN	Description
	4,264	61	>75% Grass cover, Good, HSG B
*	16,010	98	Impervious Area
*	11,583	98	Roof
	31,857	93	Weighted Average
	4,264		13.38% Pervious Area
	27,593		86.62% Impervious Area

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

Subcatchment EX-1:

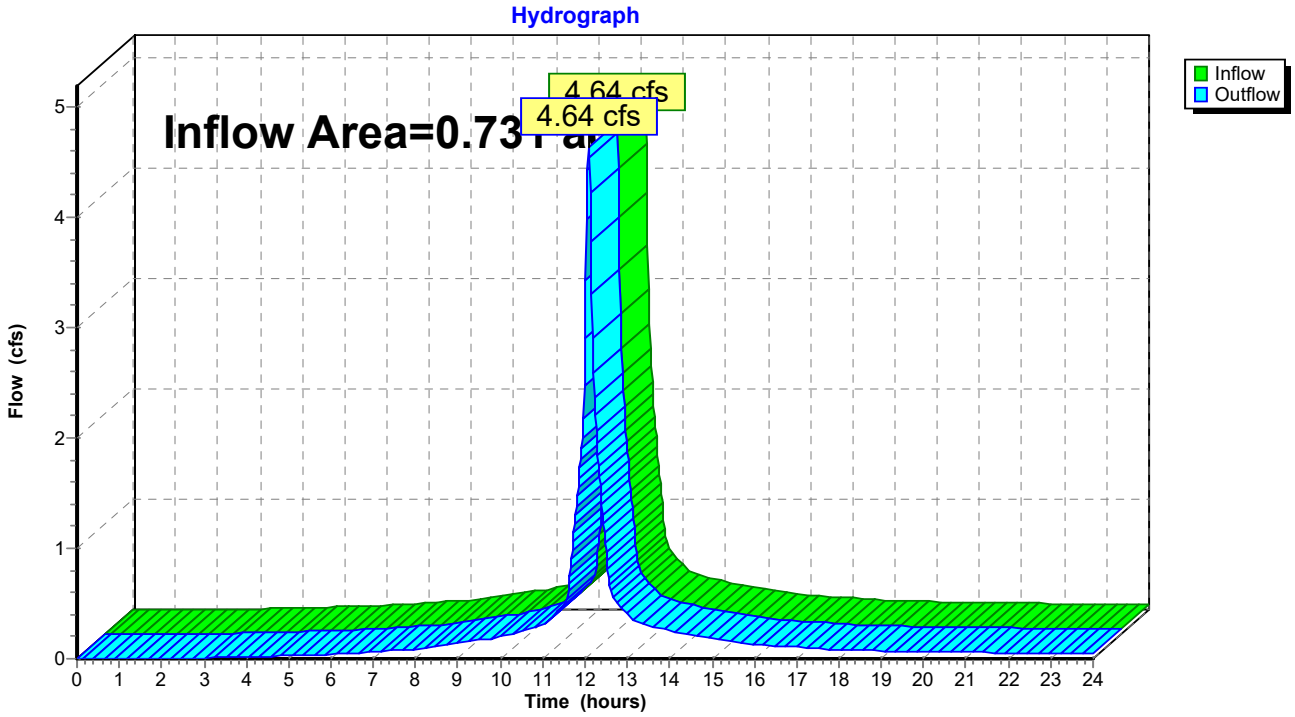


Summary for Reach DP-1: Municipal Drainage System

Inflow Area = 0.731 ac, 86.62% Impervious, Inflow Depth > 5.87" for 100 YEAR event
Inflow = 4.64 cfs @ 12.08 hrs, Volume= 0.358 af
Outflow = 4.64 cfs @ 12.08 hrs, Volume= 0.358 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach DP-1: Municipal Drainage System



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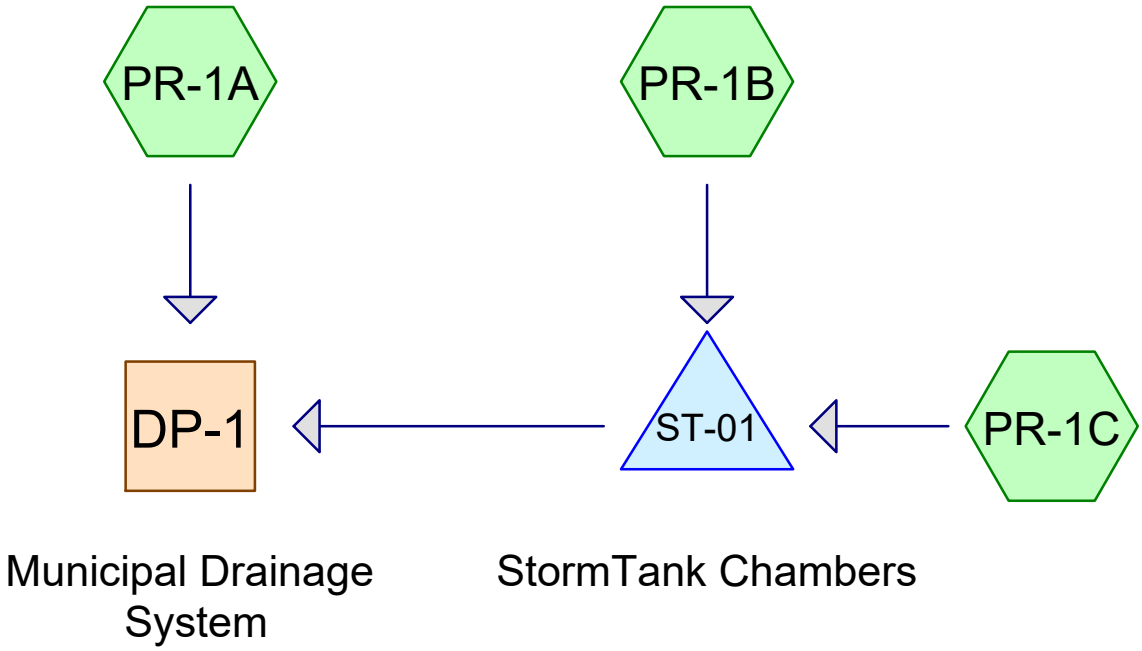
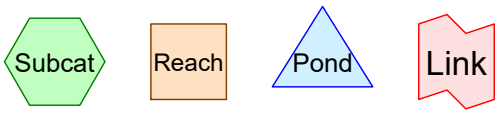
STORMWATER REPORT
HAMPTON COURT APARTMENTS
1223 BEACON STREET
BROOKLINE, MASSACHUSETTS

APPENDIX D – PROPOSED CONDITIONS HYDROCAD CALCULATIONS





Routing Diagram for Proposed Hydrologic Analysis
Prepared by Stantec Consulting Ltd., Printed 7/12/2018
HydroCAD® 10.00-20 s/n 02809 © 2017 HydroCAD Software Solutions LLC

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.077	0.000	0.000	0.000	0.077	>75% Grass cover, Good	PR-1A, PR-1C
0.000	0.000	0.000	0.000	0.107	0.107	Green Roof	PR-1B
0.000	0.000	0.000	0.000	0.084	0.084	Impervious	PR-1A, PR-1C
0.000	0.000	0.000	0.000	0.463	0.463	Roof	PR-1A
0.000	**0.077**	**0.000**	**0.000**	**0.654**	**0.731**	**TOTAL AREA**	

Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PR-1A: Runoff Area=23,760 sf 88.62% Impervious Runoff Depth>2.54"
Tc=6.0 min CN=94 Runoff=1.56 cfs 0.116 af

Subcatchment PR-1B: Runoff Area=4,673 sf 0.00% Impervious Runoff Depth>1.40"
Tc=6.0 min CN=80 Runoff=0.17 cfs 0.013 af

Subcatchment PR-1C: Runoff Area=3,424 sf 80.78% Impervious Runoff Depth>2.26"
Tc=6.0 min CN=91 Runoff=0.20 cfs 0.015 af

Reach DP-1: Municipal Drainage System Inflow=1.56 cfs 0.120 af
Outflow=1.56 cfs 0.120 af

Pond ST-01: StormTank Chambers Peak Elev=6.35' Storage=363 cf Inflow=0.38 cfs 0.027 af
Discarded=0.02 cfs 0.023 af Primary=0.13 cfs 0.004 af Outflow=0.16 cfs 0.027 af

Total Runoff Area = 0.731 ac Runoff Volume = 0.143 af Average Runoff Depth = 2.34"
25.22% Pervious = 0.184 ac 74.78% Impervious = 0.547 ac

Summary for Subcatchment PR-1A:

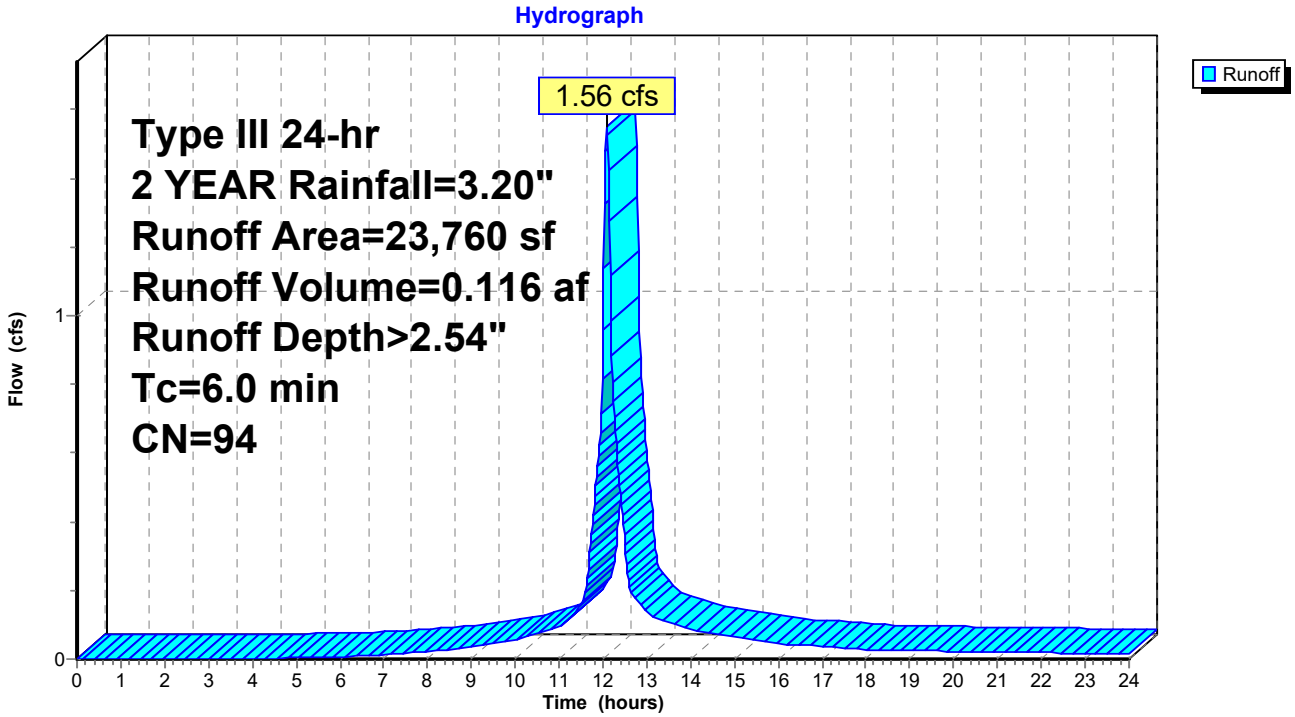
Runoff = 1.56 cfs @ 12.08 hrs, Volume= 0.116 af, Depth> 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YEAR Rainfall=3.20"

	Area (sf)	CN	Description
*	20,153	98	Roof
*	903	98	Impervious
	2,704	61	>75% Grass cover, Good, HSG B
	23,760	94	Weighted Average
	2,704		11.38% Pervious Area
	21,056		88.62% Impervious Area

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

Subcatchment PR-1A:



Summary for Subcatchment PR-1B:

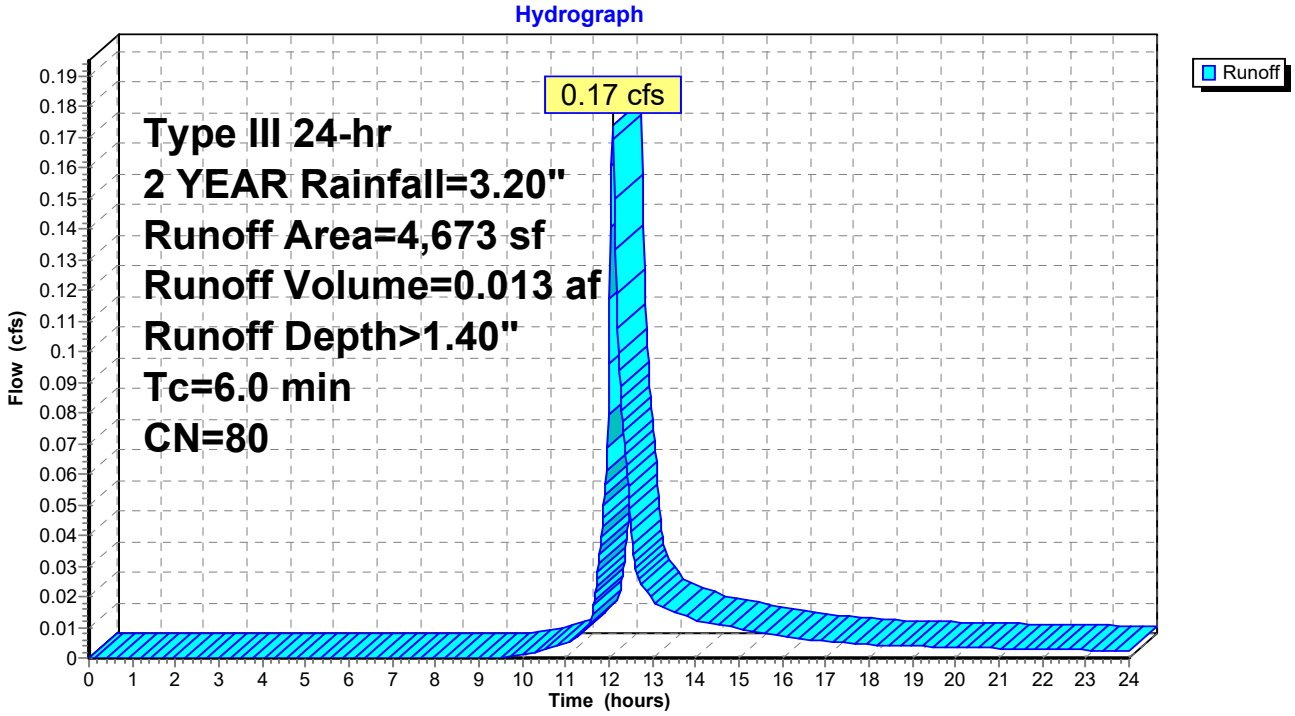
Runoff = 0.17 cfs @ 12.09 hrs, Volume= 0.013 af, Depth> 1.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YEAR Rainfall=3.20"

	Area (sf)	CN	Description
*	4,673	80	Green Roof
	4,673		100.00% Pervious Area

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

Subcatchment PR-1B:



Summary for Subcatchment PR-1C:

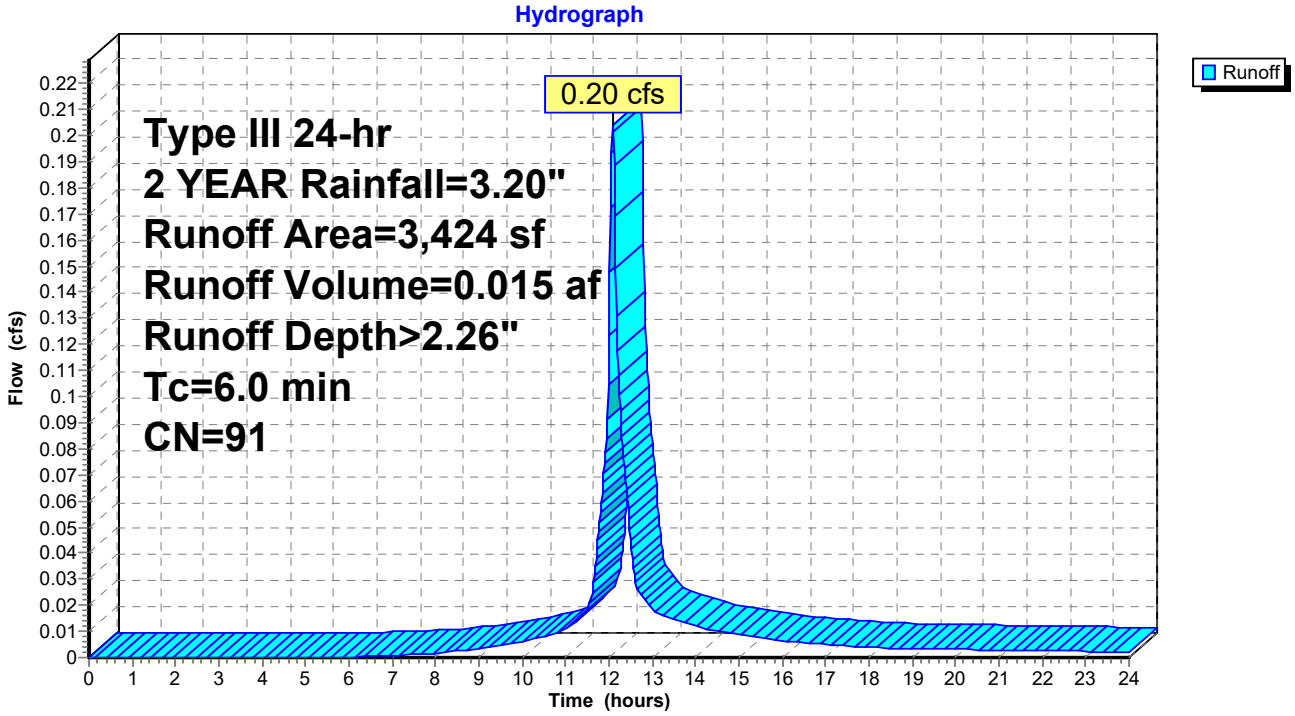
Runoff = 0.20 cfs @ 12.09 hrs, Volume= 0.015 af, Depth> 2.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YEAR Rainfall=3.20"

	Area (sf)	CN	Description
*	2,766	98	Impervious
	658	61	>75% Grass cover, Good, HSG B
	3,424	91	Weighted Average
	658		19.22% Pervious Area
	2,766		80.78% Impervious Area

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

Subcatchment PR-1C:

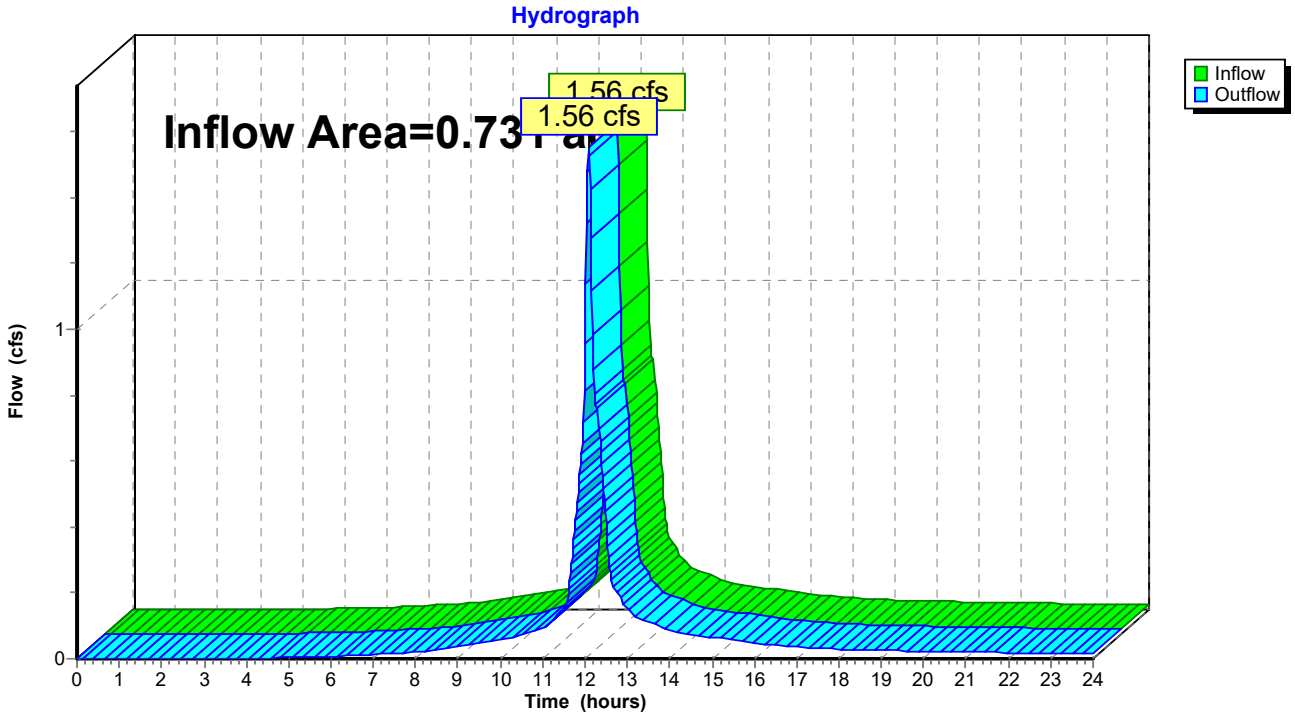


Summary for Reach DP-1: Municipal Drainage System

Inflow Area = 0.731 ac, 74.78% Impervious, Inflow Depth > 1.96" for 2 YEAR event
Inflow = 1.56 cfs @ 12.08 hrs, Volume= 0.120 af
Outflow = 1.56 cfs @ 12.08 hrs, Volume= 0.120 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach DP-1: Municipal Drainage System



Summary for Pond ST-01: StormTank Chambers

Inflow Area = 0.186 ac, 34.16% Impervious, Inflow Depth > 1.76" for 2 YEAR event
Inflow = 0.38 cfs @ 12.09 hrs, Volume= 0.027 af
Outflow = 0.16 cfs @ 12.32 hrs, Volume= 0.027 af, Atten= 58%, Lag= 14.0 min
Discarded = 0.02 cfs @ 11.48 hrs, Volume= 0.023 af
Primary = 0.13 cfs @ 12.32 hrs, Volume= 0.004 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 6.35' @ 12.32 hrs Surf.Area= 448 sf Storage= 363 cf

Plug-Flow detention time= 108.3 min calculated for 0.027 af (100% of inflow)
Center-of-Mass det. time= 107.7 min (928.0 - 820.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.40'	70 cf	**14.00'W x 32.00'L x 2.00'H Field A** 896 cf Overall - 720 cf Embedded = 176 cf x 40.0% Voids
#2A	5.40'	692 cf	**Brentwood StormTank 24"** x 80 Inside #1 Inside= 18.0"W x 24.0"H => 2.89 sf x 3.00'L = 8.7 cf Outside= 18.0"W x 24.0"H => 3.00 sf x 3.00'L = 9.0 cf 8 Rows of 10 Chambers
		763 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	5.40'	**2.410 in/hr Exfiltration over Surface area**
#2	Device 3	6.30'	**3.5' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Primary	5.40'	**Special & User-Defined** Head (feet) 0.00 0.50 1.00 1.50 2.00 Disch. (cfs) 0.000 0.000 0.400 0.400 0.400

Discarded OutFlow Max=0.02 cfs @ 11.48 hrs HW=5.42' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.13 cfs @ 12.32 hrs HW=6.35' (Free Discharge)
└─**3=Special & User-Defined** (Passes 0.13 cfs of 0.36 cfs potential flow)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 0.13 cfs @ 0.74 fps)

Pond ST-01: StormTank Chambers - Chamber Wizard Field A

Chamber Model = Brentwood StormTank 24" (Brentwood Industries StormTank)
Inside= 18.0"W x 24.0"H => 2.89 sf x 3.00'L = 8.7 cf
Outside= 18.0"W x 24.0"H => 3.00 sf x 3.00'L = 9.0 cf

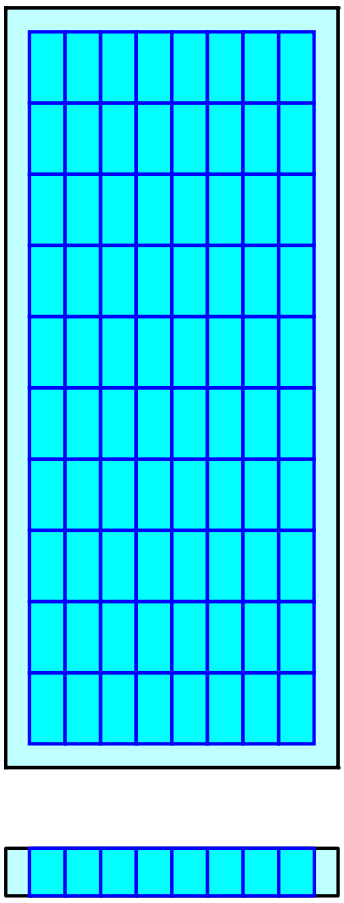
10 Chambers/Row x 3.00' Long = 30.00' Row Length +12.0" End Stone x 2 = 32.00' Base Length
8 Rows x 18.0" Wide + 12.0" Side Stone x 2 = 14.00' Base Width
24.0" Chamber Height = 2.00' Field Height

80 Chambers x 8.7 cf = 692.5 cf Chamber Storage
80 Chambers x 9.0 cf = 720.0 cf Displacement

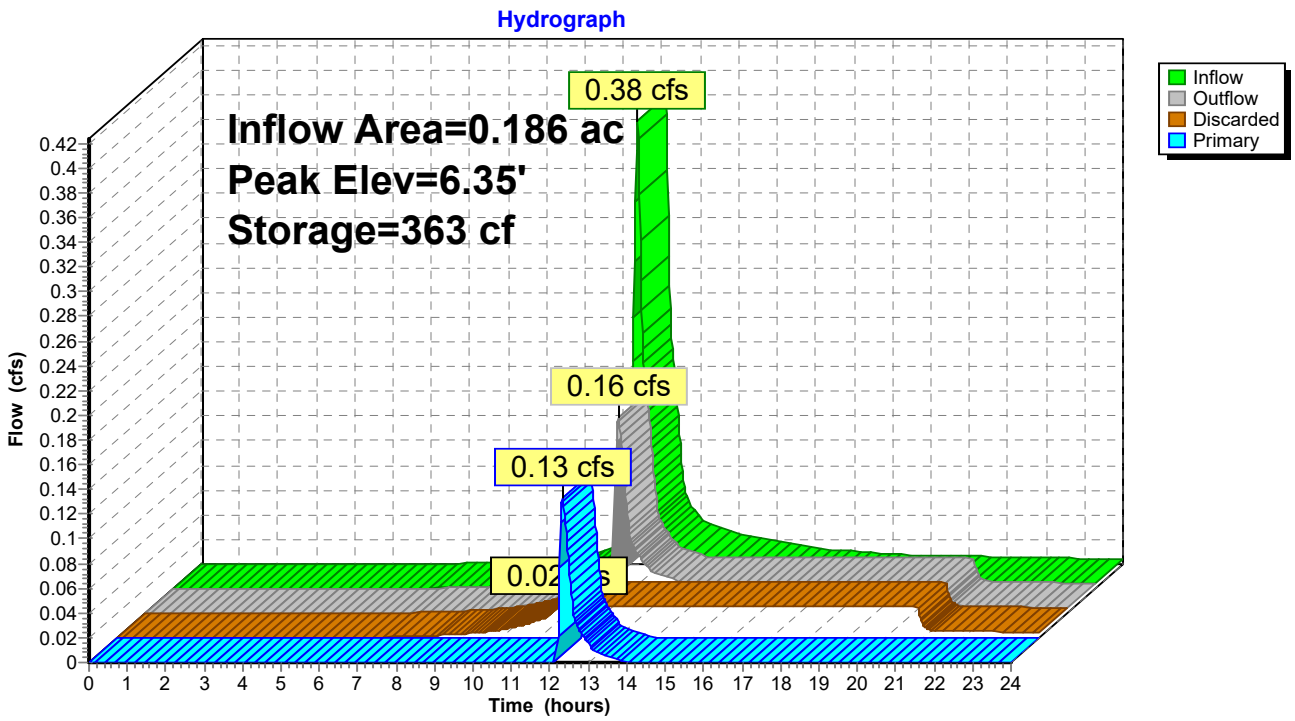
896.0 cf Field - 720.0 cf Chambers = 176.0 cf Stone x 40.0% Voids = 70.4 cf Stone Storage

Chamber Storage + Stone Storage = 762.9 cf = 0.018 af
Overall Storage Efficiency = 85.1%
Overall System Size = 32.00' x 14.00' x 2.00'

80 Chambers
33.2 cy Field
6.5 cy Stone



Pond ST-01: StormTank Chambers



Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PR-1A: Runoff Area=23,760 sf 88.62% Impervious Runoff Depth>3.91"
Tc=6.0 min CN=94 Runoff=2.34 cfs 0.178 af

Subcatchment PR-1B: Runoff Area=4,673 sf 0.00% Impervious Runoff Depth>2.54"
Tc=6.0 min CN=80 Runoff=0.32 cfs 0.023 af

Subcatchment PR-1C: Runoff Area=3,424 sf 80.78% Impervious Runoff Depth>3.59"
Tc=6.0 min CN=91 Runoff=0.32 cfs 0.024 af

Reach DP-1: Municipal Drainage System Inflow=2.76 cfs 0.195 af
Outflow=2.76 cfs 0.195 af

Pond ST-01: StormTank Chambers Peak Elev=6.54' Storage=434 cf Inflow=0.64 cfs 0.046 af
Discarded=0.02 cfs 0.029 af Primary=0.40 cfs 0.017 af Outflow=0.42 cfs 0.046 af

Total Runoff Area = 0.731 ac Runoff Volume = 0.224 af Average Runoff Depth = 3.68"
25.22% Pervious = 0.184 ac 74.78% Impervious = 0.547 ac

Summary for Subcatchment PR-1A:

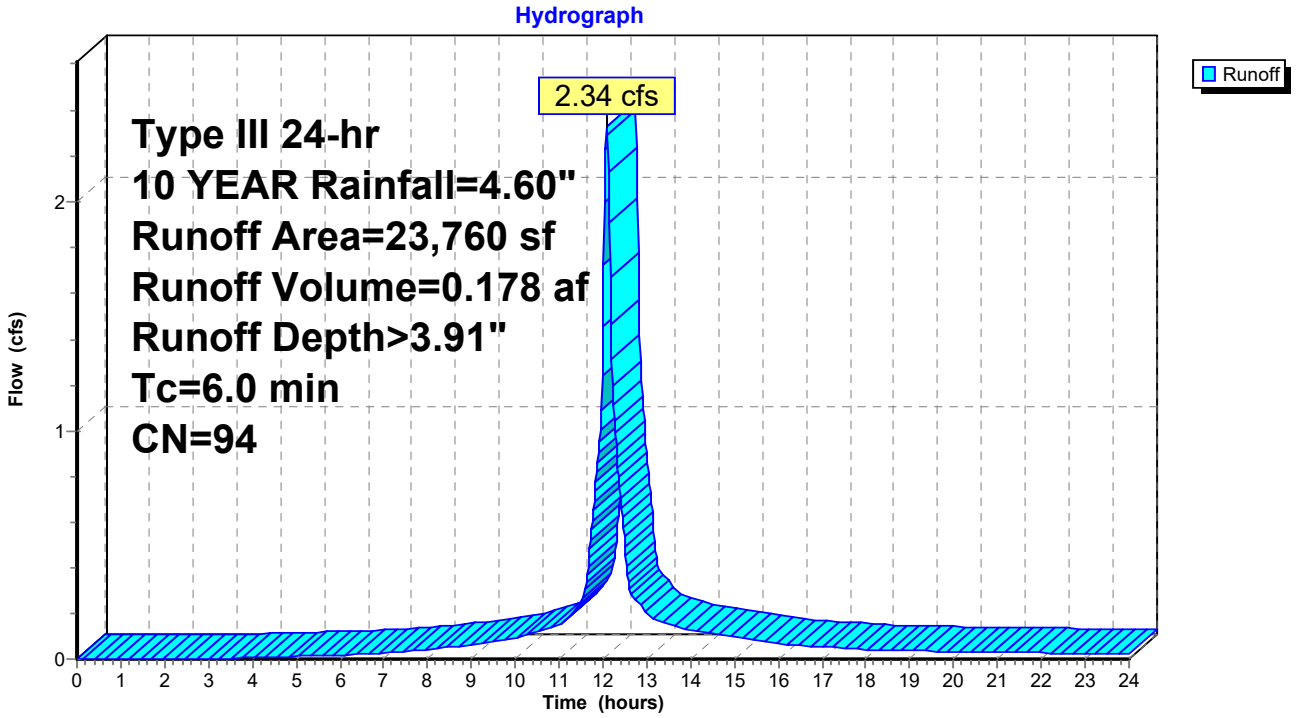
Runoff = 2.34 cfs @ 12.08 hrs, Volume= 0.178 af, Depth> 3.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YEAR Rainfall=4.60"

	Area (sf)	CN	Description
*	20,153	98	Roof
*	903	98	Impervious
	2,704	61	>75% Grass cover, Good, HSG B
	23,760	94	Weighted Average
	2,704		11.38% Pervious Area
	21,056		88.62% Impervious Area

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

Subcatchment PR-1A:



Summary for Subcatchment PR-1B:

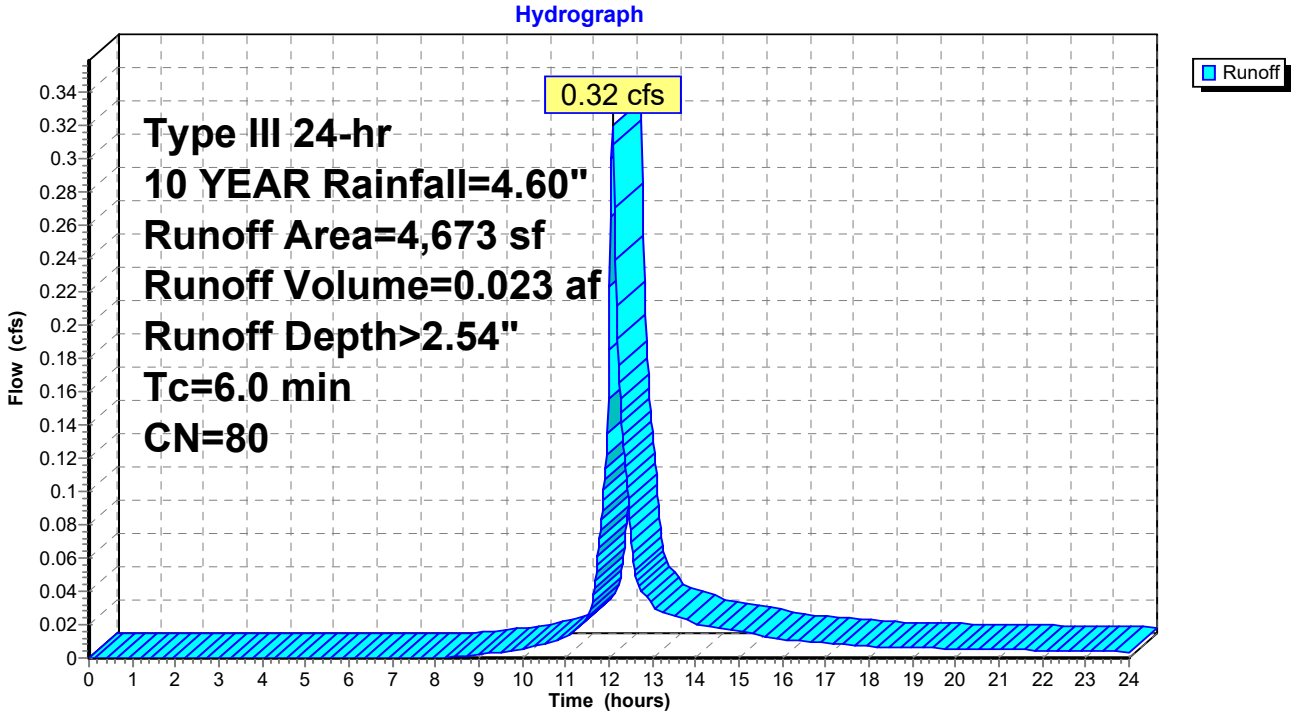
Runoff = 0.32 cfs @ 12.09 hrs, Volume= 0.023 af, Depth> 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YEAR Rainfall=4.60"

	Area (sf)	CN	Description
*	4,673	80	Green Roof
	4,673		100.00% Pervious Area

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

Subcatchment PR-1B:



Summary for Subcatchment PR-1C:

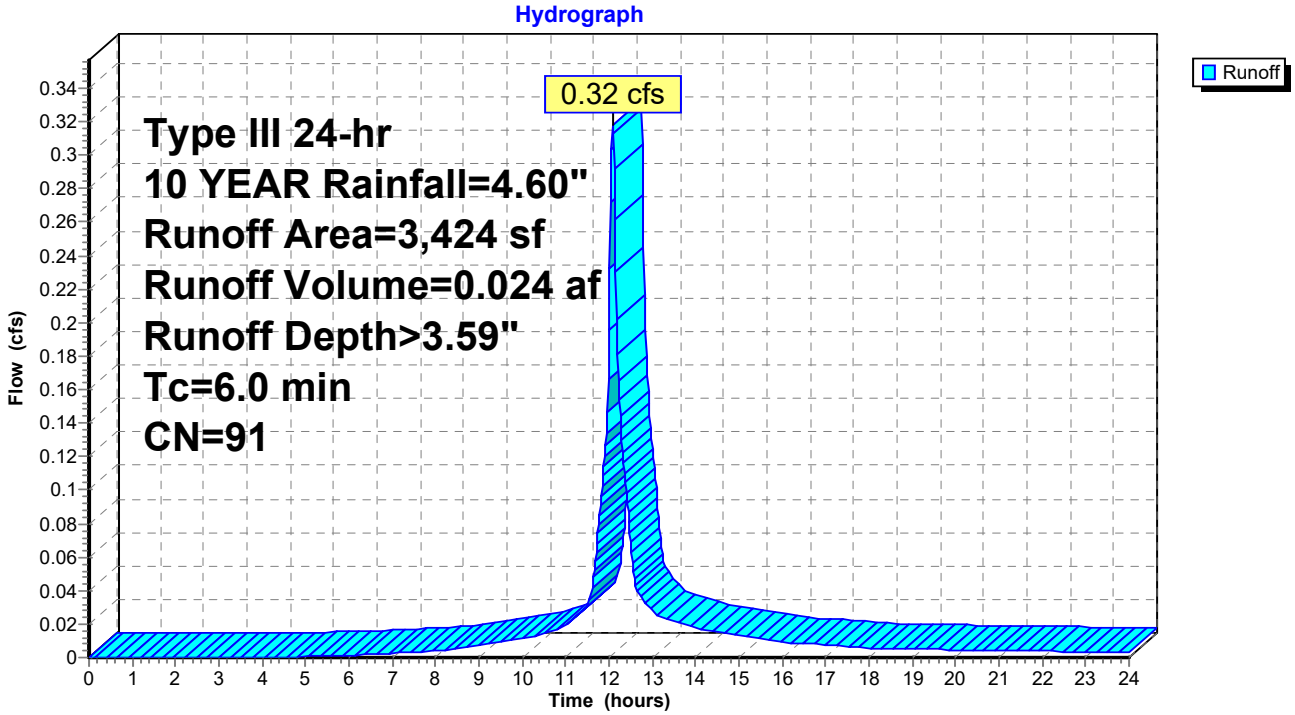
Runoff = 0.32 cfs @ 12.08 hrs, Volume= 0.024 af, Depth> 3.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YEAR Rainfall=4.60"

	Area (sf)	CN	Description
*	2,766	98	Impervious
	658	61	>75% Grass cover, Good, HSG B
	3,424	91	Weighted Average
	658		19.22% Pervious Area
	2,766		80.78% Impervious Area

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

Subcatchment PR-1C:

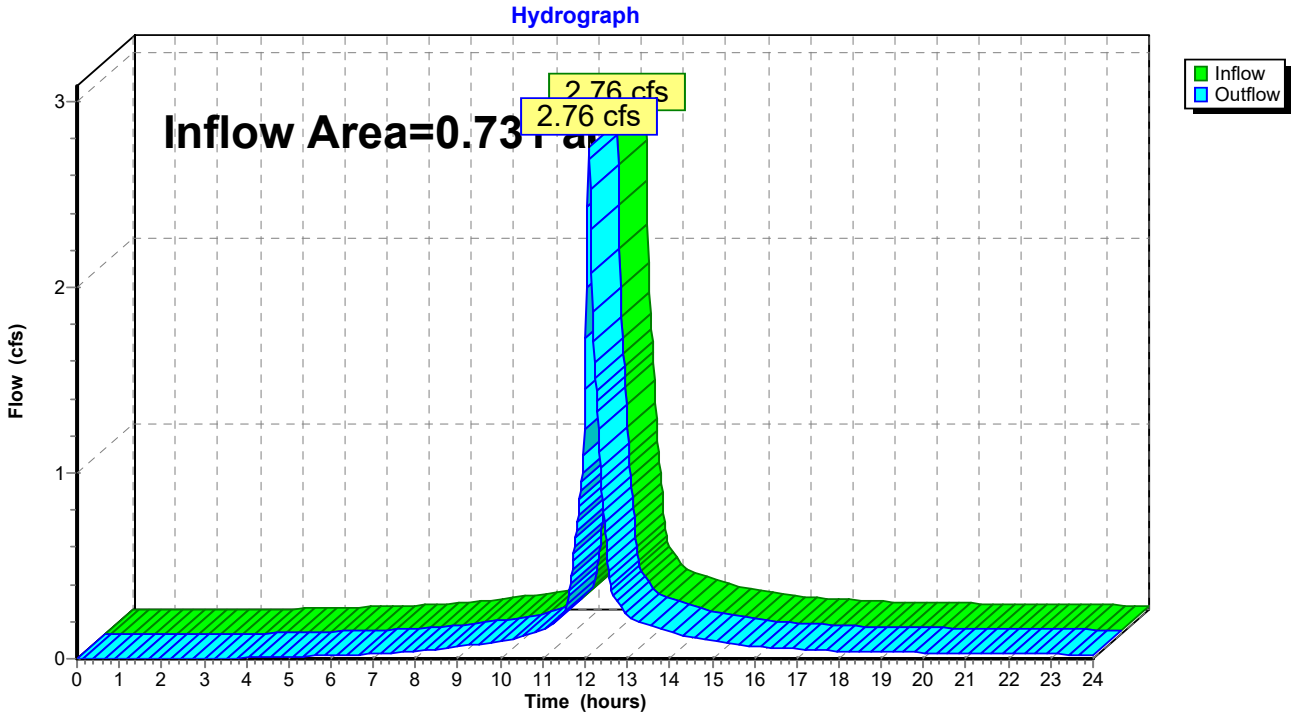


Summary for Reach DP-1: Municipal Drainage System

Inflow Area = 0.731 ac, 74.78% Impervious, Inflow Depth > 3.20" for 10 YEAR event
Inflow = 2.76 cfs @ 12.09 hrs, Volume= 0.195 af
Outflow = 2.76 cfs @ 12.09 hrs, Volume= 0.195 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach DP-1: Municipal Drainage System



Summary for Pond ST-01: StormTank Chambers

Inflow Area = 0.186 ac, 34.16% Impervious, Inflow Depth > 2.99" for 10 YEAR event
Inflow = 0.64 cfs @ 12.09 hrs, Volume= 0.046 af
Outflow = 0.42 cfs @ 12.10 hrs, Volume= 0.046 af, Atten= 33%, Lag= 0.8 min
Discarded = 0.02 cfs @ 10.70 hrs, Volume= 0.029 af
Primary = 0.40 cfs @ 12.10 hrs, Volume= 0.017 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 6.54' @ 12.18 hrs Surf.Area= 448 sf Storage= 434 cf

Plug-Flow detention time= 85.3 min calculated for 0.046 af (100% of inflow)
Center-of-Mass det. time= 84.7 min (891.3 - 806.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.40'	70 cf	**14.00'W x 32.00'L x 2.00'H Field A** 896 cf Overall - 720 cf Embedded = 176 cf x 40.0% Voids
#2A	5.40'	692 cf	**Brentwood StormTank 24"** x 80 Inside #1 Inside= 18.0"W x 24.0"H => 2.89 sf x 3.00'L = 8.7 cf Outside= 18.0"W x 24.0"H => 3.00 sf x 3.00'L = 9.0 cf 8 Rows of 10 Chambers
		763 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	5.40'	**2.410 in/hr Exfiltration over Surface area**
#2	Device 3	6.30'	**3.5' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Primary	5.40'	**Special & User-Defined** Head (feet) 0.00 0.50 1.00 1.50 2.00 Disch. (cfs) 0.000 0.000 0.400 0.400 0.400

Discarded OutFlow Max=0.02 cfs @ 10.70 hrs HW=5.42' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.40 cfs @ 12.10 hrs HW=6.46' (Free Discharge)
└─**3=Special & User-Defined** (Custom Controls 0.40 cfs)
  └─**2=Sharp-Crested Rectangular Weir** (Passes 0.40 cfs of 0.72 cfs potential flow)

Pond ST-01: StormTank Chambers - Chamber Wizard Field A

Chamber Model = Brentwood StormTank 24" (Brentwood Industries StormTank)
Inside= 18.0"W x 24.0"H => 2.89 sf x 3.00'L = 8.7 cf
Outside= 18.0"W x 24.0"H => 3.00 sf x 3.00'L = 9.0 cf

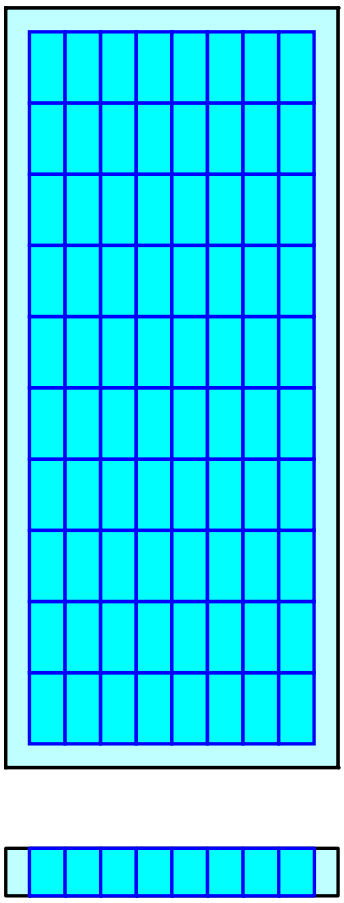
10 Chambers/Row x 3.00' Long = 30.00' Row Length +12.0" End Stone x 2 = 32.00' Base Length
8 Rows x 18.0" Wide + 12.0" Side Stone x 2 = 14.00' Base Width
24.0" Chamber Height = 2.00' Field Height

80 Chambers x 8.7 cf = 692.5 cf Chamber Storage
80 Chambers x 9.0 cf = 720.0 cf Displacement

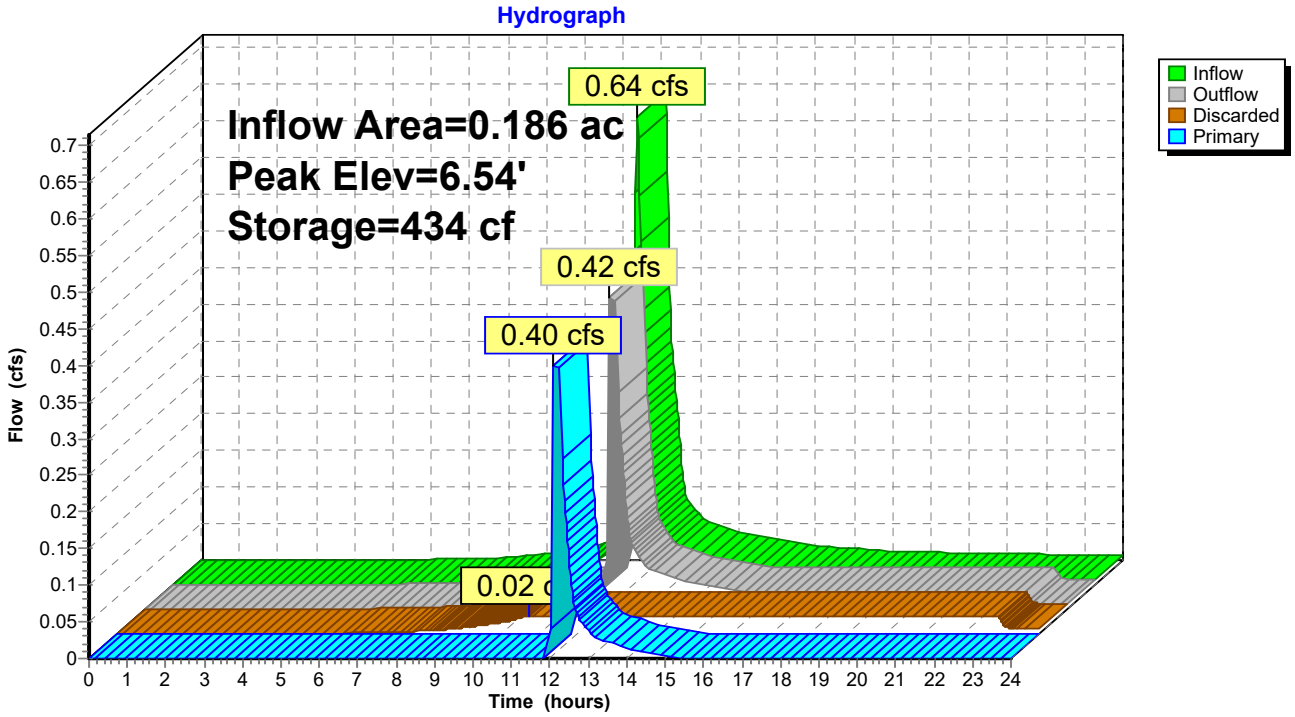
896.0 cf Field - 720.0 cf Chambers = 176.0 cf Stone x 40.0% Voids = 70.4 cf Stone Storage

Chamber Storage + Stone Storage = 762.9 cf = 0.018 af
Overall Storage Efficiency = 85.1%
Overall System Size = 32.00' x 14.00' x 2.00'

80 Chambers
33.2 cy Field
6.5 cy Stone



Pond ST-01: StormTank Chambers



Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PR-1A: Runoff Area=23,760 sf 88.62% Impervious Runoff Depth>5.99"
Tc=6.0 min CN=94 Runoff=3.49 cfs 0.272 af

Subcatchment PR-1B: Runoff Area=4,673 sf 0.00% Impervious Runoff Depth>4.41"
Tc=6.0 min CN=80 Runoff=0.55 cfs 0.039 af

Subcatchment PR-1C: Runoff Area=3,424 sf 80.78% Impervious Runoff Depth>5.64"
Tc=6.0 min CN=91 Runoff=0.49 cfs 0.037 af

Reach DP-1: Municipal Drainage System Inflow=3.89 cfs 0.313 af
Outflow=3.89 cfs 0.313 af

Pond ST-01: StormTank Chambers Peak Elev=7.33' Storage=738 cf Inflow=1.04 cfs 0.076 af
Discarded=0.02 cfs 0.034 af Primary=0.40 cfs 0.041 af Outflow=0.42 cfs 0.074 af

Total Runoff Area = 0.731 ac Runoff Volume = 0.348 af Average Runoff Depth = 5.72"
25.22% Pervious = 0.184 ac 74.78% Impervious = 0.547 ac

Summary for Subcatchment PR-1A:

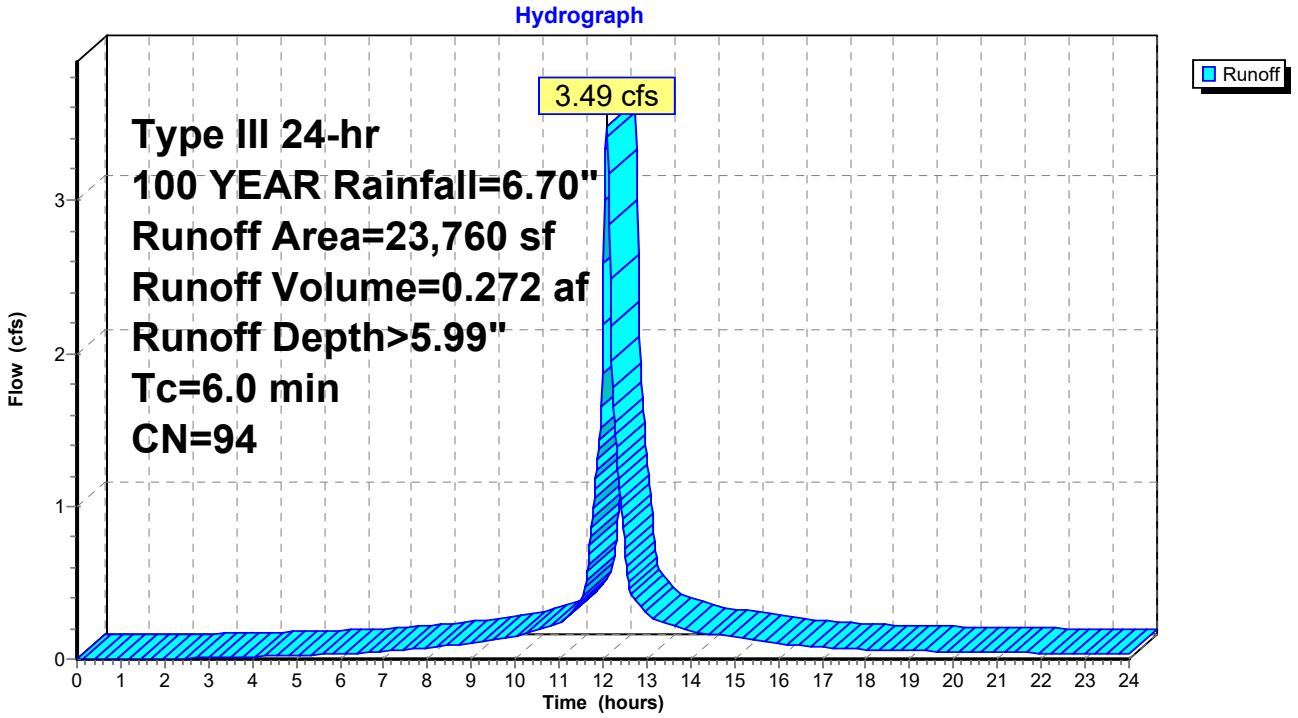
Runoff = 3.49 cfs @ 12.08 hrs, Volume= 0.272 af, Depth> 5.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YEAR Rainfall=6.70"

	Area (sf)	CN	Description
*	20,153	98	Roof
*	903	98	Impervious
	2,704	61	>75% Grass cover, Good, HSG B
	23,760	94	Weighted Average
	2,704		11.38% Pervious Area
	21,056		88.62% Impervious Area

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

Subcatchment PR-1A:



Summary for Subcatchment PR-1B:

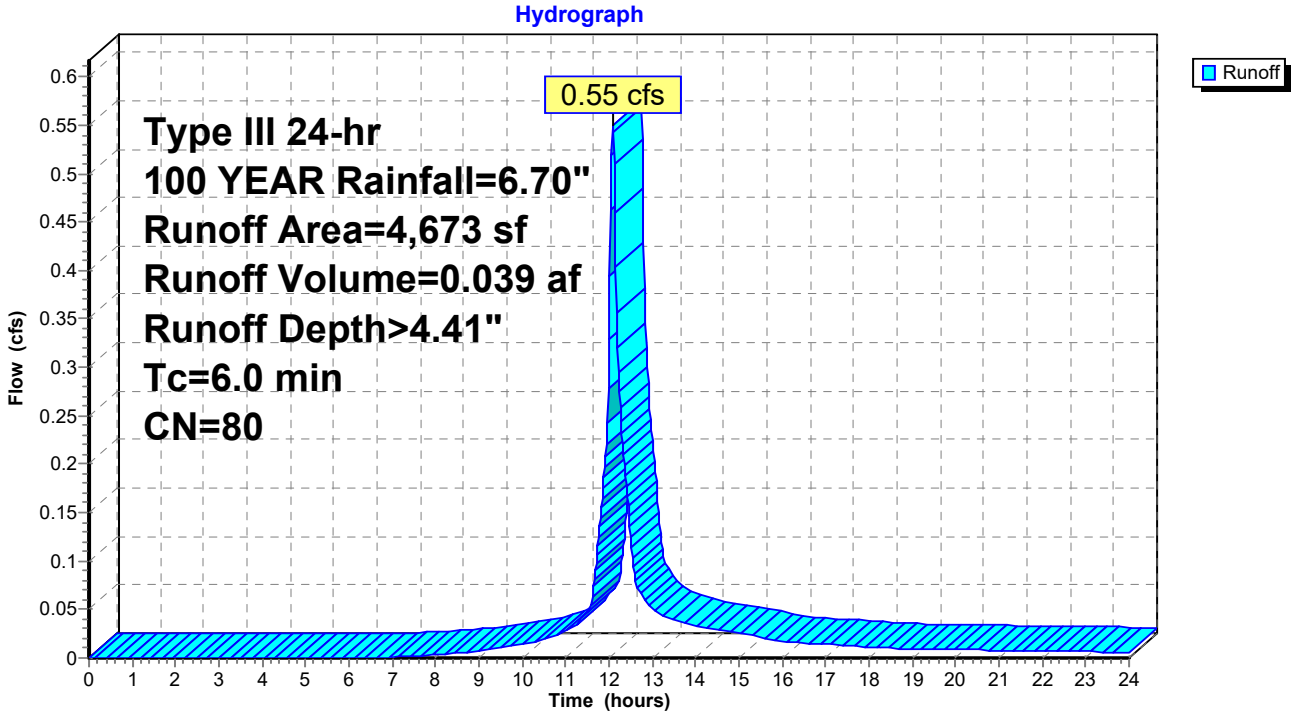
Runoff = 0.55 cfs @ 12.09 hrs, Volume= 0.039 af, Depth> 4.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YEAR Rainfall=6.70"

	Area (sf)	CN	Description
*	4,673	80	Green Roof
	4,673		100.00% Pervious Area

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

Subcatchment PR-1B:



Summary for Subcatchment PR-1C:

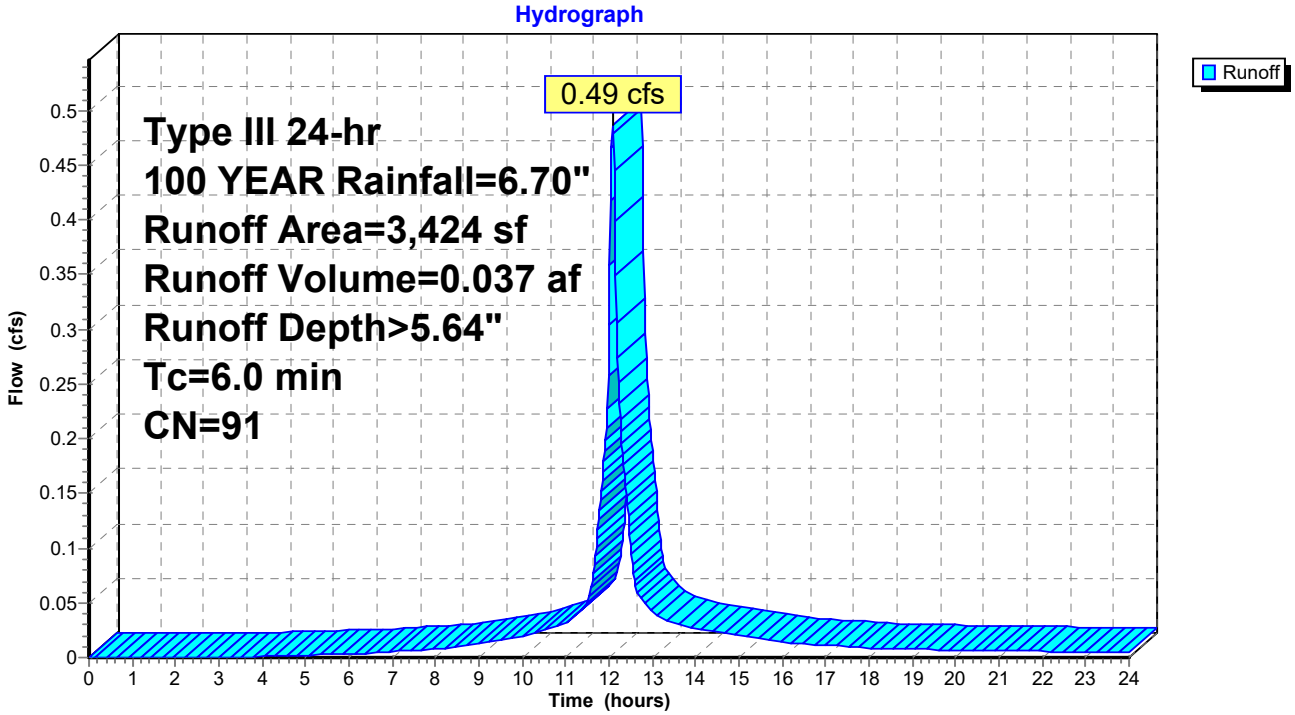
Runoff = 0.49 cfs @ 12.08 hrs, Volume= 0.037 af, Depth> 5.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YEAR Rainfall=6.70"

	Area (sf)	CN	Description
*	2,766	98	Impervious
	658	61	>75% Grass cover, Good, HSG B
	3,424	91	Weighted Average
	658		19.22% Pervious Area
	2,766		80.78% Impervious Area

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

Subcatchment PR-1C:

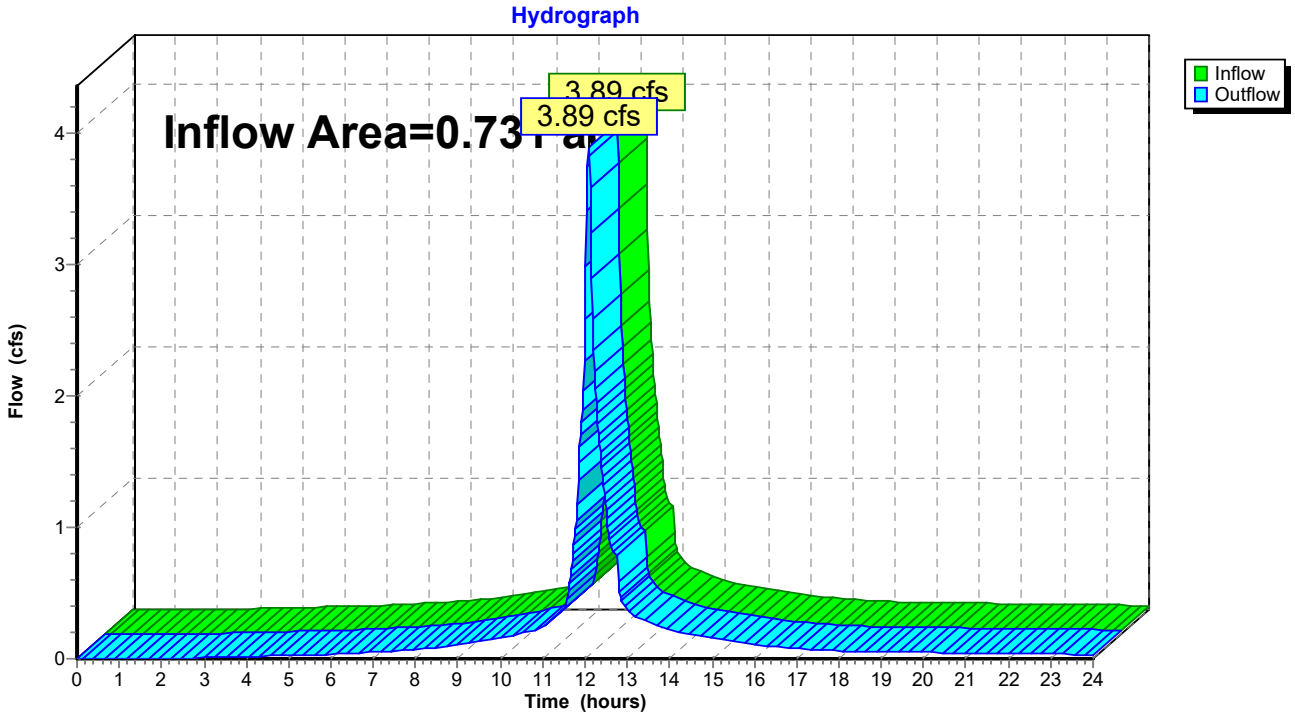


Summary for Reach DP-1: Municipal Drainage System

Inflow Area = 0.731 ac, 74.78% Impervious, Inflow Depth > 5.13" for 100 YEAR event
Inflow = 3.89 cfs @ 12.08 hrs, Volume= 0.313 af
Outflow = 3.89 cfs @ 12.08 hrs, Volume= 0.313 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Reach DP-1: Municipal Drainage System



Summary for Pond ST-01: StormTank Chambers

Inflow Area = 0.186 ac, 34.16% Impervious, Inflow Depth > 4.93" for 100 YEAR event
Inflow = 1.04 cfs @ 12.09 hrs, Volume= 0.076 af
Outflow = 0.42 cfs @ 11.98 hrs, Volume= 0.074 af, Atten= 59%, Lag= 0.0 min
Discarded = 0.02 cfs @ 9.46 hrs, Volume= 0.034 af
Primary = 0.40 cfs @ 11.98 hrs, Volume= 0.041 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 7.33' @ 12.30 hrs Surf.Area= 448 sf Storage= 738 cf

Plug-Flow detention time= 71.4 min calculated for 0.074 af (97% of inflow)
Center-of-Mass det. time= 53.3 min (846.9 - 793.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.40'	70 cf	**14.00'W x 32.00'L x 2.00'H Field A** 896 cf Overall - 720 cf Embedded = 176 cf x 40.0% Voids
#2A	5.40'	692 cf	**Brentwood StormTank 24"** x 80 Inside #1 Inside= 18.0"W x 24.0"H => 2.89 sf x 3.00'L = 8.7 cf Outside= 18.0"W x 24.0"H => 3.00 sf x 3.00'L = 9.0 cf 8 Rows of 10 Chambers
		763 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	5.40'	**2.410 in/hr Exfiltration over Surface area**
#2	Device 3	6.30'	**3.5' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Primary	5.40'	**Special & User-Defined** Head (feet) 0.00 0.50 1.00 1.50 2.00 Disch. (cfs) 0.000 0.000 0.400 0.400 0.400

Discarded OutFlow Max=0.02 cfs @ 9.46 hrs HW=5.42' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.40 cfs @ 11.98 hrs HW=6.43' (Free Discharge)
└─**3=Special & User-Defined** (Custom Controls 0.40 cfs)
  └─**2=Sharp-Crested Rectangular Weir** (Passes 0.40 cfs of 0.53 cfs potential flow)

Pond ST-01: StormTank Chambers - Chamber Wizard Field A

Chamber Model = Brentwood StormTank 24" (Brentwood Industries StormTank)
Inside= 18.0"W x 24.0"H => 2.89 sf x 3.00'L = 8.7 cf
Outside= 18.0"W x 24.0"H => 3.00 sf x 3.00'L = 9.0 cf

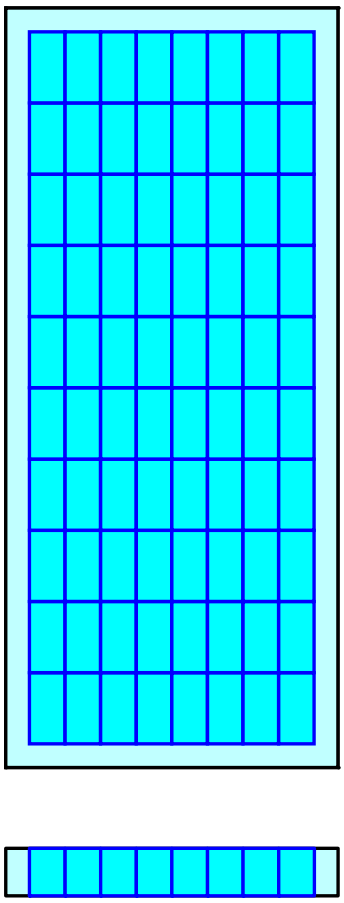
10 Chambers/Row x 3.00' Long = 30.00' Row Length +12.0" End Stone x 2 = 32.00' Base Length
8 Rows x 18.0" Wide + 12.0" Side Stone x 2 = 14.00' Base Width
24.0" Chamber Height = 2.00' Field Height

80 Chambers x 8.7 cf = 692.5 cf Chamber Storage
80 Chambers x 9.0 cf = 720.0 cf Displacement

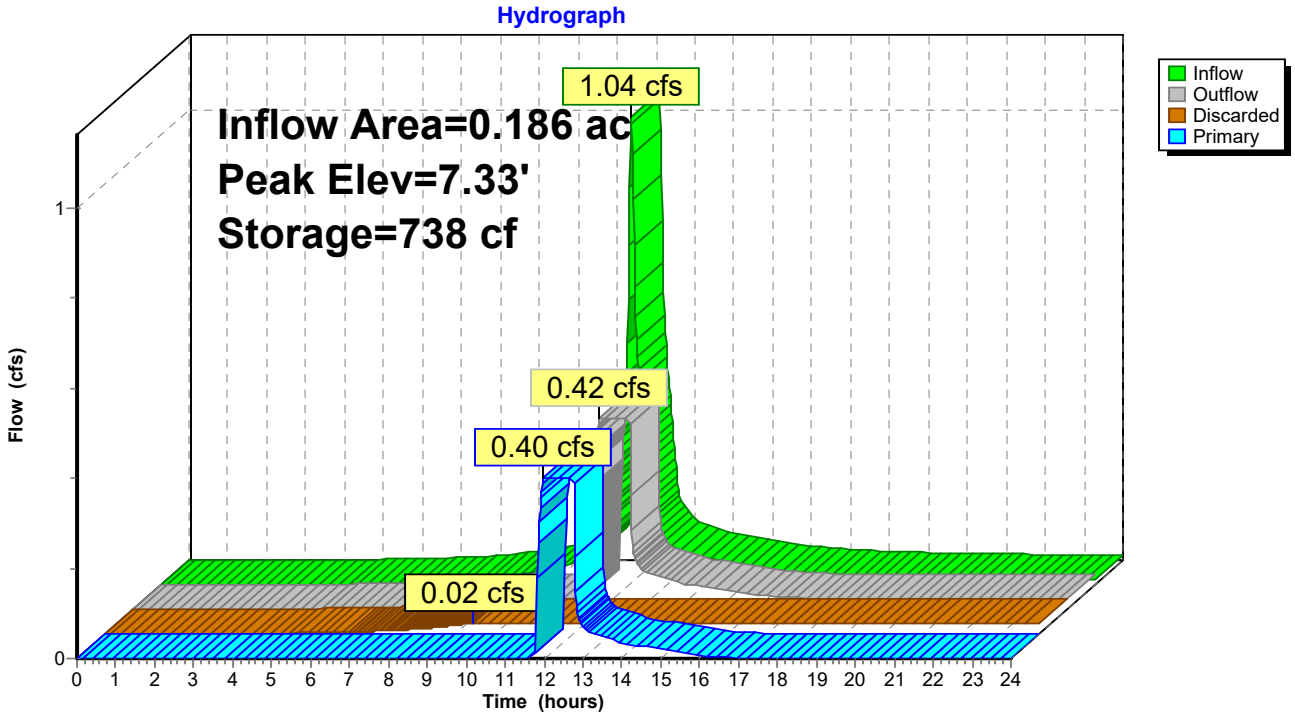
896.0 cf Field - 720.0 cf Chambers = 176.0 cf Stone x 40.0% Voids = 70.4 cf Stone Storage

Chamber Storage + Stone Storage = 762.9 cf = 0.018 af
Overall Storage Efficiency = 85.1%
Overall System Size = 32.00' x 14.00' x 2.00'

80 Chambers
33.2 cy Field
6.5 cy Stone



Pond ST-01: StormTank Chambers



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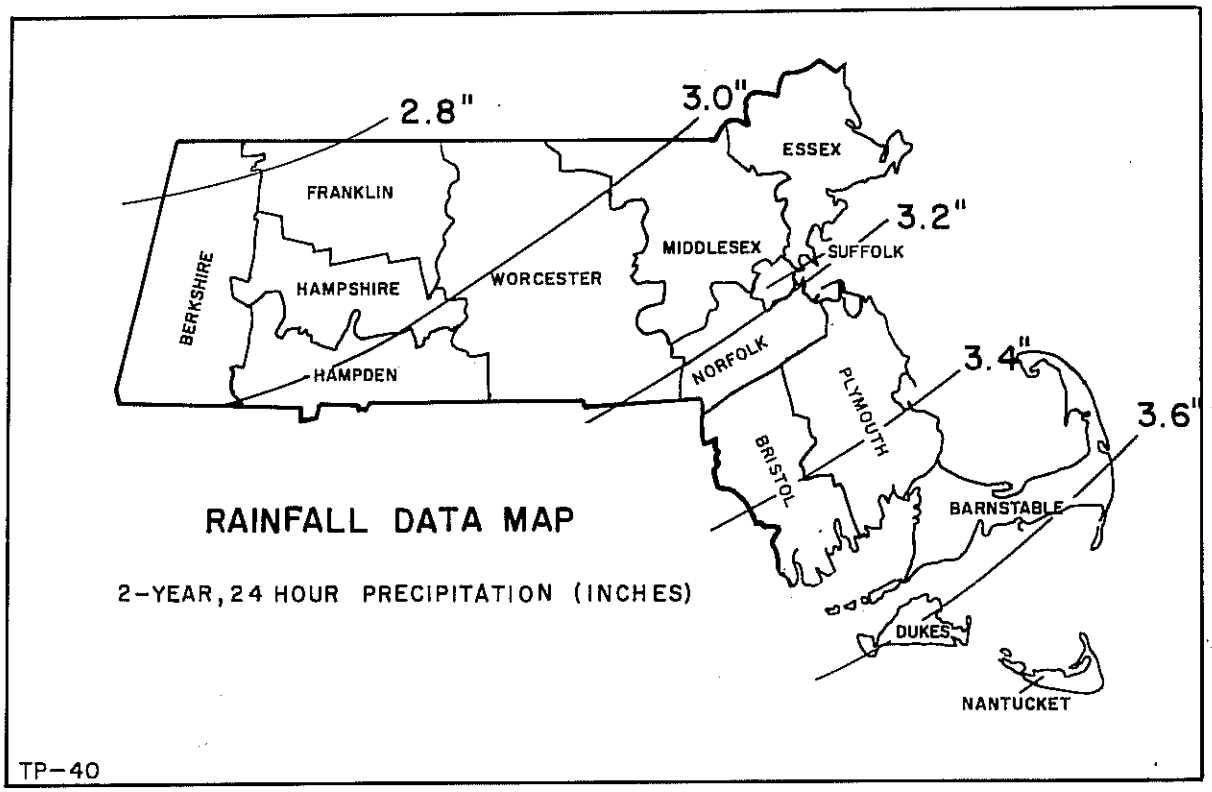
STORMWATER REPORT
HAMPTON COURT APARTMENTS
1223 BEACON STREET
BROOKLINE, MASSACHUSETTS

APPENDIX E – MASSACHUSETTS RAINFALL DATA MAPS

guidelines for SOIL & WATER CONSERVATION

. . . . in urbanizing areas of Massachusetts

USDA SOIL CONSERVATION SERVICE
AMHERST, MASSACHUSETTS OCTOBER 1977



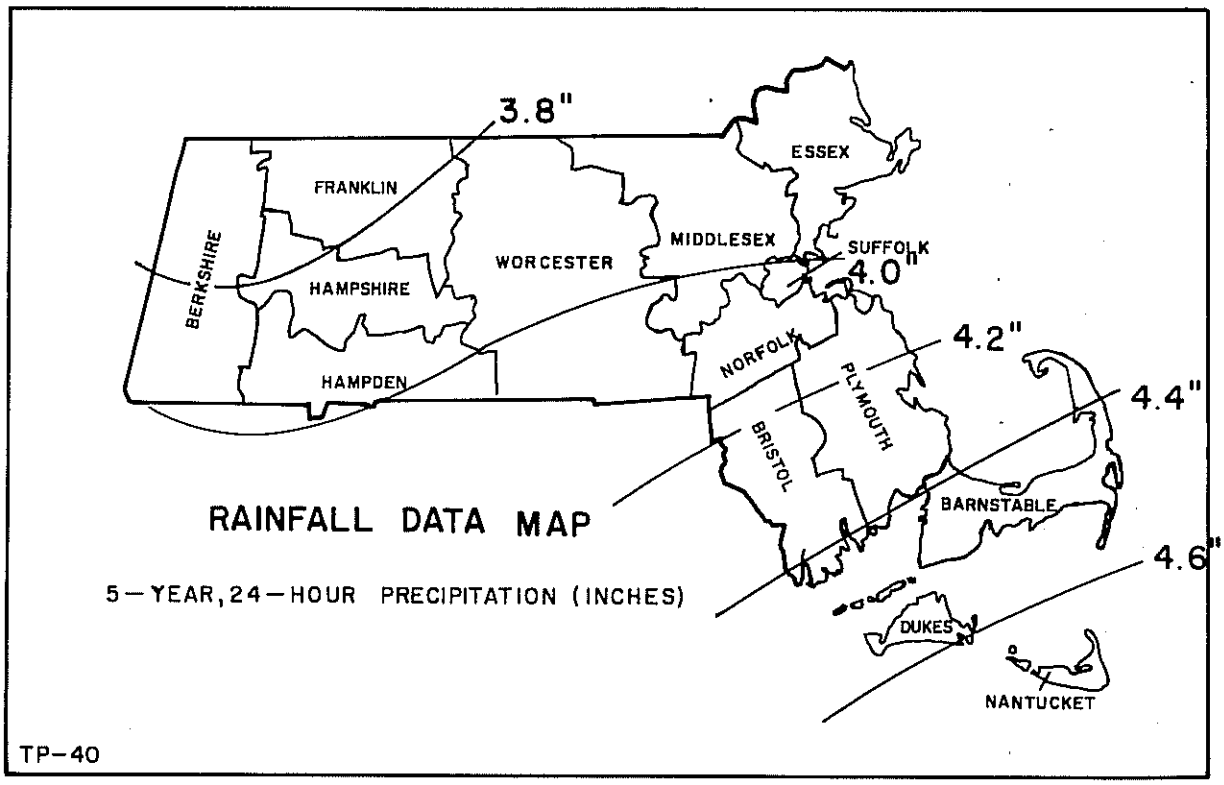
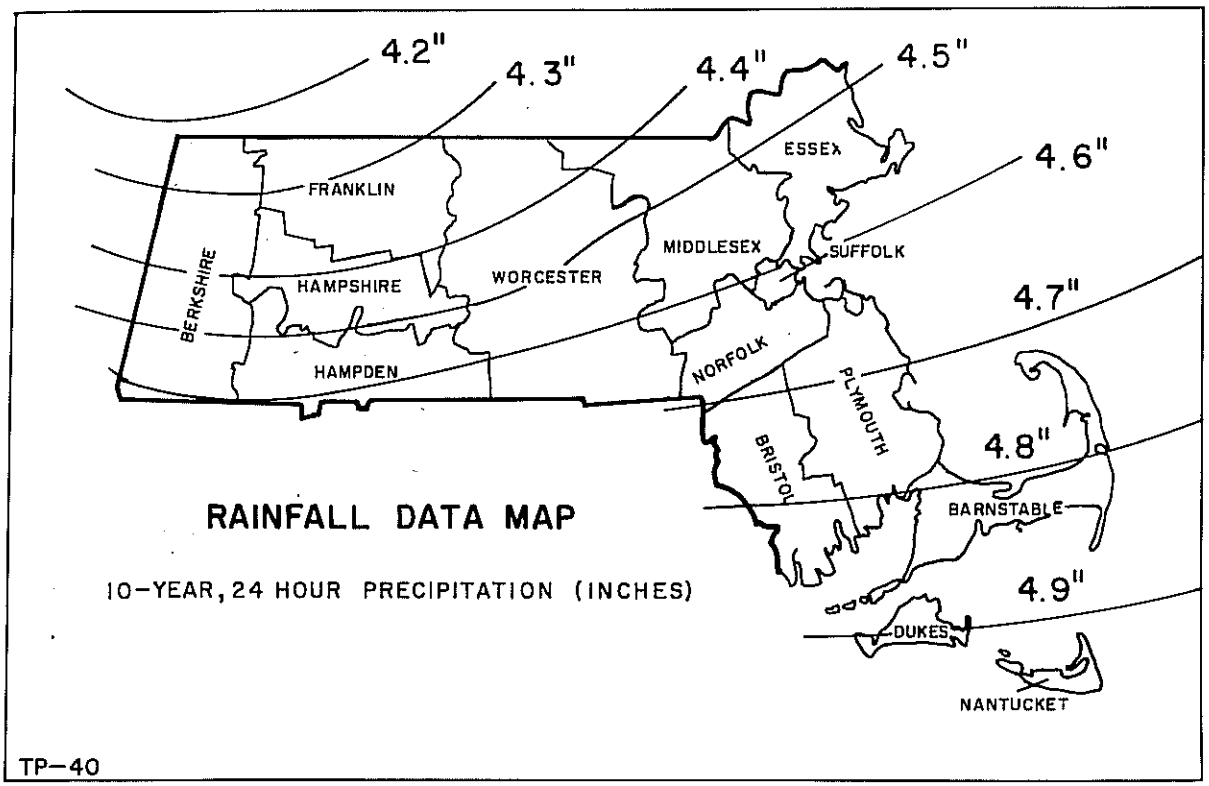


FIGURE B-1, SHEET 1 OF 3



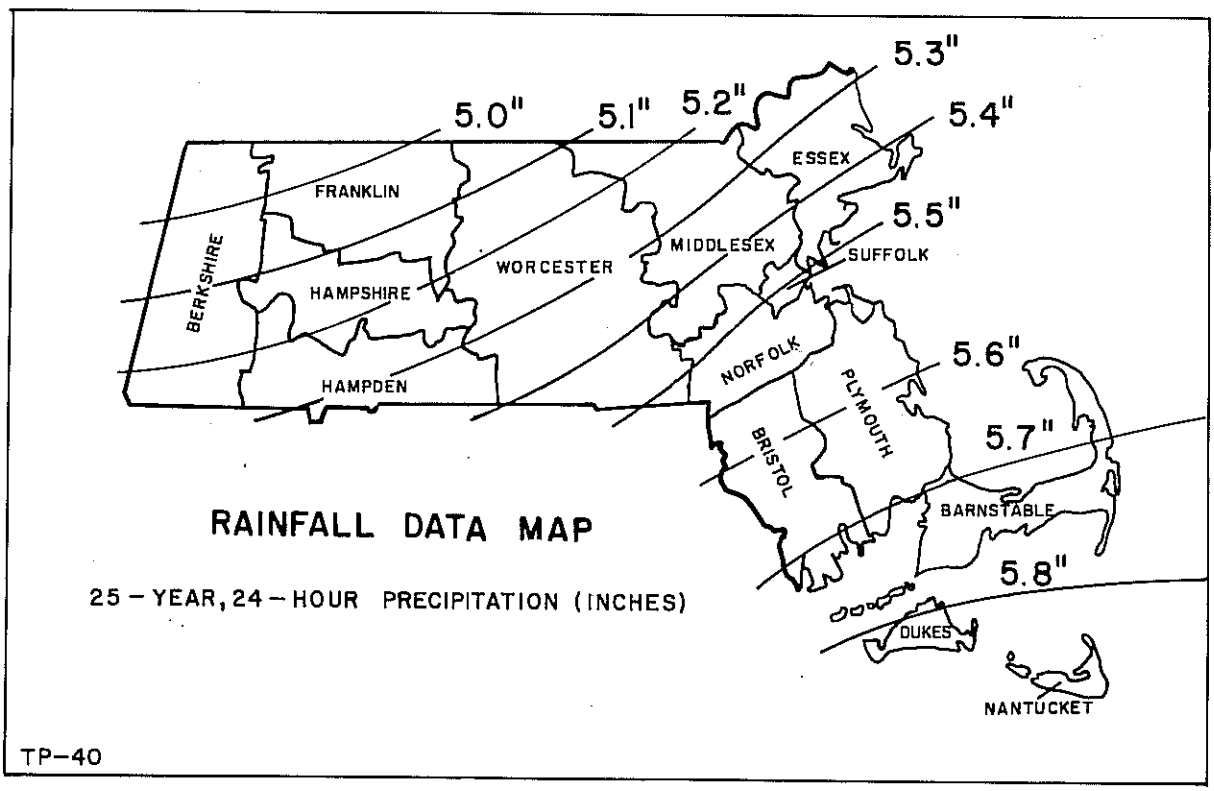
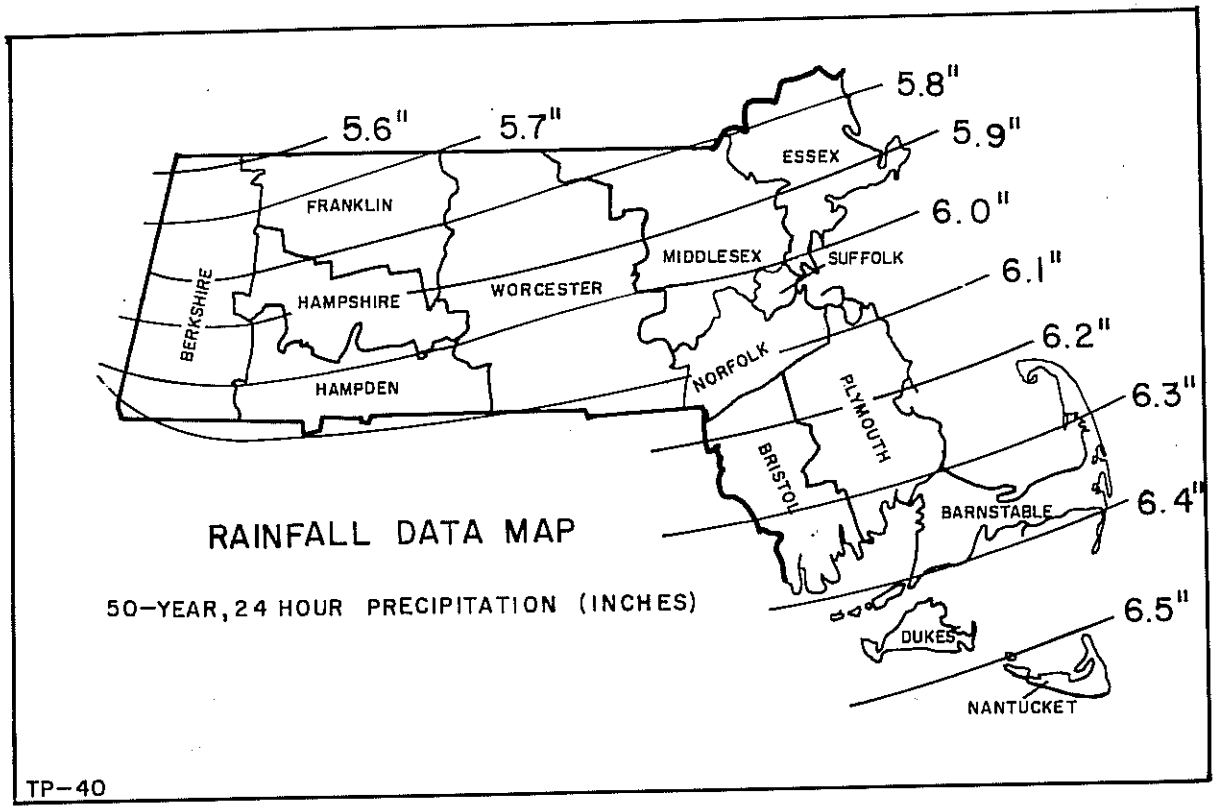


FIGURE B-1, SHEET 2 OF 3



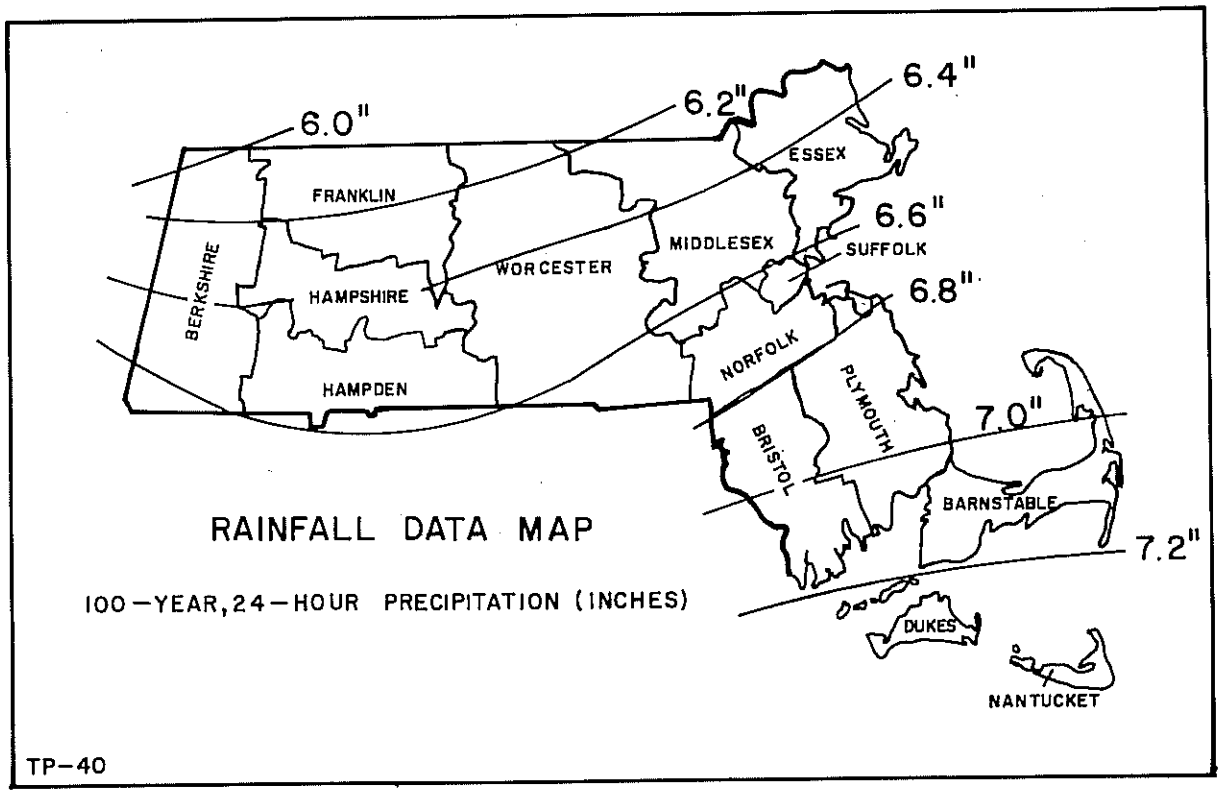


FIGURE B-1, SHEET 3 OF 3

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BROOKLINE, MASSACHUSETTS

APPENDIX F – RECHARGE VOLUME AND DRAWDOWN TIME CALCULATIONS

RECHARGE VOLUME CALCULATIONS, PART I

Date: July 11, 2018
Project: Hampton Court
Project No: 210801529
Location: Brookline, MA

Prepared By: EB
Checked By: FH

Recharge Area Design

Objective: Size an infiltration basin that will approximate the annual recharge from the existing conditions

Methodology: MA Department of Environmental Protection (DEP) Stormwater Management (Vol.3, Ch.1)

Design Criteria:

The required recharge volume equals a depth of runoff corresponding to the soil type times the impervious areas covering that soil type within the project's limit of work. A subsurface investigation verified that the soils onsite are classified as HSG "B" soils.

Based on the Site Hydrologic Soil Group:

Hydrologic Soil Group	Soil Texture	Target Depth Factor (F)
A	Sand	0.60 inches
B	Loam	0.35 inches
C	Silty Loam	0.25 inches
D	Clay	0.10 inches

Recharge Volume Required:

	Impervious Area (sf)	Target Depth (in)	Volume Required (cf)
	23,822	0.60	1,191

	Impervious area routed through stormwater systems:	Capture Area Adjustment
A	2,766	8.61
B	0	0
C	0	0
D	0	0
Total	2,766	10,258 (cf)

Recharge Volume Provided:

Stormtank Chambers ST-01

Outlet Elevation = 6.30
Bottom Basin Elev = 5.40 Area of system = 448 sf Vol. of Recharge: 343 cf *

Total Volume **343 cf** < 10,258 cf

* From HydroCAD storage table

RECHARGE VOLUME CALCULATIONS, PART II

Date: July 11, 2018
Project: Hampton Court
Project No: 210801529
Location: Brookline, MA
Prepared By: EB
Checked By: FH

Required Drawdown Time

Objective: Size an infiltration basin that will approximate the annual recharge from the existing conditions

Methodology: MA Department of Environmental Protection (DEP) Stormwater Management (Vol. 3, Ch. 1)

Provided Recharge Volume:

Stormtank Chambers ST-01

Total Recharge Volume Provided: 343 cf *from HydroCAD storage table

Required Drawdown Time: The provided recharge volume must drain from the system in a maximum of 72 hours using the following equation:

$$\text{Drawdown Time} = \frac{R_v}{(K x A_{Bot})}$$

R_v = Required Recharge Volume
K = the Permeability Rate
A_{Bot} = Bottom area of Infiltration basin

Stormtank Chambers ST-01

Outlet Elevation		R_v cf	K in/hr	A_{Bot} sf	Drawdown Time Hours
6.30	100%	343	2.41	448	3.81

Stage-Area-Storage for Pond ST-01: StormTank Chambers

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
5.40	**448**	0	6.46	448	404
5.42	448	8	6.48	448	412
5.44	448	15	6.50	448	420
5.46	448	23	6.52	448	427
5.48	448	31	6.54	448	435
5.50	448	38	6.56	448	442
5.52	448	46	6.58	448	450
5.54	448	53	6.60	448	458
5.56	448	61	6.62	448	465
5.58	448	69	6.64	448	473
5.60	448	76	6.66	448	481
5.62	448	84	6.68	448	488
5.64	448	92	6.70	448	496
5.66	448	99	6.72	448	504
5.68	448	107	6.74	448	511
5.70	448	114	6.76	448	519
5.72	448	122	6.78	448	526
5.74	448	130	6.80	448	534
5.76	448	137	6.82	448	542
5.78	448	145	6.84	448	549
5.80	448	153	6.86	448	557
5.82	448	160	6.88	448	565
5.84	448	168	6.90	448	572
5.86	448	175	6.92	448	580
5.88	448	183	6.94	448	587
5.90	448	191	6.96	448	595
5.92	448	198	6.98	448	603
5.94	448	206	7.00	448	610
5.96	448	214	7.02	448	618
5.98	448	221	7.04	448	626
6.00	448	229	7.06	448	633
6.02	448	236	7.08	448	641
6.04	448	244	7.10	448	648
6.06	448	252	7.12	448	656
6.08	448	259	7.14	448	664
6.10	448	267	7.16	448	671
6.12	448	275	7.18	448	679
6.14	448	282	7.20	448	687
6.16	448	290	7.22	448	694
6.18	448	298	7.24	448	702
6.20	448	305	7.26	448	709
6.22	448	313	7.28	448	717
6.24	448	320	7.30	448	725
6.26	448	328	7.32	448	732
6.28	448	336	7.34	448	740
6.30	448	343	7.36	448	748
6.32	448	351	7.38	448	755
6.34	448	359	7.40	448	**763**
6.36	448	366			
6.38	448	374			
6.40	448	381			
6.42	448	389			
6.44	448	397			

Storage Below Weir Elevation 6.30

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APPENDIX G – TSS REMOVAL WORKSHEETS

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TSS Removal Treatment Train Summary

Date:	July 13, 2018
Project:	Hampton Court
Project No:	210801529
Location:	Brookline, MA
Prepared By:	EB
Checked By:	FH

Objective: Stormwater management systems will be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This will be achieved by the use of following treatment trains.

Treatment Train 1:

Contech VSHS36 (WQD1) → Subsurface Detention / Infiltration System

Stantec Planning Landscape Architecture, PC
226 Causeway St. Boston MA 02114
Tel: (617) 523-8103 Fax: (617) 523-4333

Stantec Planning and Landscape Architecture P.C.
226 Causeway Street, 6th Floor
Boston Massachusetts 02114

TOTAL SUSPENDED SOLIDS (TSS) REMOVAL WORKSHEET

Project	Hampton Court	**Project #**	210801529
Location	Beacon Street, Brookline, MA	**Date**	7/12/2018
Calculated By	EB	**Checked By**	FH

Calculations

Treatment Train 1 - WQD1

Subcatchment Location: **Subcatchment P-1B & PR-1C**

A BMP	B TSS Removal Rate	C Starting TSS Load	D Amount Removed (BxC)	E Remaining Load (C-D)	F TSS Removal Rate
Contech VSHS36 Water Quality Manhole	**0.915**	**1.00**	**0.915**	**0.085**	**91.5%**
Subsurface Basin ST-01	**0.500**	**0.085**	**0.043**	**0.043**	**95.8%**

Total TSS Removal = 95.8%

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APPENDIX H – WATER QUALITY CALCULATIONS

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Project: Hampton Court
Location: Brookline, MA
Prepared For: Stantec

Purpose: To calculate the water quality flow rate (WQF) over a given site area. In this situation the WQF is derived from the first 1/2" of runoff from the contributing impervious surface.

Reference: Massachusetts Dept. of Environmental Protection Wetlands Program / United States Department of Agriculture Natural Resources Conservation Service TR-55 Manual

Procedure: Determine unit peak discharge using Figure 1 or 2. Figure 2 is in tabular form so is preferred. Using the tc, read the unit peak discharge (qu) from Figure 1 or Table in Figure 2. qu is expressed in the following units: cfs/mi^2/watershed inches (csm/in).

Compute Q Rate using the following equation:

$$Q = (qu)\ (A)\ (WQV)$$

where:

Q = flow rate associated with first 1/2" of runoff
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area (in square miles)
WQV = water quality volume in watershed inches (1/2" in this case)

Structure Name	Impv. (acres)	A (miles^2)	t_c (min)	t_c (hr)	WQV (in)	qu (csm/in.)	Q (cfs)
WQD 1	0.17	0.0002656	5.0	0.083	0.50	773.00	0.10

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APPENDIX I – CONTECH DESIGN SUMMARY

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CONTECH® ENGINEERED SOLUTIONS

VORTSENTRY® HS ESTIMATED NET ANNUAL TSS REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

HAMPTON COURT
BROOKLINE, MA

Area	0.17 ac	Unit Site Deignation	WQD 1
Weighted C	0.9	Rainfall Station #	69
t_c	5 min	Design Ratio[1]	0.0060
VSHS Model	HS36	VSHS Treatment Capacity	0.55 cfs

Rainfall Intensity[1] (in/hr)	Flow Rate (cfs)	Operating Rate[2] cfs/ft[3]	% Total Rainfall	Rel. Effcy (%)
0.02	0.00	0.00012	10.2%	10.0%
0.04	0.01	0.00023	9.6%	9.5%
0.06	0.01	0.00035	9.4%	9.3%
0.08	0.01	0.00046	7.7%	7.6%
0.10	0.02	0.00058	8.6%	8.4%
0.12	0.02	0.00069	6.3%	6.2%
0.14	0.02	0.00081	4.7%	4.6%
0.16	0.02	0.00092	4.6%	4.5%
0.18	0.03	0.00104	3.5%	3.5%
0.20	0.03	0.00115	4.3%	4.3%
0.25	0.04	0.00144	8.0%	7.8%
0.30	0.05	0.00173	5.6%	5.5%
0.35	0.05	0.00202	4.4%	4.3%
0.40	0.06	0.00231	2.5%	2.5%
0.45	0.07	0.00260	2.5%	2.5%
0.50	0.08	0.00289	1.4%	1.4%
0.75	0.11	0.00433	5.0%	4.9%
1.00	0.15	0.00577	1.0%	1.0%
1.50	0.23	0.00866	0.0%	0.0%
2.00	0.31	0.01154	0.0%	0.0%
3.00	0.46	0.01732	0.5%	0.4%
				98.0%
			% rain falling at >3"/hr =	0.0%
			Removal Efficiency Adjustment[4] =	6.5%
			Predicted Net Annual Load Removal Efficiency =	**91.5%**

1 - Design Ratio = (Total Drainage Area x Runoff Coefficient) / VortSentry HS Treatment Volume
= The Total Drainage Area and Runoff Coefficient are specified by the site engineer.
2 - Operating Rate (cfs/ft^3) = Rainfall Intensity ("/hr) x Design Ratio
3 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA
4 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

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BROOKLINE, MASSACHUSETTS

APPENDIX J – OPERATION AND MAINTENANCE LOG AND OPERATIONS AND MAINTENANCE PLAN EXHIBIT

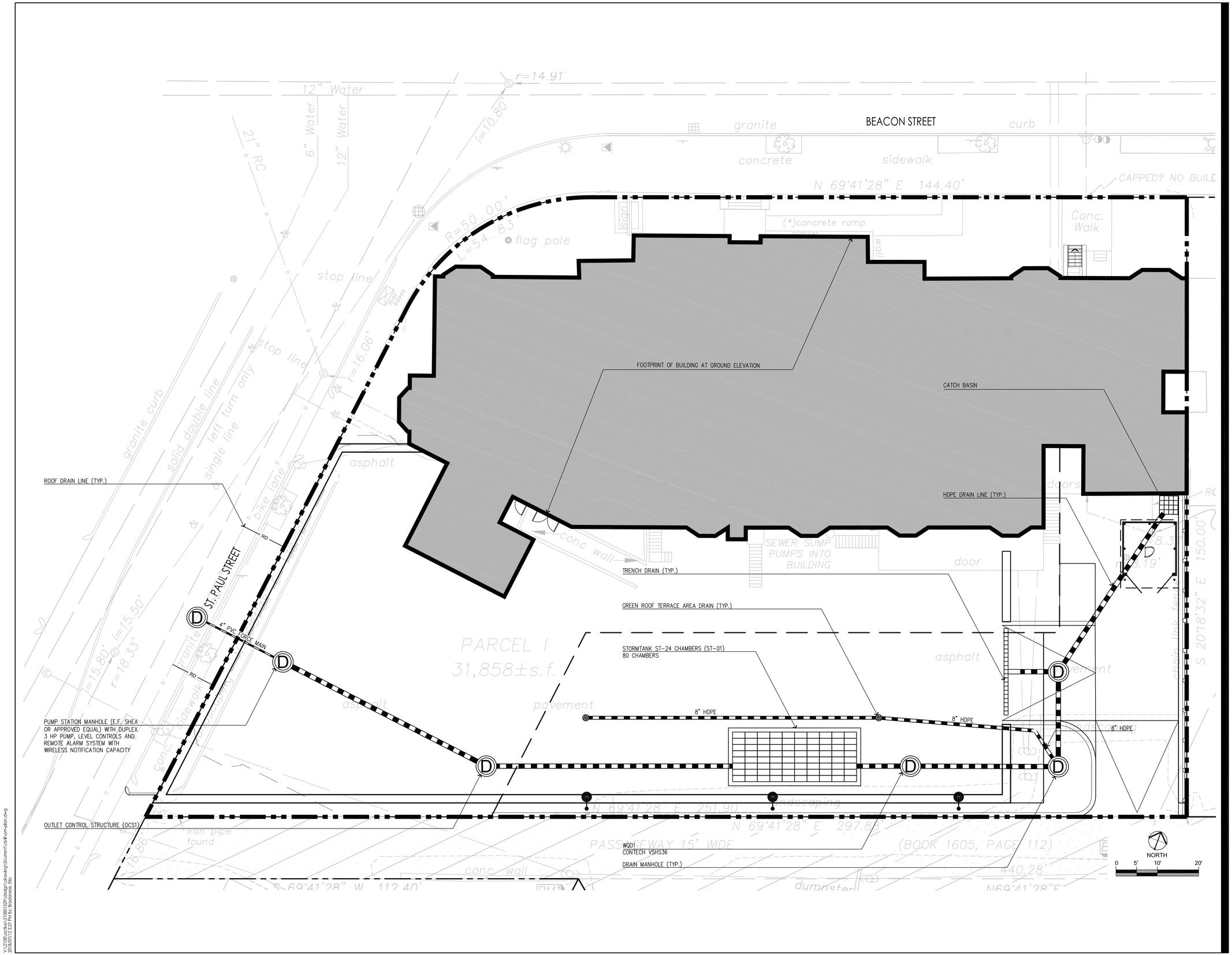
Hampton Court Apartments

Operation and Maintenance Log

Structural Best Management Practice	Action	Date Completed	Comments	Completed By	Action	Date Completed	Comments	Completed By
Roof Leaders – Clean four times per year or more frequently as necessary	Clean				Clean			
Subsurface Detention/Infiltration Basin – Inspect the basin after each major rainstorm for the first service year of operation, and per manufactures recommendation, minimum.	Inspect				Inspect			
Vegetated Areas Maintenance – Prune and weed twice per year, inspect trees and shrubs four times per year	Prune / Weed				Prune / Weed			
	Inspect				Inspect			
WQU (Contech) – Inspect annually, clean as required.	Clean				Clean			
Trench Drains - Inspect monthly. Clean as required.	Inspect				Clean			
Outlet Control Structure – Inspect annually. Clean as required.	Clean				Clean			
Pump Station Manhole - Inspect annually. Clean as required.	Clean				Clean			

Inspections for Year:_____

NOTE: See Section 9.0, Standard 9: Operations and Maintenance Plan for additional details.



Stantec

Stantec Planning and
Landscape Architecture P.C.
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Tel. 617.523.8103
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Consultants

Legend

Notes

	By	Appd.	MM.DD.YY
Comprehensive Permit Set Issued	EB	FH	07.13.18

File Name: om-plan.dwg	Dwn.	Chkd.	Dsgn.	MM.DD.YY

Permit-Seal

Client/Project
CHESTNUT HILL REALTY

1223 BEACON STREET

BROOKLINE, MA

Title
OPERATIONS & MAINTENANCE PLAN EXHIBIT

Project No. 210801529

Scale AS SHOWN

Sheet

Drawing No. OM-1

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HAMPTON COURT APARTMENTS
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APPENDIX K – CONTECH WATER QUALITY DEVICE INSPECTION AND MAINTENANCE INFORMATION

CONTECH®
ENGINEERED SOLUTIONS

VortSentry® HS Maintenance Guide

VortSentry® HS Maintenance

The VortSentry HS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit, i.e., unstable soils or heavy winter sanding will cause the treatment chamber to fill more quickly, but regular sweeping will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant deposition and transport may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (i.e. spring and fall) however more frequent inspections may be necessary in equipment washdown areas and in climates where winter sanding operations may lead to rapid accumulations of a large volume of sediment. It is useful and often required as part of a permit to keep a record of each inspection. A simple inspection and maintenance log form for doing so is available for download at www.contechstormwater.com.

The VortSentry HS should be cleaned when the sediment has accumulated to a depth of two feet in the treatment chamber. This determination can be made by taking two measurements with a stadia rod or similar measuring device; one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the distance given in Table 1, the VortSentry HS should be maintained to ensure effective treatment.

Cleaning

Cleaning of the VortSentry HS should be done during dry weather conditions when no flow is entering the system. Cleanout of the VortSentry HS with a vacuum truck is generally the most effective and convenient method of excavating pollutants from the system. Simply remove the manhole cover and insert the vacuum hose into the sump. All pollutants can be removed from this one access point from the surface with no requirements for Confined Space Entry.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use adsorbent pads, which solidify the oils. These are usually much easier to remove from the unit individually, and less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Floating trash can be netted out if you wish to separate it from the other pollutants.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure proper safety precautions. If anyone physically enters the unit, Confined Space Entry procedures need to be followed.

Disposal of all material removed from the VortSentry HS should be done is accordance with local regulations. In many locations, disposal of evacuated sediments may be handled in the same manner as disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal.

VortSentry HS Model	Diameter		Distance Between Water Surface and Top of Storage Sump		Sediment Storage		Oil Spill Storage	
	in	m	ft	m	yd^3	m^3	gal	liter
HS36	36	0.9	3.6	1.1	0.5	0.4	83	314
HS48	48	1.2	4.7	1.4	0.9	0.7	158	598
HS60	60	1.5	6	1.8	1.5	1.1	258	978
HS72	72	1.8	7.1	2.2	2.1	1.6	372	1409
HS84	84	2.1	8.4	2.6	2.9	2.2	649	2458
HS96	96	2.4	9.5	2.9	3.7	2.8	845	3199

Table 1: VortSentry HS Maintenance Indicators and Sediment Storage Capacities.

VortSentry HS Inspection & Maintenance Log

VortSentry HS Model:______________________________________ Location:____

Date	Water depth to shipment[1]	Floatable layer thickness[2]	Describe maintenance performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the distance given in Table 1, the system should be cleaned out. Note: To avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

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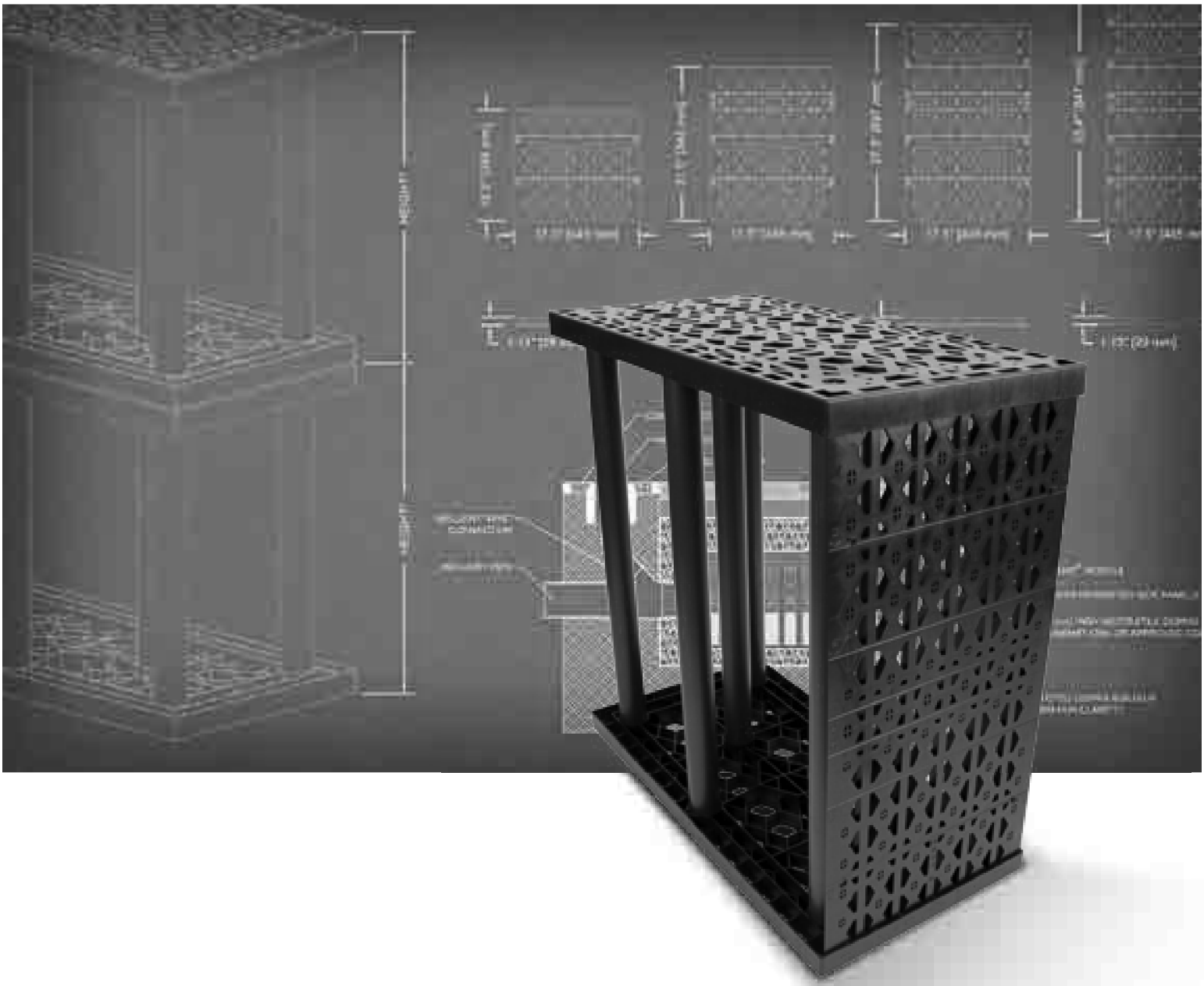
STORMWATER REPORT
HAMPTON COURT APARTMENTS
1223 BEACON STREET
BROOKLINE, MASSACHUSETTS

APPENDIX L – SUBSURFACE STORAGE CHAMBERS MAINTENANCE GUIDELINES

DESIGN GUIDE



STORMTANK® Module

BRENTWOOD®

Contents

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11.0 System Sizing
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13.0 Specifications
14.0 Appendix – Bearing Capacity Tables

General Notes

1. Brentwood recommends that the installing contractor contact either Brentwood or the local distributor prior to installation of the system to schedule a pre-construction meeting. This meeting will ensure that the installing contractor has a firm understanding of the installation instructions.
2. All systems must be designed and installed to meet or exceed Brentwood's minimum requirements. Although Brentwood offers support during the design, review, and construction phases of the Module system, it is the ultimate responsibility of the Engineer of Record to design the system in full compliance with all applicable engineering practices, laws, and regulations.
3. Brentwood requires a minimum cover of 24" (610 mm) and/or a maximum Module invert of 11' (3.35 m). Additionally, a minimum 6" (152 mm) leveling bed, 12" (305 mm) side backfill, and 12" (305 mm) top backfill are required on every system.
4. Brentwood recommends a minimum bearing capacity and subgrade compaction for all installations. If site conditions are found not to meet any design requirements during installation, the Engineer of Record must be contacted immediately.
5. All installations require a minimum two layers of geotextile fabric. One layer is to be installed around the Modules, and another layer is to be installed between the stone/soil interfaces.
6. Stone backfilling is to follow all requirements of the most current installation instructions.
7. The installing contractor must apply all protective measures to prevent sediment from entering the system during and after installation per local, state, and federal regulations.
8. The StormTank® Module carries a Limited Warranty, which can be accessed at www.brentwoodindustries.com.

10.0 Inspection & Maintenance

Description

Proper inspection and maintenance of a subsurface stormwater storage system are vital to ensuring proper product functioning and system longevity. It is recommended that during construction the contractor takes the necessary steps to prevent sediment from entering the subsurface system. This may include the installation of a bypass pipe around the system until the site is stabilized. The contractor should install and maintain all site erosion and sediment per Best Management Practices (BMP) and local, state, and federal regulations.

Once the site is stabilized, the contractor should remove and properly dispose of erosion and sediment per BMP and all local, state, and federal regulations. Care should be taken during removal to prevent collected sediment or debris from entering the stormwater system. Once the controls are removed, the system should be flushed to remove any sediment or construction debris by following the maintenance procedure outlined below.

During the first service year, a visual inspection should be completed during and after each major rainfall event, in addition to semi-annual inspections, to establish a pattern of sediment and debris buildup. Each stormwater system is unique, and multiple criteria can affect maintenance frequency. For example, whether or not a system design includes inlet protection or a pretreatment device has a substantial effect on the system's need for maintenance. Other factors include where the runoff is coming from (hardscape, gravel, soil, etc.) and seasonal changes like autumn leaves and winter salt.

During and after the second year of service, an established annual inspection frequency, based on the information collected during the first year, should be followed. At a minimum, an inspection should be performed semi-annually. Additional inspections may be required at the change of seasons for regions that experience adverse conditions (leaves, cinders, salt, sand, etc).

Maintenance Procedures

Inspection:

1. Inspect all observation ports, inflow and outflow connections, and the discharge area.
2. Identify and log any sediment and debris accumulation, system backup, or discharge rate changes.
3. If there is a sufficient need for cleanout, contact a local cleaning company for assistance.

Cleaning:

1. If a pretreatment device is installed, follow manufacturer recommendations.
2. Using a vacuum pump truck, evacuate debris from the inflow and outflow points.
3. Flush the system with clean water, forcing debris from the system.
4. Repeat steps 2 and 3 until no debris is evident.