STORMWATER REPORT
KESSELER WOODS

Lagrange Street
Newton, Massachusetts

Submitted to:

Applicant:

Chestnut Hill Realty
300 Independence Drive
Chestnut Hill, MA 02467

Prepared by:

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Executive Summary

Chestnut Hill Realty (Owner) proposes to construct an 80-unit residential building on the property located on Lagrange Street in Newton, MA. The 14.7-acre parcel is located on the north side of Lagrange Street in Newton MA, along its border with Brookline MA. The 4.29-acre project is located between Rangeley Road and Byron Road. Other related site improvements will include new parking spaces and driveways, a fire lane, a new stormwater management system, utilities, and landscaped areas. The project area currently consists of wooded areas.

Under existing conditions, stormwater from the project area flows over-land to wetlands located west of the project site. The proposed development will increase the amount of impervious area from 0 square feet to 96,703 square feet within the project area. The increase in impervious area is due to the addition of new building's roof, driveway, parking, and sidewalk surfaces. With the proposed improvements, the impervious area within the project area will be increased from 0.0% to 15.1%. This will result in an increase in the rate of stormwater runoff from the property which will be mitigated by a subsurface stormwater detention system. A minimum of 80% total suspended solids removal will be achieved for stormwater within the project area by the proposed water quality improvements which include catch basins with deep sumps and hoods, proprietary separators, a subsurface stormwater detention system, and water quality infiltration trenches.

The following report was created in accordance with the "Massachusetts Stormwater Handbook". The report is organized into sections that correspond to the categories listed in the "Massachusetts Stormwater Report Checklist".

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1.0 Project Type

Chestnut Hill Realty proposes a construction project that will erect a new residential building on the property located on Lagrange Street in Newton, MA.

Other related site improvements will include new parking spaces and driveways, walks, a new stormwater drainage system, utilities, and landscaped areas. The project area currently consists of undeveloped wooded areas and is located to the west of Lagrange Street. The project area will consist of approximately 4.29-acres.

The applicant for this project is Chestnut Hill Realty. Frank Holmes, P.E., of Stantec Planning & Landscape Architecture P.C. has prepared this report.

The project has been designed in accordance with the MADEP's Stormwater Handbook.

2.0 LID Measures

The proposed project will implement low-impact development and environmentally sensitive site design methods and strategies, including:

- The proposed design minimizes the total volume of earthwork within the project area, resulting in a net cut of 44,000 cubic yards, less than the 86,500 cubic yards from the previously approved design by H.W. Moore Associates, Inc., submitted on January 31, 2006.

- The proposed design minimizes impact to existing vegetation and land clearing by limiting disturbance to the site. The 4.29-acre area of disturbance is smaller than the previously approved area of 4.92-acres. A 1.08-acre area in the center of the site will be left unaltered.

- During the construction period every effort will be made to minimize the disturbance to existing trees and shrubs. Whenever they occur outside of the limit of work major trees and valued vegetation will be clearly marked for protection and monitored during the construction process.

Low Impact Development Project Area Design credits were not considered for this project.

3.0 Standard 1: No New Untreated Discharges

The MA Stormwater Handbook requires that the project demonstrates that there are no new untreated discharges and that new discharges will not cause erosion or scour to downstream wetlands.

The computations and strategies for Standards 4 through 6 in this report demonstrate that there will be no new untreated discharges to the wetland resource areas from the project area. A new proposed 12" outlet pipe and a new proposed 18" outlet pipe will convey overflow discharge from the proposed subsurface detention systems, discharging to the bordering vegetated wetlands to the west & north of the site.

Calculations are included in Attachment, Section 13.2 of this report.

Table 3.1 – Discharge Velocity for 2-Year Storm

Outfall	Discharge Velocity (feet per second)
Proposed 12" Pipe (P-1)	2.77
Proposed 18" Pipe (P-2)	4.61

The discharge from the new outfall is will be to a rip rap apron to reduce the energy that is associated the flow.

Calculations for the discharge velocity are included in Attachment Section 13.2 of this report as are riprap apron sizing calculations.

4.0 Standard 2: Peak Rate Attenuation

Standard 2 requires that peak rates of flow be attenuated for the proposed redevelopment condition. Peak flows will be at or below existing condition rates. The following section outlines the procedure for determining the peak rates for the existing condition as well as the methods for attenuating the peak flows in the proposed condition.

4.1 EXISTING CONDITIONS

Four (4) drainage areas (EX-1 – EX-4) have been modeled to represent existing conditions (See Figure 2) that will be affected by the proposed development. The following assumptions were made for the purpose of this hydrologic analysis:

- Drainage areas affected by the proposed project were analyzed to delineate watershed boundaries.
- The total watershed area of all drainage areas for the existing condition is used as the comparison base for the watershed area in the proposed condition.

The following is a brief description of the drainage areas:

4.1.1 Drainage Area EX-1

Drainage Area EX-1 is 135,036 square feet (approximately 3.10-acres). Drainage Area EX-1 includes undeveloped woodland areas. Stormwater runoff from Drainage Area EX-1 drains over-land to the existing wetlands west of the site. The wetlands are designated as Discharge Point 1 (DP-1) to facilitate a common point of comparison between pre- and post-development stormwater runoff conditions.

4.1.2 Drainage Area EX-2

Drainage Area EX-2 is 52,272 square feet (approximately 1.20-acres). Drainage Area EX-2 includes undeveloped woodland areas. Stormwater runoff from Drainage Area EX-2 drains over-land to Lagrange Street southeast of the site, where it is collected in the existing drain system and directed to the existing wetlands west of the site.

4.1.3 Drainage Area EX-3

Drainage Area EX-3 is 143,748 square feet (approximately 3.30-acres). Drainage Area EX-3 includes undeveloped woodland areas. Stormwater runoff from Drainage Area EX-3 drains over-land to the existing wetlands north of the site.

4.1.4 Drainage Area EX-4

Drainage Area EX-1 is 17,424 square feet (approximately 0.40-acres). Drainage Area EX-4 includes undeveloped woodland areas. Stormwater runoff from Drainage Area EX-4 drains over-land to the existing drainage system in Lagrange Street.

4.1.5 Existing Drainage Area Summary

The following table (Table 4.1.1) summarizes the existing drainage area, including the pertinent information used for hydrologic analysis:

Table 4.1.1 – Existing Conditions Drainage Area Characteristics Summary

Drainage Area	**Area** (Acres)	**Curve Number**	**Tc** (min)
EX-1	3.10	77	8.4
EX-2	1.20	77	7.3
EX-3	3.30	74	15.7
EX-4	0.40	72	9.8

4.1.6 Soil Conditions

The Natural Resources Conservation Service (NRCS) National Cooperative Soil Survey defines the soils found within the watershed being analyzed in this report. The watershed area is comprised of Hollis-Rock outcrop-Charlton complex and Charlton-Urban land-Hollis complex. The hydrologic soil groups associated with these soil types is summarized in the following table (Table 4.1.2). The referenced soil survey is included in Attachments Section 13.3 of this report.

Site visits have confirmed that the site is defined by numerous rock outcroppings. It is suspected that the depth to bedrock is shallow in most locations. A Rawls Rate of 0.09 inches per hour was assumed due to the primary NRCS classification of Hydrologic Soil Group D. As Hollis-Rock outcrop-Charlton complex is considered to have moderate permeability according to the “Soil Survey of Norfolk and Suffolk Counties, Massachusetts (Peragallo, 1989)”, the most well-draining Rawls Rate for group D was used as a conservative assumption.

Table 4.1.2 – NRCS Soil Types

Map Designation	Soil Type	Hydrologic Soil Group
104C	Hollis-Rock outcrop-Charlton complex, 3 to 15 percent slopes	D
631C	Charlton-Urban land-Hollis complex, 3 to 15 percent slopes, rocky	B

4.1.7 Peak Discharge Runoff Rates

The existing peak rates of stormwater runoff were calculated for the 2-, 10-, 25-, and 100-year storm events. The results are presented in Table 4.2.2 in section 4.2.

4.2 PROPOSED CONDITIONS

The proposed project area contains seven (7) drainage areas (See Figure 3). The following briefly describes the proposed drainage areas.

4.2.1 Drainage Area PR-1

Drainage Area PR-1 is 24,524 square feet (approximately 0.56-acres) and consists of the northern half of the roof area of the proposed building. Stormwater runoff from this area will directed to a subsurface detention system (Pond P-1) which will discharge to the wetlands located to the north of the site. (DP-1)

4.2.2 Drainage Area PR-2

Drainage Area PR-2 is 24,524 square feet (approximately 0.56-acres) and consists of the southern half of the roof area of the proposed building. Stormwater runoff from this area will directed to a subsurface detention system (Pond P-2) which will discharge to the existing wetlands west of the site. (R-1)

4.2.3 Drainage Area PR-3

Drainage Area PR-3 is 32,670 square feet (approximately 0.75-acres) and consists of the area of land behind the building that consists of the fire land and landscaped areas. Stormwater runoff from this area will be collected in a closed drainage system that will direct flow to a subsurface detention system (Pond P-2) that will discharge to the wetlands located to the west of the site. (R-1)

4.2.4 Drainage Area PR-4

Drainage Area PR-4 is 104,675 square feet (approximately 2.40-acres) and consists of paved parking, landscaped areas, and undeveloped woodland areas. Stormwater runoff from this area will be collected in a closed drainage system that will direct flow to a subsurface detention system (Pond P-2) that will discharge to the existing wetlands west of the site. (R-1)

4.2.5 Drainage Area PR-5

Drainage Area PR-5 is 18,557 square feet (approximately 0.43-acres) and consists of paved vehicular areas and undeveloped woodland areas. Stormwater runoff from this area will drain over-land to existing drainage system in Lagrange Street. (R-2)

4.2.6 Drainage Area PR-6

Drainage Area PR-6 is 64,295 square feet (approximately 1.48-acres) and consists of undeveloped woodland areas and small amounts of vehicular paved surfaces. Stormwater runoff from this area will drain over-land to existing wetlands west of the site. (R-1)

4.2.7 Drainage Area PR-7

Drainage Area PR-6 is 77,842 square feet (approximately 1.79-acres) and consists of undeveloped woodland areas. Stormwater runoff from this area will drain over-land to existing wetlands north of the site. (DP-1)

Proposed Drainage Area Summary

Table 4.2.1 – Proposed Conditions Drainage Area Characteristics Summary

Drainage Area	**Area** (Acres)	**Curve Number**	**Tc** (min)
PR-1	0.56	98	5.0
PR-2	0.56	98	5.0
PR-3	0.75	82	5.0
PR-4	2.40	84	8.9
PR-5	0.43	72	5.0
PR-6	1.48	78	7.2
PR-7	1.79	72	10.3

4.2.8 Peak Discharge Runoff Rates

Peak flows for the existing and proposed conditions were calculated for the 2-, 10-, 25-, and 100-year storm events under proposed conditions to compare with the existing rates of runoff. The peak rates of runoff of stormwater to the discharge points will decrease under the proposed condition.

The following table (Table 4.2.2) compares the peak rates of runoff under the existing and proposed conditions. "cfs" = Cubic feet per second.

Table 4.2.2 - Peak Rates of Runoff

Discharge Point	2-Year Storm		10-Year Storm		25-Year Storm		100-Year Storm	
	Exist. (cfs)	Prop. (cfs)	Exist. (cfs)	Prop. (cfs)	Exist. (cfs)	Prop. (cfs)	Exist. (cfs)	Prop. (cfs)
R-1 (Wetlands-West)	5.36	4.42	10.60	9.85	14.08	12.80	18.90	18.53
DP-1 (Wetlands-North)	7.82	7.21	15.93	15.01	21.38	19.51	28.98	27.03

4.3 METHODOLOGY AND DESIGN CRITERIA

4.3.1 Hydrologic Model Description

The drainage analysis was performed using the Soil Conservation Service (SCS) TR-55 and TR-20 methodologies and the computer program HydroCAD 8.50 by HydroCAD Software Solutions, LLC.

4.3.2 Design Storms

The analysis was performed on the 2-, 10-, 25-, and 100-year frequency rainfall events. The events were based on the 24-hour type-III duration storm.

4.3.3 Time of Concentration

Times of concentration (Tc) values were calculated using Average Velocities for Overland Flow, found in SCS TR-55 Urban Hydrology for Small Watersheds. The minimum Tc used was five (5) minutes.

4.3.4 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 the Attachments.

4.3.5 Rainfall Depth

Rainfall depths were acquired from Technical Paper 40, “The Rainfall Frequency Atlas of the United States”. Rainfall events for the 2-, 10-, 25-, and 100-year storms were analyzed.

The following rainfall depths were used in the calculations:

Storm Event	Rainfall Depth
2-Year	3.18 inches
10-Year	4.61 inches
25-Year	5.50 inches
100-Year	6.70 inches

5.0 Standard 3: Recharge

Standard 3 requires that computations or demonstrations be fulfilled in order to satisfy the stormwater recharge requirements, they are as follows:

5.1 REQUIRED RECHARGE VOLUME

The recharge volume was calculated based on the Stormwater Handbook's requirements for Hydrologic Soil Group B. As over 90% of the soils on site are mapped as Soil Group D, assuming a recharge volume requirement based on B soils is a conservative assumption.

Since not all of the impervious areas will drain to the stormwater storage volume, a capture area adjustment, by a factor of 1.06 was assumed for these calculations. For the amount of required and provided recharge volume, see the calculations included in Attachment Section 13.6. Table 5.2.1 below displays the volume of water required to be recharged versus the total available storage volume of the proposed BMP's.

Table 5.2.1 – Required and Provided Recharge Volumes

Required Recharge Volume (cf)	Storage Volume Provided (cf)
2,216	3,135

This standard is met for the project because the recharge volume is large enough to contain the required recharge volume for the entire site required by the Stormwater Handbook.

5.2 DRAWDOWN WITHIN 72 HOURS

To determine the drawdown rate for the proposed BMP's, the "Rawls Rates" displayed in Table 2.3.3 of the MA Stormwater Handbook was utilized. Based on the NRCS soil analysis, the soils have been classifies as Hydrologic Soil Group D with small areas of Hydrologic Soil Group B. Therefore, although more well-draining soils (Hydrologic Soil Group B) were assumed for the recharge volume calculation described above, an infiltration rate of 0.09 inches per hour (texture class clay loam) is assumed for the drawdown calculation since it is a more conservative assumption. The formula for calculating drawdown time for the BMP structures is displayed below:

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

Where:

Rv = Storage Volume

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

Bottom Area = Bottom Area of Recharge Structure

The Time to drawdown for the design BMP was calculated as:

Drawdown Time = ***(*****2,216** *cubic feet****) / [(*****0.09** *inches/hour****)*(*****1** *ft/*12** *inches****)*(*****6,479** *Square feet****)]*** = **45.60** *Hours*

As computed above a drawdown time of **45.60** hours is expected, which is less than the required drawdown time of 72 hours.

6.0 Standard 4: Water Quality

Stormwater management systems will be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). The MA Stormwater Handbook states that 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. Stormwater detention basins are sized to capture the required water quality volume as determined in accordance with the Massachusetts Stormwater Handbook; and

c. Stormwater best manages practices have been designed to provide at least 80% TSS removal in accordance with the Massachusetts Stormwater Handbook

6.1 LONG TERM POLLUTION PREVENTION PLAN

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

Deicing

To prevent increased pollutant concentrations in stormwater discharges, the amount of road salt applied will be controlled. Calibration devices for spreaders in trucks will be required for contractors employed to plow driveways and parking areas. The amount of deicing materials used will be monitored with the goal of using only enough to make the roadway and parking areas safe.

Snow Storage/Disposal

Snow storage/disposal will be allowed in landscaped areas within the property, but will be prohibited in any areas between the edge of the proposed paved areas and the wetlands adjacent to the project area.

Pavement Sweeping

A pavement sweeping program will be implemented to remove contaminants directly from paved surfaces to prevent their release into the drainage system. Pavement sweeping can be an effective initial treatment for reducing pollutant loadings in stormwater.

Mechanical or regenerative air sweepers will not be acceptable substitutes. Sweeping will occur on average twice per year, with a concentration in the spring and fall. The removed material will be properly disposed in accordance with local and state laws. Pavement sweeping operations

will occur at times when the parking lot is not in use so that sweepers can get as close to curbs as possible.

Once removed from paved surfaces, the sweeping will be handled and disposed of in accordance with the MassDEP's Bureau of Waste Prevention's written policy regarding the reuse and disposal of street sweepings.

Fertilizer/Pesticide/Herbicide Application

Landscaping maintenance contractors will be required to implement a program to test soils at the project area 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.

Spill Prevention Practices

A spill prevention program will be implemented 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 project area will be clearly posted and project area 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].

Storm Drain Stenciling

The pavement adjacent to storm drains will be stenciled with painted messages warning citizens, residents, and visitors to the project area not to dump pollutants into the drains. In unpaved areas, signs will be posted in the vicinity of area.

6.2 WATER QUALITY VOLUME COMPUTATIONS

The required Water Quality Volume for each drainage area is calculated at ½" multiplied by the amount of impervious area within the drainage area.

Calculations for the required and provided Water Quality Volume for each applicable drainage area are included in Attachment Section 13.8.

Runoff from impervious areas will be treated to remove a minimum of 80% TSS. This will be achieved through the use of a combination of Best Management Practices including catch basins with deep sumps and hoods, stormceptors, and the subsurface stormwater detention systems. In this way, Standard 4 is met for the following reasons:

- A long term pollution prevention plan that fully meets the requirements of Standard 4 will be implemented and maintained.
- The pollution prevention plan includes street sweeping; proper management of snow, salt, sand, and other deicing chemicals; proper management of fertilizers, herbicides, and pesticides; and stabilization of existing eroding surfaces.
- The design provides treatment for runoff from existing and proposed impervious surfaces within the project area to achieve 80% TSS removal, through the use of the subsurface stormwater detention systems.
- The following pollution prevention measures have been considered:
    - Deicing materials will only be used to the extent needed to make the roadway and parking areas 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.
  - The maintenance of structural BMP's is addressed in Standard 9: Operation and Maintenance Plan.

- There are no discharges to impaired waters.

6.3 TSS REMOVAL COMPUTATIONS

There will be a minimum 80% TSS removal rate from all drainage areas in the proposed condition. This will be achieved by the use of catch basins with deep sumps and hoods, stormceptors, and subsurface stormwater detention systems.

7.0 Standard 5: Land Uses with Higher Potential Pollutant Loads

The Kesseler Woods project area is not considered a land use with Higher Potential Pollutant Loads and therefore Standard 5 is not applicable to this project.

8.0 Standard 6: Critical Areas

The Kesseler Woods project is not in a critical area and therefore Standard 6 is not applicable to this project.

9.0 Standard 7: Redevelopment

The Kesseler Woods Project is not a redevelopment and therefore Standard 7 is not applicable to this project.

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

Pollution prevention and erosion and sedimentation control measures will be implemented at the Kesseler Woods project and will control construction related impacts during construction and land disturbance activities. The project will disturb more than one acre of land during the construction process and thus will require a Stormwater Pollution Prevention Plan (SWPPP).

The Site Preparation and Erosion Control Plan (L-001) addresses erosion and sedimentation control.

10.1 EROSION AND SEDIMENT CONTROL MEASURES

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 project areas may also transport sediment to downstream resource areas and 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 resource areas during the earthwork and construction phases of the project. Erosion and sedimentation control measures will be installed prior to project area excavation or disturbance and will be maintained throughout the construction period. Water will be used during the duration of the project to control dust on project area. Regular pavement and sidewalk sweeping is encouraged as required.

Silt Fence and Straw Bale Barriers

Prior to any ground disturbance, a professional engineer or land surveyor will certify that a barrier of staked straw bales and silt fence is in place at the down gradient limit of work in accordance with the plan filed with the Conservation Commission. The barrier will be placed to trap sediment transported by runoff before it reaches the drainage system or leaves the construction project area. The silt fence is a semi-permeable barrier made of a synthetic porous fabric which provides additional protection when used with straw bale barriers. When necessary, additional straw bale and silt fence barriers will be installed immediately down gradient of erosion-prone areas, such as the base of steep exposed slopes and around the base of stockpiles, throughout the construction phase of the project. The barriers will be entrenched into the substrate to prevent underflow.

The erosion control barriers will be inspected weekly and after every storm event. Any sediment that collects behind the barriers will be removed and will be either reused at the project area or disposed of at a suitable off project area location. Any damaged sections of silt fence or hay bales will be repaired or replaced. The underside of straw bales will be kept in close contact

with the earth and reset as necessary. Straw bale barriers and silt fences will be maintained and cleaned until slopes have healthy stands of grass.

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 project area 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.

Slope Stabilization

A temporary vegetative cover will be established on areas of exposed soils (including stockpiles) that remain inactive and unstabilized for a period of more than 30 days for slopes. The seeded surfaces will be covered with a layer of straw mulch or hydro mulch as described above. During winter months erosion control blankets will be used in place of vegetated cover.

Upon completion of final grading, any areas not covered by pavement, other forms of stabilization, or other methods of landscaping will be seeded with an erosion control seed mix. On slopes 4:1 and greater, loamed and seeded areas will be mulched with hay to prevent erosion prior to germination of the seed. After disturbed areas have been stabilized, the temporary erosion control measures will be removed and accumulated sediment will be removed and disposed of in an appropriate location.

Stabilized Construction Entrance

Temporary stabilized construction entrances will be installed at the project area. 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.

10.2 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 product 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 project area 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.

10.3 PRODUCT SPECIFIC PRACTICES

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

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. No storage will occur within 100 feet of a waterway.

Concrete Trucks

Concrete trucks will not be allowed to wash out or discharge surplus concrete or drum wash water within 100 feet of wetland resources or into drainage structures that are already in place.

10.4 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 project area 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 project area 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.

10.5 MAINTENANCE PROGRAM PRACTICES: PRIOR TO 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 project area 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 straw bales if depths reach 6-inches or greater and as-needed.

- Sediment shall be contained within the construction project area and away from drainage structures.
- Damaged or deteriorated erosion control measures will be repaired immediately after identification.
- The underside of the straw bales shall be kept in close contact with the ground and reset as necessary.
- The contractor's project area 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.

11.0 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 project area. An Operations and Maintenance Log is included in Attachment 13.9.

The Stormwater Management System Owner will be Chestnut Hill Realty. The responsible party for maintenance will be the owner of the property.

Non-structural pollutant controls include encouraging the use of salt substitutes for maintenance of parking and roadway areas and sweeping of driveways and parking areas on a regular basis. Structural pollutant controls include catch basins.

Chestnut Hill Realty will perform the inspections and maintenance as outlined in the Operations and Maintenance Plan with their own maintenance personnel. For planning purposes, a budget of $2,500 has been budgeted for pavement sweeping, drainage structure cleaning, and maintenance of vegetated areas.

11.1 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.

Catch Basins

All catch basins at the site will be equipped with deep sumps and hooded outlets to trap debris, sediments, and floating contaminants, which are the largest constituents of urban runoff. The proper removal of sediments and associated pollutants and trash occurs only when catch basin inlets and sumps 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.

Catch basins 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, which is 2 feet for catch basins) will be removed as needed. After the first year, the frequency of the catch basin 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 catch basin 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.

Stormwater Outfall

The stormwater drainage system at the proposed project area has one proposed outfall locations where stormwater is discharged and directed to the wetland.

The outfall location will be inspected monthly for the first three months after construction to ensure proper functioning and correct any areas that have settled or are not functioning correctly. The outfalls will be inspected annually after initial three month period. Annual inspections will be supplemented after large storms. Vegetation around outfalls will be maintained to prevent blockages at the outfall. Rip-rap will be maintained, as necessary. Trash and debris at the outfalls will be removed and properly disposed.

Subsurface Stormwater Detention Systems

The subsurface stormwater detention systems will be used to detain runoff from the proposed building and surrounding site. The subsurface stormwater detention systems will be inspected at least once each year by removing the cleanout covers and the cover of the manhole structure to ensure that the system is draining. Once constructed, the systems will be observed after rainfalls for the first 6 months to determine if it is properly draining.

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 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

The planted areas will be inspected on a semi-annual basis and any litter removed. Weeds and invasive plant species will be removed by hand. Maintain planted areas adjacent to pavement to prevent soil washout. Immediately clean any soil deposits on pavement. 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. Re-seed bare areas; install appropriate erosion control measures when native soil is exposed or erosion channels are forming. Plant alternative mixtures of grass species in the event of unsuccessful establishment. The grass vegetation should not be cut to a height less than four inches.

Fertilizer usage will be avoided. If deemed necessary, slow release fertilizer will be used. 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. Fertilizers will not be used in the bioretention area as excessive nutrients may be discharged to adjacent surface waters. 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.

Pesticide/Herbicide Usage

No pesticides are to be used unless a single spot treatment is required for a specific control application, erosion and sediment control measures.

Pavement Sweeping

A pavement sweeping program will be implemented to remove contaminants directly from paved surfaces to prevent their release into the drainage system. Pavement sweeping can be an effective initial treatment for reducing pollutant loadings in stormwater.

Once removed from paved surfaces, the sweeping will be handled and disposed of in accordance with the MassDEP's Bureau of Waste Prevention's written policy regarding the reuse and disposal of street sweepings.

Proprietary Separators

Proprietary separators 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, Stormceptor Inspection and Maintenance Log.

Water Quality Infiltration Trenches

As infiltration trenches are prone to clogging, it is imperative that they are maintained on a regular schedule. Infiltration trenches will be inspected after the first several rainfall events, after all major storms, and regularly every six months. If ponded water is present, topsoil or stone aggregate will be removed and replaced.

12.0 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."

Proponents of projects within Wetlands jurisdiction must demonstrate compliance with this requirement by submitting to the issuing authority an Illicit Discharge Compliance Statement verifying that no illicit discharges exist on the project area and by including in the pollution prevention plan measures to prevent illicit discharges to the stormwater management system.

It is with full understanding that the SWPPP for the Kesseler Woods project will identify allowable non-stormwater discharges and the measures used to eliminate or reduce them and describe how they will be prevented from becoming contaminated.

Standard 10 also states that "The Illicit Discharge Compliance Statement must be accompanied by a project area map that is drawn to scale and that identifies the location of any systems for conveying stormwater on the project area and shows that these systems do not allow the entry of any illicit discharges into the stormwater management system. The project area map shall identify the location of any systems for conveying wastewater and/or groundwater on the project area 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 is a Utility Plan that displays the location of all of the stormwater management components as well as other utilities (existing and proposed) on the project area and conforms to requirements of a "project area map" to accompany the Illicit Discharge Compliance Statement.

The Illicit Discharge Compliance Statement for the Kesseler Woods 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 exist on the Kesseler Woods Site area off of Lagrange Street in Newton, Massachusetts.

13.0 Attachments

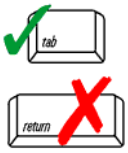
13.1 MA STORMWATER REPORT CHECKLIST AND CERTIFICATION

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

Frank Holmes 8.5.14
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): _____

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.

13.2 DISCHARGE VELOCITY AND RIPRAP SIZING CALCULATIONS

Stantec Planning and Landscape Architecture P.C.
226 Causeway Street
Boston MA 02114
Tel: (617) 523-8103
Fax: (617) 523-4333

Standard 1: Rip-Rap Apron Sizing

Project	Kesseler Woods	Project #	
Location	Newton, MA	Sheet	1 of 1
Calculated by	MC	Date	8/1/2014
Checked by	FH	Revised	-

Objective: To size a rip-rap outfall that will decrease discharge velocity and prevent downstream erosion.

Methedology: U.S. Federal Highway Administration, 2006, Hydraulic Design of Energy Dissipators for Culverts and Channels, Hydraulic Engineering Center Circular No. 14.

Design Criteria:

Location	Pipe Diameter (ft)	*Design Flow Q (cfs)
12" HDPE (Pond P-1)	1	1.28
18" HDPE (Pond P-2)	1.5	3.11

*Refer to HydroCAD 2 year storm for determination of Q and Velocity

Calculations:

Stone Sizing:

D50 = 0.2 * Dia * (Q/√g*Dia^2.5)^4/3 * (Dia/TW)

Where:
D50 = Median Stone Diameter
TW = Tailwater Height (ft) (0.4xDia)
Dia = Pipe Diameter (ft)
Q = Flow (cfs)
g = acceleration due to gravity (32.2 ft/sec^2)
D100 = Max Stone Diameter = 1.5xD50

Location	D50 (ft)	D50(in)	D100 (in)
12" HDPE (Pond P-1)	0.0687	0.8243	1.2364
18" HDPE (Pond P-2)	0.0871	1.0454	1.5681

Assumes Specific gravity of stone to be: 2.65

Apron Dimensions
Using the Table 10.1 below, dimensions can be determined based on pipe diameter

D50 (in.)	Apron Length (ft.)	Apron Depth (in.)
5	4D	3.5D50
6	4D	3.3D50
10	5D	2.4D50
14	6D	2.2D50
20	7D	2.0D50
22	8D	2.0D50

Table 10.1 (from reference material noted above)

use D50=5 in
Width = 3D + (2/3)L

	Apron Dimensions		
Location	Length (ft)	Width (ft)	Depth (in)
12" HDPE (Pond P-1)	4.0	5.7	17.50
18" HDPE (Pond P-2)	6.0	8.5	17.50

Summary for Pond P-1:

[82] Warning: Early inflow requires earlier time span

Inflow Area = 0.563 ac,100.00% Impervious, Inflow Depth > 2.76" for 2 year event
Inflow = 1.75 cfs @ 12.07 hrs, Volume= 0.129 af
Outflow = 1.29 cfs @ 12.15 hrs, Volume= 0.111 af, Atten= 26%, Lag= 4.7 min
Primary = 1.29 cfs @ 12.15 hrs, Volume= 0.111 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 186.86' @ 12.15 hrs Surf.Area= 0.033 ac Storage= 0.035 af

Plug-Flow detention time= 93.8 min calculated for 0.111 af (86% of inflow)
Center-of-Mass det. time= 50.8 min (788.7 - 737.9)

Volume	Invert	Avail.Storage	Storage Description
#1	185.00'	0.017 af	**71.40'W x 20.00'L x 3.00'H Prismatoid** 0.098 af Overall - 0.042 af Embedded = 0.056 af x 30.0% Voids
#2	186.00'	0.041 af	**StormTank 18W** x 273 Inside #1 Inside= 36.0"W x 18.0"H => 4.37 sf x 1.50'L = 6.5 cf Outside= 36.0"W x 18.0"H => 4.50 sf x 1.50'L = 6.8 cf
		0.058 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	186.20'	**10.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=1.28 cfs @ 12.15 hrs HW=186.86' (Free Discharge)
1=Orifice/Grate (Orifice Controls 1.28 cfs @ 2.77 fps)

Summary for Pond P-2:

[82] Warning: Early inflow requires earlier time span

Inflow Area = 3.716 ac, 41.93% Impervious, Inflow Depth > 1.70" for 2 year event
Inflow = 7.00 cfs @ 12.10 hrs, Volume= 0.527 af
Outflow = 3.11 cfs @ 12.36 hrs, Volume= 0.450 af, Atten= 56%, Lag= 15.5 min
Primary = 3.11 cfs @ 12.36 hrs, Volume= 0.450 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 178.54' @ 12.36 hrs Surf.Area= 0.116 ac Storage= 0.199 af

Plug-Flow detention time= 97.1 min calculated for 0.450 af (85% of inflow)
Center-of-Mass det. time= 53.3 min (835.3 - 782.0)

Volume	Invert	Avail.Storage	Storage Description
#1	176.00'	0.078 af	**174.45'W x 29.00'L x 5.00'H Prismatoid** 0.581 af Overall - 0.322 af Embedded = 0.259 af x 30.0% Voids
#2	177.00'	0.156 af	**StormTank 36W** x 519 Inside #1 Inside= 36.0"W x 36.0"H => 8.73 sf x 1.50'L = 13.1 cf Outside= 36.0"W x 36.0"H => 9.00 sf x 1.50'L = 13.5 cf
#3	177.00'	0.156 af	**StormTank 36W** x 519 Inside #1 Inside= 36.0"W x 36.0"H => 8.73 sf x 1.50'L = 13.1 cf Outside= 36.0"W x 36.0"H => 9.00 sf x 1.50'L = 13.5 cf
		0.390 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	179.30'	**12.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	178.15'	**12.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	177.20'	**10.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=3.10 cfs @ 12.36 hrs HW=178.53' (Free Discharge)
- **1=Orifice/Grate** (Controls 0.00 cfs)
- **2=Orifice/Grate** (Orifice Controls 0.59 cfs @ 2.11 fps)
- **3=Orifice/Grate** (Orifice Controls 2.52 cfs @ 4.61 fps)

13.3 SOIL MAP AND INFORMATION

Hydrologic Soil Group—Middlesex County, Massachusetts
(Kesseler Woods)

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: http://websoilsurvey.nrcs.usda.gov
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: Middlesex County, Massachusetts
Survey Area Data: Version 13, Dec 17, 2013

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

Date(s) aerial images were photographed: Mar 30, 2011—May 1, 2011

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

Hydrologic Soil Group— Summary by Map Unit — Middlesex County, Massachusetts (MA017)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
32B	Wareham loamy fine sand, 0 to 5 percent slopes	C	0.1	1.2%
52A	Freetown muck, 0 to 1 percent slopes	A/D	0.5	5.2%
104C	Hollis-Rock outcrop-Charlton complex, 3 to 15 percent slopes	D	8.4	79.3%
603	Urban land, wet substratum		0.1	0.9%
631C	Charlton-Urban land-Hollis complex, 3 to 15 percent slopes, rocky	B	1.4	13.5%
Totals for Area of Interest			**10.6**	**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

13.4 PIPE HYDRAULIC CALCULATIONS

Pipe Calculations

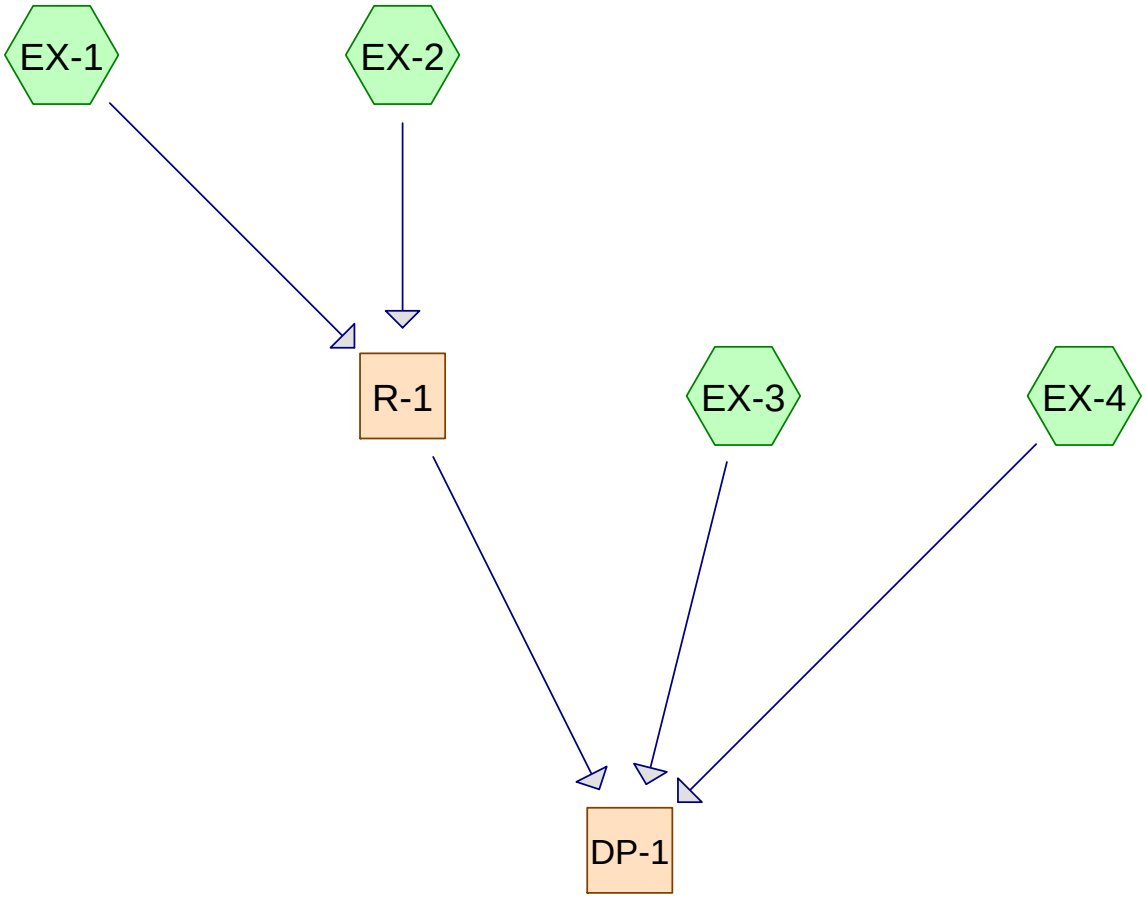
Location: Newton, MA

Kesseler Woods | **Designed By:** MC | **Date:** August 1, 2014

100-Year | **Checked BY:** FH | **Revised:**

LOCATION		DRAINAGE AREA (Acres)				FLOW TIME (min)		RUNOFF (cfs)		FLOW IN PIPE: PIPE				FULL FLOW		DESIGN FLOW		RIM	INVERT			
From	To	Area Ac	Runoff Coeff., C	Increment CA	Sum CA	Tc	Time In Section	Intensity (In/Hr)	Design Flow	Diam (In.)	Length (Ft.)	Slope (Ft./Ft.)	Manning Coeff.	Capacity (Cfs)	Velocity (Fps)	Depth (Ft.)	Velocity (Fps.)	Upper	Upper	Lower	Angle	PIPE % FULL
CB1	DMH1	0.41	0.84	0.34	0.34	5.0	0.04	6.7	2.28	12	14	0.014	0.012	4.6	5.8	0.50	5.8	189.00	185.80	185.60	3.14	50
CB2	DMH1	0.41	0.84	0.34	0.34	5.0	0.07	6.7	2.28	12	20	0.010	0.012	3.9	4.9	0.55	5.0	189.00	185.80	185.60	2.94	58
DMH1	DMH2	-	-	-	0.68	5.1	0.59	6.7	4.56	12	241	0.015	0.012	4.7	6.0	0.80	6.8	188.60	184.50	181.00	1.85	97
CB3	DMH2	0.46	0.84	0.39	0.39	8.9	0.07	6.7	2.61	12	18	0.006	0.012	3.0	3.8	0.74	4.3	183.80	181.00	180.90	2.14	87
CB4	DMH2	0.46	0.84	0.39	0.39	8.9	0.02	6.7	2.61	12	8	0.012	0.012	4.2	5.4	0.58	5.7	184.00	181.00	180.90	2.82	62
DMH2	DMH3	-	-	-	1.46	9.5	0.39	6.7	9.78	20	139	0.006	0.012	11.7	5.3	1.19	6.0	184.26	180.90	180.12	2.26	84
CB5	DMH3	0.30	0.84	0.25	0.25	5.0	0.04	6.7	1.68	12	15	0.033	0.012	7.0	8.9	0.33	7.1	187.00	183.00	182.50	2.45	24
CB6	DMH3	0.30	0.84	0.25	0.25	5.0	0.05	6.7	1.68	12	20	0.025	0.012	6.1	7.8	0.36	6.7	187.00	183.00	182.50	2.57	28
DMH3	WQI1	-	-	-	1.96	9.9	0.36	6.7	13.13	24	131	0.005	0.012	17.4	5.5	1.33	6.1	187.00	180.12	179.47	2.47	75
CB7	WQI1	0.14	0.84	0.12	0.12	5.0	0.15	6.7	0.80	12	31	0.008	0.012	3.5	4.4	0.33	3.5	185.00	181.75	181.50	2.45	23
WQI1	P2	-	-	-	2.08	10.3	0.05	6.7	13.94	24	21	0.006	0.012	19.0	6.0	1.30	6.7	185.50	179.22	179.10	2.53	73
CB8	DMH4	0.33	0.82	0.27	0.27	5.0	0.65	6.7	1.81	12	145	0.005	0.012	2.7	3.5	0.61	3.7	186.00	180.75	180.03	2.70	67
DMH4	WQI2	-	-	-	0.27	5.7	0.63	6.7	1.81	12	139	0.005	0.012	2.7	3.5	0.61	3.7	183.90	180.03	179.33	2.70	67
CB9	WQI2	0.21	0.82	0.17	0.17	5.0	0.49	6.7	1.14	12	89	0.004	0.012	2.4	3.1	0.48	3.0	183.00	180.80	180.43	3.06	48
WQI2	P2	-	-	-	0.44	6.3	0.02	6.7	2.95	12	8	0.010	0.012	3.9	4.9	0.66	5.4	184.00	179.08	179.00	2.49	76
RD South	P2	0.56	0.98	0.55	0.55	6.8	0.00	6.7	3.69	12	8	0.750	0.012	33.5	42.5	0.25	30.2	-	185.00	179.00	2.09	11
P2	DMH5	-	-	-	3.07	10.4	0.00	6.7	20.57	18	4	0.050	0.012	25.5	14.4	1.04	16.0	186.00	179.20	179.00	2.35	81
DMH5	FE2	-	-	-	3.07	10.4	0.10	6.7	20.57	18	150	0.181	0.012	48.5	27.4	0.68	26.1	186.00	179.20	152.00	2.95	42
RD North	P1	0.56	0.98	0.55	0.55	11.0	0.03	6.7	3.69	12	25	0.112	0.012	12.9	16.4	0.36	14.1	-	189.00	186.20	2.57	29
P1	FE1	-	-	-	0.55	11.0	0.01	6.7	3.69	12	18	0.289	0.012	20.8	26.4	0.29	20.4	189.00	186.20	181.00	2.27	18

13.5 HYDROCAD DATA/WATERSHED MAPS



Subcat Reach Pond Link

Routing Diagram for Kesseler_EX
Prepared by Stantec Consulting Ltd., Printed 5/27/2014

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.510	55	Woods, Good, HSG B (EX-3, EX-4)
7.490	77	Woods, Good, HSG D (EX-1, EX-2, EX-3, EX-4)

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.510	HSG B	EX-3, EX-4
0.000	HSG C	
7.490	HSG D	EX-1, EX-2, EX-3, EX-4
0.000	Other	

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	0.510	0.000	7.490	0.000	8.000	Woods, Good	EX-1, EX-2, EX-3, EX-4

Summary for Subcatchment EX-1:

Runoff = 3.80 cfs @ 12.13 hrs, Volume= 0.284 af, Depth> 1.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.18"

Area (ac)	CN	Description
3.100	77	Woods, Good, HSG D
3.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1200	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.18"
0.7	105	0.2300	2.40		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.7	170	0.1060	1.63		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.4	325	Total			

Summary for Subcatchment EX-2:

Runoff = 1.54 cfs @ 12.11 hrs, Volume= 0.110 af, Depth> 1.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.18"

Area (ac)	CN	Description
1.200	77	Woods, Good, HSG D
1.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.2000	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.18"
0.3	45	0.2700	2.60		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.1	180	0.0780	1.40		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.3	275	Total			

Summary for Subcatchment EX-3:

Runoff = 2.75 cfs @ 12.24 hrs, Volume= 0.256 af, Depth> 0.93"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.18"

Area (ac)	CN	Description
2.890	77	Woods, Good, HSG D
0.410	55	Woods, Good, HSG B
3.300	74	Weighted Average
3.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	50	0.0800	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.18"
3.4	300	0.0870	1.47		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
5.2	330	0.0450	1.06		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
15.7	680	Total			

Summary for Subcatchment EX-4:

Runoff = 0.34 cfs @ 12.15 hrs, Volume= 0.028 af, Depth> 0.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.18"

Area (ac)	CN	Description
0.300	77	Woods, Good, HSG D
0.100	55	Woods, Good, HSG B
0.400	72	Weighted Average
0.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.18"
0.4	55	0.1800	2.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.8	105	Total			

Summary for Reach DP-1:

Inflow Area = 8.000 ac, 0.00% Impervious, Inflow Depth > 1.02" for 2 year event
Inflow = 7.82 cfs @ 12.15 hrs, Volume= 0.677 af
Outflow = 7.82 cfs @ 12.15 hrs, Volume= 0.677 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach R-1:

Inflow Area = 4.300 ac, 0.00% Impervious, Inflow Depth > 1.10" for 2 year event
Inflow = 5.36 cfs @ 12.12 hrs, Volume= 0.394 af
Outflow = 5.36 cfs @ 12.12 hrs, Volume= 0.394 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Subcatchment EX-1:

Runoff = 7.57 cfs @ 12.12 hrs, Volume= 0.551 af, Depth> 2.13"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.61"

Area (ac)	CN	Description
3.100	77	Woods, Good, HSG D
3.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1200	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.18"
0.7	105	0.2300	2.40		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.7	170	0.1060	1.63		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.4	325	Total			

Summary for Subcatchment EX-2:

Runoff = 3.05 cfs @ 12.11 hrs, Volume= 0.213 af, Depth> 2.13"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.61"

Area (ac)	CN	Description
1.200	77	Woods, Good, HSG D
1.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.2000	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.18"
0.3	45	0.2700	2.60		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.1	180	0.0780	1.40		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.3	275	Total			

Summary for Subcatchment EX-3:

Runoff = 5.82 cfs @ 12.22 hrs, Volume= 0.521 af, Depth> 1.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.61"

Area (ac)	CN	Description
2.890	77	Woods, Good, HSG D
0.410	55	Woods, Good, HSG B
3.300	74	Weighted Average
3.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	50	0.0800	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.18"
3.4	300	0.0870	1.47		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
5.2	330	0.0450	1.06		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
15.7	680	Total			

Summary for Subcatchment EX-4:

Runoff = 0.76 cfs @ 12.15 hrs, Volume= 0.058 af, Depth> 1.75"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.61"

Area (ac)	CN	Description
0.300	77	Woods, Good, HSG D
0.100	55	Woods, Good, HSG B
0.400	72	Weighted Average
0.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.18"
0.4	55	0.1800	2.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.8	105	Total			

Summary for Reach DP-1:

Inflow Area = 8.000 ac, 0.00% Impervious, Inflow Depth > 2.02" for 10 year event
Inflow = 15.93 cfs @ 12.14 hrs, Volume= 1.344 af
Outflow = 15.93 cfs @ 12.14 hrs, Volume= 1.344 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach R-1:

Inflow Area = 4.300 ac, 0.00% Impervious, Inflow Depth > 2.13" for 10 year event
Inflow = 10.60 cfs @ 12.12 hrs, Volume= 0.765 af
Outflow = 10.60 cfs @ 12.12 hrs, Volume= 0.765 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Subcatchment EX-1:

Runoff = 10.06 cfs @ 12.12 hrs, Volume= 0.733 af, Depth> 2.84"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year Rainfall=5.50"

Area (ac)	CN	Description
3.100	77	Woods, Good, HSG D
3.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1200	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.18"
0.7	105	0.2300	2.40		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.7	170	0.1060	1.63		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.4	325	Total			

Summary for Subcatchment EX-2:

Runoff = 4.05 cfs @ 12.11 hrs, Volume= 0.284 af, Depth> 2.84"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year Rainfall=5.50"

Area (ac)	CN	Description
1.200	77	Woods, Good, HSG D
1.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.2000	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.18"
0.3	45	0.2700	2.60		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.1	180	0.0780	1.40		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.3	275	Total			

Summary for Subcatchment EX-3:

Runoff = 7.91 cfs @ 12.22 hrs, Volume= 0.705 af, Depth> 2.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year Rainfall=5.50"

Area (ac)	CN	Description
2.890	77	Woods, Good, HSG D
0.410	55	Woods, Good, HSG B
3.300	74	Weighted Average
3.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	50	0.0800	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.18"
3.4	300	0.0870	1.47		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
5.2	330	0.0450	1.06		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
15.7	680	Total			

Summary for Subcatchment EX-4:

Runoff = 1.05 cfs @ 12.14 hrs, Volume= 0.080 af, Depth> 2.40"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year Rainfall=5.50"

Area (ac)	CN	Description
0.300	77	Woods, Good, HSG D
0.100	55	Woods, Good, HSG B
0.400	72	Weighted Average
0.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.18"
0.4	55	0.1800	2.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.8	105	Total			

Summary for Reach DP-1:

Inflow Area = 8.000 ac, 0.00% Impervious, Inflow Depth > 2.70" for 25 year event
Inflow = 21.38 cfs @ 12.14 hrs, Volume= 1.802 af
Outflow = 21.38 cfs @ 12.14 hrs, Volume= 1.802 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach R-1:

Inflow Area = 4.300 ac, 0.00% Impervious, Inflow Depth > 2.84" for 25 year event
Inflow = 14.08 cfs @ 12.12 hrs, Volume= 1.017 af
Outflow = 14.08 cfs @ 12.12 hrs, Volume= 1.017 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Subcatchment EX-1:

Runoff = 13.50 cfs @ 12.12 hrs, Volume= 0.990 af, Depth> 3.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=6.70"

Area (ac)	CN	Description
3.100	77	Woods, Good, HSG D
3.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1200	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.18"
0.7	105	0.2300	2.40		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.7	170	0.1060	1.63		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.4	325	Total			

Summary for Subcatchment EX-2:

Runoff = 5.43 cfs @ 12.11 hrs, Volume= 0.383 af, Depth> 3.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=6.70"

Area (ac)	CN	Description
1.200	77	Woods, Good, HSG D
1.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.2000	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.18"
0.3	45	0.2700	2.60		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.1	180	0.0780	1.40		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.3	275	Total			

Summary for Subcatchment EX-3:

Runoff = 10.84 cfs @ 12.22 hrs, Volume= 0.967 af, Depth> 3.52"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=6.70"

Area (ac)	CN	Description
2.890	77	Woods, Good, HSG D
0.410	55	Woods, Good, HSG B
3.300	74	Weighted Average
3.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	50	0.0800	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.18"
3.4	300	0.0870	1.47		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
5.2	330	0.0450	1.06		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
15.7	680	Total			

Summary for Subcatchment EX-4:

Runoff = 1.45 cfs @ 12.14 hrs, Volume= 0.111 af, Depth> 3.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=6.70"

Area (ac)	CN	Description
0.300	77	Woods, Good, HSG D
0.100	55	Woods, Good, HSG B
0.400	72	Weighted Average
0.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.18"
0.4	55	0.1800	2.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.8	105	Total			

Summary for Reach DP-1:

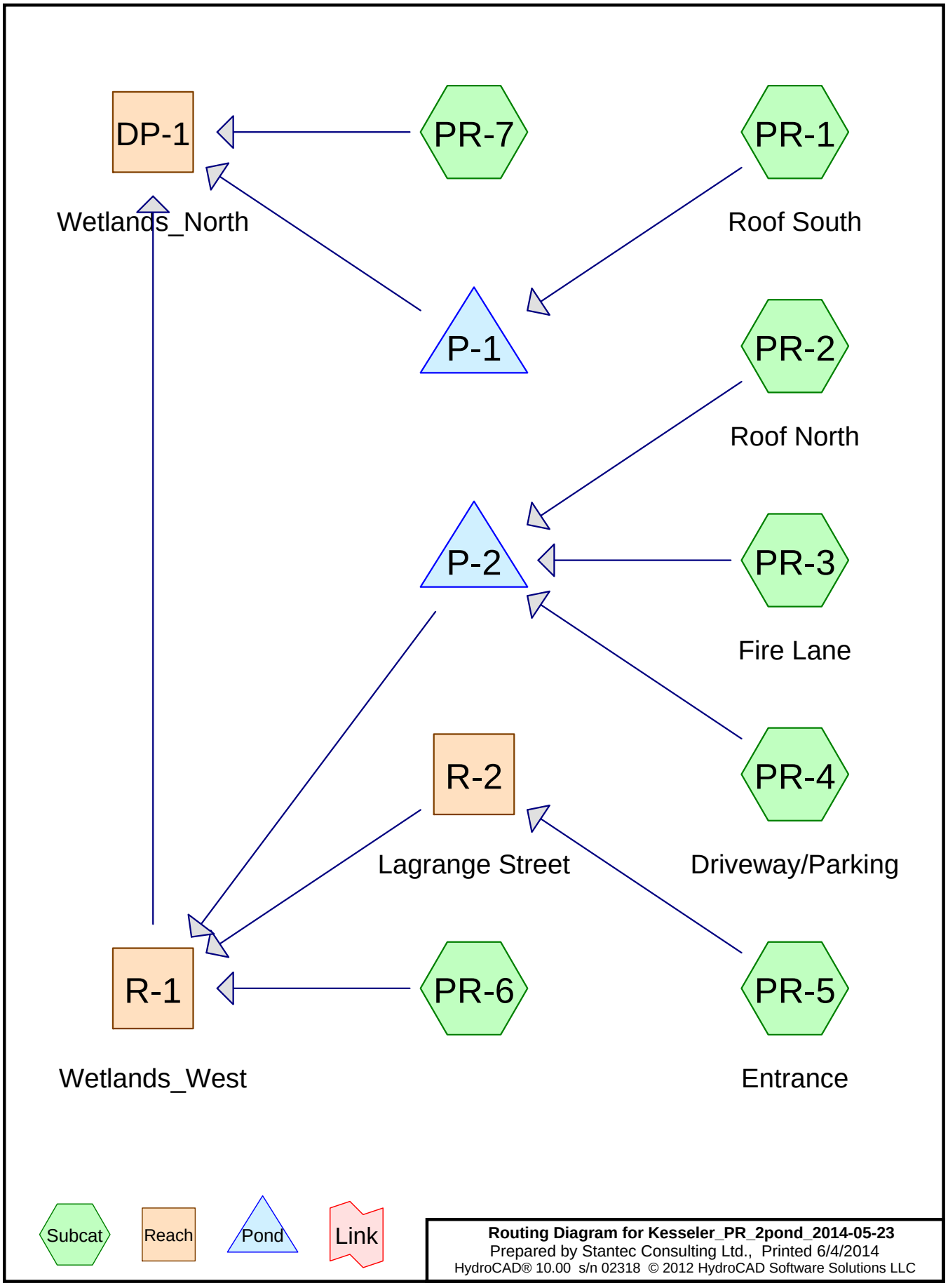
Inflow Area = 8.000 ac, 0.00% Impervious, Inflow Depth > 3.68" for 100 year event
Inflow = 28.98 cfs @ 12.14 hrs, Volume= 2.452 af
Outflow = 28.98 cfs @ 12.14 hrs, Volume= 2.452 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach R-1:

Inflow Area = 4.300 ac, 0.00% Impervious, Inflow Depth > 3.83" for 100 year event
Inflow = 18.90 cfs @ 12.12 hrs, Volume= 1.374 af
Outflow = 18.90 cfs @ 12.12 hrs, Volume= 1.374 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs



Routing Diagram for Kesseler_PR_2pond_2014-05-23
Prepared by Stantec Consulting Ltd., Printed 6/4/2014

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.094	98	Paved parking, HSG D (PR-3, PR-4, PR-5, PR-6)
1.126	98	Roofs, HSG D (PR-1, PR-2)
0.513	55	Woods, Good, HSG B (PR-5, PR-7)
5.235	77	Woods, Good, HSG D (PR-3, PR-4, PR-5, PR-6, PR-7)

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.513	HSG B	PR-5, PR-7
0.000	HSG C	
7.455	HSG D	PR-1, PR-2, PR-3, PR-4, PR-5, PR-6, PR-7
0.000	Other	

Summary for Subcatchment PR-1: Roof South

Runoff = 1.75 cfs @ 12.07 hrs, Volume= 0.129 af, Depth> 2.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.18"

Area (ac)	CN	Description
0.563	98	Roofs, HSG D
0.563		100.00% Impervious Area

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

Summary for Subcatchment PR-2: Roof North

Runoff = 1.75 cfs @ 12.07 hrs, Volume= 0.129 af, Depth> 2.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.18"

Area (ac)	CN	Description
0.563	98	Roofs, HSG D
0.563		100.00% Impervious Area

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

Summary for Subcatchment PR-3: Fire Lane

Runoff = 1.34 cfs @ 12.08 hrs, Volume= 0.088 af, Depth> 1.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.18"

Area (ac)	CN	Description
0.164	98	Paved parking, HSG D
0.586	77	Woods, Good, HSG D
0.750	82	Weighted Average
0.586		78.13% Pervious Area
0.164		21.87% Impervious Area

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

Summary for Subcatchment PR-4: Driveway/Parking

Runoff = 4.16 cfs @ 12.13 hrs, Volume= 0.310 af, Depth> 1.55"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.18"

Area (ac)	CN	Description
0.831	98	Paved parking, HSG D
1.572	77	Woods, Good, HSG D
2.403	84	Weighted Average
1.572		65.42% Pervious Area
0.831		34.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0800	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
1.1	110	0.1090	1.65		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.6	114	0.0260	3.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.9	274	Total			

Summary for Subcatchment PR-5: Entrance

Runoff = 0.43 cfs @ 12.09 hrs, Volume= 0.030 af, Depth> 0.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.18"

Area (ac)	CN	Description
0.253	77	Woods, Good, HSG D
0.138	55	Woods, Good, HSG B
0.035	98	Paved parking, HSG D
0.426	72	Weighted Average
0.391		91.78% Pervious Area
0.035		8.22% Impervious Area

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

Summary for Subcatchment PR-6:

Runoff = 2.02 cfs @ 12.11 hrs, Volume= 0.142 af, Depth> 1.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.18"

Area (ac)	CN	Description
1.412	77	Woods, Good, HSG D
0.064	98	Paved parking, HSG D
1.476	78	Weighted Average
1.412		95.66% Pervious Area
0.064		4.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	50	0.2000	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
2.2	220	0.1130	1.68		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.2	270	Total			

Summary for Subcatchment PR-7:

Runoff = 1.51 cfs @ 12.16 hrs, Volume= 0.124 af, Depth> 0.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.18"

Area (ac)	CN	Description
1.412	77	Woods, Good, HSG D
0.375	55	Woods, Good, HSG B
1.787	72	Weighted Average
1.787		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0800	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
3.1	240	0.0660	1.28		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.3	290	Total			

Summary for Reach DP-1: Wetlands_North

Inflow Area = 7.968 ac, 27.86% Impervious, Inflow Depth > 1.29" for 2 year event
Inflow = 7.21 cfs @ 12.16 hrs, Volume= 0.857 af
Outflow = 7.21 cfs @ 12.16 hrs, Volume= 0.857 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach R-1: Wetlands_West

Inflow Area = 5.618 ac, 29.49% Impervious, Inflow Depth > 1.33" for 2 year event
Inflow = 4.42 cfs @ 12.16 hrs, Volume= 0.622 af
Outflow = 4.42 cfs @ 12.16 hrs, Volume= 0.622 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach R-2: Lagrange Street

Inflow Area = 0.426 ac, 8.22% Impervious, Inflow Depth > 0.83" for 2 year event
Inflow = 0.43 cfs @ 12.09 hrs, Volume= 0.030 af
Outflow = 0.43 cfs @ 12.09 hrs, Volume= 0.030 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Pond P-1:

Inflow Area = 0.563 ac,100.00% Impervious, Inflow Depth > 2.76" for 2 year event
Inflow = 1.75 cfs @ 12.07 hrs, Volume= 0.129 af
Outflow = 1.29 cfs @ 12.15 hrs, Volume= 0.111 af, Atten= 26%, Lag= 4.7 min
Primary = 1.29 cfs @ 12.15 hrs, Volume= 0.111 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 186.86' @ 12.15 hrs Surf.Area= 0.033 ac Storage= 0.035 af

Plug-Flow detention time= 93.8 min calculated for 0.111 af (86% of inflow)
Center-of-Mass det. time= 50.8 min (788.7 - 737.9)

Volume	Invert	Avail.Storage	Storage Description
#1	185.00'	0.017 af	**71.40'W x 20.00'L x 3.00'H Prismatoid** 0.098 af Overall - 0.042 af Embedded = 0.056 af x 30.0% Voids
#2	186.00'	0.041 af	**StormTank 18W** x 273 Inside #1 Inside= 36.0"W x 18.0"H => 4.37 sf x 1.50'L = 6.5 cf Outside= 36.0"W x 18.0"H => 4.50 sf x 1.50'L = 6.8 cf
		0.058 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	186.20'	**10.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=1.28 cfs @ 12.15 hrs HW=186.86' (Free Discharge)
1=Orifice/Grate (Orifice Controls 1.28 cfs @ 2.77 fps)

Summary for Pond P-2:

Inflow Area = 3.716 ac, 41.93% Impervious, Inflow Depth > 1.70" for 2 year event
Inflow = 7.00 cfs @ 12.10 hrs, Volume= 0.527 af
Outflow = 3.11 cfs @ 12.36 hrs, Volume= 0.450 af, Atten= 56%, Lag= 15.5 min
Primary = 3.11 cfs @ 12.36 hrs, Volume= 0.450 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 178.54' @ 12.36 hrs Surf.Area= 0.116 ac Storage= 0.199 af

Plug-Flow detention time= 97.1 min calculated for 0.450 af (85% of inflow)
Center-of-Mass det. time= 53.3 min (835.3 - 782.0)

Volume	Invert	Avail.Storage	Storage Description
#1	176.00'	0.078 af	**174.45'W x 29.00'L x 5.00'H Prismatoid** 0.581 af Overall - 0.322 af Embedded = 0.259 af x 30.0% Voids
#2	177.00'	0.156 af	**StormTank 36W** x 519 Inside #1 Inside= 36.0"W x 36.0"H => 8.73 sf x 1.50'L = 13.1 cf Outside= 36.0"W x 36.0"H => 9.00 sf x 1.50'L = 13.5 cf
#3	177.00'	0.156 af	**StormTank 36W** x 519 Inside #1 Inside= 36.0"W x 36.0"H => 8.73 sf x 1.50'L = 13.1 cf Outside= 36.0"W x 36.0"H => 9.00 sf x 1.50'L = 13.5 cf
		0.390 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	179.30'	**12.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	178.15'	**12.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	177.20'	**10.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=3.10 cfs @ 12.36 hrs HW=178.53' (Free Discharge)
- **1=Orifice/Grate** (Controls 0.00 cfs)
- **2=Orifice/Grate** (Orifice Controls 0.59 cfs @ 2.11 fps)
- **3=Orifice/Grate** (Orifice Controls 2.52 cfs @ 4.61 fps)

Summary for Subcatchment PR-1: Roof South

Runoff = 2.55 cfs @ 12.07 hrs, Volume= 0.191 af, Depth> 4.06"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.61"

Area (ac)	CN	Description
0.563	98	Roofs, HSG D
0.563		100.00% Impervious Area

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

Summary for Subcatchment PR-2: Roof North

Runoff = 2.55 cfs @ 12.07 hrs, Volume= 0.191 af, Depth> 4.06"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.61"

Area (ac)	CN	Description
0.563	98	Roofs, HSG D
0.563		100.00% Impervious Area

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

Summary for Subcatchment PR-3: Fire Lane

Runoff = 2.40 cfs @ 12.08 hrs, Volume= 0.160 af, Depth> 2.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.61"

Area (ac)	CN	Description
0.164	98	Paved parking, HSG D
0.586	77	Woods, Good, HSG D
0.750	82	Weighted Average
0.586		78.13% Pervious Area
0.164		21.87% Impervious Area

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

Summary for Subcatchment PR-4: Driveway/Parking

Runoff = 7.26 cfs @ 12.13 hrs, Volume= 0.547 af, Depth> 2.73"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.61"

Area (ac)	CN	Description
0.831	98	Paved parking, HSG D
1.572	77	Woods, Good, HSG D
2.403	84	Weighted Average
1.572		65.42% Pervious Area
0.831		34.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0800	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
1.1	110	0.1090	1.65		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.6	114	0.0260	3.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.9	274	Total			

Summary for Subcatchment PR-5: Entrance

Runoff = 0.94 cfs @ 12.08 hrs, Volume= 0.062 af, Depth> 1.75"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.61"

Area (ac)	CN	Description
0.253	77	Woods, Good, HSG D
0.138	55	Woods, Good, HSG B
0.035	98	Paved parking, HSG D
0.426	72	Weighted Average
0.391		91.78% Pervious Area
0.035		8.22% Impervious Area

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

Summary for Subcatchment PR-6:

Runoff = 3.91 cfs @ 12.11 hrs, Volume= 0.273 af, Depth> 2.22"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.61"

Area (ac)	CN	Description
1.412	77	Woods, Good, HSG D
0.064	98	Paved parking, HSG D
1.476	78	Weighted Average
1.412		95.66% Pervious Area
0.064		4.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	50	0.2000	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
2.2	220	0.1130	1.68		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.2	270	Total			

Summary for Subcatchment PR-7:

Runoff = 3.35 cfs @ 12.15 hrs, Volume= 0.261 af, Depth> 1.75"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.61"

Area (ac)	CN	Description
1.412	77	Woods, Good, HSG D
0.375	55	Woods, Good, HSG B
1.787	72	Weighted Average
1.787		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0800	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
3.1	240	0.0660	1.28		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.3	290	Total			

Summary for Reach DP-1: Wetlands_North

Inflow Area = 7.968 ac, 27.86% Impervious, Inflow Depth > 2.38" for 10 year event
Inflow = 15.01 cfs @ 12.15 hrs, Volume= 1.583 af
Outflow = 15.01 cfs @ 12.15 hrs, Volume= 1.583 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach R-1: Wetlands_West

Inflow Area = 5.618 ac, 29.49% Impervious, Inflow Depth > 2.46" for 10 year event
Inflow = 9.85 cfs @ 12.15 hrs, Volume= 1.150 af
Outflow = 9.85 cfs @ 12.15 hrs, Volume= 1.150 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach R-2: Lagrange Street

Inflow Area = 0.426 ac, 8.22% Impervious, Inflow Depth > 1.75" for 10 year event
Inflow = 0.94 cfs @ 12.08 hrs, Volume= 0.062 af
Outflow = 0.94 cfs @ 12.08 hrs, Volume= 0.062 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Pond P-1:

Inflow Area = 0.563 ac,100.00% Impervious, Inflow Depth > 4.06" for 10 year event
Inflow = 2.55 cfs @ 12.07 hrs, Volume= 0.191 af
Outflow = 1.81 cfs @ 12.15 hrs, Volume= 0.172 af, Atten= 29%, Lag= 5.0 min
Primary = 1.81 cfs @ 12.15 hrs, Volume= 0.172 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 187.09' @ 12.15 hrs Surf.Area= 0.033 ac Storage= 0.041 af

Plug-Flow detention time= 74.6 min calculated for 0.172 af (90% of inflow)
Center-of-Mass det. time= 41.2 min (776.0 - 734.9)

Volume	Invert	Avail.Storage	Storage Description
#1	185.00'	0.017 af	**71.40'W x 20.00'L x 3.00'H Prismatoid** 0.098 af Overall - 0.042 af Embedded = 0.056 af x 30.0% Voids
#2	186.00'	0.041 af	**StormTank 18W** x 273 Inside #1 Inside= 36.0"W x 18.0"H => 4.37 sf x 1.50'L = 6.5 cf Outside= 36.0"W x 18.0"H => 4.50 sf x 1.50'L = 6.8 cf
		0.058 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	186.20'	**10.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=1.80 cfs @ 12.15 hrs HW=187.09' (Free Discharge)
1=Orifice/Grate (Orifice Controls 1.80 cfs @ 3.31 fps)

Summary for Pond P-2:

Inflow Area = 3.716 ac, 41.93% Impervious, Inflow Depth > 2.90" for 10 year event
Inflow = 11.85 cfs @ 12.10 hrs, Volume= 0.897 af
Outflow = 6.38 cfs @ 12.28 hrs, Volume= 0.815 af, Atten= 46%, Lag= 10.8 min
Primary = 6.38 cfs @ 12.28 hrs, Volume= 0.815 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 179.28' @ 12.28 hrs Surf.Area= 0.116 ac Storage= 0.278 af

Plug-Flow detention time= 74.2 min calculated for 0.812 af (91% of inflow)
Center-of-Mass det. time= 43.8 min (816.6 - 772.9)

Volume	Invert	Avail.Storage	Storage Description
#1	176.00'	0.078 af	**174.45'W x 29.00'L x 5.00'H Prismatoid** 0.581 af Overall - 0.322 af Embedded = 0.259 af x 30.0% Voids
#2	177.00'	0.156 af	**StormTank 36W** x 519 Inside #1 Inside= 36.0"W x 36.0"H => 8.73 sf x 1.50'L = 13.1 cf Outside= 36.0"W x 36.0"H => 9.00 sf x 1.50'L = 13.5 cf
#3	177.00'	0.156 af	**StormTank 36W** x 519 Inside #1 Inside= 36.0"W x 36.0"H => 8.73 sf x 1.50'L = 13.1 cf Outside= 36.0"W x 36.0"H => 9.00 sf x 1.50'L = 13.5 cf
		0.390 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	179.30'	**12.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	178.15'	**12.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	177.20'	**10.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=6.37 cfs @ 12.28 hrs HW=179.27' (Free Discharge)
- **1=Orifice/Grate** (Controls 0.00 cfs)
- **2=Orifice/Grate** (Orifice Controls 2.99 cfs @ 3.80 fps)
- **3=Orifice/Grate** (Orifice Controls 3.38 cfs @ 6.20 fps)

Summary for Subcatchment PR-1: Roof South

Runoff = 3.05 cfs @ 12.07 hrs, Volume= 0.229 af, Depth> 4.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year Rainfall=5.50"

Area (ac)	CN	Description
0.563	98	Roofs, HSG D
0.563		100.00% Impervious Area

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

Summary for Subcatchment PR-2: Roof North

Runoff = 3.05 cfs @ 12.07 hrs, Volume= 0.229 af, Depth> 4.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year Rainfall=5.50"

Area (ac)	CN	Description
0.563	98	Roofs, HSG D
0.563		100.00% Impervious Area

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

Summary for Subcatchment PR-3: Fire Lane

Runoff = 3.08 cfs @ 12.08 hrs, Volume= 0.207 af, Depth> 3.31"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year Rainfall=5.50"

Area (ac)	CN	Description
0.164	98	Paved parking, HSG D
0.586	77	Woods, Good, HSG D
0.750	82	Weighted Average
0.586		78.13% Pervious Area
0.164		21.87% Impervious Area

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

Summary for Subcatchment PR-4: Driveway/Parking

Runoff = 9.29 cfs @ 12.12 hrs, Volume= 0.702 af, Depth> 3.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year Rainfall=5.50"

Area (ac)	CN	Description
0.831	98	Paved parking, HSG D
1.572	77	Woods, Good, HSG D
2.403	84	Weighted Average
1.572		65.42% Pervious Area
0.831		34.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0800	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
1.1	110	0.1090	1.65		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.6	114	0.0260	3.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.9	274	Total			

Summary for Subcatchment PR-5: Entrance

Runoff = 1.29 cfs @ 12.08 hrs, Volume= 0.085 af, Depth> 2.40"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year Rainfall=5.50"

Area (ac)	CN	Description
0.253	77	Woods, Good, HSG D
0.138	55	Woods, Good, HSG B
0.035	98	Paved parking, HSG D
0.426	72	Weighted Average
0.391		91.78% Pervious Area
0.035		8.22% Impervious Area

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

Summary for Subcatchment PR-6:

Runoff = 5.15 cfs @ 12.11 hrs, Volume= 0.361 af, Depth> 2.93"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year Rainfall=5.50"

Area (ac)	CN	Description
1.412	77	Woods, Good, HSG D
0.064	98	Paved parking, HSG D
1.476	78	Weighted Average
1.412		95.66% Pervious Area
0.064		4.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	50	0.2000	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
2.2	220	0.1130	1.68		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.2	270	Total			

Summary for Subcatchment PR-7:

Runoff = 4.62 cfs @ 12.15 hrs, Volume= 0.357 af, Depth> 2.40"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year Rainfall=5.50"

Area (ac)	CN	Description
1.412	77	Woods, Good, HSG D
0.375	55	Woods, Good, HSG B
1.787	72	Weighted Average
1.787		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0800	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
3.1	240	0.0660	1.28		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.3	290	Total			

Summary for Reach DP-1: Wetlands_North

Inflow Area = 7.968 ac, 27.86% Impervious, Inflow Depth > 3.11" for 25 year event
Inflow = 19.51 cfs @ 12.15 hrs, Volume= 2.065 af
Outflow = 19.51 cfs @ 12.15 hrs, Volume= 2.065 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach R-1: Wetlands_West

Inflow Area = 5.618 ac, 29.49% Impervious, Inflow Depth > 3.20" for 25 year event
Inflow = 12.80 cfs @ 12.14 hrs, Volume= 1.498 af
Outflow = 12.80 cfs @ 12.14 hrs, Volume= 1.498 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach R-2: Lagrange Street

Inflow Area = 0.426 ac, 8.22% Impervious, Inflow Depth > 2.40" for 25 year event
Inflow = 1.29 cfs @ 12.08 hrs, Volume= 0.085 af
Outflow = 1.29 cfs @ 12.08 hrs, Volume= 0.085 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Pond P-1:

Inflow Area = 0.563 ac,100.00% Impervious, Inflow Depth > 4.87" for 25 year event
Inflow = 3.05 cfs @ 12.07 hrs, Volume= 0.229 af
Outflow = 2.09 cfs @ 12.16 hrs, Volume= 0.210 af, Atten= 31%, Lag= 5.3 min
Primary = 2.09 cfs @ 12.16 hrs, Volume= 0.210 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 187.25' @ 12.16 hrs Surf.Area= 0.033 ac Storage= 0.046 af

Plug-Flow detention time= 66.7 min calculated for 0.210 af (92% of inflow)
Center-of-Mass det. time= 37.2 min (771.0 - 733.9)

Volume	Invert	Avail.Storage	Storage Description
#1	185.00'	0.017 af	**71.40'W x 20.00'L x 3.00'H Prismatoid** 0.098 af Overall - 0.042 af Embedded = 0.056 af x 30.0% Voids
#2	186.00'	0.041 af	**StormTank 18W** x 273 Inside #1 Inside= 36.0"W x 18.0"H => 4.37 sf x 1.50'L = 6.5 cf Outside= 36.0"W x 18.0"H => 4.50 sf x 1.50'L = 6.8 cf
		0.058 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	186.20'	**10.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=2.08 cfs @ 12.16 hrs HW=187.24' (Free Discharge)
1=Orifice/Grate (Orifice Controls 2.08 cfs @ 3.81 fps)

Summary for Pond P-2:

Inflow Area = 3.716 ac, 41.93% Impervious, Inflow Depth > 3.67" for 25 year event
Inflow = 14.92 cfs @ 12.10 hrs, Volume= 1.138 af
Outflow = 8.43 cfs @ 12.27 hrs, Volume= 1.053 af, Atten= 43%, Lag= 9.9 min
Primary = 8.43 cfs @ 12.27 hrs, Volume= 1.053 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 179.72' @ 12.27 hrs Surf.Area= 0.116 ac Storage= 0.325 af

Plug-Flow detention time= 66.5 min calculated for 1.049 af (92% of inflow)
Center-of-Mass det. time= 40.5 min (809.0 - 768.5)

Volume	Invert	Avail.Storage	Storage Description
#1	176.00'	0.078 af	**174.45'W x 29.00'L x 5.00'H Prismatoid** 0.581 af Overall - 0.322 af Embedded = 0.259 af x 30.0% Voids
#2	177.00'	0.156 af	**StormTank 36W** x 519 Inside #1 Inside= 36.0"W x 36.0"H => 8.73 sf x 1.50'L = 13.1 cf Outside= 36.0"W x 36.0"H => 9.00 sf x 1.50'L = 13.5 cf
#3	177.00'	0.156 af	**StormTank 36W** x 519 Inside #1 Inside= 36.0"W x 36.0"H => 8.73 sf x 1.50'L = 13.1 cf Outside= 36.0"W x 36.0"H => 9.00 sf x 1.50'L = 13.5 cf
		0.390 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	179.30'	**12.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	178.15'	**12.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	177.20'	**10.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=8.39 cfs @ 12.27 hrs HW=179.72' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 0.68 cfs @ 2.20 fps)
- **2=Orifice/Grate** (Orifice Controls 3.91 cfs @ 4.97 fps)
- **3=Orifice/Grate** (Orifice Controls 3.81 cfs @ 6.98 fps)

Summary for Subcatchment PR-1: Roof South

Runoff = 3.72 cfs @ 12.07 hrs, Volume= 0.280 af, Depth> 5.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=6.70"

Area (ac)	CN	Description
0.563	98	Roofs, HSG D
0.563		100.00% Impervious Area

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

Summary for Subcatchment PR-2: Roof North

Runoff = 3.72 cfs @ 12.07 hrs, Volume= 0.280 af, Depth> 5.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=6.70"

Area (ac)	CN	Description
0.563	98	Roofs, HSG D
0.563		100.00% Impervious Area

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

Summary for Subcatchment PR-3: Fire Lane

Runoff = 4.04 cfs @ 12.07 hrs, Volume= 0.273 af, Depth> 4.36"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=6.70"

Area (ac)	CN	Description
0.164	98	Paved parking, HSG D
0.586	77	Woods, Good, HSG D
0.750	82	Weighted Average
0.586		78.13% Pervious Area
0.164		21.87% Impervious Area

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

Summary for Subcatchment PR-4: Driveway/Parking

Runoff = 11.97 cfs @ 12.12 hrs, Volume= 0.916 af, Depth> 4.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=6.70"

Area (ac)	CN	Description
0.831	98	Paved parking, HSG D
1.572	77	Woods, Good, HSG D
2.403	84	Weighted Average
1.572		65.42% Pervious Area
0.831		34.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0800	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
1.1	110	0.1090	1.65		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.6	114	0.0260	3.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.9	274	Total			

Summary for Subcatchment PR-5: Entrance

Runoff = 1.79 cfs @ 12.08 hrs, Volume= 0.118 af, Depth> 3.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=6.70"

Area (ac)	CN	Description
0.253	77	Woods, Good, HSG D
0.138	55	Woods, Good, HSG B
0.035	98	Paved parking, HSG D
0.426	72	Weighted Average
0.391		91.78% Pervious Area
0.035		8.22% Impervious Area

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

Summary for Subcatchment PR-6:

Runoff = 6.87 cfs @ 12.11 hrs, Volume= 0.484 af, Depth> 3.94"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=6.70"

Area (ac)	CN	Description
1.412	77	Woods, Good, HSG D
0.064	98	Paved parking, HSG D
1.476	78	Weighted Average
1.412		95.66% Pervious Area
0.064		4.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	50	0.2000	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
2.2	220	0.1130	1.68		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.2	270	Total			

Summary for Subcatchment PR-7:

Runoff = 6.42 cfs @ 12.15 hrs, Volume= 0.495 af, Depth> 3.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=6.70"

Area (ac)	CN	Description
1.412	77	Woods, Good, HSG D
0.375	55	Woods, Good, HSG B
1.787	72	Weighted Average
1.787		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0800	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
3.1	240	0.0660	1.28		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.3	290	Total			

Summary for Reach DP-1: Wetlands_North

Inflow Area = 7.968 ac, 27.86% Impervious, Inflow Depth > 4.12" for 100 year event
Inflow = 27.03 cfs @ 12.17 hrs, Volume= 2.739 af
Outflow = 27.03 cfs @ 12.17 hrs, Volume= 2.739 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach R-1: Wetlands_West

Inflow Area = 5.618 ac, 29.49% Impervious, Inflow Depth > 4.23" for 100 year event
Inflow = 18.53 cfs @ 12.19 hrs, Volume= 1.983 af
Outflow = 18.53 cfs @ 12.19 hrs, Volume= 1.983 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach R-2: Lagrange Street

Inflow Area = 0.426 ac, 8.22% Impervious, Inflow Depth > 3.33" for 100 year event
Inflow = 1.79 cfs @ 12.08 hrs, Volume= 0.118 af
Outflow = 1.79 cfs @ 12.08 hrs, Volume= 0.118 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Pond P-1:

Inflow Area = 0.563 ac,100.00% Impervious, Inflow Depth > 5.97" for 100 year event
Inflow = 3.72 cfs @ 12.07 hrs, Volume= 0.280 af
Outflow = 2.44 cfs @ 12.16 hrs, Volume= 0.261 af, Atten= 34%, Lag= 5.6 min
Primary = 2.44 cfs @ 12.16 hrs, Volume= 0.261 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 187.48' @ 12.16 hrs Surf.Area= 0.033 ac Storage= 0.052 af

Plug-Flow detention time= 58.2 min calculated for 0.260 af (93% of inflow)
Center-of-Mass det. time= 33.1 min (766.1 - 733.0)

Volume	Invert	Avail.Storage	Storage Description
#1	185.00'	0.017 af	**71.40'W x 20.00'L x 3.00'H Prismatoid** 0.098 af Overall - 0.042 af Embedded = 0.056 af x 30.0% Voids
#2	186.00'	0.041 af	**StormTank 18W** x 273 Inside #1 Inside= 36.0"W x 18.0"H => 4.37 sf x 1.50'L = 6.5 cf Outside= 36.0"W x 18.0"H => 4.50 sf x 1.50'L = 6.8 cf
		0.058 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	186.20'	**10.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=2.43 cfs @ 12.16 hrs HW=187.47' (Free Discharge)
1=Orifice/Grate (Orifice Controls 2.43 cfs @ 4.45 fps)

Summary for Pond P-2:

Inflow Area = 3.716 ac, 41.93% Impervious, Inflow Depth > 4.74" for 100 year event
Inflow = 19.09 cfs @ 12.10 hrs, Volume= 1.469 af
Outflow = 13.00 cfs @ 12.22 hrs, Volume= 1.380 af, Atten= 32%, Lag= 7.1 min
Primary = 13.00 cfs @ 12.22 hrs, Volume= 1.380 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 180.55' @ 12.22 hrs Surf.Area= 0.116 ac Storage= 0.374 af

Plug-Flow detention time= 59.1 min calculated for 1.380 af (94% of inflow)
Center-of-Mass det. time= 36.8 min (800.4 - 763.6)

Volume	Invert	Avail.Storage	Storage Description
#1	176.00'	0.078 af	**174.45'W x 29.00'L x 5.00'H Prismatoid** 0.581 af Overall - 0.322 af Embedded = 0.259 af x 30.0% Voids
#2	177.00'	0.156 af	**StormTank 36W** x 519 Inside #1 Inside= 36.0"W x 36.0"H => 8.73 sf x 1.50'L = 13.1 cf Outside= 36.0"W x 36.0"H => 9.00 sf x 1.50'L = 13.5 cf
#3	177.00'	0.156 af	**StormTank 36W** x 519 Inside #1 Inside= 36.0"W x 36.0"H => 8.73 sf x 1.50'L = 13.1 cf Outside= 36.0"W x 36.0"H => 9.00 sf x 1.50'L = 13.5 cf
		0.390 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	179.30'	**12.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	178.15'	**12.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	177.20'	**10.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=12.71 cfs @ 12.22 hrs HW=180.49' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 3.14 cfs @ 3.99 fps)
- **2=Orifice/Grate** (Orifice Controls 5.13 cfs @ 6.53 fps)
- **3=Orifice/Grate** (Orifice Controls 4.45 cfs @ 8.16 fps)

Stantec

226 Causeway Street
Boston MA U.S.A., 02114
www.stantec.com
P.617.523.8103

Chestnut Hill Realty

SITE PLAN	CEL	TPK	11.26.13
Issued	By	Appd.	MM.DD.YY
File Name:	JM		
	Dwn.	Chkd.	Dsgn. MM.DD.YY

Permit-Seal

Client/Project
CHESTNUT HILL REALTY

THE RESIDENCES AT
KESSELER WOODS

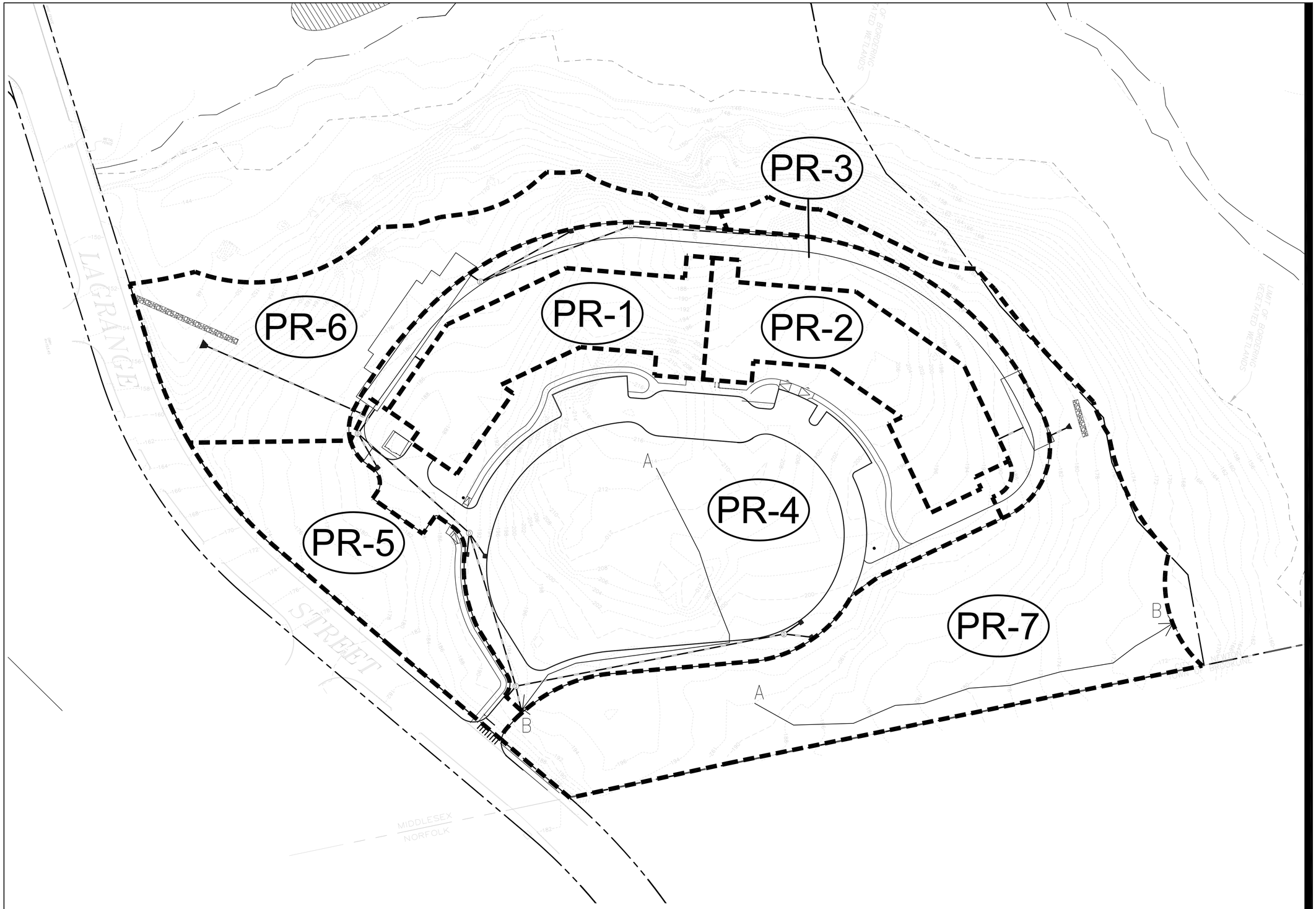
NEWTON, MA

Title
EXISTING CONDITIONS PLAN

Project No.
210801167

Scale
AS NOTED

Drawing No.



LEGEND

- DRAINAGE AREA
- PR — DRAINAGE AREA LABEL
- DP-1 — DISCHARGE POINT
- A B — TIME OF CONCENTRATION

NORTH

0 20' 40' 80'

Stantec

226 Causeway Street
Boston MA U.S.A., 02114
www.stantec.com
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Chestnut Hill Realty

SITE PLAN	CEL	TPK	11.26.13
Issued	By	Appd.	MM.DD.YY
File Name:	JM		
	Dwn.	Chkd.	Dsgn. MM.DD.YY

Permit-Seal

Client/Project

CHESTNUT HILL REALTY

THE RESIDENCES AT
KESSELER WOODS

NEWTON, MA

Title

PROPOSED CONDITIONS PLAN

Project No. 210801167

Scale AS NOTED

Drawing No.

13.6 RECHARGE CALCULATIONS

Stantec Planning and Landscape Architecture P.C.
226 Causeway Street
Boston MA 02114
Tel: (617) 523-8103
Fax: (617) 523-4333

Recharge / Infiltration Calculations

Project	Kesseler Woods	Project #	
Location	Newton, MA	Sheet	1 of 1
Calculated by	MC	Date	6/5/2014
Checked by	FH	Revised	
Title	Recharge Calculations		

Recharge Calculations

Objective: To size a recharge system that will approximate the annual recharge from pre-development conditions

Methodology: MA Department of Environmental Protection (DEP) Stormwater Management (Volume Three)

Design Criteria: Based on the Site Hydrologic Soil Group:

Hydrologic Soil Group	Volume to Recharge (x Total Imp. Area)
A	0.60 inches of runoff
B	0.35 inches of runoff
C	0.25 inches of runoff
D	0.10 inches of runoff

Recharge Area Required:

The soils are considered to be classified as hydrologic soil group B.

	Impervious "B" Soil (sf)	Total Impervious (sf)
The total impervious area within project site =	71,395	71,395
Required Volume to be recharged (Cubic Feet) =	2,082	**2,082**

Capture Area Adjustment

Impervious Area Draining to Recharge Volume (All New Impervious Area) (sf) = 67,083

Required Volume Adjustment Factor (Total Impervious Area/Impervious Area Draining to Recharge Volume = 71,395 sf / 67,083 sf) = 1.06

Adjusted Required Volume to be Recharged (2,082 cf * 1.06) (cf) = 2,216

Recharge Area Provided: Recharge Volumes were determined using the Static Method as described in Volume 3 of the "Massachusetts Stormwater Handbook" See the Hydrocad Calculations enclosed for the Storage Volumes provided.

Subsurface Stormwater Detention System P-1

Outlet Elevation = 186.20
Bottom Basin Elev = 185.00
Cummulative Storage Between elev. 185.00 and 186.20 = 696 cubic feet
(Volume from HydroCAD)

Subsurface Stormwater Detention System P-2

Outlet Elevation = 177.20
Bottom Basin Elev = 176.00
Cummulative Storage Between elev. 176.00 and 177.20 = 2,439 cubic feet
(Volume from HydroCAD)

Total Storage Volume = 3,135 cubic feet

3,135 > 2,216

13.7 STORMCEPTOR SIZING

SIZING WATER QUALITY INLET - WQI-1

Date: August 4, 2014
Revised:
Revised:
Project: Kesseler Woods
Project No:
Location: Newton, MA

Prepared By: MC
Checked By: FH

Objective: To size the Stormceptor according to the DEP's Standard Method

Methodology: MA DEP's Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices, dated Sep. 10, 2013

Design Criteria: **Q1 = (qu)(A)(WQV)**

Q1 = flow rate associated with first 1-inch 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 (use 1-inch in this method)

Flow Rate to be Treated:

Post Development Impervious Area (AC)

Total Post Development Drainage Area:		2.40	ac
Percentage of Impervious Area		35	%
Total Impervious Area:		0.83	ac

using time of concentration = 6 min = 0.1 hours

qu =			752	csm/in *
A=	0.83	X 0.0015625 mi2 =	0.00130	mi2
WQV =			0.5	in
Q1 =			0.49	CFS

Flow Rate Provided:

Stormceptor model: STC 900
WQF provided:* 0.83 CFS

* Mass DEP - Q Rate, Sept. 10, 2013

Stantec Planning and Landscape Architecture P.C.
226 Causeway Street
Boston, MA 02114
Tel: (617) 523-8103 Fax: (617) 523-4333

SIZING WATER QUALITY INLET - WQI-2

Date: August 4, 2014
Revised:
Revised:
Project: Kesseler Woods
Project No:
Location: Newton, MA

Prepared By: MC
Checked By: FH

Objective: To size the Stormceptor according to the DEP's Standard Method

Methodology: MA DEP's Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices, dated Sep. 10, 2013

Design Criteria: **Q1 = (qu)(A)(WQV)**

Q1 = flow rate associated with first 1-inch 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 (use 1-inch in this method)

Flow Rate to be Treated:

Post Development Impervious Area (AC)

Total Post Development Drainage Area:		0.81	ac
Percentage of Impervious Area		28	%
Total Impervious Area:		0.23	ac

using time of concentration = 6 min = 0.1 hours

qu =			752	csm/in *
A=	0.23	X 0.0015625 mi2 =	0.00036	mi2
WQV =			0.5	in
Q1 =			0.13	CFS

Flow Rate Provided:

Stormceptor model: STC 450i
WQF provided:* 0.37 CFS

* Mass DEP - Q Rate, Sept. 10, 2013

Stantec Planning and Landscape Architecture P.C.
226 Causeway Street
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13.8 TREATMENT TRAIN & WATER QUALITY VOLUME CALCULATIONS

Stantec Consulting Ltd.
226 Causeway Street
Boston, MA 02114
(617) 523-8103

TSS Removal Calculations

Project: *Kesseler Woods*
Location: *Newton, MA*
Designed By: MC Date: 6/2/2014
Checked by: FH

Treatment Train #1

Sequence of Treatment	Description of BMP	Design Removal Rate	TSS Loading	Amount Removed	TSS Final Loading
1	Catch Basin with Deep Sump and Hood	25%	100.0%	25.0%	75.0%
2	Water Quality Inlet	80%	75.0%	60.0%	15.0%
3	Stormwater Detention Basin	50%	15.0%	7.5%	7.5%
4	Water Quality Infiltration Trench	80%	7.5%	6.0%	1.5%

Total TSS Removal = 98.5%

Stantec Consulting Ltd.
226 Causeway Street
Boston, MA 02114
(617) 523-8103

TSS Removal Calculations

Project: *Kesseler Woods*
Location: *Newton, MA*
Designed By: MC Date: 6/2/2014
Checked by: FH

Treatment Train #2

Sequence of Treatment	Description of BMP	Design Removal Rate	TSS Loading	Amount Removed	TSS Final Loading
1	None	0%	100.0%	0.0%	0.0%

Total TSS Removal = 0.0%

TSS Removal Calculations - Weighted Average

Stantec Consulting Ltd.
226 Causeway Street
Boston, MA 02114
(617) 523-8103

Project: *Kesseler Woods*
Location: *Newton, MA*
Designed By: MC Date: 6/2/2014
Checked by: FH

Drainage Area	Treatment Train	Total TSS Removal	Contributing Paved Area (SF)	Total TSS Removal x Contributing Paved Area
PR1	**1**	98.5%	0	0
PR2	**1**	98.5%	0	0
PR3	**1**	98.5%	7,143	7,036
PR4	**1**	98.5%	36,198	35,655
PR5	**2**	0.0%	1,525	0
PR6	**2**	0.0%	2,788	0
PR7	**2**	0.0%	0	0
		Total Area (SF)	47,654	**Total** 42,691

Total Weighted TSS Removal = 89.6%

Stantec Planning and Landscape Architecture P.C.
226 Causeway Street
Boston MA 02114
Tel: (617) 523-8103
Fax: (617) 523-4333

Water Quality Calculations

Project	Kesseler Woods	Project #	
Location	Newton, MA	Date	6/5/2014
Calculated by	MC	Revised	
Checked by	FH		
Title	Water Quality Calculations		

Water Quality Calculations

Objective: To size water quality volume to meet the requirements for total suspended solids removal of the "Massachusetts Stormwater Handbook"

Methodology: MA Department of Environmental Protection (DEP) Stormwater Management (Volume Three)

Design Criteria: Required Bioretention Basin Volume (Cubic Feet) = 0.5 Inches * Contributing Paved Impervious Area (Square Feet)

Water Quality Quantities Required:

Subsurface Basin 1-P:

Contributing Impervious Area (Square Feet) = 0

Required Bioretention Basin Volume = (0.5 Inches * Contributing Paved Impervious Area)/12 (Cubic Feet) **0**

Subsurface Basin 2-P:

Contributing Impervious Area (Square Feet) = 46,130

Required Bioretention Basin Volume = (0.5 Inches * Contributing Paved Impervious Area)/12 (Cubic Feet) **1,922**

Water Quality Quantities Provided*:

Subsurface Basin 1-P

Elevation (Ft)	Height (ft)	Volume (cf)
185.00		
	1.2	**697**
186.20		

697	**>**	**0**

Subsurface Basin 2-P

Elevation (Ft)	Height (ft)	Volume (cf)
176.00		
	1.2	**2,439**
177.20		

2,439	**>**	**1,922**

**** Storage volumes obtained from HydroCAD***

Stage-Area-Storage for Pond P-1:

Elevation (feet)	Storage (acre-feet)	Elevation (feet)	Storage (acre-feet)	Elevation (feet)	Storage (acre-feet)
185.00	0.000	186.06	0.012	187.12	0.042
185.02	0.000	186.08	0.012	187.14	0.043
185.04	0.000	186.10	0.013	187.16	0.043
185.06	0.001	186.12	0.013	187.18	0.044
185.08	0.001	186.14	0.014	187.20	0.044
185.10	0.001	186.16	0.014	187.22	0.045
185.12	0.001	186.18	0.015	187.24	0.045
185.14	0.001	186.20	0.016	187.26	0.046
185.16	0.002	186.22	0.016	187.28	0.047
185.18	0.002	186.24	0.017	187.30	0.047
185.20	0.002	186.26	0.017	187.32	0.048
185.22	0.002	186.28	0.018	187.34	0.048
185.24	0.002	186.30	0.018	187.36	0.049
185.26	0.003	186.32	0.019	187.38	0.049
185.28	0.003	186.34	0.020	187.40	0.050
185.30	0.003	186.36	0.020	187.42	0.051
185.32	0.003	186.38	0.021	187.44	0.051
185.34	0.003	186.40	0.021	187.46	0.052
185.36	0.004	186.42	0.022	187.48	0.052
185.38	0.004	186.44	0.022	187.50	0.053
185.40	0.004	186.46	0.023	187.52	0.053
185.42	0.004	186.48	0.024	187.54	0.053
185.44	0.004	186.50	0.024	187.56	0.054
185.46	0.005	186.52	0.025	187.58	0.054
185.48	0.005	186.54	0.025	187.60	0.054
185.50	0.005	186.56	0.026	187.62	0.054
185.52	0.005	186.58	0.026	187.64	0.054
185.54	0.005	186.60	0.027	187.66	0.055
185.56	0.006	186.62	0.028	187.68	0.055
185.58	0.006	186.64	0.028	187.70	0.055
185.60	0.006	186.66	0.029	187.72	0.055
185.62	0.006	186.68	0.029	187.74	0.055
185.64	0.006	186.70	0.030	187.76	0.055
185.66	0.006	186.72	0.031	187.78	0.056
185.68	0.007	186.74	0.031	187.80	0.056
185.70	0.007	186.76	0.032	187.82	0.056
185.72	0.007	186.78	0.032	187.84	0.056
185.74	0.007	186.80	0.033	187.86	0.056
185.76	0.007	186.82	0.033	187.88	0.057
185.78	0.008	186.84	0.034	187.90	0.057
185.80	0.008	186.86	0.035	187.92	0.057
185.82	0.008	186.88	0.035	187.94	0.057
185.84	0.008	186.90	0.036	187.96	0.057
185.86	0.008	186.92	0.036	187.98	0.058
185.88	0.009	186.94	0.037	188.00	**0.058**
185.90	0.009	186.96	0.037		
185.92	0.009	186.98	0.038		
185.94	0.009	187.00	0.039		
185.96	0.009	187.02	0.039		
185.98	0.010	187.04	0.040		
186.00	0.010	187.06	0.040		
186.02	0.010	187.08	0.041		
186.04	0.011	187.10	0.041		

Stage-Area-Storage for Pond P-2:

Elevation (feet)	Storage (acre-feet)	Elevation (feet)	Storage (acre-feet)
176.00	0.000	178.65	0.211
176.05	0.002	178.70	0.216
176.10	0.003	178.75	0.222
176.15	0.005	178.80	0.227
176.20	0.007	178.85	0.232
176.25	0.009	178.90	0.238
176.30	0.010	178.95	0.243
176.35	0.012	179.00	0.248
176.40	0.014	179.05	0.254
176.45	0.016	179.10	0.259
176.50	0.017	179.15	0.264
176.55	0.019	179.20	0.270
176.60	0.021	179.25	0.275
176.65	0.023	179.30	0.280
176.70	0.024	179.35	0.286
176.75	0.026	179.40	0.291
176.80	0.028	179.45	0.296
176.85	0.030	179.50	0.302
176.90	0.031	179.55	0.307
176.95	0.033	179.60	0.312
177.00	0.035	179.65	0.318
177.05	0.040	179.70	0.323
177.10	0.046	179.75	0.328
177.15	0.051	179.80	0.334
177.20	0.056	179.85	0.339
177.25	0.062	179.90	0.344
177.30	0.067	179.95	0.350
177.35	0.072	180.00	0.355
177.40	0.078	180.05	0.357
177.45	0.083	180.10	0.358
177.50	0.088	180.15	0.360
177.55	0.094	180.20	0.362
177.60	0.099	180.25	0.364
177.65	0.104	180.30	0.365
177.70	0.110	180.35	0.367
177.75	0.115	180.40	0.369
177.80	0.120	180.45	0.371
177.85	0.126	180.50	0.372
177.90	0.131	180.55	0.374
177.95	0.136	180.60	0.376
178.00	0.142	180.65	0.378
178.05	0.147	180.70	0.379
178.10	0.152	180.75	0.381
178.15	0.158	180.80	0.383
178.20	0.163	180.85	0.385
178.25	0.168	180.90	0.386
178.30	0.174	180.95	0.388
178.35	0.179	181.00	**0.390**
178.40	0.184		
178.45	0.190		
178.50	0.195		
178.55	0.200		
178.60	0.206		

13.9 OPERATIONS AND MAINTENANCE PLAN LOG

Kesseler Woods

Operation and Maintenance Log

NOTE: See Operations and Maintenance Plan for details of inspection requirements.

Structural Best Management Practice	Action	Date Completed	Comments	Completed By	Action	Date Completed	Comments	Completed By
Catch Basins/Area Drains – Inspect four times per year. Clean when sump is 50% full.	Inspect							
	Inspect							
	Inspect							
	Inspect							
Stormwater Outfalls – Inspect annually. Maintain vegetation and repair riprap as required.	Inspect				Clean (If Required. See Plan for details.)			
Subsurface Stormwater Detention System – Inspect once per year.	Inspect							
Vegetated Areas Maintenance – Inspect twice per year.	Inspect							
	Inspect							
Pavement Sweeping – Sweep twice per year.	Sweep							
	Sweep							
WQI (Stormceptor) – Inspect annually, clean as required.	Inspect							
Water Quality Infiltration Trenches – Inspect twice per year, clean as required.	Inspect							
	Inspect							

13.10 RAINFALL DATA MAPS AND I.D.F. CURVES

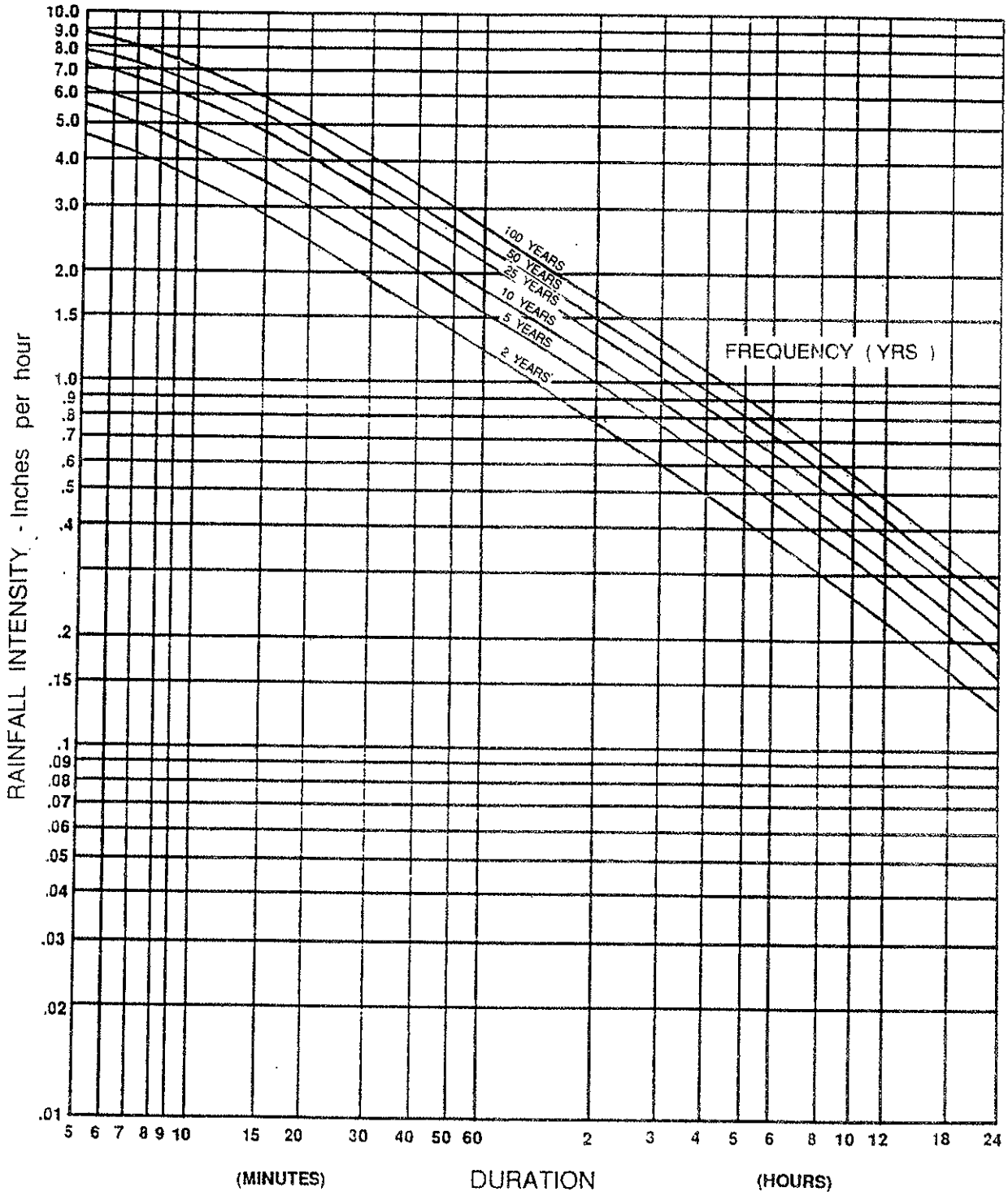
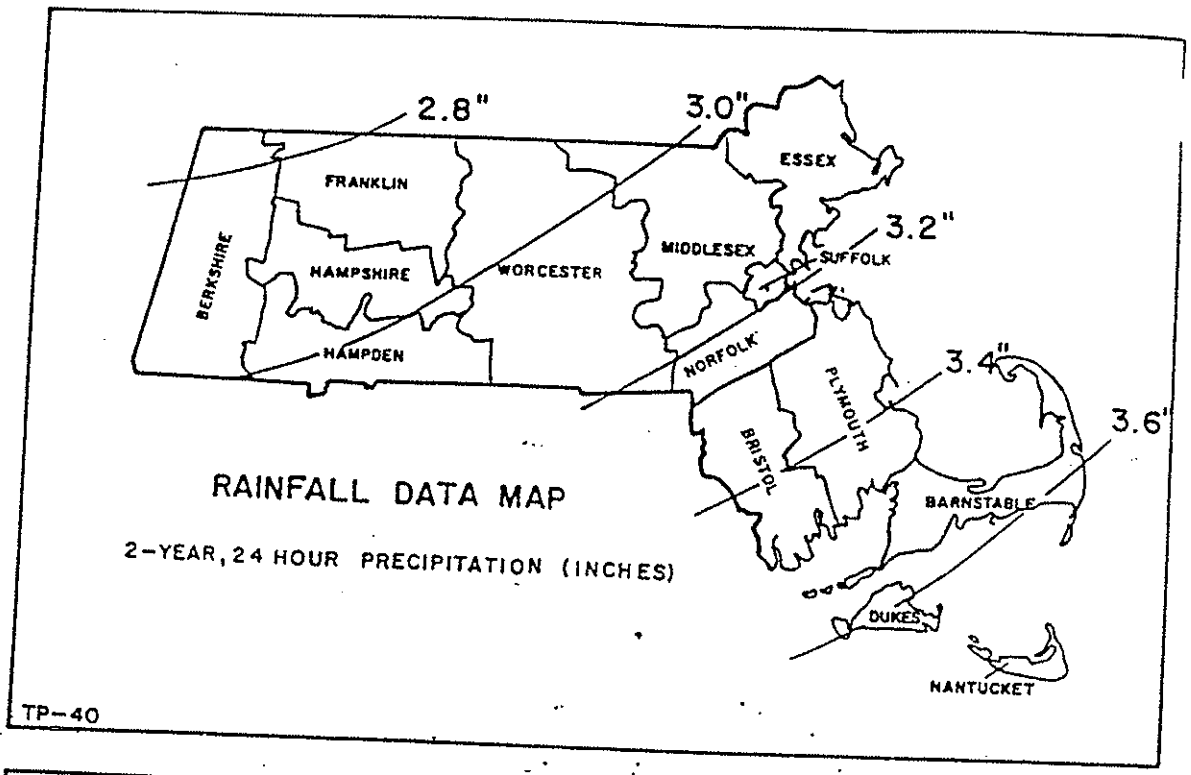


Figure 10-7. Intensity — Duration — Frequency Curve for Springfield, MA

1 year Storm, 24hr frequency use 2.5" statewide



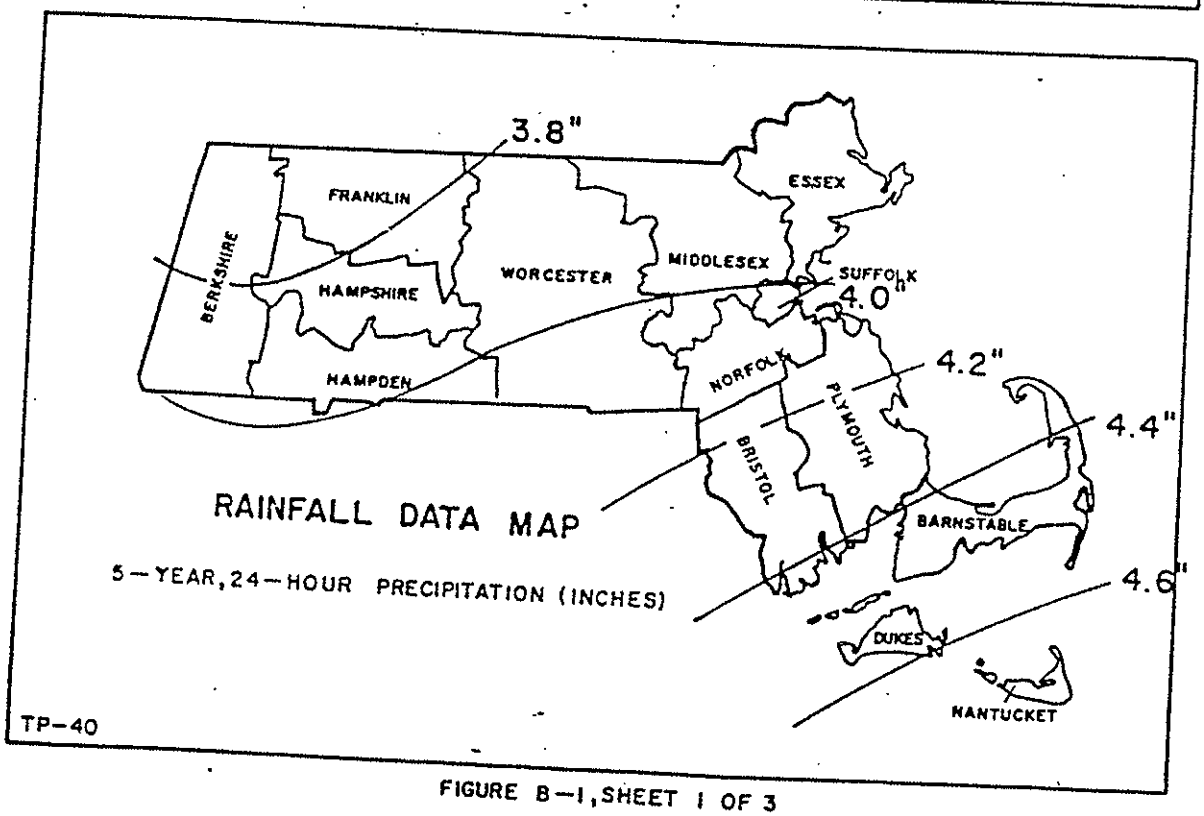
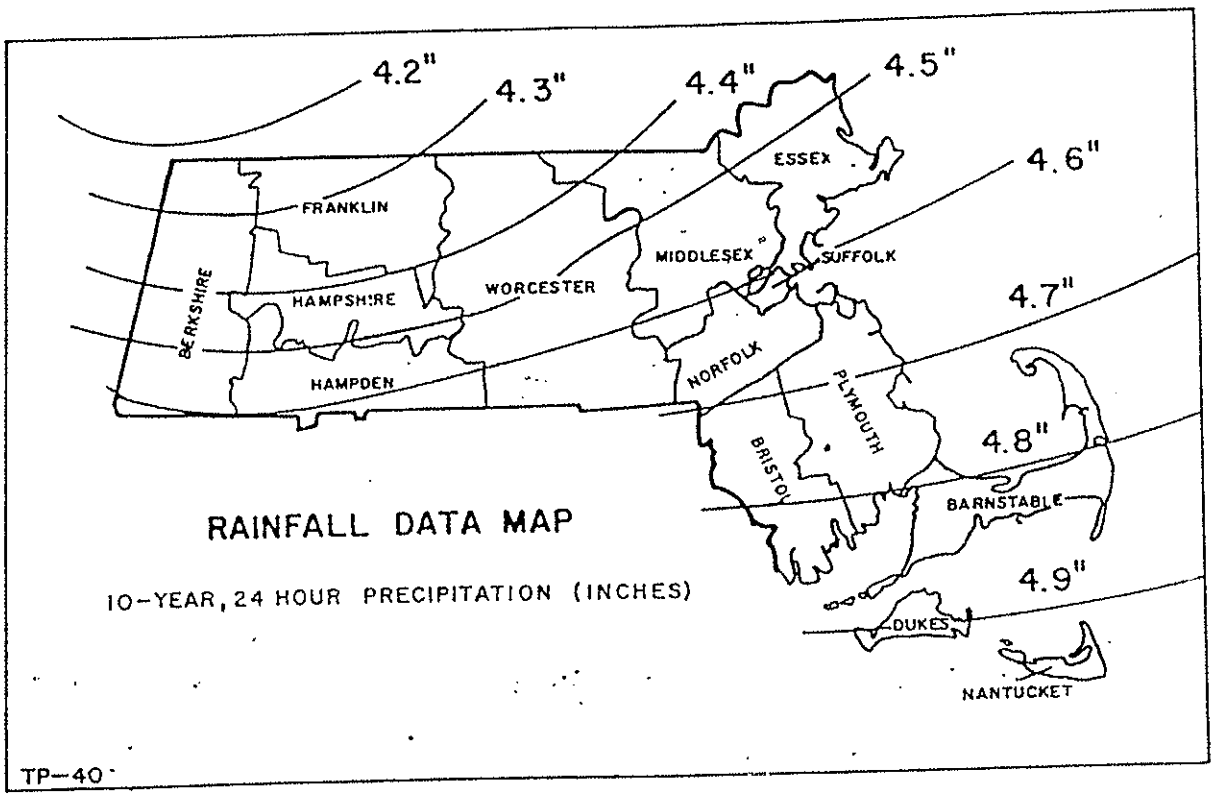


FIGURE B-1, SHEET 1 OF 3



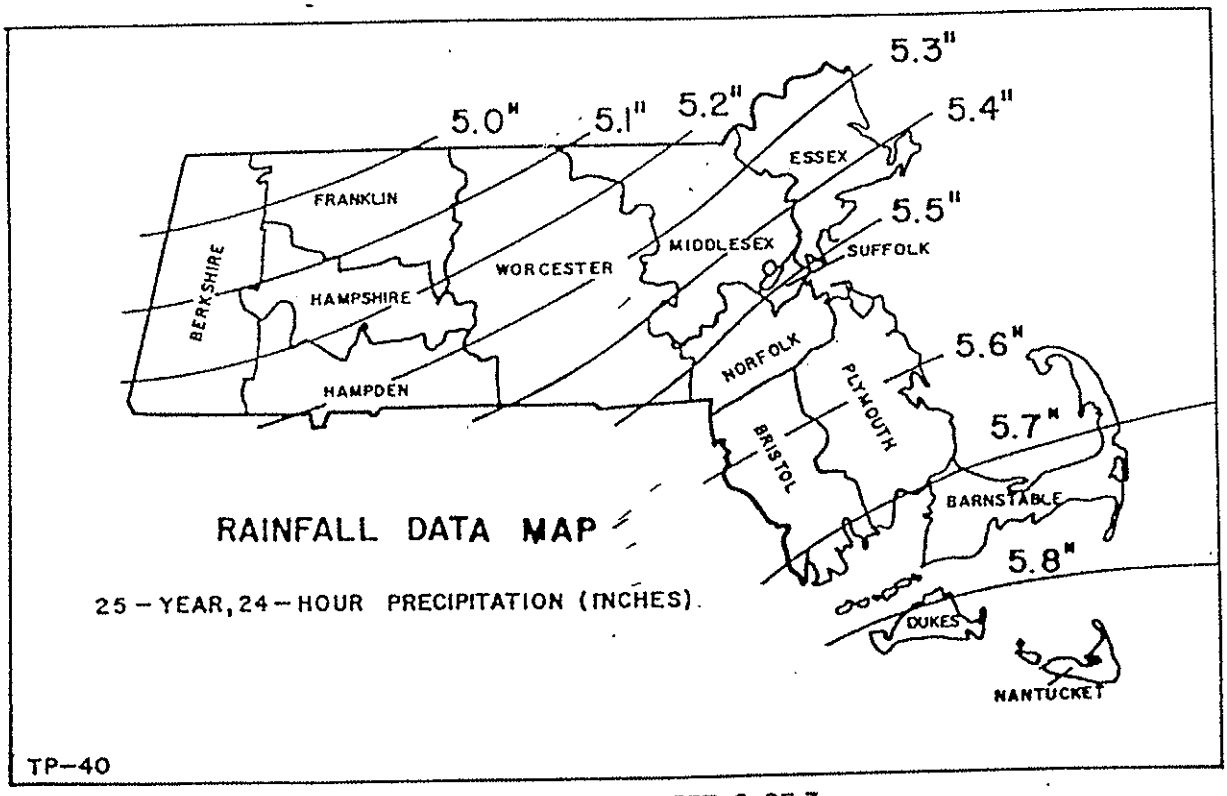
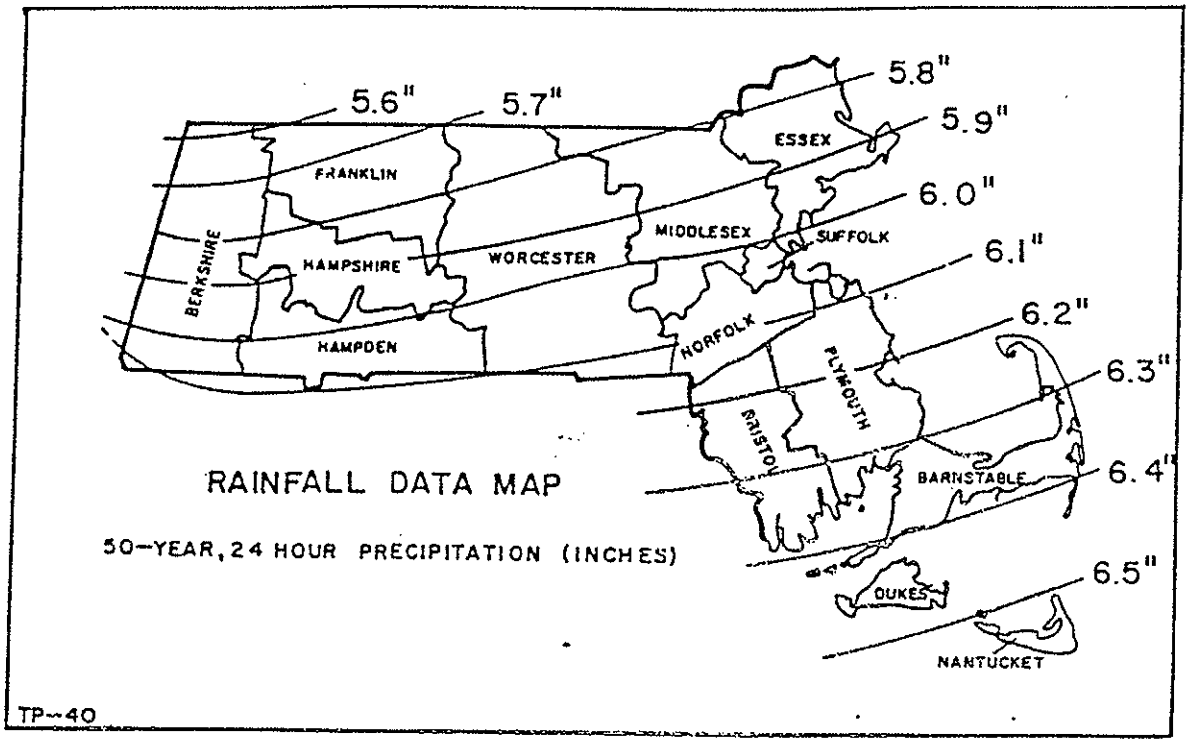


FIGURE B-1, SHEET 2 OF 3



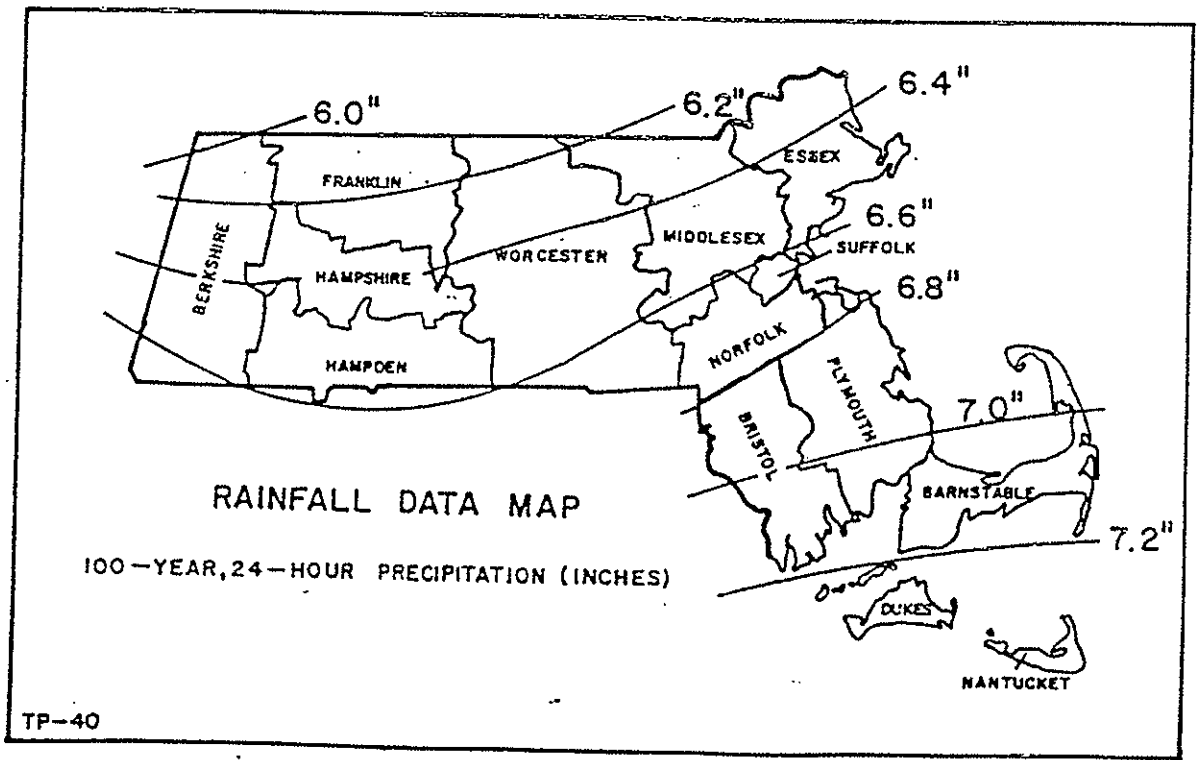


FIGURE B-1, SHEET 3 OF 3