

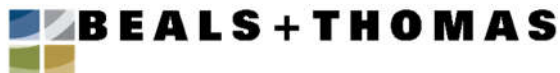
# Abbreviated Stormwater Management Report

## BLAIR SQUARE SITE IMPROVEMENTS

**0 Railroad Bed  
Holliston, Massachusetts**

*Prepared for:*  
**Holliston Planning Board  
703 Washington Street  
Holliston, MA 01746**

*Prepared by:*



**September 3, 2021**

*Calculated by:* **Nathaniel Bautz, EIT**

*Checked by:* **Jeffrey R. Murphy, PE**

*Approved by:*



*Jeffrey R. Murphy 9/3/21*

**Jeffrey R. Murphy, PE**

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- ATTACHMENT 4: SITE OWNER’S MANUAL
- ATTACHMENT 5: CONSTRUCTION PERIOD EROSION, SEDIMENTATION AND POLLUTION PREVENTION PLAN

## 1.0 INTRODUCTION

The proposed project includes several Low Impact Development (LID) stormwater Best Management Practices (BMPs) to address stormwater runoff from the proposed Blair Square Improvements. The proposed stormwater BMPs will control peak runoff rates, promote groundwater recharge and sediment removal.

The proposed project has been designed to the extent applicable, in accordance with the requirements of the DEP Stormwater Handbook, as well as the Holliston Stormwater Management and Land Disturbance Regulation and associated Stormwater Performance Standards.

The pre- and post-development hydrologic conditions were modeled using HydroCAD™ version 10.10 to demonstrate that post-development stormwater runoff rates will be less than or equal to the pre-development rates. Watershed maps with soil types as well as detailed analysis of the model results are also included. The following table summarizes the peak runoff rates for the pre- and post-development conditions.

Table 1: Pre- & Post-development Peak Runoff Rate Comparison, units are in cubic feet per second (cfs).

| Storm Event    | 2 Year     |             | 10 Year    |             | 25 Year    |             | 50 Year    |             | 100 Year   |             |
|----------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|
|                | <i>Pre</i> | <i>Post</i> | <i>Pre</i> | <i>Post</i> | <i>Pre</i> | <i>Post</i> | <i>Pre</i> | <i>Post</i> | <i>Pre</i> | <i>Post</i> |
| Design Point 1 | 0.36       | 0.07        | 1.03       | 0.16        | 1.47       | 0.27        | 1.83       | 0.35        | 2.51       | 0.57        |
| Design Point 2 | 0.19       | 0.09        | 0.56       | 0.32        | 0.81       | 0.48        | 1.00       | 0.61        | 1.39       | 0.86        |
| Design Point 3 | 0.09       | 0.05        | 0.23       | 0.17        | 0.33       | 0.26        | 0.41       | 0.32        | 0.55       | 0.46        |

## **2.0 PRE-DEVELOPMENT CONDITIONS**

### **2.1 Site Conditions**

The Project site is a parcel of land comprised of a former railroad corridor, which contains a section of the Upper Charles Rail Trail. The parcel is bound to the east by Central Street, to the north by Railroad Street, to the south by Front Street, and to the West by Exchange Street. Along the existing stone dust path is a mix of existing grassed areas with small gardens and various site amenities, as well as strips of wooded areas on either side of the trail mostly to the south of the proposed improvements.

Stormwater from the existing rail trail is relatively self-contained to a series of low-lying areas on the east side of the trail given the limited longitudinal slope of the trail. However, in a macro level view of the site, stormwater drains primarily in three directions which have identified as design points (DPs) for the hydrologic analysis.

- DP-1: The northern portion of the site drains generally drains to series of low-lying areas along the east side of the Upper Charles Trail, as the trail is flanked on both sides by slightly higher terrain. Overall, this area pitches north towards Central Street.
- DP-2: The southwest portion of the site drains towards Railroad Street, which generally slopes to the south beyond the limit of work.
- DP-3: A small area of the project site drains southeasterly towards Front Street, which also slopes to the south beyond the limit of work.

These design points have been labeled accordingly on the watershed maps in Attachment 2.

### **2.2 Soil Description**

The Natural Resources Conservation Service (NRCS) maps the proposed site as Urban Land Classification, as much of the site is located in previously developed/filled land associated with the construction of the railroad. However, it is bordered to the east and west by Sudbury Fine Sandy Loam and Canton Fine Sandy Loam soils, which are mapped as Hydrologic Soil Class B and A, respectively.

In-situ soil testing was performed by DGT Associates in August of 2020, which was witnessed by the Holliston Board of Health. The results of the testing are contained in a memo from DGT Associates dated September 28, 2020, which is included in Attachment 1. A total of three test pits were performed along with two percolation tests and a permeability test. The test pits appeared to indicate the presence of sandy soil with rapidly permeable sands with ample offset to seasonal high groundwater (7-9'). Each of the percolation tests performed was <2 min/inch and the permeability test result



observed was 49.4 in/hr. As such the soil conditions appear to be very favorable for stormwater infiltration. According the DGT memo, the design RAWLS rate recommended for sand per the Massachusetts DEP Stormwater Handbook is 8.27 in/hr. However, for the hydrology calculations, a more conservative infiltration rate of 2.41 in/hr was used to not overestimate the infiltration occurring in the proposed rain gardens. An infiltration rate of 1.02 in/hr was used for the permeable paver base to account for slightly decreased performance over time.

### **2.3 Existing Hydrologic Analysis**

Existing subcatchment areas were delineated based on existing runoff patterns and topographic information. This information is shown on the *Pre-Development Conditions Hydrologic Areas Map* included in Attachment 2. Summaries of each area with respect to Curve Number and peak runoff rates can be found in the model results also in Attachment 2.

### 3.0 **POST-DEVELOPMENT CONDITIONS**

#### 3.1 **Design Strategy**

During the design of the project, consideration was given to appropriate grading and mitigation of stormwater runoff through the incorporation of various Low Impact Development (LID) strategies.

The proposed project includes improvements consisting of a plaza area and connected walkways comprised of permeable pavers, a picnic pavilion, granite block seating walls, a Veteran's Memorial, various new sitting benches and amenities, and replacement of an existing sidewalk along Central Street.

Overall, the proposed project will constitute a relatively minor increase in impervious area and runoff. To address this, a series of LID stormwater BMPs are proposed. The majority of the proposed hardscape will be the plaza area made from permeable pavers. These pavers will allow water to flow through the gaps between the pavers into a crushed stone base layer beneath to allow for infiltration of stormwater and recharge to groundwater. A covered pavilion area is also proposed and will have permeable pavers beneath and alongside the edge beyond the roof overhang, so that water from the roof can infiltrate through the pavers.

Management of stormwater runoff from the remaining areas of the site will be accomplished through the implementation of three rain gardens situated at proposed low points along the east side of the trail. The rain gardens will provide multiple functions of runoff attenuation, infiltration/recharge to groundwater, total suspended solids (TSS) removal and total phosphorus removal (TP). While no impervious surfaces are proposed on the project which would require treatment under the MassDEP stormwater handbook (i.e. no required water quality treatment of paved impervious surfaces with pollutants), the TSS and TP removal functions still would be present given the biological functions of the proposed plantings in the rain gardens.

The proposed project has been designed to the extent applicable, in accordance with the requirements of the DEP Stormwater Handbook.

#### 3.2 **Proposed Hydrologic Analysis**

The established design points used in the pre-development conditions analysis were used in the post-development analysis for direct comparison. The tributary areas and flow paths were modified to reflect post-development conditions. See Attachment 2 for the *Post- Development Conditions Hydrologic Areas Map*. Summaries of each area with respect to Curve Number, BMP modeling, and peak runoff rates can be found in the model results in Attachment 2.

### 3.3 Stormwater Management Controls Sizing

#### ***Rain Gardens***

The proposed rain gardens were sized in accordance with the guidance provided in Volume 2, Chapter 2 of the MassDEP Stormwater Handbook. The rain gardens are sized based on roughly 5% of the tributary area to each one, since not specifically required for recharge or water quality treatment.

The proposed rain gardens were modeled using the Simple Dynamic Method, as described in Chapter 3 of the Massachusetts Stormwater Handbook, using a conservative Rawl's exfiltration rate of 2.41 inches per hour. The rain gardens have been designed to fully dewater within 72 hours. Recharge and Drawdown calculations are provided in Attachment 3.

#### ***Permeable Pavers***

The proposed plaza area will be constructed of permeable pavers. The proposed footprint of the pavers is approximately 5,190 SF. The proposed stone layer beneath the pavers will be approximately 11-inches deep per the proposed cross-section. The stormwater storage available in the void space of the stone is approximately 1,427 CF assuming a 30% void ratio in the stone. This will provide much more than would be required by MassDEP for recharge from traditional solid impervious areas for Hydrologic Soil Class A sites (0.60 inches x paver surface area = 260 cf). The 1,427 CF of storage beneath the pavers equates to the volume produced by approximately 3.64 inches of rain over that area, which is just above a typical 2-year storm event of 3.10 inches for Middlesex County, MA.

The paver stone has been designed to fully dewater within 72 hours. In addition to exfiltration of water into the underlying soil, an underdrain pipe has also been designed to provide additional outflow from the stone base in the event it becomes saturated. This underdrain is routed into the base stone layer of Rain Garden-1. Recharge and Drawdown calculations are provided in Attachment 3.

### 3.4 Compliance with DEP Stormwater Management Standards

The proposed project was designed to the extent applicable with the ten (10) DEP Stormwater Management Standards. The following summary provides key information related to the proposed stormwater management BMPs and mitigation measures for stormwater runoff.

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**STANDARD 1:**                    **No new stormwater conveyance (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.**

There are no wetlands or waters on or near the site and there are no proposed stormwater outfalls; therefore this standard does not apply. However, please note that runoff from proposed hardscape surfaces and surficial runoff from grassed/landscaped areas will be infiltrated through the permeable paver stone base or directed to one of the three rain gardens for infiltration. No stormwater outfalls are proposed.

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**STANDARD 2:**                    **Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.**

The stormwater management design will control post-development peak discharge rates for the 2-, 10-, 25-, 50- and 100-year, 24-hour storms so as to maintain pre-development peak discharge rates. Refer to Section 1.0 Introduction for a summary of the peak runoff rates.

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**STANDARD 3:**                    **Loss of annual recharge to groundwater shall be eliminated or minimized through the use of environmentally sensitive site design, low impact development techniques, stormwater management practices and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil types. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.**

The project includes a relatively small change in overall impervious area. The majority of the proposed plaza area will be constructed of permeable pavers with a porous crushed stone layer beneath the pavers that will allow for infiltration into the underlying soils. A granite block

sitting wall, several small concrete pads, and a brick memorial are the only proposed impervious surfaces, which are small in size and will produce a minimal amount of runoff which will be able to infiltrate into the adjacent soils. Similarly, roof runoff from the proposed pavilion will fall onto the permeable pavers below for infiltration. Ample recharge of stormwater will be provided in combination by the permeable paver stone base and three rain gardens.

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**STANDARD 4:**                    **Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS).**

The proposed project does not include impervious surfaces that would require treatment under the MassDEP Stormwater Handbook, so water quality treatment is not required. Despite this, TSS removal will still be provided by the proposed rain gardens by nature of their function.

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**STANDARD 5:**                    **For land uses with higher potential pollutant loads (LUHPPLs), source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable.**

The proposed project is not associated with stormwater discharges from land uses with higher potential pollutant loads.

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**STANDARD 6:**                    **Stormwater discharges to critical areas must utilize certain stormwater management BMPs approved for critical areas. Critical areas are Outstanding Resource Waters, shellfish beds, swimming beaches, coldwater fisheries and recharge areas for public water supplies.**

There are no stormwater discharges to critical areas associated with this project.

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**STANDARD 7:**                    **Redevelopment of previously developed sites must meet the Stormwater Management Standards to the maximum extent practicable. However, if it is not practicable to meet all the Standards, new (retrofitted or expanded) stormwater management systems must be designed to improve existing conditions.**

Although the site is previously developed, this standard does not apply because the proposed project includes a small increase in impervious area.

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**STANDARD 8:**            **A plan to control construction-related impacts during erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.**

A Construction Period Erosion, Sedimentation and Pollution Prevention Plan has been prepared and is included in Attachment 5; therefore the requirements of Standard 8 are fulfilled.

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**STANDARD 9:**            **A Long-Term Operation and Maintenance (O&M) Plan shall be developed and implemented to ensure that stormwater management systems function as designed.**

The Site Owner's Manual included in Attachment 4 complies with the Long-Term Pollution Prevention Plan (Standard 4) and the Long-Term Operation and Maintenance Plan (Standard 9) requirements of the 2008 Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Standards. The Manual outlines source control and pollution prevention measures and maintenance requirements of the stormwater best management practices (BMPs) associated with the proposed project.

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**STANDARD 10:**            **All illicit discharges to the stormwater management system are prohibited.**

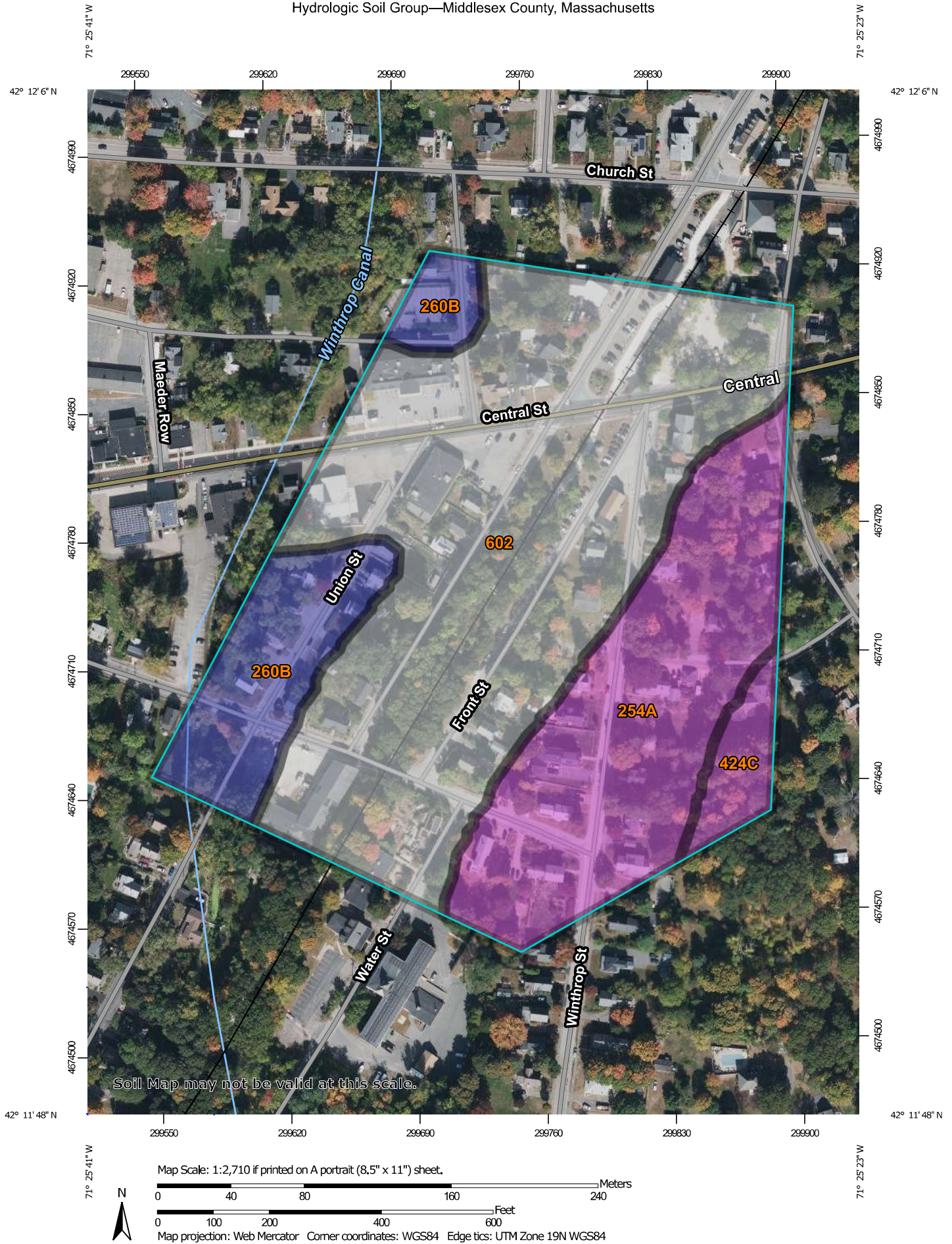
There will be no illicit discharges to the proposed stormwater management system associated with the proposed project.

**Attachment 1**  
**Soil Data**

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# Hydrologic Soil Group—Middlesex County, Massachusetts



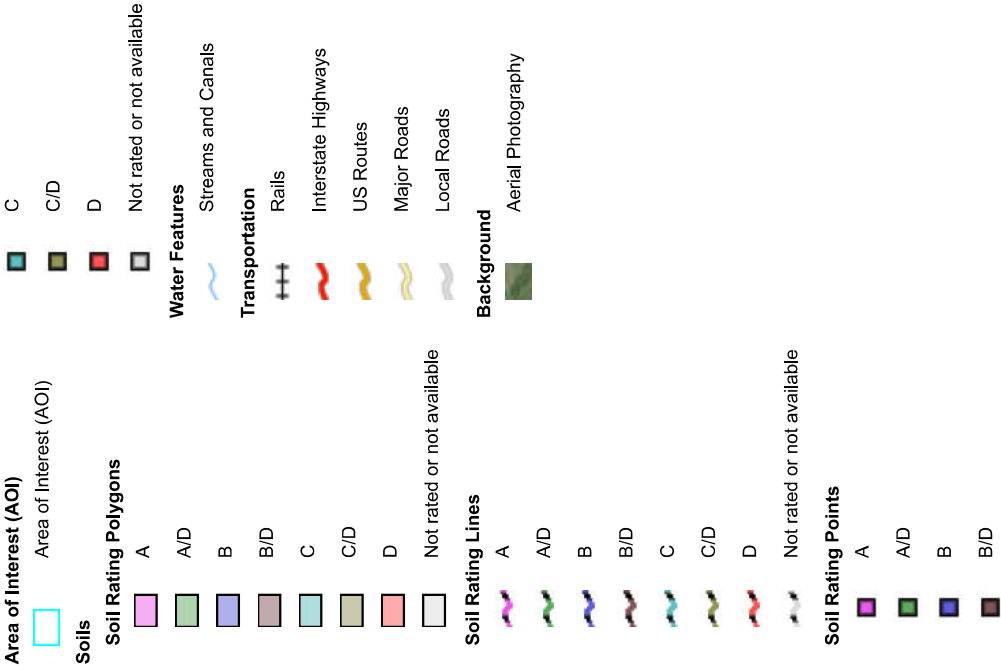
**Natural Resources  
Conservation Service**

Web Soil Survey  
National Cooperative Soil Survey

8/31/2021  
Page 1 of 4



MAP LEGEND



MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Middlesex County, Massachusetts  
Survey Area Data: Version 20, Jun 9, 2020

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

Date(s) aerial images were photographed: Aug 31, 2020—Oct 22, 2020

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

## Hydrologic Soil Group

| Map unit symbol                    | Map unit name  | Rating | Acres in AOI | Percent of AOI |
|------------------------------------|--|--------|--------------|----------------|
| 254A                               | Merrimac fine sandy loam, 0 to 3 percent slopes                    | A      | 6.1          | 26.7%          |
| 260B                               | Sudbury fine sandy loam, 3 to 8 percent slopes                     | B      | 2.8          | 12.5%          |
| 424C                               | Canton fine sandy loam, 8 to 15 percent slopes, extremely bouldery | A      | 0.7          | 3.3%           |
| 602                                | Urban land   |        | 13.1         | 57.6%          |
| <b>Totals for Area of Interest</b> |  |        | <b>22.7</b>  | <b>100.0%</b>  |

## 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



**DGT Associates**  
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Engineering

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September 28, 2020

Job: 25639

Town of Holliston – Board of Health  
Attn: Mr. Scott Moles – Health Director / Agent  
703 Washington Street  
Holliston, MA 01746

RE: Blair Square in Holliston, MA 01746 – Soil Testing

Dear Mr. Moles,

This report contains the results of the on-site soil testing conducted by DGT Associates on September 23, 2020 at the subject site. The testing consisted of three (3) deep observation holes (AKA test pits), two (2) percolation tests, and one (1) permeability test. Rodenhiser Excavating, Septic & Drains and Builders provided the backhoe service. A Soil Test Hole Location Plan is contained in Attachment 3.

The purpose of the testing was to assess the suitability of the soils for the design of a soil absorption system (SAS) and stormwater infiltration systems for the proposed site modifications. Testing was performed by Massachusetts Licensed Soil Evaluator (Joseph A. Losanno, EIT) of DGT and witnessed by Scott Moles from the Town of Holliston Board of Health.

According to the Natural Resources Conservation Service (NRCS) Soils Mapping, the soil in the area of testing is Urban Land. Attachment 2 contains the NRCS Map for the site and descriptions of the soil type.

Generally, the testing revealed a thin topsoil mixed with fill and trash, over a fine sand subsoil, over a fine sand substratum. No signs of Estimated Seasonal High Groundwater Table (ESHGWT), including redoximorphic features, weeping or standing groundwater, were observed during our testing. However, root intrusion at approximately seven to nine feet (7-9') below grade at test hole TH 20-03 were observed. The elevation root intrusion appears to match surrounding sites design ESHGWT. A monitor well was installed in this test hole for future monitoring of the groundwater table. At this time the bottom of the test holes are assumed to be the design ESHGWT. The deep observation hole logs are contained in Attachment 1.

Ledge / Bedrock / Refusal was not observed during the soil exploration.

Two (2) percolation tests were performed within the fine sand substratum layers adjacent to test pits TH 20-01 and TH 20-03. The resulting percolation rates were both less than two (2) minutes per inch. The percolation test logs are contained at the end of Attachment 1.

A permeability test utilizing the US Army Corps of Engineers method "In-situ Permeability Testing in the Vadose Zone" was performed in the substratum of test pit TH 20-02. The permeability rate observed was 49.4 inches per hour. The design permeability rate that will be used for stormwater infiltration in the area of these test pits will be based on the RAWLS rate published in the Massachusetts Stormwater Handbook for sand material (8.27 inches per hour). The tabulation of this test is included at the end of Attachment 1.



**DGT Associates**  
Surveying &  
Engineering

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Framingham, MA 01701  
508.879.0030  
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Please contact me if you have any questions regarding this report.

Sincerely,  
DGT Associates

Joseph A. Losanno, EIT (SE 13870)  
Project Engineer

**Attachments:**

1. Form 11 & Form 12 & Permeability Test Log
2. NRCS Soils Map & Information
3. Soil Test Hole Location Plan
4. USGS Surficial Geology Map & Information

Location Address or Lot No. Blair Square – Holliston, MA 01746**On-site Witnessed Soil Testing Review**Deep Hole Number TH 20-01 Date: 08/23/2020 Time: A.M. Weather 60° SunnyLocation (identify on site plan) see sketchLand Use Walking Trail Slope (%) 0 - 3 Surface Stones NoneVegetation Lawn / WoodedLandform Ground MorainesPosition on landscape (sketch on the back) see sketch

Distances from:

Open Water Body See sketch Feet Drainageway See sketch FeetPossible Wet Area See sketch Feet Property Line See sketch FeetDrinking Water Well See sketch Feet Other \_\_\_\_\_**DEEP OBSERVATION HOLE LOG**

| Depth from Surface (inches) | Soil Horizon | Soil Texture (USDA) | Soil Color (Munsell) | Soil Mottling | Other (Structure, Stones, Boulders, Consistency, % Gravel)  |
|-----------------------------|--------------|---------------------|----------------------|---------------|---|
| 0 – 11"                     | A / Fill     | Sandy Loam          | 10 YR 4/2            | None Observed | Massive-Friable – mix of topsoil w/ brush, roots, and trash |
| 11 – 120"                   | C            | Sand (Fine)         | 2.5 Y 7/2            | None Observed | Loose-Single Grained  |

Parent Material (geologic) Excavated and filled land Depth to Bedrock: None ObservedDepth to Groundwater: Standing Water in the Hole: None Observed Weeping from Pit Face: None ObservedEstimated Seasonal High Ground Water: > 120" below grade

Location Address or Lot No. Blair Square – Holliston, MA 01746**On-site Witnessed Soil Testing Review**Deep Hole Number TH 20-02 Date: 08/23/2020 Time: A.M. Weather 60° SunnyLocation (identify on site plan) see sketchLand Use Walking Trail Slope (%) 0 - 3 Surface Stones NoneVegetation Lawn / WoodedLandform Ground MorainesPosition on landscape (sketch on the back) see sketch

Distances from:

|                     |                   |      |               |                   |      |
|---------------------|-------------------|------|---------------|-------------------|------|
| Open Water Body     | <u>See sketch</u> | Feet | Drainageway   | <u>See sketch</u> | Feet |
| Possible Wet Area   | <u>See sketch</u> | Feet | Property Line | <u>See sketch</u> | Feet |
| Drinking Water Well | <u>See sketch</u> | Feet | Other         | <u></u>           |      |

**DEEP OBSERVATION HOLE LOG**

| Depth from Surface (Inches) | Soil Horizon   | Soil Texture (USDA) | Soil Color (Munsell) | Soil Mottling | Other (Structure, Stones, Boulders, Consistency, % Gravel)  |
|-----------------------------|----------------|---------------------|----------------------|---------------|---|
| 0 – 8"                      | A / Fill       | Sandy Loam          | 10 YR 4/2            | None Observed | Massive-Friable – mix of topsoil w/ brush, roots, and trash |
| 8 – 30"                     | B <sub>w</sub> | Sand (Fine)         | 10 YR 7/3            | None Observed | Loose-Single Grained w/ some roots                          |
| 30 – 130"                   | C              | Sand (Fine)         | 2.5 Y 7/2            | None Observed | Loose-Single Grained  |

Parent Material (geologic) Excavated and filled land Depth to Bedrock: None ObservedDepth to Groundwater: Standing Water in the Hole: None Observed Weeping from Pit Face: None ObservedEstimated Seasonal High Ground Water: > 130" below grade

Location Address or Lot No. Blair Square – Holliston, MA 01746**On-site Witnessed Soil Testing Review**Deep Hole Number TH 20-03 Date: 08/23/2020 Time: A.M. Weather 60° SunnyLocation (identify on site plan) see sketchLand Use Walking Trail Slope (%) 0 - 3 Surface Stones NoneVegetation Lawn / WoodedLandform Ground MorainesPosition on landscape (sketch on the back) see sketch

Distances from:

|                     |                   |      |               |                   |      |
|---------------------|-------------------|------|---------------|-------------------|------|
| Open Water Body     | <u>See sketch</u> | Feet | Drainageway   | <u>See sketch</u> | Feet |
| Possible Wet Area   | <u>See sketch</u> | Feet | Property Line | <u>See sketch</u> | Feet |
| Drinking Water Well | <u>See sketch</u> | Feet | Other         | <u></u>           |      |

**DEEP OBSERVATION HOLE LOG**

| Depth from Surface (Inches) | Soil Horizon                    | Soil Texture (USDA)  | Soil Color (Munsell) | Soil Mottling | Other (Structure, Stones, Boulders, Consistency, % Gravel)  |
|-----------------------------|---------------------------------|----------------------|----------------------|---------------|---|
| 0 – 12"                     | A / Fill                        | Sandy Loam           | 10 YR 4/2            | None Observed | Massive-Friable – mix of topsoil w/ brush, roots, and trash |
| 12 – 40"                    | B <sub>w</sub> / C <sub>1</sub> | Sand (Fine – Medium) | 10 YR 6/4            | None Observed | Loose-Single Grained  |
| 40 – 118"                   | C <sub>2</sub>                  | Sand (Fine)          | 10 YR 7/4            | Inconclusive  | Loose-Single Grained (root intrusion @ 7-9' below grade)    |

Parent Material (geologic) Excavated and filled land Depth to Bedrock: None ObservedDepth to Groundwater: Standing Water in the Hole: None Observed Weeping from Pit Face: None ObservedEstimated Seasonal High Ground Water: Inconclusive – Monitor well installed for future monitoring





Commonwealth of Massachusetts  
City/Town of Holliston  
**Percolation Test**  
**Form 12**

Percolation test results must be submitted with the Soil Suitability Assessment for On-site Sewage Disposal. DEP has provided this form for use by local Boards of Health. Other forms may be used, but the information must be substantially the same as that provided here. Before using this form, check with the local Board of Health to determine the form they use.

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



## A. Site Information

Owner Name

Blair Square

Street Address or Lot #

Holliston

City/Town

MA

State

01746

Zip Code

DGT Associates

508-879-0030

Contact Person (if different from Owner)

Telephone Number

## B. Test Results

|                    | <u>09/23/2020</u><br>Date                        | <u>10:30 A.M.</u><br>Time | <u>09/23/2020</u><br>Date                        | <u>11:06 A.M.</u><br>Time |
|--------------------|--|---------------------------|--|---------------------------|
| Observation Hole # | <u>TH 20-01</u>                                  |                           | <u>TH 20-03</u>                                  |                           |
| Depth of Perc      | <u>36 - 48"</u>                                  |                           | <u>38 - 50"</u>                                  |                           |
| Start Pre-Soak     | <u>10:30 A.M.</u>                                |                           | <u>11:06 A.M.</u>                                |                           |
| End Pre-Soak       | <u>10:45 P.M.</u>                                |                           | <u>11:21 A.M.</u>                                |                           |
| Time at 12"        | <u>10:45 A.M.</u>                                |                           | <u>11:21 A.M.</u>                                |                           |
| Time at 9"         | <u>10:47 A.M.</u>                                |                           | <u>11:23 A.M.</u>                                |                           |
| Time at 6"         | <u>10:49 A.M.</u>                                |                           | <u>11:26 A.M.</u>                                |                           |
| Time (9"-6")       | <u>2 minutes</u>                                 |                           | <u>3 minutes</u>                                 |                           |
| Rate (Min./Inch)   | <u>&lt;2 minutes per inch</u>                    |                           | <u>&lt;2 Minutes per Inch</u>                    |                           |
|                    | Test Passed: <input checked="" type="checkbox"/> |                           | Test Passed: <input checked="" type="checkbox"/> |                           |
|                    | Test Failed: <input type="checkbox"/>            |                           | Test Failed: <input type="checkbox"/>            |                           |

Joseph Losanno, E.I.T.

Test Performed By:

Scott Moles

Witnessed By:

Comments:

\_\_\_\_\_  
\_\_\_\_\_

**Permeability Test @ TH 20-02**

Date Performed: 23-Sep-20  
 Soil Horizon of Perm Test: C  
 Depth to water level = 24"  
 Depth to bottom of tube = 35"  
 Start Soak: 11:50 A.M.  
 Start Test: 12:05 P.M.

|                               | Time Interval<br>(Minutes) | Incremental<br>Volume(L) |
|-------------------------------|----------------------------|--------------------------|
|                               | 1                          | 1.500                    |
|                               | 1                          | 1.000                    |
|                               | 1                          | 14.250                   |
|                               | 1                          | 1.250                    |
|                               | 1                          | 1.000                    |
|                               | 1                          | 1.000                    |
|                               | 1                          | 1.000                    |
|                               | 1                          | 1.000                    |
|                               | 1                          | 1.250                    |
|                               | 1                          | 1.250                    |
| <b>Cumulative Time/Volume</b> | <b>10</b>                  | <b>24.500</b>            |

$Q = \text{Cumulative Volume cm}^3 / \text{Total time in seconds}$   
 $Q = 40.833 \text{ cm}^3/\text{sec}$

Computation of Permeability(k)

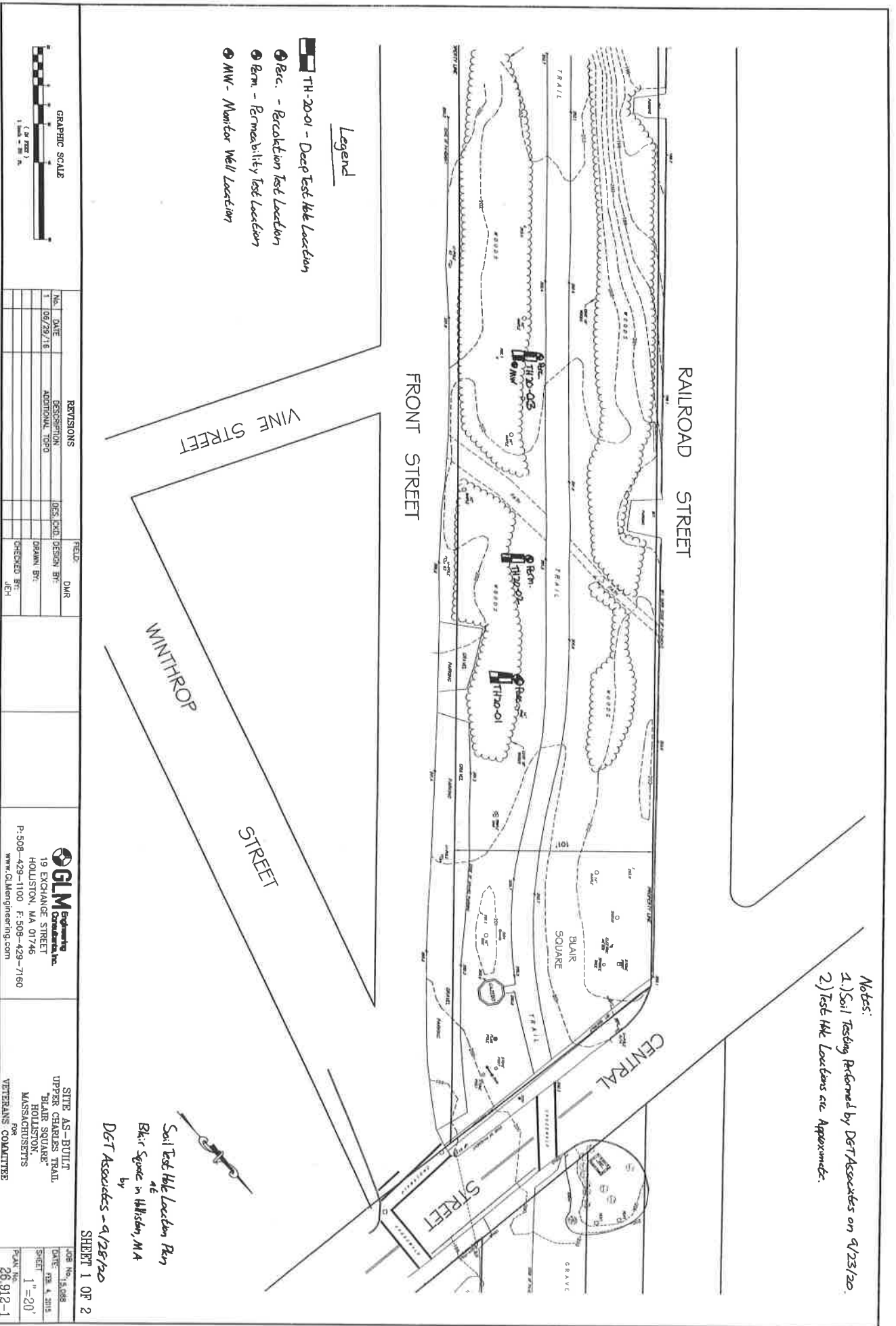
$$k = Q / 5.5 \text{ r Hw} =$$

k=coefficient of permeability (cm/sec)  
 r=inside radius of pipe in centimeters=  
 Hw=applied head in centimeters=  
 Q=Computed flow rate in CC/sec=

7.6 (6" DIA.)  
 28 cm (11 inches)  
 40.833 cm<sup>3</sup>/sec

$$k = Q / 5.5 \text{ r Hw} = \boxed{0.03489 \text{ cm/sec}} \quad 49.448 \text{ IN/HR}$$

Notes:  
 1.) Soil Testing Performed by DGT Associates on 4/23/20.  
 2.) Test Hole Locations are Approximate.



## Attachment 2 Hydrologic Analysis

---

## PRE- & POST-DEVELOPMENT CALCULATION SUMMARY

### OBJECTIVE

To determine the pre- and post-development peak rates of runoff from the site for the 2, 10, 25, 50, & 100-year storm events at the design points.

### CONCLUSION(S)

Peak Runoff Rates (CFS):

| Storm Event    | 2 Year |      | 10 Year |      | 25 Year |      | 50 Year |      | 100 Year |      |
|----------------|--------|------|---------|------|---------|------|---------|------|----------|------|
|                | Pre    | Post | Pre     | Post | Pre     | Post | Pre     | Post | Pre      | Post |
| Design Point 1 | 0.36   | 0.07 | 1.03    | 0.16 | 1.47    | 0.27 | 1.83    | 0.35 | 2.51     | 0.57 |
| Design Point 2 | 0.19   | 0.09 | 0.56    | 0.32 | 0.81    | 0.48 | 1.00    | 0.61 | 1.39     | 0.86 |
| Design Point 3 | 0.09   | 0.05 | 0.23    | 0.17 | 0.33    | 0.26 | 0.41    | 0.32 | 0.55     | 0.46 |

**Conclusion:** Overall runoff rates from the project area will be less than or equal to pre-development conditions in accordance with Standard 2 of the MassDEP Stormwater Management Regulations.

### CALCULATION METHODS

1. Runoff curve numbers (CN), time-of-concentration (Tc), and runoff rates were calculated based on TR-55 methodology.
2. AutoCAD 2019 computer program was utilized for digitizing ground cover areas.
3. Peak runoff rates were computed using HydroCAD version 10.10

### ASSUMPTIONS

1. The ground cover types were determined using aerial imagery. Hydrologic soil class B was used for modeling based on a review of surrounding soil types as shown on the United States Department of Agriculture, NRCS Soil Survey map information. Hydrologic soil group B was used for more conservative sizing of the proposed stormwater management BMPs.
2. An exfiltration rate of 2.41 in/hr was used for the rain garden modeling despite the higher infiltration rates observed during in-situ testing as to not overestimate the infiltrative capacity of the soils over time. A rate of 1.02 in/hr was assumed beneath the permeable pavers as it is anticipated there may be some slight compaction of the soils resulting from the installation process.

### SOURCES OF DATA/ EQUATIONS

1. Pre-and Post-Development Conditions Hydrologic Areas Maps prepared by Beals and Thomas, Inc. File No. 143903P005A-001-002.
2. NRCS Soil Survey for Plymouth County, hydrologic soil group report, downloaded from Web Soil Survey on 08/31/2021.
3. TR-55 urban Hydrology for Small Watersheds, SCS, 1986.
4. Massachusetts DEP Stormwater Management Handbook, February 2008.

### LIST OF APPENDICES

- A. Pre-Development Conditions Hydrologic Analysis
- B. Post-Development Conditions Hydrologic Analysis

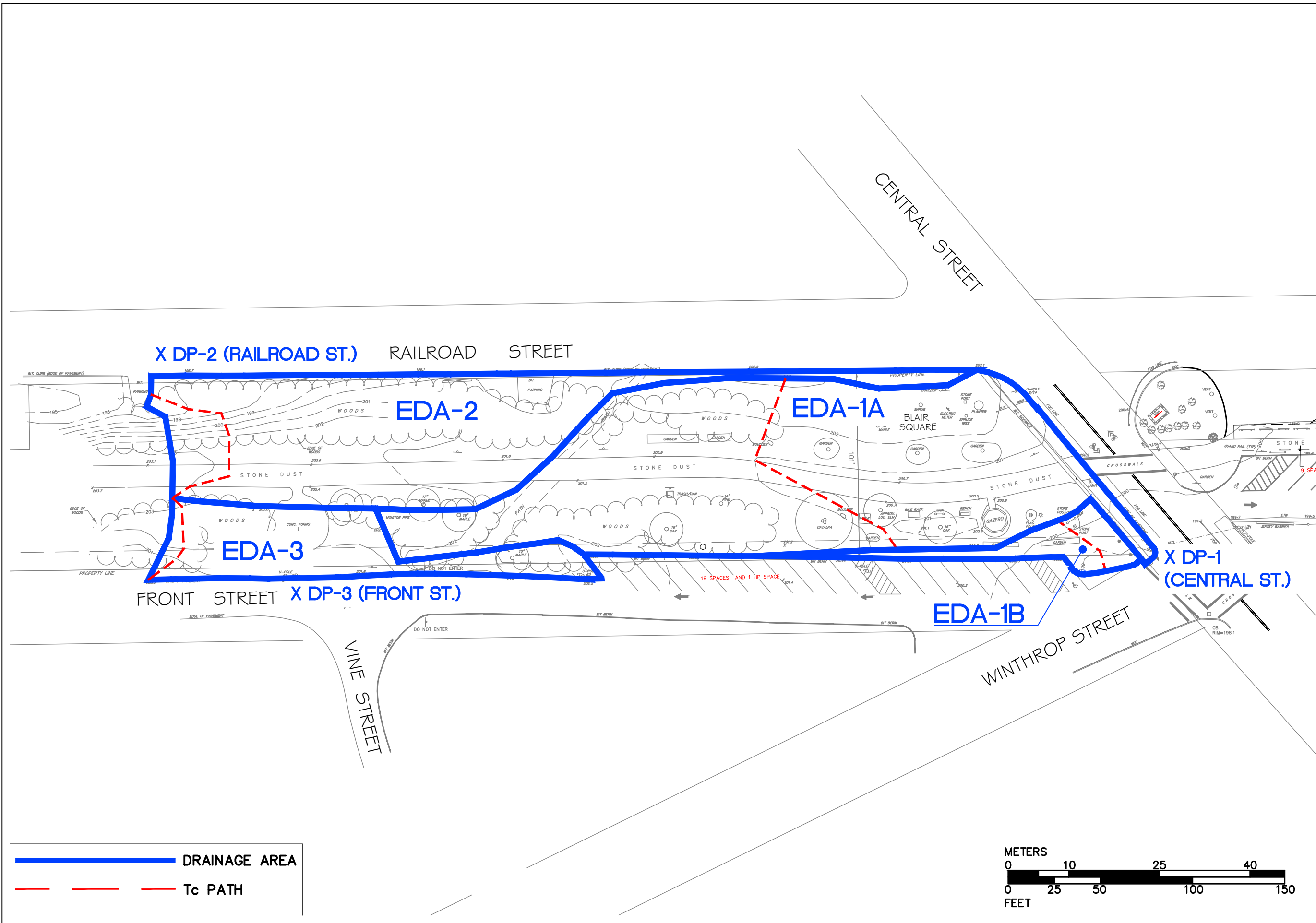
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|-----|----------|------------|------------|------------|-------------|------------|
| 0   | NBB      | 09/02/2021 | JRM        | 09/03/2021 | JRM         | 09/03/2021 |
|     |          |            |            |            |             |            |

NBB/JRM/143903CS001A

## Appendix A

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### Pre-Development Conditions Hydrologic Analysis



Pre-Development Conditions  
Hydrologic Areas Map  
Figure Number 001

Scale: 1" = 50'  
Date: 09/03/2021  
Plan No. 143903P005A-001  
B+T Project No. 1439.03

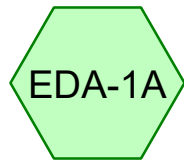
Blair Square Site Improvements  
Holliston, Massachusetts

Holliston Panning Board  
703 Washington Street  
Holliston, Massachusetts

North Arrow

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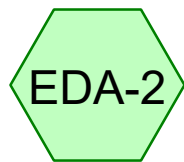
Pre-Development  
Conditions



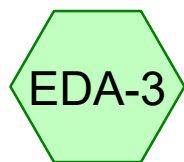
EDA-1A



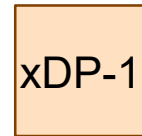
EDA-1B



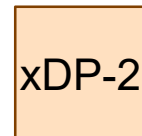
EDA-2



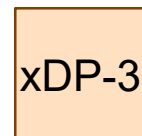
EDA-3



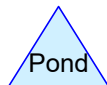
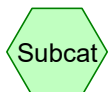
Central Street



Railroad Street



Front Street



Routing Diagram for 143903HC001

Prepared by Beals and Thomas, Inc., Printed 9/3/2021

HydroCAD® 10.10-5a s/n 04493 © 2020 HydroCAD Software Solutions LLC



**Area Listing (selected nodes)**

| Area<br>(acres) | CN        | Description<br>(subcatchment-numbers)                        |
|-----------------|-----------|--|
| 0.724           | 61        | >75% Grass cover, Good, HSG B (EDA-1A, EDA-1B, EDA-2, EDA-3) |
| 0.053           | 96        | Compacted Earth, HSG B (EDA-1A, EDA-2, EDA-3)                |
| 0.017           | 98        | Impervious Surface, HSG B (EDA-1A, EDA-2)                    |
| 0.003           | 98        | Roofs, HSG B (EDA-1A)  |
| 0.131           | 96        | Stone Dust Path, HSG B (EDA-1A, EDA-2)                       |
| 0.281           | 55        | Woods, Good, HSG B (EDA-1A, EDA-2, EDA-3)                    |
| <b>1.209</b>    | <b>66</b> | <b>TOTAL AREA</b>  |

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

|                                     |   |
|-------------------------------------|---|
| <b>Subcatchment EDA-1A: EDA-1A</b>  | Runoff Area=0.633 ac 2.05% Impervious Runoff Depth>0.59"<br>Tc=6.0 min CN=66 Runoff=0.35 cfs 0.031 af |
| <b>Subcatchment EDA-1B: EDA-1B</b>  | Runoff Area=0.048 ac 0.00% Impervious Runoff Depth>0.40"<br>Tc=6.0 min CN=61 Runoff=0.01 cfs 0.002 af |
| <b>Subcatchment EDA-2: EDA-2</b>    | Runoff Area=0.385 ac 1.82% Impervious Runoff Depth>0.55"<br>Tc=6.0 min CN=65 Runoff=0.19 cfs 0.018 af |
| <b>Subcatchment EDA-3: EDA-3</b>    | Runoff Area=0.143 ac 0.00% Impervious Runoff Depth>0.63"<br>Tc=6.0 min CN=67 Runoff=0.09 cfs 0.008 af |
| <b>Reach xDP-1: Central Street</b>  | Inflow=0.36 cfs 0.033 af<br>Outflow=0.36 cfs 0.033 af   |
| <b>Reach xDP-2: Railroad Street</b> | Inflow=0.19 cfs 0.018 af<br>Outflow=0.19 cfs 0.018 af   |
| <b>Reach xDP-3: Front Street</b>    | Inflow=0.09 cfs 0.008 af<br>Outflow=0.09 cfs 0.008 af   |

**Total Runoff Area = 1.209 ac Runoff Volume = 0.058 af Average Runoff Depth = 0.58"**  
**98.35% Pervious = 1.189 ac 1.65% Impervious = 0.020 ac**

**Summary for Subcatchment EDA-1A: EDA-1A**

Runoff = 0.35 cfs @ 12.11 hrs, Volume= 0.031 af, Depth> 0.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-002yr Rainfall=3.10"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.111     | 55 | Woods, Good, HSG B            |
| 0.417     | 61 | >75% Grass cover, Good, HSG B |
| * 0.016   | 96 | Compacted Earth, HSG B        |
| * 0.076   | 96 | Stone Dust Path, HSG B        |
| * 0.010   | 98 | Impervious Surface, HSG B     |
| 0.003     | 98 | Roofs, HSG B                  |
| 0.633     | 66 | Weighted Average              |
| 0.620     |    | 97.95% Pervious Area          |
| 0.013     |    | 2.05% Impervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

**Summary for Subcatchment EDA-1B: EDA-1B**

Runoff = 0.01 cfs @ 12.13 hrs, Volume= 0.002 af, Depth> 0.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-002yr Rainfall=3.10"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.048     | 61 | >75% Grass cover, Good, HSG B |
| 0.048     |    | 100.00% Pervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

**Summary for Subcatchment EDA-2: EDA-2**

Runoff = 0.19 cfs @ 12.11 hrs, Volume= 0.018 af, Depth> 0.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-002yr Rainfall=3.10"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.131     | 55 | Woods, Good, HSG B            |
| 0.188     | 61 | >75% Grass cover, Good, HSG B |
| * 0.004   | 96 | Compacted Earth, HSG B        |
| * 0.055   | 96 | Stone Dust Path, HSG B        |
| * 0.007   | 98 | Impervious Surface, HSG B     |
| 0.385     | 65 | Weighted Average              |
| 0.378     |    | 98.18% Pervious Area          |
| 0.007     |    | 1.82% Impervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

### Summary for Subcatchment EDA-3: EDA-3

Runoff = 0.09 cfs @ 12.11 hrs, Volume= 0.008 af, Depth> 0.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-002yr Rainfall=3.10"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.039     | 55 | Woods, Good, HSG B            |
| 0.071     | 61 | >75% Grass cover, Good, HSG B |
| * 0.033   | 96 | Compacted Earth, HSG B        |
| 0.143     | 67 | Weighted Average              |
| 0.143     |    | 100.00% Pervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

### Summary for Reach xDP-1: Central Street

Inflow Area = 0.681 ac, 1.91% Impervious, Inflow Depth > 0.58" for Middlesex-002yr event  
Inflow = 0.36 cfs @ 12.11 hrs, Volume= 0.033 af  
Outflow = 0.36 cfs @ 12.11 hrs, Volume= 0.033 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Summary for Reach xDP-2: Railroad Street

Inflow Area = 0.385 ac, 1.82% Impervious, Inflow Depth > 0.55" for Middlesex-002yr event  
Inflow = 0.19 cfs @ 12.11 hrs, Volume= 0.018 af  
Outflow = 0.19 cfs @ 12.11 hrs, Volume= 0.018 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Summary for Reach xDP-3: Front Street**

Inflow Area = 0.143 ac, 0.00% Impervious, Inflow Depth > 0.63" for Middlesex-002yr event  
Inflow = 0.09 cfs @ 12.11 hrs, Volume= 0.008 af  
Outflow = 0.09 cfs @ 12.11 hrs, Volume= 0.008 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

|                                     |   |
|-------------------------------------|---|
| <b>Subcatchment EDA-1A: EDA-1A</b>  | Runoff Area=0.633 ac 2.05% Impervious Runoff Depth>1.39"<br>Tc=6.0 min CN=66 Runoff=0.97 cfs 0.074 af |
| <b>Subcatchment EDA-1B: EDA-1B</b>  | Runoff Area=0.048 ac 0.00% Impervious Runoff Depth>1.08"<br>Tc=6.0 min CN=61 Runoff=0.05 cfs 0.004 af |
| <b>Subcatchment EDA-2: EDA-2</b>    | Runoff Area=0.385 ac 1.82% Impervious Runoff Depth>1.33"<br>Tc=6.0 min CN=65 Runoff=0.56 cfs 0.043 af |
| <b>Subcatchment EDA-3: EDA-3</b>    | Runoff Area=0.143 ac 0.00% Impervious Runoff Depth>1.46"<br>Tc=6.0 min CN=67 Runoff=0.23 cfs 0.017 af |
| <b>Reach xDP-1: Central Street</b>  | Inflow=1.03 cfs 0.078 af<br>Outflow=1.03 cfs 0.078 af   |
| <b>Reach xDP-2: Railroad Street</b> | Inflow=0.56 cfs 0.043 af<br>Outflow=0.56 cfs 0.043 af   |
| <b>Reach xDP-3: Front Street</b>    | Inflow=0.23 cfs 0.017 af<br>Outflow=0.23 cfs 0.017 af   |

**Total Runoff Area = 1.209 ac Runoff Volume = 0.138 af Average Runoff Depth = 1.37"**  
**98.35% Pervious = 1.189 ac 1.65% Impervious = 0.020 ac**

**Summary for Subcatchment EDA-1A: EDA-1A**

Runoff = 0.97 cfs @ 12.10 hrs, Volume= 0.074 af, Depth> 1.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-010yr Rainfall=4.50"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.111     | 55 | Woods, Good, HSG B            |
| 0.417     | 61 | >75% Grass cover, Good, HSG B |
| * 0.016   | 96 | Compacted Earth, HSG B        |
| * 0.076   | 96 | Stone Dust Path, HSG B        |
| * 0.010   | 98 | Impervious Surface, HSG B     |
| 0.003     | 98 | Roofs, HSG B                  |
| 0.633     | 66 | Weighted Average              |
| 0.620     |    | 97.95% Pervious Area          |
| 0.013     |    | 2.05% Impervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

**Summary for Subcatchment EDA-1B: EDA-1B**

Runoff = 0.05 cfs @ 12.10 hrs, Volume= 0.004 af, Depth> 1.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-010yr Rainfall=4.50"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.048     | 61 | >75% Grass cover, Good, HSG B |
| 0.048     |    | 100.00% Pervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

**Summary for Subcatchment EDA-2: EDA-2**

Runoff = 0.56 cfs @ 12.10 hrs, Volume= 0.043 af, Depth> 1.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-010yr Rainfall=4.50"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.131     | 55 | Woods, Good, HSG B            |
| 0.188     | 61 | >75% Grass cover, Good, HSG B |
| * 0.004   | 96 | Compacted Earth, HSG B        |
| * 0.055   | 96 | Stone Dust Path, HSG B        |
| * 0.007   | 98 | Impervious Surface, HSG B     |
| 0.385     | 65 | Weighted Average              |
| 0.378     |    | 98.18% Pervious Area          |
| 0.007     |    | 1.82% Impervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

### Summary for Subcatchment EDA-3: EDA-3

Runoff = 0.23 cfs @ 12.10 hrs, Volume= 0.017 af, Depth> 1.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-010yr Rainfall=4.50"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.039     | 55 | Woods, Good, HSG B            |
| 0.071     | 61 | >75% Grass cover, Good, HSG B |
| * 0.033   | 96 | Compacted Earth, HSG B        |
| 0.143     | 67 | Weighted Average              |
| 0.143     |    | 100.00% Pervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

### Summary for Reach xDP-1: Central Street

Inflow Area = 0.681 ac, 1.91% Impervious, Inflow Depth > 1.37" for Middlesex-010yr event  
Inflow = 1.03 cfs @ 12.10 hrs, Volume= 0.078 af  
Outflow = 1.03 cfs @ 12.10 hrs, Volume= 0.078 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Summary for Reach xDP-2: Railroad Street

Inflow Area = 0.385 ac, 1.82% Impervious, Inflow Depth > 1.33" for Middlesex-010yr event  
Inflow = 0.56 cfs @ 12.10 hrs, Volume= 0.043 af  
Outflow = 0.56 cfs @ 12.10 hrs, Volume= 0.043 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs



**Summary for Reach xDP-3: Front Street**

Inflow Area = 0.143 ac, 0.00% Impervious, Inflow Depth > 1.46" for Middlesex-010yr event  
Inflow = 0.23 cfs @ 12.10 hrs, Volume= 0.017 af  
Outflow = 0.23 cfs @ 12.10 hrs, Volume= 0.017 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

|                                     |   |
|-------------------------------------|---|
| <b>Subcatchment EDA-1A: EDA-1A</b>  | Runoff Area=0.633 ac 2.05% Impervious Runoff Depth>1.93"<br>Tc=6.0 min CN=66 Runoff=1.39 cfs 0.102 af |
| <b>Subcatchment EDA-1B: EDA-1B</b>  | Runoff Area=0.048 ac 0.00% Impervious Runoff Depth>1.55"<br>Tc=6.0 min CN=61 Runoff=0.08 cfs 0.006 af |
| <b>Subcatchment EDA-2: EDA-2</b>    | Runoff Area=0.385 ac 1.82% Impervious Runoff Depth>1.85"<br>Tc=6.0 min CN=65 Runoff=0.81 cfs 0.059 af |
| <b>Subcatchment EDA-3: EDA-3</b>    | Runoff Area=0.143 ac 0.00% Impervious Runoff Depth>2.01"<br>Tc=6.0 min CN=67 Runoff=0.33 cfs 0.024 af |
| <b>Reach xDP-1: Central Street</b>  | Inflow=1.47 cfs 0.108 af<br>Outflow=1.47 cfs 0.108 af   |
| <b>Reach xDP-2: Railroad Street</b> | Inflow=0.81 cfs 0.059 af<br>Outflow=0.81 cfs 0.059 af   |
| <b>Reach xDP-3: Front Street</b>    | Inflow=0.33 cfs 0.024 af<br>Outflow=0.33 cfs 0.024 af   |

**Total Runoff Area = 1.209 ac Runoff Volume = 0.192 af Average Runoff Depth = 1.90"**  
**98.35% Pervious = 1.189 ac 1.65% Impervious = 0.020 ac**

**Summary for Subcatchment EDA-1A: EDA-1A**

Runoff = 1.39 cfs @ 12.09 hrs, Volume= 0.102 af, Depth> 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-025yr Rainfall=5.30"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.111     | 55 | Woods, Good, HSG B            |
| 0.417     | 61 | >75% Grass cover, Good, HSG B |
| * 0.016   | 96 | Compacted Earth, HSG B        |
| * 0.076   | 96 | Stone Dust Path, HSG B        |
| * 0.010   | 98 | Impervious Surface, HSG B     |
| 0.003     | 98 | Roofs, HSG B                  |
| 0.633     | 66 | Weighted Average              |
| 0.620     |    | 97.95% Pervious Area          |
| 0.013     |    | 2.05% Impervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

**Summary for Subcatchment EDA-1B: EDA-1B**

Runoff = 0.08 cfs @ 12.10 hrs, Volume= 0.006 af, Depth> 1.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-025yr Rainfall=5.30"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.048     | 61 | >75% Grass cover, Good, HSG B |
| 0.048     |    | 100.00% Pervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

**Summary for Subcatchment EDA-2: EDA-2**

Runoff = 0.81 cfs @ 12.09 hrs, Volume= 0.059 af, Depth> 1.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-025yr Rainfall=5.30"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.131     | 55 | Woods, Good, HSG B            |
| 0.188     | 61 | >75% Grass cover, Good, HSG B |
| * 0.004   | 96 | Compacted Earth, HSG B        |
| * 0.055   | 96 | Stone Dust Path, HSG B        |
| * 0.007   | 98 | Impervious Surface, HSG B     |
| 0.385     | 65 | Weighted Average              |
| 0.378     |    | 98.18% Pervious Area          |
| 0.007     |    | 1.82% Impervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

### Summary for Subcatchment EDA-3: EDA-3

Runoff = 0.33 cfs @ 12.09 hrs, Volume= 0.024 af, Depth> 2.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-025yr Rainfall=5.30"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.039     | 55 | Woods, Good, HSG B            |
| 0.071     | 61 | >75% Grass cover, Good, HSG B |
| * 0.033   | 96 | Compacted Earth, HSG B        |
| 0.143     | 67 | Weighted Average              |
| 0.143     |    | 100.00% Pervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

### Summary for Reach xDP-1: Central Street

Inflow Area = 0.681 ac, 1.91% Impervious, Inflow Depth > 1.91" for Middlesex-025yr event  
Inflow = 1.47 cfs @ 12.09 hrs, Volume= 0.108 af  
Outflow = 1.47 cfs @ 12.09 hrs, Volume= 0.108 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Summary for Reach xDP-2: Railroad Street

Inflow Area = 0.385 ac, 1.82% Impervious, Inflow Depth > 1.85" for Middlesex-025yr event  
Inflow = 0.81 cfs @ 12.09 hrs, Volume= 0.059 af  
Outflow = 0.81 cfs @ 12.09 hrs, Volume= 0.059 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Summary for Reach xDP-3: Front Street**

Inflow Area = 0.143 ac, 0.00% Impervious, Inflow Depth > 2.01" for Middlesex-025yr event  
Inflow = 0.33 cfs @ 12.09 hrs, Volume= 0.024 af  
Outflow = 0.33 cfs @ 12.09 hrs, Volume= 0.024 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

|                                     |   |
|-------------------------------------|---|
| <b>Subcatchment EDA-1A: EDA-1A</b>  | Runoff Area=0.633 ac 2.05% Impervious Runoff Depth>2.36"<br>Tc=6.0 min CN=66 Runoff=1.72 cfs 0.125 af |
| <b>Subcatchment EDA-1B: EDA-1B</b>  | Runoff Area=0.048 ac 0.00% Impervious Runoff Depth>1.94"<br>Tc=6.0 min CN=61 Runoff=0.10 cfs 0.008 af |
| <b>Subcatchment EDA-2: EDA-2</b>    | Runoff Area=0.385 ac 1.82% Impervious Runoff Depth>2.28"<br>Tc=6.0 min CN=65 Runoff=1.00 cfs 0.073 af |
| <b>Subcatchment EDA-3: EDA-3</b>    | Runoff Area=0.143 ac 0.00% Impervious Runoff Depth>2.45"<br>Tc=6.0 min CN=67 Runoff=0.41 cfs 0.029 af |
| <b>Reach xDP-1: Central Street</b>  | Inflow=1.83 cfs 0.132 af<br>Outflow=1.83 cfs 0.132 af   |
| <b>Reach xDP-2: Railroad Street</b> | Inflow=1.00 cfs 0.073 af<br>Outflow=1.00 cfs 0.073 af   |
| <b>Reach xDP-3: Front Street</b>    | Inflow=0.41 cfs 0.029 af<br>Outflow=0.41 cfs 0.029 af   |

**Total Runoff Area = 1.209 ac Runoff Volume = 0.235 af Average Runoff Depth = 2.33"**  
**98.35% Pervious = 1.189 ac 1.65% Impervious = 0.020 ac**

**Summary for Subcatchment EDA-1A: EDA-1A**

Runoff = 1.72 cfs @ 12.09 hrs, Volume= 0.125 af, Depth> 2.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-050yr Rainfall=5.90"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.111     | 55 | Woods, Good, HSG B            |
| 0.417     | 61 | >75% Grass cover, Good, HSG B |
| * 0.016   | 96 | Compacted Earth, HSG B        |
| * 0.076   | 96 | Stone Dust Path, HSG B        |
| * 0.010   | 98 | Impervious Surface, HSG B     |
| 0.003     | 98 | Roofs, HSG B                  |
| 0.633     | 66 | Weighted Average              |
| 0.620     |    | 97.95% Pervious Area          |
| 0.013     |    | 2.05% Impervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

**Summary for Subcatchment EDA-1B: EDA-1B**

Runoff = 0.10 cfs @ 12.10 hrs, Volume= 0.008 af, Depth> 1.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-050yr Rainfall=5.90"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.048     | 61 | >75% Grass cover, Good, HSG B |
| 0.048     |    | 100.00% Pervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

**Summary for Subcatchment EDA-2: EDA-2**

Runoff = 1.00 cfs @ 12.09 hrs, Volume= 0.073 af, Depth> 2.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-050yr Rainfall=5.90"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.131     | 55 | Woods, Good, HSG B            |
| 0.188     | 61 | >75% Grass cover, Good, HSG B |
| * 0.004   | 96 | Compacted Earth, HSG B        |
| * 0.055   | 96 | Stone Dust Path, HSG B        |
| * 0.007   | 98 | Impervious Surface, HSG B     |
| 0.385     | 65 | Weighted Average              |
| 0.378     |    | 98.18% Pervious Area          |
| 0.007     |    | 1.82% Impervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

### Summary for Subcatchment EDA-3: EDA-3

Runoff = 0.41 cfs @ 12.09 hrs, Volume= 0.029 af, Depth> 2.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-050yr Rainfall=5.90"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.039     | 55 | Woods, Good, HSG B            |
| 0.071     | 61 | >75% Grass cover, Good, HSG B |
| * 0.033   | 96 | Compacted Earth, HSG B        |
| 0.143     | 67 | Weighted Average              |
| 0.143     |    | 100.00% Pervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

### Summary for Reach xDP-1: Central Street

Inflow Area = 0.681 ac, 1.91% Impervious, Inflow Depth > 2.33" for Middlesex-050yr event  
Inflow = 1.83 cfs @ 12.09 hrs, Volume= 0.132 af  
Outflow = 1.83 cfs @ 12.09 hrs, Volume= 0.132 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Summary for Reach xDP-2: Railroad Street

Inflow Area = 0.385 ac, 1.82% Impervious, Inflow Depth > 2.28" for Middlesex-050yr event  
Inflow = 1.00 cfs @ 12.09 hrs, Volume= 0.073 af  
Outflow = 1.00 cfs @ 12.09 hrs, Volume= 0.073 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs



**Summary for Reach xDP-3: Front Street**

Inflow Area = 0.143 ac, 0.00% Impervious, Inflow Depth > 2.45" for Middlesex-050yr event  
Inflow = 0.41 cfs @ 12.09 hrs, Volume= 0.029 af  
Outflow = 0.41 cfs @ 12.09 hrs, Volume= 0.029 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

|                                     |   |
|-------------------------------------|---|
| <b>Subcatchment EDA-1A: EDA-1A</b>  | Runoff Area=0.633 ac 2.05% Impervious Runoff Depth>3.20"<br>Tc=6.0 min CN=66 Runoff=2.36 cfs 0.169 af |
| <b>Subcatchment EDA-1B: EDA-1B</b>  | Runoff Area=0.048 ac 0.00% Impervious Runoff Depth>2.70"<br>Tc=6.0 min CN=61 Runoff=0.15 cfs 0.011 af |
| <b>Subcatchment EDA-2: EDA-2</b>    | Runoff Area=0.385 ac 1.82% Impervious Runoff Depth>3.10"<br>Tc=6.0 min CN=65 Runoff=1.39 cfs 0.099 af |
| <b>Subcatchment EDA-3: EDA-3</b>    | Runoff Area=0.143 ac 0.00% Impervious Runoff Depth>3.30"<br>Tc=6.0 min CN=67 Runoff=0.55 cfs 0.039 af |
| <b>Reach xDP-1: Central Street</b>  | Inflow=2.51 cfs 0.180 af<br>Outflow=2.51 cfs 0.180 af   |
| <b>Reach xDP-2: Railroad Street</b> | Inflow=1.39 cfs 0.099 af<br>Outflow=1.39 cfs 0.099 af   |
| <b>Reach xDP-3: Front Street</b>    | Inflow=0.55 cfs 0.039 af<br>Outflow=0.55 cfs 0.039 af   |

**Total Runoff Area = 1.209 ac Runoff Volume = 0.318 af Average Runoff Depth = 3.16"**  
**98.35% Pervious = 1.189 ac 1.65% Impervious = 0.020 ac**

**Summary for Subcatchment EDA-1A: EDA-1A**

Runoff = 2.36 cfs @ 12.09 hrs, Volume= 0.169 af, Depth> 3.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-100yr Rainfall=7.00"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.111     | 55 | Woods, Good, HSG B            |
| 0.417     | 61 | >75% Grass cover, Good, HSG B |
| * 0.016   | 96 | Compacted Earth, HSG B        |
| * 0.076   | 96 | Stone Dust Path, HSG B        |
| * 0.010   | 98 | Impervious Surface, HSG B     |
| 0.003     | 98 | Roofs, HSG B                  |
| 0.633     | 66 | Weighted Average              |
| 0.620     |    | 97.95% Pervious Area          |
| 0.013     |    | 2.05% Impervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

**Summary for Subcatchment EDA-1B: EDA-1B**

Runoff = 0.15 cfs @ 12.09 hrs, Volume= 0.011 af, Depth> 2.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-100yr Rainfall=7.00"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.048     | 61 | >75% Grass cover, Good, HSG B |
| 0.048     |    | 100.00% Pervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

**Summary for Subcatchment EDA-2: EDA-2**

Runoff = 1.39 cfs @ 12.09 hrs, Volume= 0.099 af, Depth> 3.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-100yr Rainfall=7.00"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.131     | 55 | Woods, Good, HSG B            |
| 0.188     | 61 | >75% Grass cover, Good, HSG B |
| * 0.004   | 96 | Compacted Earth, HSG B        |
| * 0.055   | 96 | Stone Dust Path, HSG B        |
| * 0.007   | 98 | Impervious Surface, HSG B     |
| 0.385     | 65 | Weighted Average              |
| 0.378     |    | 98.18% Pervious Area          |
| 0.007     |    | 1.82% Impervious Area         |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description           |
|----------|---------------|---------------|-------------------|----------------|-----------------------|
| 6.0      |               |               |                   |                | Direct Entry, Tc Min. |

### Summary for Subcatchment EDA-3: EDA-3

Runoff = 0.55 cfs @ 12.09 hrs, Volume= 0.039 af, Depth> 3.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-100yr Rainfall=7.00"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.039     | 55 | Woods, Good, HSG B            |
| 0.071     | 61 | >75% Grass cover, Good, HSG B |
| * 0.033   | 96 | Compacted Earth, HSG B        |
| 0.143     | 67 | Weighted Average              |
| 0.143     |    | 100.00% Pervious Area         |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description           |
|----------|---------------|---------------|-------------------|----------------|-----------------------|
| 6.0      |               |               |                   |                | Direct Entry, Tc Min. |

### Summary for Reach xDP-1: Central Street

Inflow Area = 0.681 ac, 1.91% Impervious, Inflow Depth > 3.16" for Middlesex-100yr event  
Inflow = 2.51 cfs @ 12.09 hrs, Volume= 0.180 af  
Outflow = 2.51 cfs @ 12.09 hrs, Volume= 0.180 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Summary for Reach xDP-2: Railroad Street

Inflow Area = 0.385 ac, 1.82% Impervious, Inflow Depth > 3.10" for Middlesex-100yr event  
Inflow = 1.39 cfs @ 12.09 hrs, Volume= 0.099 af  
Outflow = 1.39 cfs @ 12.09 hrs, Volume= 0.099 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Summary for Reach xDP-3: Front Street**

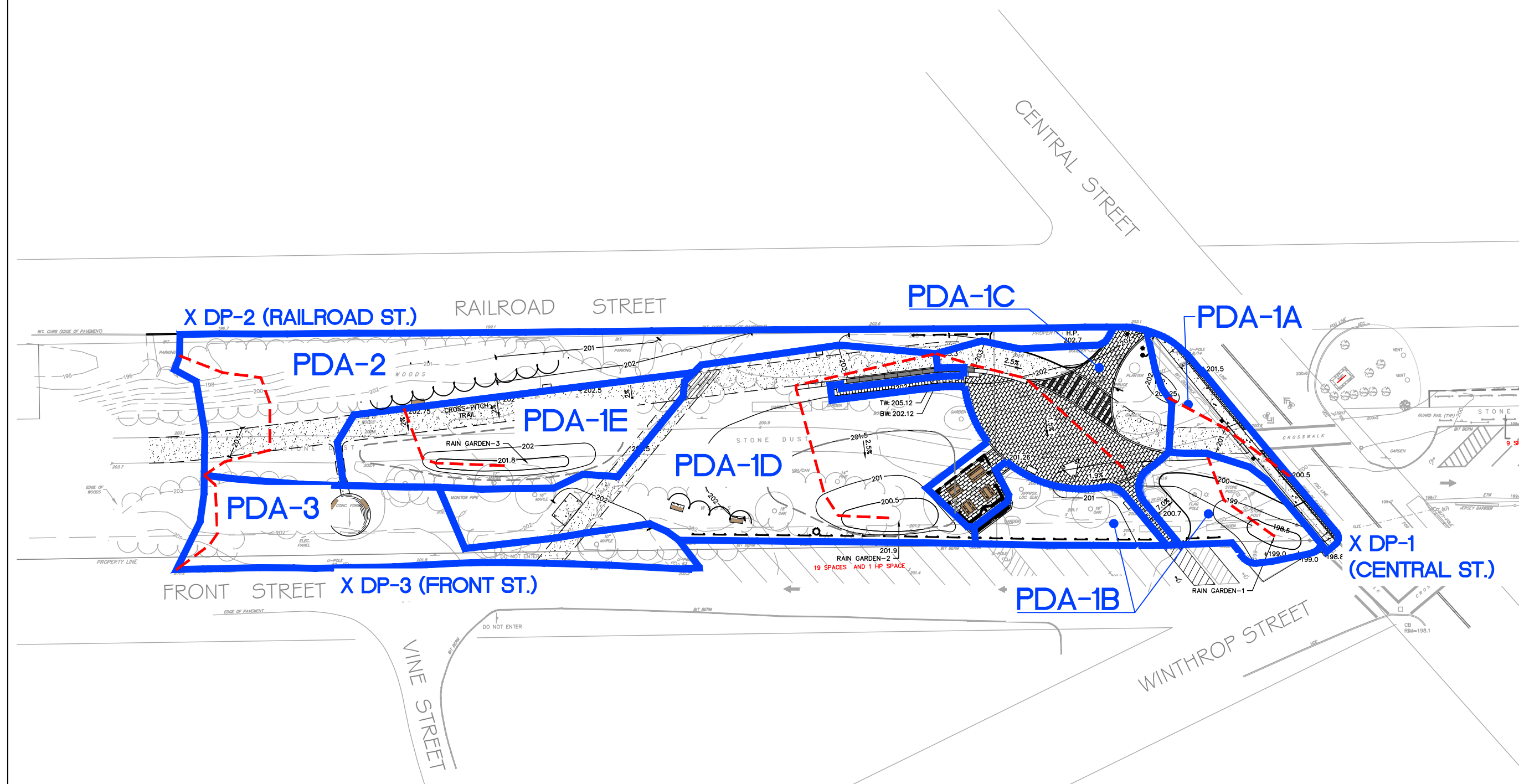
Inflow Area = 0.143 ac, 0.00% Impervious, Inflow Depth > 3.30" for Middlesex-100yr event  
Inflow = 0.55 cfs @ 12.09 hrs, Volume= 0.039 af  
Outflow = 0.55 cfs @ 12.09 hrs, Volume= 0.039 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

## Appendix B

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### Post-Development Conditions Hydrologic Analysis

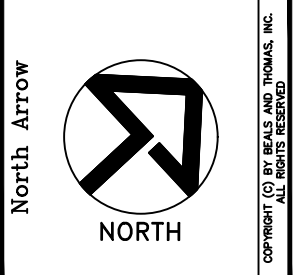


Post-Development Conditions  
Hydrologic Areas Map  
Figure Number 002

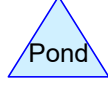
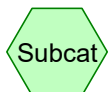
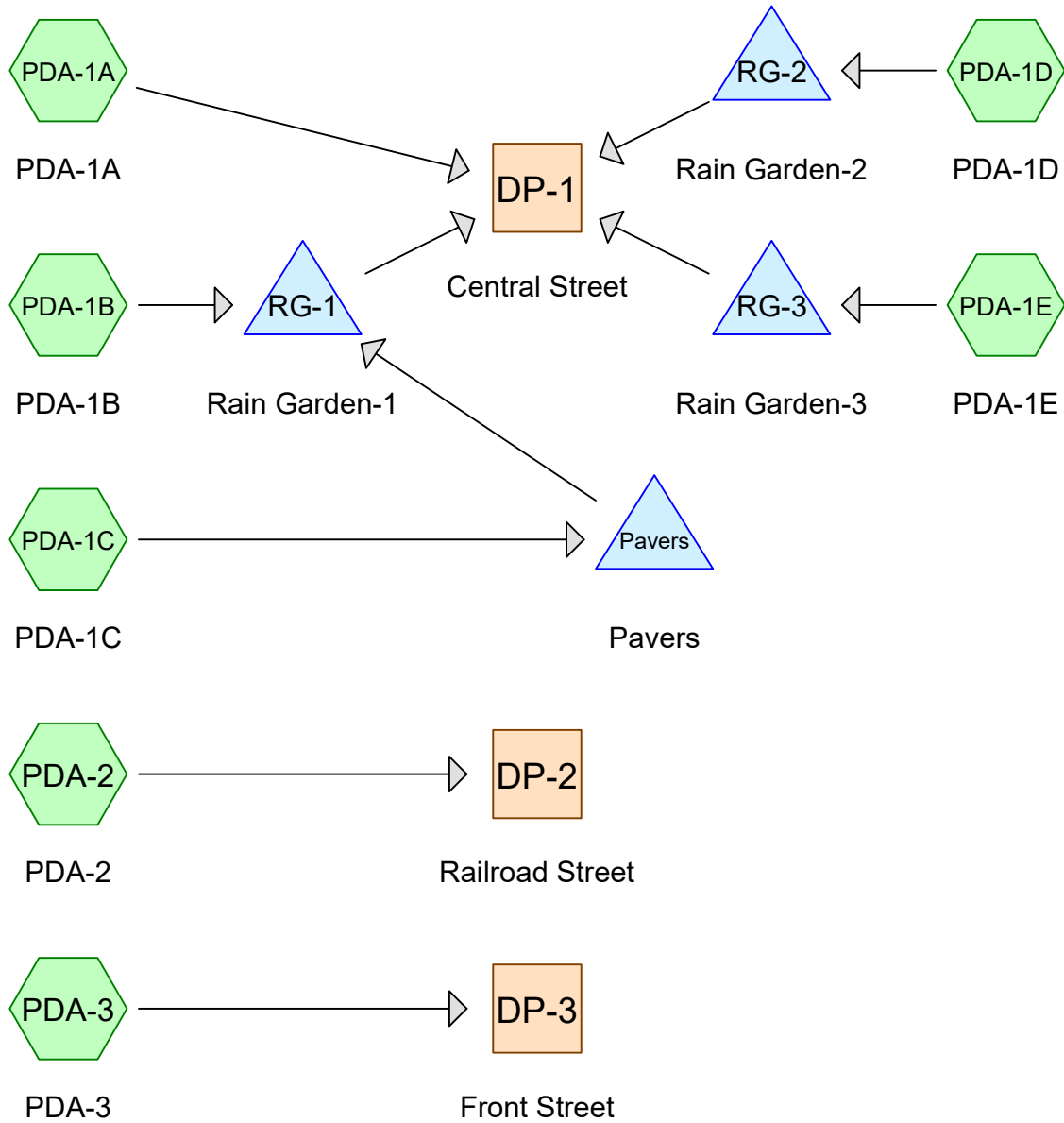
Scale: 1" = 50'  
Date: 09/03/2021  
Plan No. 143903P005A-002  
B+T Project No. 1439.03

Blair Square Site Improvements  
Holliston, Massachusetts

Holliston Panning Board  
703 Washington Street  
Holliston, Massachusetts



Post-Development  
Conditions



**Routing Diagram for 143903HC001**

Prepared by Beals and Thomas, Inc., Printed 9/3/2021  
HydroCAD® 10.10-5a s/n 04493 © 2020 HydroCAD Software Solutions LLC



**Area Listing (selected nodes)**

| Area<br>(acres) | CN        | Description<br>(subcatchment-numbers)  |
|-----------------|-----------|--|
| 0.736           | 61        | >75% Grass cover, Good, HSG B (PDA-1A, PDA-1B, PDA-1C, PDA-1D, PDA-1E, PDA-2, PDA-3) |
| 0.029           | 98        | Impervious Surface, HSG B (PDA-1A, PDA-1D, PDA-3)                                    |
| 0.119           | 98        | Pavers, HSG B (PDA-1C)   |
| 0.156           | 96        | Stone Dust Path, HSG B (PDA-1A, PDA-1C, PDA-1D, PDA-1E, PDA-2, PDA-3)                |
| 0.169           | 55        | Woods, Good, HSG B (PDA-1D, PDA-1E, PDA-2, PDA-3)                                    |
| <b>1.209</b>    | <b>69</b> | <b>TOTAL AREA</b>  |

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

|                                    |  |
|------------------------------------|--|
| <b>Subcatchment PDA-1A: PDA-1A</b> | Runoff Area=0.048 ac 27.08% Impervious Runoff Depth>1.20"<br>Tc=6.0 min CN=78 Runoff=0.07 cfs 0.005 af                                       |
| <b>Subcatchment PDA-1B: PDA-1B</b> | Runoff Area=0.112 ac 0.00% Impervious Runoff Depth>0.40"<br>Tc=6.0 min CN=61 Runoff=0.03 cfs 0.004 af  |
| <b>Subcatchment PDA-1C: PDA-1C</b> | Runoff Area=0.164 ac 72.56% Impervious Runoff Depth>2.35"<br>Tc=6.0 min CN=93 Runoff=0.44 cfs 0.032 af                                       |
| <b>Subcatchment PDA-1D: PDA-1D</b> | Runoff Area=0.334 ac 2.69% Impervious Runoff Depth>0.59"<br>Tc=6.0 min CN=66 Runoff=0.18 cfs 0.016 af  |
| <b>Subcatchment PDA-1E: PDA-1E</b> | Runoff Area=0.141 ac 0.00% Impervious Runoff Depth>0.92"<br>Tc=6.0 min CN=73 Runoff=0.14 cfs 0.011 af  |
| <b>Subcatchment PDA-2: PDA-2</b>   | Runoff Area=0.267 ac 0.00% Impervious Runoff Depth>0.44"<br>Tc=6.0 min CN=62 Runoff=0.09 cfs 0.010 af  |
| <b>Subcatchment PDA-3: PDA-3</b>   | Runoff Area=0.143 ac 4.90% Impervious Runoff Depth>0.44"<br>Tc=6.0 min CN=62 Runoff=0.05 cfs 0.005 af  |
| <b>Reach DP-1: Central Street</b>  | Inflow=0.07 cfs 0.005 af<br>Outflow=0.07 cfs 0.005 af  |
| <b>Reach DP-2: Railroad Street</b> | Inflow=0.09 cfs 0.010 af<br>Outflow=0.09 cfs 0.010 af  |
| <b>Reach DP-3: Front Street</b>    | Inflow=0.05 cfs 0.005 af<br>Outflow=0.05 cfs 0.005 af  |
| <b>Pond Pavers: Pavers</b>         | Peak Elev=199.49' Storage=194 cf Inflow=0.44 cfs 0.032 af<br>Discarded=0.12 cfs 0.027 af Primary=0.06 cfs 0.005 af Outflow=0.18 cfs 0.032 af |
| <b>Pond RG-1: Rain Garden-1</b>    | Peak Elev=198.65' Storage=140 cf Inflow=0.08 cfs 0.009 af<br>Discarded=0.02 cfs 0.009 af Primary=0.00 cfs 0.000 af Outflow=0.02 cfs 0.009 af |
| <b>Pond RG-2: Rain Garden-2</b>    | Peak Elev=198.91' Storage=179 cf Inflow=0.18 cfs 0.016 af<br>Outflow=0.03 cfs 0.016 af   |
| <b>Pond RG-3: Rain Garden-3</b>    | Peak Elev=201.82' Storage=151 cf Inflow=0.14 cfs 0.011 af<br>Outflow=0.02 cfs 0.011 af   |

**Total Runoff Area = 1.209 ac Runoff Volume = 0.083 af Average Runoff Depth = 0.82"**  
**87.76% Pervious = 1.061 ac 12.24% Impervious = 0.148 ac**

**Summary for Subcatchment PDA-1A: PDA-1A**

Runoff = 0.07 cfs @ 12.09 hrs, Volume= 0.005 af, Depth> 1.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-002yr Rainfall=3.10"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.026     | 61 | >75% Grass cover, Good, HSG B |
| * 0.013   | 98 | Impervious Surface, HSG B     |
| * 0.009   | 96 | Stone Dust Path, HSG B        |
| 0.048     | 78 | Weighted Average              |
| 0.035     |    | 72.92% Pervious Area          |
| 0.013     |    | 27.08% Impervious Area        |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description           |
|----------|---------------|---------------|-------------------|----------------|-----------------------|
| 6.0      |               |               |                   |                | Direct Entry, Tc Min. |

**Summary for Subcatchment PDA-1B: PDA-1B**

Runoff = 0.03 cfs @ 12.13 hrs, Volume= 0.004 af, Depth> 0.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-002yr Rainfall=3.10"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.112     | 61 | >75% Grass cover, Good, HSG B |
| 0.112     |    | 100.00% Pervious Area         |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description           |
|----------|---------------|---------------|-------------------|----------------|-----------------------|
| 6.0      |               |               |                   |                | Direct Entry, Tc Min. |

**Summary for Subcatchment PDA-1C: PDA-1C**

Runoff = 0.44 cfs @ 12.09 hrs, Volume= 0.032 af, Depth> 2.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-002yr Rainfall=3.10"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.021     | 61 | >75% Grass cover, Good, HSG B |
| * 0.024   | 96 | Stone Dust Path, HSG B        |
| * 0.119   | 98 | Pavers, HSG B                 |
| 0.164     | 93 | Weighted Average              |
| 0.045     |    | 27.44% Pervious Area          |
| 0.119     |    | 72.56% Impervious Area        |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

**Summary for Subcatchment PDA-1D: PDA-1D**

Runoff = 0.18 cfs @ 12.11 hrs, Volume= 0.016 af, Depth> 0.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-002yr Rainfall=3.10"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.046     | 55 | Woods, Good, HSG B            |
| 0.233     | 61 | >75% Grass cover, Good, HSG B |
| * 0.046   | 96 | Stone Dust Path, HSG B        |
| * 0.009   | 98 | Impervious Surface, HSG B     |
| 0.334     | 66 | Weighted Average              |
| 0.325     |    | 97.31% Pervious Area          |
| 0.009     |    | 2.69% Impervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

**Summary for Subcatchment PDA-1E: PDA-1E**

Runoff = 0.14 cfs @ 12.10 hrs, Volume= 0.011 af, Depth> 0.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-002yr Rainfall=3.10"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.003     | 55 | Woods, Good, HSG B            |
| 0.088     | 61 | >75% Grass cover, Good, HSG B |
| * 0.050   | 96 | Stone Dust Path, HSG B        |
| 0.141     | 73 | Weighted Average              |
| 0.141     |    | 100.00% Pervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

**Summary for Subcatchment PDA-2: PDA-2**

Runoff = 0.09 cfs @ 12.12 hrs, Volume= 0.010 af, Depth> 0.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-002yr Rainfall=3.10"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.081     | 55 | Woods, Good, HSG B            |
| 0.164     | 61 | >75% Grass cover, Good, HSG B |
| * 0.022   | 96 | Stone Dust Path, HSG B        |
| 0.267     | 62 | Weighted Average              |
| 0.267     |    | 100.00% Pervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

### Summary for Subcatchment PDA-3: PDA-3

Runoff = 0.05 cfs @ 12.12 hrs, Volume= 0.005 af, Depth> 0.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-002yr Rainfall=3.10"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.039     | 55 | Woods, Good, HSG B            |
| 0.092     | 61 | >75% Grass cover, Good, HSG B |
| * 0.005   | 96 | Stone Dust Path, HSG B        |
| * 0.007   | 98 | Impervious Surface, HSG B     |
| 0.143     | 62 | Weighted Average              |
| 0.136     |    | 95.10% Pervious Area          |
| 0.007     |    | 4.90% Impervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

### Summary for Reach DP-1: Central Street

Inflow Area = 0.799 ac, 17.65% Impervious, Inflow Depth > 0.07" for Middlesex-002yr event  
Inflow = 0.07 cfs @ 12.09 hrs, Volume= 0.005 af  
Outflow = 0.07 cfs @ 12.09 hrs, Volume= 0.005 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Summary for Reach DP-2: Railroad Street

Inflow Area = 0.267 ac, 0.00% Impervious, Inflow Depth > 0.44" for Middlesex-002yr event  
Inflow = 0.09 cfs @ 12.12 hrs, Volume= 0.010 af  
Outflow = 0.09 cfs @ 12.12 hrs, Volume= 0.010 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Summary for Reach DP-3: Front Street**

Inflow Area = 0.143 ac, 4.90% Impervious, Inflow Depth > 0.44" for Middlesex-002yr event  
 Inflow = 0.05 cfs @ 12.12 hrs, Volume= 0.005 af  
 Outflow = 0.05 cfs @ 12.12 hrs, Volume= 0.005 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Summary for Pond Pavers: Pavers**

Inflow Area = 0.164 ac, 72.56% Impervious, Inflow Depth > 2.35" for Middlesex-002yr event  
 Inflow = 0.44 cfs @ 12.09 hrs, Volume= 0.032 af  
 Outflow = 0.18 cfs @ 12.29 hrs, Volume= 0.032 af, Atten= 58%, Lag= 12.5 min  
 Discarded = 0.12 cfs @ 11.86 hrs, Volume= 0.027 af  
 Primary = 0.06 cfs @ 12.29 hrs, Volume= 0.005 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 199.49' @ 12.29 hrs Surf.Area= 5,190 sf Storage= 194 cf

Plug-Flow detention time= 6.2 min calculated for 0.032 af (100% of inflow)  
 Center-of-Mass det. time= 6.0 min ( 799.2 - 793.1 )

| Volume              | Invert               | Avail.Storage | Storage Description  |                           |
|---------------------|----------------------|---------------|--|---------------------------|
| #1                  | 199.37'              | 1,448 cf      | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |                           |
| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Voids<br>(%)  | Inc.Store<br>(cubic-feet)                                  | Cum.Store<br>(cubic-feet) |
| 199.37              | 5,190                | 0.0           | 0  | 0                         |
| 199.38              | 5,190                | 30.0          | 16   | 16                        |
| 200.30              | 5,190                | 30.0          | 1,432  | 1,448                     |

| Device | Routing   | Invert  | Outlet Devices  |
|--------|-----------|---------|---|
| #1     | Discarded | 199.37' | <b>1.020 in/hr Exfiltration over Surface area</b>   |
| #2     | Primary   | 199.30' | <b>4.0" Round Culvert</b> L= 17.0' Ke= 1.000<br>Inlet / Outlet Invert= 199.30' / 198.90' S= 0.0235 '/' Cc= 0.900<br>n= 0.020 Corrugated PE, corrugated interior, Flow Area= 0.09 sf |

**Discarded OutFlow** Max=0.12 cfs @ 11.86 hrs HW=199.38' (Free Discharge)  
 ↑ **1=Exfiltration** (Exfiltration Controls 0.12 cfs)

**Primary OutFlow** Max=0.06 cfs @ 12.29 hrs HW=199.49' (Free Discharge)  
 ↑ **2=Culvert** (Inlet Controls 0.06 cfs @ 1.13 fps)

**Summary for Pond RG-1: Rain Garden-1**

Inflow Area = 0.276 ac, 43.12% Impervious, Inflow Depth > 0.37" for Middlesex-002yr event  
 Inflow = 0.08 cfs @ 12.26 hrs, Volume= 0.009 af  
 Outflow = 0.02 cfs @ 12.91 hrs, Volume= 0.009 af, Atten= 75%, Lag= 39.1 min  
 Discarded = 0.02 cfs @ 12.91 hrs, Volume= 0.009 af  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 198.65' @ 12.91 hrs Surf.Area= 372 sf Storage= 140 cf

Plug-Flow detention time= 76.9 min calculated for 0.009 af (100% of inflow)  
 Center-of-Mass det. time= 76.7 min ( 915.1 - 838.4 )

| Volume              | Invert               | Avail.Storage | Storage Description  |                           |
|---------------------|----------------------|---------------|--|---------------------------|
| #1                  | 195.74'              | 339 cf        | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |                           |
| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Voids<br>(%)  | Inc.Store<br>(cubic-feet)                                  | Cum.Store<br>(cubic-feet) |
| 195.74              | 202                  | 0.0           | 0  | 0                         |
| 195.75              | 202                  | 30.0          | 1  | 1                         |
| 196.75              | 202                  | 30.0          | 61   | 61                        |
| 196.76              | 202                  | 10.0          | 0  | 61                        |
| 198.50              | 202                  | 10.0          | 35   | 97                        |
| 198.51              | 202                  | 100.0         | 2  | 99                        |
| 199.00              | 780                  | 100.0         | 241  | 339                       |

| Device | Routing   | Invert  | Outlet Devices   |      |      |      |      |      |      |      |      |      |      |  |
|--------|-----------|---------|--|------|------|------|------|------|------|------|------|------|------|--|
| #1     | Discarded | 195.74' | <b>2.410 in/hr Exfiltration over Surface area</b>              |      |      |      |      |      |      |      |      |      |      |  |
| #2     | Primary   | 198.80' | <b>3.0' long x 4.0' breadth Broad-Crested Rectangular Weir</b> |      |      |      |      |      |      |      |      |      |      |  |
|        |           |         | Head (feet)  | 0.20 | 0.40 | 0.60 | 0.80 | 1.00 | 1.20 | 1.40 | 1.60 | 1.80 | 2.00 |  |
|        |           |         |  | 2.50 | 3.00 | 3.50 | 4.00 | 4.50 | 5.00 | 5.50 |      |      |      |  |
|        |           |         | Coef. (English)  | 2.38 | 2.54 | 2.69 | 2.68 | 2.67 | 2.67 | 2.65 | 2.66 | 2.66 |      |  |
|        |           |         |  | 2.68 | 2.72 | 2.73 | 2.76 | 2.79 | 2.88 | 3.07 | 3.32 |      |      |  |

**Discarded OutFlow** Max=0.02 cfs @ 12.91 hrs HW=198.65' (Free Discharge)

↑ **1=Exfiltration** (Exfiltration Controls 0.02 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=195.74' (Free Discharge)

↑ **2=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)

### Summary for Pond RG-2: Rain Garden-2

Inflow Area = 0.334 ac, 2.69% Impervious, Inflow Depth > 0.59" for Middlesex-002yr event  
 Inflow = 0.18 cfs @ 12.11 hrs, Volume= 0.016 af  
 Outflow = 0.03 cfs @ 11.96 hrs, Volume= 0.016 af, Atten= 83%, Lag= 0.0 min  
 Discarded = 0.03 cfs @ 11.96 hrs, Volume= 0.016 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 198.91' @ 12.97 hrs Surf.Area= 561 sf Storage= 179 cf

Plug-Flow detention time= 45.5 min calculated for 0.016 af (100% of inflow)  
 Center-of-Mass det. time= 45.3 min ( 938.4 - 893.1 )

| Volume | Invert  | Avail.Storage | Storage Description  |  |
|--------|---------|---------------|--|--|
| #1     | 197.74' | 1,891 cf      | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |  |

| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Voids<br>(%) | Inc.Store<br>(cubic-feet) | Cum.Store<br>(cubic-feet) |
|---------------------|----------------------|--------------|---------------------------|---------------------------|
| 197.74              | 561                  | 0.0          | 0                         | 0                         |
| 197.75              | 561                  | 30.0         | 2                         | 2                         |
| 198.75              | 561                  | 30.0         | 168                       | 170                       |
| 198.76              | 561                  | 10.0         | 1                         | 171                       |
| 200.50              | 561                  | 10.0         | 98                        | 268                       |
| 200.51              | 561                  | 100.0        | 6                         | 274                       |
| 201.00              | 1,248                | 100.0        | 443                       | 717                       |
| 201.50              | 3,450                | 100.0        | 1,175                     | 1,891                     |

| Device | Routing   | Invert  | Outlet Devices                                    |
|--------|-----------|---------|---|
| #1     | Discarded | 197.74' | <b>2.410 in/hr Exfiltration over Surface area</b> |

**Discarded OutFlow** Max=0.03 cfs @ 11.96 hrs HW=197.75' (Free Discharge)

↑**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

### Summary for Pond RG-3: Rain Garden-3

Inflow Area = 0.141 ac, 0.00% Impervious, Inflow Depth > 0.92" for Middlesex-002yr event  
 Inflow = 0.14 cfs @ 12.10 hrs, Volume= 0.011 af  
 Outflow = 0.02 cfs @ 12.95 hrs, Volume= 0.011 af, Atten= 87%, Lag= 51.4 min  
 Discarded = 0.02 cfs @ 12.95 hrs, Volume= 0.011 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 201.82' @ 12.95 hrs Surf.Area= 341 sf Storage= 151 cf

Plug-Flow detention time= 77.2 min calculated for 0.011 af (100% of inflow)  
 Center-of-Mass det. time= 77.0 min ( 943.6 - 866.6 )

| Volume | Invert  | Avail.Storage | Storage Description  |
|--------|---------|---------------|--|
| #1     | 199.04' | 944 cf        | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |

| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Voids<br>(%) | Inc.Store<br>(cubic-feet) | Cum.Store<br>(cubic-feet) |
|---------------------|----------------------|--------------|---------------------------|---------------------------|
| 199.04              | 301                  | 0.0          | 0                         | 0                         |
| 199.05              | 301                  | 30.0         | 1                         | 1                         |
| 200.05              | 301                  | 30.0         | 90                        | 91                        |
| 200.06              | 301                  | 10.0         | 0                         | 92                        |
| 201.80              | 301                  | 10.0         | 52                        | 144                       |
| 201.81              | 301                  | 100.0        | 3                         | 147                       |
| 202.00              | 945                  | 100.0        | 118                       | 265                       |
| 202.40              | 2,450                | 100.0        | 679                       | 944                       |

| Device | Routing   | Invert  | Outlet Devices                                    |
|--------|-----------|---------|---|
| #1     | Discarded | 199.04' | <b>2.410 in/hr Exfiltration over Surface area</b> |

**Discarded OutFlow** Max=0.02 cfs @ 12.95 hrs HW=201.82' (Free Discharge)

↑**1=Exfiltration** (Exfiltration Controls 0.02 cfs)



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

|                                    |  |
|------------------------------------|--|
| <b>Subcatchment PDA-1A: PDA-1A</b> | Runoff Area=0.048 ac 27.08% Impervious Runoff Depth>2.29"<br>Tc=6.0 min CN=78 Runoff=0.13 cfs 0.009 af                                       |
| <b>Subcatchment PDA-1B: PDA-1B</b> | Runoff Area=0.112 ac 0.00% Impervious Runoff Depth>1.08"<br>Tc=6.0 min CN=61 Runoff=0.12 cfs 0.010 af  |
| <b>Subcatchment PDA-1C: PDA-1C</b> | Runoff Area=0.164 ac 72.56% Impervious Runoff Depth>3.70"<br>Tc=6.0 min CN=93 Runoff=0.67 cfs 0.051 af                                       |
| <b>Subcatchment PDA-1D: PDA-1D</b> | Runoff Area=0.334 ac 2.69% Impervious Runoff Depth>1.39"<br>Tc=6.0 min CN=66 Runoff=0.51 cfs 0.039 af  |
| <b>Subcatchment PDA-1E: PDA-1E</b> | Runoff Area=0.141 ac 0.00% Impervious Runoff Depth>1.89"<br>Tc=6.0 min CN=73 Runoff=0.31 cfs 0.022 af  |
| <b>Subcatchment PDA-2: PDA-2</b>   | Runoff Area=0.267 ac 0.00% Impervious Runoff Depth>1.14"<br>Tc=6.0 min CN=62 Runoff=0.32 cfs 0.025 af  |
| <b>Subcatchment PDA-3: PDA-3</b>   | Runoff Area=0.143 ac 4.90% Impervious Runoff Depth>1.14"<br>Tc=6.0 min CN=62 Runoff=0.17 cfs 0.014 af  |
| <b>Reach DP-1: Central Street</b>  | Inflow=0.16 cfs 0.015 af<br>Outflow=0.16 cfs 0.015 af  |
| <b>Reach DP-2: Railroad Street</b> | Inflow=0.32 cfs 0.025 af<br>Outflow=0.32 cfs 0.025 af  |
| <b>Reach DP-3: Front Street</b>    | Inflow=0.17 cfs 0.014 af<br>Outflow=0.17 cfs 0.014 af  |
| <b>Pond Pavers: Pavers</b>         | Peak Elev=199.62' Storage=395 cf Inflow=0.67 cfs 0.051 af<br>Discarded=0.12 cfs 0.040 af Primary=0.13 cfs 0.011 af Outflow=0.25 cfs 0.051 af |
| <b>Pond RG-1: Rain Garden-1</b>    | Peak Elev=198.87' Storage=247 cf Inflow=0.22 cfs 0.021 af<br>Discarded=0.03 cfs 0.015 af Primary=0.13 cfs 0.006 af Outflow=0.16 cfs 0.021 af |
| <b>Pond RG-2: Rain Garden-2</b>    | Peak Elev=200.91' Storage=611 cf Inflow=0.51 cfs 0.039 af<br>Outflow=0.06 cfs 0.039 af   |
| <b>Pond RG-3: Rain Garden-3</b>    | Peak Elev=202.05' Storage=319 cf Inflow=0.31 cfs 0.022 af<br>Outflow=0.06 cfs 0.022 af   |

**Total Runoff Area = 1.209 ac Runoff Volume = 0.170 af Average Runoff Depth = 1.69"**  
**87.76% Pervious = 1.061 ac 12.24% Impervious = 0.148 ac**

**Summary for Subcatchment PDA-1A: PDA-1A**

Runoff = 0.13 cfs @ 12.09 hrs, Volume= 0.009 af, Depth> 2.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-010yr Rainfall=4.50"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.026     | 61 | >75% Grass cover, Good, HSG B |
| * 0.013   | 98 | Impervious Surface, HSG B     |
| * 0.009   | 96 | Stone Dust Path, HSG B        |
| 0.048     | 78 | Weighted Average              |
| 0.035     |    | 72.92% Pervious Area          |
| 0.013     |    | 27.08% Impervious Area        |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description           |
|----------|---------------|---------------|-------------------|----------------|-----------------------|
| 6.0      |               |               |                   |                | Direct Entry, Tc Min. |

**Summary for Subcatchment PDA-1B: PDA-1B**

Runoff = 0.12 cfs @ 12.10 hrs, Volume= 0.010 af, Depth> 1.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-010yr Rainfall=4.50"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.112     | 61 | >75% Grass cover, Good, HSG B |
| 0.112     |    | 100.00% Pervious Area         |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description           |
|----------|---------------|---------------|-------------------|----------------|-----------------------|
| 6.0      |               |               |                   |                | Direct Entry, Tc Min. |

**Summary for Subcatchment PDA-1C: PDA-1C**

Runoff = 0.67 cfs @ 12.08 hrs, Volume= 0.051 af, Depth> 3.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-010yr Rainfall=4.50"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.021     | 61 | >75% Grass cover, Good, HSG B |
| * 0.024   | 96 | Stone Dust Path, HSG B        |
| * 0.119   | 98 | Pavers, HSG B                 |
| 0.164     | 93 | Weighted Average              |
| 0.045     |    | 27.44% Pervious Area          |
| 0.119     |    | 72.56% Impervious Area        |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

### Summary for Subcatchment PDA-1D: PDA-1D

Runoff = 0.51 cfs @ 12.10 hrs, Volume= 0.039 af, Depth> 1.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-010yr Rainfall=4.50"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.046     | 55 | Woods, Good, HSG B            |
| 0.233     | 61 | >75% Grass cover, Good, HSG B |
| * 0.046   | 96 | Stone Dust Path, HSG B        |
| * 0.009   | 98 | Impervious Surface, HSG B     |
| 0.334     | 66 | Weighted Average              |
| 0.325     |    | 97.31% Pervious Area          |
| 0.009     |    | 2.69% Impervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

### Summary for Subcatchment PDA-1E: PDA-1E

Runoff = 0.31 cfs @ 12.09 hrs, Volume= 0.022 af, Depth> 1.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-010yr Rainfall=4.50"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.003     | 55 | Woods, Good, HSG B            |
| 0.088     | 61 | >75% Grass cover, Good, HSG B |
| * 0.050   | 96 | Stone Dust Path, HSG B        |
| 0.141     | 73 | Weighted Average              |
| 0.141     |    | 100.00% Pervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

### Summary for Subcatchment PDA-2: PDA-2

Runoff = 0.32 cfs @ 12.10 hrs, Volume= 0.025 af, Depth> 1.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-010yr Rainfall=4.50"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.081     | 55 | Woods, Good, HSG B            |
| 0.164     | 61 | >75% Grass cover, Good, HSG B |
| * 0.022   | 96 | Stone Dust Path, HSG B        |
| 0.267     | 62 | Weighted Average              |
| 0.267     |    | 100.00% Pervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

### Summary for Subcatchment PDA-3: PDA-3

Runoff = 0.17 cfs @ 12.10 hrs, Volume= 0.014 af, Depth> 1.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-010yr Rainfall=4.50"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.039     | 55 | Woods, Good, HSG B            |
| 0.092     | 61 | >75% Grass cover, Good, HSG B |
| * 0.005   | 96 | Stone Dust Path, HSG B        |
| * 0.007   | 98 | Impervious Surface, HSG B     |
| 0.143     | 62 | Weighted Average              |
| 0.136     |    | 95.10% Pervious Area          |
| 0.007     |    | 4.90% Impervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

### Summary for Reach DP-1: Central Street

Inflow Area = 0.799 ac, 17.65% Impervious, Inflow Depth > 0.22" for Middlesex-010yr event  
Inflow = 0.16 cfs @ 12.45 hrs, Volume= 0.015 af  
Outflow = 0.16 cfs @ 12.45 hrs, Volume= 0.015 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Summary for Reach DP-2: Railroad Street

Inflow Area = 0.267 ac, 0.00% Impervious, Inflow Depth > 1.14" for Middlesex-010yr event  
Inflow = 0.32 cfs @ 12.10 hrs, Volume= 0.025 af  
Outflow = 0.32 cfs @ 12.10 hrs, Volume= 0.025 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Summary for Reach DP-3: Front Street**

Inflow Area = 0.143 ac, 4.90% Impervious, Inflow Depth > 1.14" for Middlesex-010yr event  
 Inflow = 0.17 cfs @ 12.10 hrs, Volume= 0.014 af  
 Outflow = 0.17 cfs @ 12.10 hrs, Volume= 0.014 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Summary for Pond Pavers: Pavers**

Inflow Area = 0.164 ac, 72.56% Impervious, Inflow Depth > 3.70" for Middlesex-010yr event  
 Inflow = 0.67 cfs @ 12.08 hrs, Volume= 0.051 af  
 Outflow = 0.25 cfs @ 12.33 hrs, Volume= 0.051 af, Atten= 63%, Lag= 14.9 min  
 Discarded = 0.12 cfs @ 11.73 hrs, Volume= 0.040 af  
 Primary = 0.13 cfs @ 12.33 hrs, Volume= 0.011 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 199.62' @ 12.33 hrs Surf.Area= 5,190 sf Storage= 395 cf

Plug-Flow detention time= 10.0 min calculated for 0.051 af (100% of inflow)  
 Center-of-Mass det. time= 9.8 min ( 790.7 - 780.9 )

| Volume              | Invert               | Avail.Storage | Storage Description  |                           |
|---------------------|----------------------|---------------|--|---------------------------|
| #1                  | 199.37'              | 1,448 cf      | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |                           |
| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Voids<br>(%)  | Inc.Store<br>(cubic-feet)                                  | Cum.Store<br>(cubic-feet) |
| 199.37              | 5,190                | 0.0           | 0  | 0                         |
| 199.38              | 5,190                | 30.0          | 16   | 16                        |
| 200.30              | 5,190                | 30.0          | 1,432  | 1,448                     |

| Device | Routing   | Invert  | Outlet Devices  |
|--------|-----------|---------|---|
| #1     | Discarded | 199.37' | <b>1.020 in/hr Exfiltration over Surface area</b>   |
| #2     | Primary   | 199.30' | <b>4.0" Round Culvert</b> L= 17.0' Ke= 1.000<br>Inlet / Outlet Invert= 199.30' / 198.90' S= 0.0235 '/' Cc= 0.900<br>n= 0.020 Corrugated PE, corrugated interior, Flow Area= 0.09 sf |

**Discarded OutFlow** Max=0.12 cfs @ 11.73 hrs HW=199.38' (Free Discharge)  
 ↑ **1=Exfiltration** (Exfiltration Controls 0.12 cfs)

**Primary OutFlow** Max=0.13 cfs @ 12.33 hrs HW=199.62' (Free Discharge)  
 ↑ **2=Culvert** (Inlet Controls 0.13 cfs @ 1.45 fps)

**Summary for Pond RG-1: Rain Garden-1**

Inflow Area = 0.276 ac, 43.12% Impervious, Inflow Depth > 0.92" for Middlesex-010yr event  
 Inflow = 0.22 cfs @ 12.13 hrs, Volume= 0.021 af  
 Outflow = 0.16 cfs @ 12.48 hrs, Volume= 0.021 af, Atten= 25%, Lag= 20.8 min  
 Discarded = 0.03 cfs @ 12.48 hrs, Volume= 0.015 af  
 Primary = 0.13 cfs @ 12.48 hrs, Volume= 0.006 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 198.87' @ 12.48 hrs Surf.Area= 625 sf Storage= 247 cf

Plug-Flow detention time= 66.7 min calculated for 0.021 af (100% of inflow)  
 Center-of-Mass det. time= 66.6 min ( 886.2 - 819.7 )

| Volume              | Invert               | Avail.Storage | Storage Description  |                           |
|---------------------|----------------------|---------------|--|---------------------------|
| #1                  | 195.74'              | 339 cf        | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |                           |
| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Voids<br>(%)  | Inc.Store<br>(cubic-feet)                                  | Cum.Store<br>(cubic-feet) |
| 195.74              | 202                  | 0.0           | 0  | 0                         |
| 195.75              | 202                  | 30.0          | 1  | 1                         |
| 196.75              | 202                  | 30.0          | 61   | 61                        |
| 196.76              | 202                  | 10.0          | 0  | 61                        |
| 198.50              | 202                  | 10.0          | 35   | 97                        |
| 198.51              | 202                  | 100.0         | 2  | 99                        |
| 199.00              | 780                  | 100.0         | 241  | 339                       |

| Device | Routing   | Invert  | Outlet Devices   |      |      |      |      |      |      |      |      |      |      |  |
|--------|-----------|---------|--|------|------|------|------|------|------|------|------|------|------|--|
| #1     | Discarded | 195.74' | <b>2.410 in/hr Exfiltration over Surface area</b>              |      |      |      |      |      |      |      |      |      |      |  |
| #2     | Primary   | 198.80' | <b>3.0' long x 4.0' breadth Broad-Crested Rectangular Weir</b> |      |      |      |      |      |      |      |      |      |      |  |
|        |           |         | Head (feet)  | 0.20 | 0.40 | 0.60 | 0.80 | 1.00 | 1.20 | 1.40 | 1.60 | 1.80 | 2.00 |  |
|        |           |         |  | 2.50 | 3.00 | 3.50 | 4.00 | 4.50 | 5.00 | 5.50 |      |      |      |  |
|        |           |         | Coef. (English)  | 2.38 | 2.54 | 2.69 | 2.68 | 2.67 | 2.67 | 2.65 | 2.66 | 2.66 |      |  |
|        |           |         |  | 2.68 | 2.72 | 2.73 | 2.76 | 2.79 | 2.88 | 3.07 | 3.32 |      |      |  |

**Discarded OutFlow** Max=0.03 cfs @ 12.48 hrs HW=198.87' (Free Discharge)

↑ **1=Exfiltration** (Exfiltration Controls 0.03 cfs)

**Primary OutFlow** Max=0.13 cfs @ 12.48 hrs HW=198.87' (Free Discharge)

↑ **2=Broad-Crested Rectangular Weir** (Weir Controls 0.13 cfs @ 0.62 fps)

### Summary for Pond RG-2: Rain Garden-2

Inflow Area = 0.334 ac, 2.69% Impervious, Inflow Depth > 1.39" for Middlesex-010yr event  
 Inflow = 0.51 cfs @ 12.10 hrs, Volume= 0.039 af  
 Outflow = 0.06 cfs @ 13.03 hrs, Volume= 0.039 af, Atten= 88%, Lag= 56.1 min  
 Discarded = 0.06 cfs @ 13.03 hrs, Volume= 0.039 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 200.91' @ 13.03 hrs Surf.Area= 1,122 sf Storage= 611 cf

Plug-Flow detention time= 120.9 min calculated for 0.039 af (100% of inflow)  
 Center-of-Mass det. time= 120.8 min ( 984.6 - 863.9 )

| Volume | Invert  | Avail.Storage | Storage Description  |  |
|--------|---------|---------------|--|--|
| #1     | 197.74' | 1,891 cf      | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |  |

| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Voids<br>(%) | Inc.Store<br>(cubic-feet) | Cum.Store<br>(cubic-feet) |
|---------------------|----------------------|--------------|---------------------------|---------------------------|
| 197.74              | 561                  | 0.0          | 0                         | 0                         |
| 197.75              | 561                  | 30.0         | 2                         | 2                         |
| 198.75              | 561                  | 30.0         | 168                       | 170                       |
| 198.76              | 561                  | 10.0         | 1                         | 171                       |
| 200.50              | 561                  | 10.0         | 98                        | 268                       |
| 200.51              | 561                  | 100.0        | 6                         | 274                       |
| 201.00              | 1,248                | 100.0        | 443                       | 717                       |
| 201.50              | 3,450                | 100.0        | 1,175                     | 1,891                     |

| Device | Routing   | Invert  | Outlet Devices                                    |
|--------|-----------|---------|---|
| #1     | Discarded | 197.74' | <b>2.410 in/hr Exfiltration over Surface area</b> |

**Discarded OutFlow** Max=0.06 cfs @ 13.03 hrs HW=200.91' (Free Discharge)

↑**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

### Summary for Pond RG-3: Rain Garden-3

Inflow Area = 0.141 ac, 0.00% Impervious, Inflow Depth > 1.89" for Middlesex-010yr event  
 Inflow = 0.31 cfs @ 12.09 hrs, Volume= 0.022 af  
 Outflow = 0.06 cfs @ 12.55 hrs, Volume= 0.022 af, Atten= 79%, Lag= 27.5 min  
 Discarded = 0.06 cfs @ 12.55 hrs, Volume= 0.022 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 202.05' @ 12.55 hrs Surf.Area= 1,139 sf Storage= 319 cf

Plug-Flow detention time= 77.4 min calculated for 0.022 af (100% of inflow)  
 Center-of-Mass det. time= 77.3 min ( 921.9 - 844.6 )

| Volume | Invert  | Avail.Storage | Storage Description  |
|--------|---------|---------------|--|
| #1     | 199.04' | 944 cf        | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |

| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Voids<br>(%) | Inc.Store<br>(cubic-feet) | Cum.Store<br>(cubic-feet) |
|---------------------|----------------------|--------------|---------------------------|---------------------------|
| 199.04              | 301                  | 0.0          | 0                         | 0                         |
| 199.05              | 301                  | 30.0         | 1                         | 1                         |
| 200.05              | 301                  | 30.0         | 90                        | 91                        |
| 200.06              | 301                  | 10.0         | 0                         | 92                        |
| 201.80              | 301                  | 10.0         | 52                        | 144                       |
| 201.81              | 301                  | 100.0        | 3                         | 147                       |
| 202.00              | 945                  | 100.0        | 118                       | 265                       |
| 202.40              | 2,450                | 100.0        | 679                       | 944                       |

| Device | Routing   | Invert  | Outlet Devices                                    |
|--------|-----------|---------|---|
| #1     | Discarded | 199.04' | <b>2.410 in/hr Exfiltration over Surface area</b> |

**Discarded OutFlow** Max=0.06 cfs @ 12.55 hrs HW=202.05' (Free Discharge)

↑**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

|                                    |  |
|------------------------------------|--|
| <b>Subcatchment PDA-1A: PDA-1A</b> | Runoff Area=0.048 ac 27.08% Impervious Runoff Depth>2.96"<br>Tc=6.0 min CN=78 Runoff=0.17 cfs 0.012 af                                       |
| <b>Subcatchment PDA-1B: PDA-1B</b> | Runoff Area=0.112 ac 0.00% Impervious Runoff Depth>1.55"<br>Tc=6.0 min CN=61 Runoff=0.19 cfs 0.014 af  |
| <b>Subcatchment PDA-1C: PDA-1C</b> | Runoff Area=0.164 ac 72.56% Impervious Runoff Depth>4.49"<br>Tc=6.0 min CN=93 Runoff=0.81 cfs 0.061 af                                       |
| <b>Subcatchment PDA-1D: PDA-1D</b> | Runoff Area=0.334 ac 2.69% Impervious Runoff Depth>1.93"<br>Tc=6.0 min CN=66 Runoff=0.73 cfs 0.054 af  |
| <b>Subcatchment PDA-1E: PDA-1E</b> | Runoff Area=0.141 ac 0.00% Impervious Runoff Depth>2.51"<br>Tc=6.0 min CN=73 Runoff=0.41 cfs 0.030 af  |
| <b>Subcatchment PDA-2: PDA-2</b>   | Runoff Area=0.267 ac 0.00% Impervious Runoff Depth>1.62"<br>Tc=6.0 min CN=62 Runoff=0.48 cfs 0.036 af  |
| <b>Subcatchment PDA-3: PDA-3</b>   | Runoff Area=0.143 ac 4.90% Impervious Runoff Depth>1.62"<br>Tc=6.0 min CN=62 Runoff=0.26 cfs 0.019 af  |
| <b>Reach DP-1: Central Street</b>  | Inflow=0.27 cfs 0.023 af<br>Outflow=0.27 cfs 0.023 af  |
| <b>Reach DP-2: Railroad Street</b> | Inflow=0.48 cfs 0.036 af<br>Outflow=0.48 cfs 0.036 af  |
| <b>Reach DP-3: Front Street</b>    | Inflow=0.26 cfs 0.019 af<br>Outflow=0.26 cfs 0.019 af  |
| <b>Pond Pavers: Pavers</b>         | Peak Elev=199.71' Storage=522 cf Inflow=0.81 cfs 0.061 af<br>Discarded=0.12 cfs 0.046 af Primary=0.15 cfs 0.015 af Outflow=0.28 cfs 0.061 af |
| <b>Pond RG-1: Rain Garden-1</b>    | Peak Elev=198.89' Storage=262 cf Inflow=0.31 cfs 0.030 af<br>Discarded=0.04 cfs 0.018 af Primary=0.20 cfs 0.012 af Outflow=0.24 cfs 0.030 af |
| <b>Pond RG-2: Rain Garden-2</b>    | Peak Elev=201.11' Storage=880 cf Inflow=0.73 cfs 0.054 af<br>Outflow=0.10 cfs 0.054 af   |
| <b>Pond RG-3: Rain Garden-3</b>    | Peak Elev=202.15' Storage=442 cf Inflow=0.41 cfs 0.030 af<br>Outflow=0.08 cfs 0.030 af   |

**Total Runoff Area = 1.209 ac Runoff Volume = 0.227 af Average Runoff Depth = 2.25"**  
**87.76% Pervious = 1.061 ac 12.24% Impervious = 0.148 ac**



**Summary for Subcatchment PDA-1A: PDA-1A**

Runoff = 0.17 cfs @ 12.09 hrs, Volume= 0.012 af, Depth> 2.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-025yr Rainfall=5.30"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.026     | 61 | >75% Grass cover, Good, HSG B |
| * 0.013   | 98 | Impervious Surface, HSG B     |
| * 0.009   | 96 | Stone Dust Path, HSG B        |
| 0.048     | 78 | Weighted Average              |
| 0.035     |    | 72.92% Pervious Area          |
| 0.013     |    | 27.08% Impervious Area        |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description           |
|----------|---------------|---------------|-------------------|----------------|-----------------------|
| 6.0      |               |               |                   |                | Direct Entry, Tc Min. |

**Summary for Subcatchment PDA-1B: PDA-1B**

Runoff = 0.19 cfs @ 12.10 hrs, Volume= 0.014 af, Depth> 1.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-025yr Rainfall=5.30"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.112     | 61 | >75% Grass cover, Good, HSG B |
| 0.112     |    | 100.00% Pervious Area         |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description           |
|----------|---------------|---------------|-------------------|----------------|-----------------------|
| 6.0      |               |               |                   |                | Direct Entry, Tc Min. |

**Summary for Subcatchment PDA-1C: PDA-1C**

Runoff = 0.81 cfs @ 12.08 hrs, Volume= 0.061 af, Depth> 4.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-025yr Rainfall=5.30"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.021     | 61 | >75% Grass cover, Good, HSG B |
| * 0.024   | 96 | Stone Dust Path, HSG B        |
| * 0.119   | 98 | Pavers, HSG B                 |
| 0.164     | 93 | Weighted Average              |
| 0.045     |    | 27.44% Pervious Area          |
| 0.119     |    | 72.56% Impervious Area        |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

**Summary for Subcatchment PDA-1D: PDA-1D**

Runoff = 0.73 cfs @ 12.09 hrs, Volume= 0.054 af, Depth> 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-025yr Rainfall=5.30"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.046     | 55 | Woods, Good, HSG B            |
| 0.233     | 61 | >75% Grass cover, Good, HSG B |
| * 0.046   | 96 | Stone Dust Path, HSG B        |
| * 0.009   | 98 | Impervious Surface, HSG B     |
| 0.334     | 66 | Weighted Average              |
| 0.325     |    | 97.31% Pervious Area          |
| 0.009     |    | 2.69% Impervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

**Summary for Subcatchment PDA-1E: PDA-1E**

Runoff = 0.41 cfs @ 12.09 hrs, Volume= 0.030 af, Depth> 2.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-025yr Rainfall=5.30"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.003     | 55 | Woods, Good, HSG B            |
| 0.088     | 61 | >75% Grass cover, Good, HSG B |
| * 0.050   | 96 | Stone Dust Path, HSG B        |
| 0.141     | 73 | Weighted Average              |
| 0.141     |    | 100.00% Pervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

**Summary for Subcatchment PDA-2: PDA-2**

Runoff = 0.48 cfs @ 12.10 hrs, Volume= 0.036 af, Depth> 1.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-025yr Rainfall=5.30"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.081     | 55 | Woods, Good, HSG B            |
| 0.164     | 61 | >75% Grass cover, Good, HSG B |
| * 0.022   | 96 | Stone Dust Path, HSG B        |
| 0.267     | 62 | Weighted Average              |
| 0.267     |    | 100.00% Pervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

### Summary for Subcatchment PDA-3: PDA-3

Runoff = 0.26 cfs @ 12.10 hrs, Volume= 0.019 af, Depth> 1.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-025yr Rainfall=5.30"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.039     | 55 | Woods, Good, HSG B            |
| 0.092     | 61 | >75% Grass cover, Good, HSG B |
| * 0.005   | 96 | Stone Dust Path, HSG B        |
| * 0.007   | 98 | Impervious Surface, HSG B     |
| 0.143     | 62 | Weighted Average              |
| 0.136     |    | 95.10% Pervious Area          |
| 0.007     |    | 4.90% Impervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

### Summary for Reach DP-1: Central Street

Inflow Area = 0.799 ac, 17.65% Impervious, Inflow Depth > 0.35" for Middlesex-025yr event  
Inflow = 0.27 cfs @ 12.33 hrs, Volume= 0.023 af  
Outflow = 0.27 cfs @ 12.33 hrs, Volume= 0.023 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Summary for Reach DP-2: Railroad Street

Inflow Area = 0.267 ac, 0.00% Impervious, Inflow Depth > 1.62" for Middlesex-025yr event  
Inflow = 0.48 cfs @ 12.10 hrs, Volume= 0.036 af  
Outflow = 0.48 cfs @ 12.10 hrs, Volume= 0.036 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Summary for Reach DP-3: Front Street**

Inflow Area = 0.143 ac, 4.90% Impervious, Inflow Depth > 1.62" for Middlesex-025yr event  
 Inflow = 0.26 cfs @ 12.10 hrs, Volume= 0.019 af  
 Outflow = 0.26 cfs @ 12.10 hrs, Volume= 0.019 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Summary for Pond Pavers: Pavers**

Inflow Area = 0.164 ac, 72.56% Impervious, Inflow Depth > 4.49" for Middlesex-025yr event  
 Inflow = 0.81 cfs @ 12.08 hrs, Volume= 0.061 af  
 Outflow = 0.28 cfs @ 12.36 hrs, Volume= 0.061 af, Atten= 66%, Lag= 16.4 min  
 Discarded = 0.12 cfs @ 11.68 hrs, Volume= 0.046 af  
 Primary = 0.15 cfs @ 12.36 hrs, Volume= 0.015 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 199.71' @ 12.36 hrs Surf.Area= 5,190 sf Storage= 522 cf

Plug-Flow detention time= 12.1 min calculated for 0.061 af (100% of inflow)  
 Center-of-Mass det. time= 11.9 min ( 787.8 - 776.0 )

| Volume              | Invert               | Avail.Storage | Storage Description  |                           |
|---------------------|----------------------|---------------|--|---------------------------|
| #1                  | 199.37'              | 1,448 cf      | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |                           |
| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Voids<br>(%)  | Inc.Store<br>(cubic-feet)                                  | Cum.Store<br>(cubic-feet) |
| 199.37              | 5,190                | 0.0           | 0  | 0                         |
| 199.38              | 5,190                | 30.0          | 16   | 16                        |
| 200.30              | 5,190                | 30.0          | 1,432  | 1,448                     |

| Device | Routing   | Invert  | Outlet Devices  |
|--------|-----------|---------|---|
| #1     | Discarded | 199.37' | <b>1.020 in/hr Exfiltration over Surface area</b>   |
| #2     | Primary   | 199.30' | <b>4.0" Round Culvert</b> L= 17.0' Ke= 1.000<br>Inlet / Outlet Invert= 199.30' / 198.90' S= 0.0235 '/' Cc= 0.900<br>n= 0.020 Corrugated PE, corrugated interior, Flow Area= 0.09 sf |

**Discarded OutFlow** Max=0.12 cfs @ 11.68 hrs HW=199.38' (Free Discharge)  
 ↑ **1=Exfiltration** (Exfiltration Controls 0.12 cfs)

**Primary OutFlow** Max=0.15 cfs @ 12.36 hrs HW=199.71' (Free Discharge)  
 ↑ **2=Culvert** (Inlet Controls 0.15 cfs @ 1.76 fps)

**Summary for Pond RG-1: Rain Garden-1**

Inflow Area = 0.276 ac, 43.12% Impervious, Inflow Depth > 1.29" for Middlesex-025yr event  
 Inflow = 0.31 cfs @ 12.12 hrs, Volume= 0.030 af  
 Outflow = 0.24 cfs @ 12.37 hrs, Volume= 0.030 af, Atten= 22%, Lag= 15.0 min  
 Discarded = 0.04 cfs @ 12.37 hrs, Volume= 0.018 af  
 Primary = 0.20 cfs @ 12.37 hrs, Volume= 0.012 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 198.89' @ 12.37 hrs Surf.Area= 653 sf Storage= 262 cf

Plug-Flow detention time= 57.5 min calculated for 0.030 af (100% of inflow)  
 Center-of-Mass det. time= 57.4 min ( 872.1 - 814.8 )

| Volume              | Invert               | Avail.Storage | Storage Description  |                           |
|---------------------|----------------------|---------------|--|---------------------------|
| #1                  | 195.74'              | 339 cf        | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |                           |
| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Voids<br>(%)  | Inc.Store<br>(cubic-feet)                                  | Cum.Store<br>(cubic-feet) |
| 195.74              | 202                  | 0.0           | 0  | 0                         |
| 195.75              | 202                  | 30.0          | 1  | 1                         |
| 196.75              | 202                  | 30.0          | 61   | 61                        |
| 196.76              | 202                  | 10.0          | 0  | 61                        |
| 198.50              | 202                  | 10.0          | 35   | 97                        |
| 198.51              | 202                  | 100.0         | 2  | 99                        |
| 199.00              | 780                  | 100.0         | 241  | 339                       |

| Device | Routing   | Invert  | Outlet Devices   |      |      |      |      |      |      |      |      |      |      |  |
|--------|-----------|---------|--|------|------|------|------|------|------|------|------|------|------|--|
| #1     | Discarded | 195.74' | <b>2.410 in/hr Exfiltration over Surface area</b>              |      |      |      |      |      |      |      |      |      |      |  |
| #2     | Primary   | 198.80' | <b>3.0' long x 4.0' breadth Broad-Crested Rectangular Weir</b> |      |      |      |      |      |      |      |      |      |      |  |
|        |           |         | Head (feet)  | 0.20 | 0.40 | 0.60 | 0.80 | 1.00 | 1.20 | 1.40 | 1.60 | 1.80 | 2.00 |  |
|        |           |         |  | 2.50 | 3.00 | 3.50 | 4.00 | 4.50 | 5.00 | 5.50 |      |      |      |  |
|        |           |         | Coef. (English)  | 2.38 | 2.54 | 2.69 | 2.68 | 2.67 | 2.67 | 2.65 | 2.66 | 2.66 |      |  |
|        |           |         |  | 2.68 | 2.72 | 2.73 | 2.76 | 2.79 | 2.88 | 3.07 | 3.32 |      |      |  |

**Discarded OutFlow** Max=0.04 cfs @ 12.37 hrs HW=198.89' (Free Discharge)

↑ **1=Exfiltration** (Exfiltration Controls 0.04 cfs)

**Primary OutFlow** Max=0.20 cfs @ 12.37 hrs HW=198.89' (Free Discharge)

↑ **2=Broad-Crested Rectangular Weir** (Weir Controls 0.20 cfs @ 0.72 fps)

### Summary for Pond RG-2: Rain Garden-2

Inflow Area = 0.334 ac, 2.69% Impervious, Inflow Depth > 1.93" for Middlesex-025yr event  
 Inflow = 0.73 cfs @ 12.09 hrs, Volume= 0.054 af  
 Outflow = 0.10 cfs @ 12.88 hrs, Volume= 0.054 af, Atten= 87%, Lag= 47.3 min  
 Discarded = 0.10 cfs @ 12.88 hrs, Volume= 0.054 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 201.11' @ 12.88 hrs Surf.Area= 1,731 sf Storage= 880 cf

Plug-Flow detention time= 133.6 min calculated for 0.054 af (100% of inflow)  
 Center-of-Mass det. time= 132.9 min ( 986.8 - 853.8 )

| Volume | Invert  | Avail.Storage | Storage Description  |  |
|--------|---------|---------------|--|--|
| #1     | 197.74' | 1,891 cf      | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |  |

| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Voids<br>(%) | Inc.Store<br>(cubic-feet) | Cum.Store<br>(cubic-feet) |
|---------------------|----------------------|--------------|---------------------------|---------------------------|
| 197.74              | 561                  | 0.0          | 0                         | 0                         |
| 197.75              | 561                  | 30.0         | 2                         | 2                         |
| 198.75              | 561                  | 30.0         | 168                       | 170                       |
| 198.76              | 561                  | 10.0         | 1                         | 171                       |
| 200.50              | 561                  | 10.0         | 98                        | 268                       |
| 200.51              | 561                  | 100.0        | 6                         | 274                       |
| 201.00              | 1,248                | 100.0        | 443                       | 717                       |
| 201.50              | 3,450                | 100.0        | 1,175                     | 1,891                     |

| Device | Routing   | Invert  | Outlet Devices                                    |
|--------|-----------|---------|---|
| #1     | Discarded | 197.74' | <b>2.410 in/hr Exfiltration over Surface area</b> |

**Discarded OutFlow** Max=0.10 cfs @ 12.88 hrs HW=201.11' (Free Discharge)

↑**1=Exfiltration** (Exfiltration Controls 0.10 cfs)

### Summary for Pond RG-3: Rain Garden-3

Inflow Area = 0.141 ac, 0.00% Impervious, Inflow Depth > 2.51" for Middlesex-025yr event  
 Inflow = 0.41 cfs @ 12.09 hrs, Volume= 0.030 af  
 Outflow = 0.08 cfs @ 12.55 hrs, Volume= 0.030 af, Atten= 80%, Lag= 27.4 min  
 Discarded = 0.08 cfs @ 12.55 hrs, Volume= 0.030 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 202.15' @ 12.55 hrs Surf.Area= 1,491 sf Storage= 442 cf

Plug-Flow detention time= 79.3 min calculated for 0.030 af (100% of inflow)  
 Center-of-Mass det. time= 79.1 min ( 915.4 - 836.3 )

| Volume | Invert  | Avail.Storage | Storage Description  |
|--------|---------|---------------|--|
| #1     | 199.04' | 944 cf        | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |

| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Voids<br>(%) | Inc.Store<br>(cubic-feet) | Cum.Store<br>(cubic-feet) |
|---------------------|----------------------|--------------|---------------------------|---------------------------|
| 199.04              | 301                  | 0.0          | 0                         | 0                         |
| 199.05              | 301                  | 30.0         | 1                         | 1                         |
| 200.05              | 301                  | 30.0         | 90                        | 91                        |
| 200.06              | 301                  | 10.0         | 0                         | 92                        |
| 201.80              | 301                  | 10.0         | 52                        | 144                       |
| 201.81              | 301                  | 100.0        | 3                         | 147                       |
| 202.00              | 945                  | 100.0        | 118                       | 265                       |
| 202.40              | 2,450                | 100.0        | 679                       | 944                       |

| Device | Routing   | Invert  | Outlet Devices                                    |
|--------|-----------|---------|---|
| #1     | Discarded | 199.04' | <b>2.410 in/hr Exfiltration over Surface area</b> |

**Discarded OutFlow** Max=0.08 cfs @ 12.55 hrs HW=202.15' (Free Discharge)

↑**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

|                                    |  |
|------------------------------------|--|
| <b>Subcatchment PDA-1A: PDA-1A</b> | Runoff Area=0.048 ac 27.08% Impervious Runoff Depth>3.49"<br>Tc=6.0 min CN=78 Runoff=0.20 cfs 0.014 af                                       |
| <b>Subcatchment PDA-1B: PDA-1B</b> | Runoff Area=0.112 ac 0.00% Impervious Runoff Depth>1.94"<br>Tc=6.0 min CN=61 Runoff=0.24 cfs 0.018 af  |
| <b>Subcatchment PDA-1C: PDA-1C</b> | Runoff Area=0.164 ac 72.56% Impervious Runoff Depth>5.08"<br>Tc=6.0 min CN=93 Runoff=0.91 cfs 0.069 af                                       |
| <b>Subcatchment PDA-1D: PDA-1D</b> | Runoff Area=0.334 ac 2.69% Impervious Runoff Depth>2.36"<br>Tc=6.0 min CN=66 Runoff=0.91 cfs 0.066 af  |
| <b>Subcatchment PDA-1E: PDA-1E</b> | Runoff Area=0.141 ac 0.00% Impervious Runoff Depth>3.00"<br>Tc=6.0 min CN=73 Runoff=0.50 cfs 0.035 af  |
| <b>Subcatchment PDA-2: PDA-2</b>   | Runoff Area=0.267 ac 0.00% Impervious Runoff Depth>2.02"<br>Tc=6.0 min CN=62 Runoff=0.61 cfs 0.045 af  |
| <b>Subcatchment PDA-3: PDA-3</b>   | Runoff Area=0.143 ac 4.90% Impervious Runoff Depth>2.02"<br>Tc=6.0 min CN=62 Runoff=0.32 cfs 0.024 af  |
| <b>Reach DP-1: Central Street</b>  | Inflow=0.35 cfs 0.031 af<br>Outflow=0.35 cfs 0.031 af  |
| <b>Reach DP-2: Railroad Street</b> | Inflow=0.61 cfs 0.045 af<br>Outflow=0.61 cfs 0.045 af  |
| <b>Reach DP-3: Front Street</b>    | Inflow=0.32 cfs 0.024 af<br>Outflow=0.32 cfs 0.024 af  |
| <b>Pond Pavers: Pavers</b>         | Peak Elev=199.77' Storage=621 cf Inflow=0.91 cfs 0.069 af<br>Discarded=0.12 cfs 0.051 af Primary=0.17 cfs 0.019 af Outflow=0.30 cfs 0.069 af |
| <b>Pond RG-1: Rain Garden-1</b>    | Peak Elev=198.91' Storage=273 cf Inflow=0.37 cfs 0.037 af<br>Discarded=0.04 cfs 0.020 af Primary=0.26 cfs 0.017 af Outflow=0.29 cfs 0.037 af |
| <b>Pond RG-2: Rain Garden-2</b>    | Peak Elev=201.22' Storage=1,096 cf Inflow=0.91 cfs 0.066 af<br>Outflow=0.12 cfs 0.064 af   |
| <b>Pond RG-3: Rain Garden-3</b>    | Peak Elev=202.21' Storage=544 cf Inflow=0.50 cfs 0.035 af<br>Outflow=0.10 cfs 0.035 af   |

**Total Runoff Area = 1.209 ac Runoff Volume = 0.271 af Average Runoff Depth = 2.69"**  
**87.76% Pervious = 1.061 ac 12.24% Impervious = 0.148 ac**

**Summary for Subcatchment PDA-1A: PDA-1A**

Runoff = 0.20 cfs @ 12.09 hrs, Volume= 0.014 af, Depth> 3.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-050yr Rainfall=5.90"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.026     | 61 | >75% Grass cover, Good, HSG B |
| * 0.013   | 98 | Impervious Surface, HSG B     |
| * 0.009   | 96 | Stone Dust Path, HSG B        |
| 0.048     | 78 | Weighted Average              |
| 0.035     |    | 72.92% Pervious Area          |
| 0.013     |    | 27.08% Impervious Area        |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description           |
|----------|---------------|---------------|-------------------|----------------|-----------------------|
| 6.0      |               |               |                   |                | Direct Entry, Tc Min. |

**Summary for Subcatchment PDA-1B: PDA-1B**

Runoff = 0.24 cfs @ 12.10 hrs, Volume= 0.018 af, Depth> 1.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-050yr Rainfall=5.90"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.112     | 61 | >75% Grass cover, Good, HSG B |
| 0.112     |    | 100.00% Pervious Area         |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description           |
|----------|---------------|---------------|-------------------|----------------|-----------------------|
| 6.0      |               |               |                   |                | Direct Entry, Tc Min. |

**Summary for Subcatchment PDA-1C: PDA-1C**

Runoff = 0.91 cfs @ 12.08 hrs, Volume= 0.069 af, Depth> 5.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-050yr Rainfall=5.90"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.021     | 61 | >75% Grass cover, Good, HSG B |
| * 0.024   | 96 | Stone Dust Path, HSG B        |
| * 0.119   | 98 | Pavers, HSG B                 |
| 0.164     | 93 | Weighted Average              |
| 0.045     |    | 27.44% Pervious Area          |
| 0.119     |    | 72.56% Impervious Area        |



| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

### Summary for Subcatchment PDA-1D: PDA-1D

Runoff = 0.91 cfs @ 12.09 hrs, Volume= 0.066 af, Depth> 2.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-050yr Rainfall=5.90"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.046     | 55 | Woods, Good, HSG B            |
| 0.233     | 61 | >75% Grass cover, Good, HSG B |
| * 0.046   | 96 | Stone Dust Path, HSG B        |
| * 0.009   | 98 | Impervious Surface, HSG B     |
| 0.334     | 66 | Weighted Average              |
| 0.325     |    | 97.31% Pervious Area          |
| 0.009     |    | 2.69% Impervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

### Summary for Subcatchment PDA-1E: PDA-1E

Runoff = 0.50 cfs @ 12.09 hrs, Volume= 0.035 af, Depth> 3.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-050yr Rainfall=5.90"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.003     | 55 | Woods, Good, HSG B            |
| 0.088     | 61 | >75% Grass cover, Good, HSG B |
| * 0.050   | 96 | Stone Dust Path, HSG B        |
| 0.141     | 73 | Weighted Average              |
| 0.141     |    | 100.00% Pervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

### Summary for Subcatchment PDA-2: PDA-2

Runoff = 0.61 cfs @ 12.09 hrs, Volume= 0.045 af, Depth> 2.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-050yr Rainfall=5.90"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.081     | 55 | Woods, Good, HSG B            |
| 0.164     | 61 | >75% Grass cover, Good, HSG B |
| * 0.022   | 96 | Stone Dust Path, HSG B        |
| 0.267     | 62 | Weighted Average              |
| 0.267     |    | 100.00% Pervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

### Summary for Subcatchment PDA-3: PDA-3

Runoff = 0.32 cfs @ 12.09 hrs, Volume= 0.024 af, Depth> 2.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-050yr Rainfall=5.90"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.039     | 55 | Woods, Good, HSG B            |
| 0.092     | 61 | >75% Grass cover, Good, HSG B |
| * 0.005   | 96 | Stone Dust Path, HSG B        |
| * 0.007   | 98 | Impervious Surface, HSG B     |
| 0.143     | 62 | Weighted Average              |
| 0.136     |    | 95.10% Pervious Area          |
| 0.007     |    | 4.90% Impervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

### Summary for Reach DP-1: Central Street

Inflow Area = 0.799 ac, 17.65% Impervious, Inflow Depth > 0.46" for Middlesex-050yr event  
Inflow = 0.35 cfs @ 12.25 hrs, Volume= 0.031 af  
Outflow = 0.35 cfs @ 12.25 hrs, Volume= 0.031 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Summary for Reach DP-2: Railroad Street

Inflow Area = 0.267 ac, 0.00% Impervious, Inflow Depth > 2.02" for Middlesex-050yr event  
Inflow = 0.61 cfs @ 12.09 hrs, Volume= 0.045 af  
Outflow = 0.61 cfs @ 12.09 hrs, Volume= 0.045 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Summary for Reach DP-3: Front Street**

Inflow Area = 0.143 ac, 4.90% Impervious, Inflow Depth > 2.02" for Middlesex-050yr event  
 Inflow = 0.32 cfs @ 12.09 hrs, Volume= 0.024 af  
 Outflow = 0.32 cfs @ 12.09 hrs, Volume= 0.024 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Summary for Pond Pavers: Pavers**

Inflow Area = 0.164 ac, 72.56% Impervious, Inflow Depth > 5.08" for Middlesex-050yr event  
 Inflow = 0.91 cfs @ 12.08 hrs, Volume= 0.069 af  
 Outflow = 0.30 cfs @ 12.37 hrs, Volume= 0.069 af, Atten= 67%, Lag= 17.4 min  
 Discarded = 0.12 cfs @ 11.66 hrs, Volume= 0.051 af  
 Primary = 0.17 cfs @ 12.37 hrs, Volume= 0.019 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 199.77' @ 12.37 hrs Surf.Area= 5,190 sf Storage= 621 cf

Plug-Flow detention time= 13.5 min calculated for 0.069 af (100% of inflow)  
 Center-of-Mass det. time= 13.3 min ( 786.2 - 772.9 )

| Volume              | Invert               | Avail.Storage | Storage Description  |                           |
|---------------------|----------------------|---------------|--|---------------------------|
| #1                  | 199.37'              | 1,448 cf      | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |                           |
| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Voids<br>(%)  | Inc.Store<br>(cubic-feet)                                  | Cum.Store<br>(cubic-feet) |
| 199.37              | 5,190                | 0.0           | 0  | 0                         |
| 199.38              | 5,190                | 30.0          | 16   | 16                        |
| 200.30              | 5,190                | 30.0          | 1,432  | 1,448                     |

| Device | Routing   | Invert  | Outlet Devices  |
|--------|-----------|---------|---|
| #1     | Discarded | 199.37' | <b>1.020 in/hr Exfiltration over Surface area</b>   |
| #2     | Primary   | 199.30' | <b>4.0" Round Culvert</b> L= 17.0' Ke= 1.000<br>Inlet / Outlet Invert= 199.30' / 198.90' S= 0.0235 '/' Cc= 0.900<br>n= 0.020 Corrugated PE, corrugated interior, Flow Area= 0.09 sf |

**Discarded OutFlow** Max=0.12 cfs @ 11.66 hrs HW=199.38' (Free Discharge)  
 ↑ **1=Exfiltration** (Exfiltration Controls 0.12 cfs)

**Primary OutFlow** Max=0.17 cfs @ 12.37 hrs HW=199.77' (Free Discharge)  
 ↑ **2=Culvert** (Inlet Controls 0.17 cfs @ 1.99 fps)

**Summary for Pond RG-1: Rain Garden-1**

Inflow Area = 0.276 ac, 43.12% Impervious, Inflow Depth > 1.60" for Middlesex-050yr event  
 Inflow = 0.37 cfs @ 12.11 hrs, Volume= 0.037 af  
 Outflow = 0.29 cfs @ 12.29 hrs, Volume= 0.037 af, Atten= 21%, Lag= 11.0 min  
 Discarded = 0.04 cfs @ 12.29 hrs, Volume= 0.020 af  
 Primary = 0.26 cfs @ 12.29 hrs, Volume= 0.017 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 198.91' @ 12.29 hrs Surf.Area= 672 sf Storage= 273 cf

Plug-Flow detention time= 52.9 min calculated for 0.037 af (100% of inflow)  
 Center-of-Mass det. time= 52.8 min ( 865.0 - 812.2 )

| Volume              | Invert               | Avail.Storage | Storage Description  |                           |
|---------------------|----------------------|---------------|--|---------------------------|
| #1                  | 195.74'              | 339 cf        | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |                           |
| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Voids<br>(%)  | Inc.Store<br>(cubic-feet)                                  | Cum.Store<br>(cubic-feet) |
| 195.74              | 202                  | 0.0           | 0  | 0                         |
| 195.75              | 202                  | 30.0          | 1  | 1                         |
| 196.75              | 202                  | 30.0          | 61   | 61                        |
| 196.76              | 202                  | 10.0          | 0  | 61                        |
| 198.50              | 202                  | 10.0          | 35   | 97                        |
| 198.51              | 202                  | 100.0         | 2  | 99                        |
| 199.00              | 780                  | 100.0         | 241  | 339                       |

| Device | Routing   | Invert  | Outlet Devices   |      |      |      |      |      |      |      |      |      |      |  |
|--------|-----------|---------|--|------|------|------|------|------|------|------|------|------|------|--|
| #1     | Discarded | 195.74' | <b>2.410 in/hr Exfiltration over Surface area</b>              |      |      |      |      |      |      |      |      |      |      |  |
| #2     | Primary   | 198.80' | <b>3.0' long x 4.0' breadth Broad-Crested Rectangular Weir</b> |      |      |      |      |      |      |      |      |      |      |  |
|        |           |         | Head (feet)  | 0.20 | 0.40 | 0.60 | 0.80 | 1.00 | 1.20 | 1.40 | 1.60 | 1.80 | 2.00 |  |
|        |           |         |  | 2.50 | 3.00 | 3.50 | 4.00 | 4.50 | 5.00 | 5.50 |      |      |      |  |
|        |           |         | Coef. (English)  | 2.38 | 2.54 | 2.69 | 2.68 | 2.67 | 2.67 | 2.65 | 2.66 | 2.66 |      |  |
|        |           |         |  | 2.68 | 2.72 | 2.73 | 2.76 | 2.79 | 2.88 | 3.07 | 3.32 |      |      |  |

**Discarded OutFlow** Max=0.04 cfs @ 12.29 hrs HW=198.91' (Free Discharge)

↑ **1=Exfiltration** (Exfiltration Controls 0.04 cfs)

**Primary OutFlow** Max=0.25 cfs @ 12.29 hrs HW=198.91' (Free Discharge)

↑ **2=Broad-Crested Rectangular Weir** (Weir Controls 0.25 cfs @ 0.78 fps)

### Summary for Pond RG-2: Rain Garden-2

Inflow Area = 0.334 ac, 2.69% Impervious, Inflow Depth > 2.36" for Middlesex-050yr event  
 Inflow = 0.91 cfs @ 12.09 hrs, Volume= 0.066 af  
 Outflow = 0.12 cfs @ 12.80 hrs, Volume= 0.064 af, Atten= 86%, Lag= 42.7 min  
 Discarded = 0.12 cfs @ 12.80 hrs, Volume= 0.064 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 201.22' @ 12.80 hrs Surf.Area= 2,212 sf Storage= 1,096 cf

Plug-Flow detention time= 137.3 min calculated for 0.064 af (97% of inflow)  
 Center-of-Mass det. time= 121.3 min ( 969.2 - 847.8 )

| Volume | Invert  | Avail.Storage | Storage Description  |  |
|--------|---------|---------------|--|--|
| #1     | 197.74' | 1,891 cf      | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |  |

| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Voids<br>(%) | Inc.Store<br>(cubic-feet) | Cum.Store<br>(cubic-feet) |
|---------------------|----------------------|--------------|---------------------------|---------------------------|
| 197.74              | 561                  | 0.0          | 0                         | 0                         |
| 197.75              | 561                  | 30.0         | 2                         | 2                         |
| 198.75              | 561                  | 30.0         | 168                       | 170                       |
| 198.76              | 561                  | 10.0         | 1                         | 171                       |
| 200.50              | 561                  | 10.0         | 98                        | 268                       |
| 200.51              | 561                  | 100.0        | 6                         | 274                       |
| 201.00              | 1,248                | 100.0        | 443                       | 717                       |
| 201.50              | 3,450                | 100.0        | 1,175                     | 1,891                     |

| Device | Routing   | Invert  | Outlet Devices                                    |
|--------|-----------|---------|---|
| #1     | Discarded | 197.74' | <b>2.410 in/hr Exfiltration over Surface area</b> |

**Discarded OutFlow** Max=0.12 cfs @ 12.80 hrs HW=201.22' (Free Discharge)

↑**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

### Summary for Pond RG-3: Rain Garden-3

Inflow Area = 0.141 ac, 0.00% Impervious, Inflow Depth > 3.00" for Middlesex-050yr event  
 Inflow = 0.50 cfs @ 12.09 hrs, Volume= 0.035 af  
 Outflow = 0.10 cfs @ 12.55 hrs, Volume= 0.035 af, Atten= 81%, Lag= 27.6 min  
 Discarded = 0.10 cfs @ 12.55 hrs, Volume= 0.035 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 202.21' @ 12.55 hrs Surf.Area= 1,730 sf Storage= 544 cf

Plug-Flow detention time= 81.8 min calculated for 0.035 af (100% of inflow)  
 Center-of-Mass det. time= 81.6 min ( 912.8 - 831.2 )

| Volume | Invert  | Avail.Storage | Storage Description  |
|--------|---------|---------------|--|
| #1     | 199.04' | 944 cf        | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |

| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Voids<br>(%) | Inc.Store<br>(cubic-feet) | Cum.Store<br>(cubic-feet) |
|---------------------|----------------------|--------------|---------------------------|---------------------------|
| 199.04              | 301                  | 0.0          | 0                         | 0                         |
| 199.05              | 301                  | 30.0         | 1                         | 1                         |
| 200.05              | 301                  | 30.0         | 90                        | 91                        |
| 200.06              | 301                  | 10.0         | 0                         | 92                        |
| 201.80              | 301                  | 10.0         | 52                        | 144                       |
| 201.81              | 301                  | 100.0        | 3                         | 147                       |
| 202.00              | 945                  | 100.0        | 118                       | 265                       |
| 202.40              | 2,450                | 100.0        | 679                       | 944                       |

| Device | Routing   | Invert  | Outlet Devices                                    |
|--------|-----------|---------|---|
| #1     | Discarded | 199.04' | <b>2.410 in/hr Exfiltration over Surface area</b> |

**Discarded OutFlow** Max=0.10 cfs @ 12.55 hrs HW=202.21' (Free Discharge)

↑**1=Exfiltration** (Exfiltration Controls 0.10 cfs)

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

|                                    |  |
|------------------------------------|--|
| <b>Subcatchment PDA-1A: PDA-1A</b> | Runoff Area=0.048 ac 27.08% Impervious Runoff Depth>4.47"<br>Tc=6.0 min CN=78 Runoff=0.25 cfs 0.018 af                                       |
| <b>Subcatchment PDA-1B: PDA-1B</b> | Runoff Area=0.112 ac 0.00% Impervious Runoff Depth>2.70"<br>Tc=6.0 min CN=61 Runoff=0.35 cfs 0.025 af  |
| <b>Subcatchment PDA-1C: PDA-1C</b> | Runoff Area=0.164 ac 72.56% Impervious Runoff Depth>6.17"<br>Tc=6.0 min CN=93 Runoff=1.09 cfs 0.084 af                                       |
| <b>Subcatchment PDA-1D: PDA-1D</b> | Runoff Area=0.334 ac 2.69% Impervious Runoff Depth>3.20"<br>Tc=6.0 min CN=66 Runoff=1.25 cfs 0.089 af  |
| <b>Subcatchment PDA-1E: PDA-1E</b> | Runoff Area=0.141 ac 0.00% Impervious Runoff Depth>3.93"<br>Tc=6.0 min CN=73 Runoff=0.65 cfs 0.046 af  |
| <b>Subcatchment PDA-2: PDA-2</b>   | Runoff Area=0.267 ac 0.00% Impervious Runoff Depth>2.80"<br>Tc=6.0 min CN=62 Runoff=0.86 cfs 0.062 af  |
| <b>Subcatchment PDA-3: PDA-3</b>   | Runoff Area=0.143 ac 4.90% Impervious Runoff Depth>2.80"<br>Tc=6.0 min CN=62 Runoff=0.46 cfs 0.033 af  |
| <b>Reach DP-1: Central Street</b>  | Inflow=0.57 cfs 0.045 af<br>Outflow=0.57 cfs 0.045 af  |
| <b>Reach DP-2: Railroad Street</b> | Inflow=0.86 cfs 0.062 af<br>Outflow=0.86 cfs 0.062 af  |
| <b>Reach DP-3: Front Street</b>    | Inflow=0.46 cfs 0.033 af<br>Outflow=0.46 cfs 0.033 af  |
| <b>Pond Pavers: Pavers</b>         | Peak Elev=199.89' Storage=810 cf Inflow=1.09 cfs 0.084 af<br>Discarded=0.12 cfs 0.059 af Primary=0.21 cfs 0.025 af Outflow=0.33 cfs 0.084 af |
| <b>Pond RG-1: Rain Garden-1</b>    | Peak Elev=198.94' Storage=296 cf Inflow=0.50 cfs 0.050 af<br>Discarded=0.04 cfs 0.022 af Primary=0.39 cfs 0.027 af Outflow=0.43 cfs 0.050 af |
| <b>Pond RG-2: Rain Garden-2</b>    | Peak Elev=201.39' Storage=1,547 cf Inflow=1.25 cfs 0.089 af<br>Outflow=0.17 cfs 0.085 af   |
| <b>Pond RG-3: Rain Garden-3</b>    | Peak Elev=202.31' Storage=749 cf Inflow=0.65 cfs 0.046 af<br>Outflow=0.12 cfs 0.046 af   |

**Total Runoff Area = 1.209 ac Runoff Volume = 0.358 af Average Runoff Depth = 3.55"**  
**87.76% Pervious = 1.061 ac 12.24% Impervious = 0.148 ac**

**Summary for Subcatchment PDA-1A: PDA-1A**

Runoff = 0.25 cfs @ 12.09 hrs, Volume= 0.018 af, Depth> 4.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-100yr Rainfall=7.00"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.026     | 61 | >75% Grass cover, Good, HSG B |
| * 0.013   | 98 | Impervious Surface, HSG B     |
| * 0.009   | 96 | Stone Dust Path, HSG B        |
| 0.048     | 78 | Weighted Average              |
| 0.035     |    | 72.92% Pervious Area          |
| 0.013     |    | 27.08% Impervious Area        |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description           |
|----------|---------------|---------------|-------------------|----------------|-----------------------|
| 6.0      |               |               |                   |                | Direct Entry, Tc Min. |

**Summary for Subcatchment PDA-1B: PDA-1B**

Runoff = 0.35 cfs @ 12.09 hrs, Volume= 0.025 af, Depth> 2.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-100yr Rainfall=7.00"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.112     | 61 | >75% Grass cover, Good, HSG B |
| 0.112     |    | 100.00% Pervious Area         |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description           |
|----------|---------------|---------------|-------------------|----------------|-----------------------|
| 6.0      |               |               |                   |                | Direct Entry, Tc Min. |

**Summary for Subcatchment PDA-1C: PDA-1C**

Runoff = 1.09 cfs @ 12.08 hrs, Volume= 0.084 af, Depth> 6.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-100yr Rainfall=7.00"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.021     | 61 | >75% Grass cover, Good, HSG B |
| * 0.024   | 96 | Stone Dust Path, HSG B        |
| * 0.119   | 98 | Pavers, HSG B                 |
| 0.164     | 93 | Weighted Average              |
| 0.045     |    | 27.44% Pervious Area          |
| 0.119     |    | 72.56% Impervious Area        |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

**Summary for Subcatchment PDA-1D: PDA-1D**

Runoff = 1.25 cfs @ 12.09 hrs, Volume= 0.089 af, Depth> 3.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-100yr Rainfall=7.00"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.046     | 55 | Woods, Good, HSG B            |
| 0.233     | 61 | >75% Grass cover, Good, HSG B |
| * 0.046   | 96 | Stone Dust Path, HSG B        |
| * 0.009   | 98 | Impervious Surface, HSG B     |
| 0.334     | 66 | Weighted Average              |
| 0.325     |    | 97.31% Pervious Area          |
| 0.009     |    | 2.69% Impervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

**Summary for Subcatchment PDA-1E: PDA-1E**

Runoff = 0.65 cfs @ 12.09 hrs, Volume= 0.046 af, Depth> 3.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-100yr Rainfall=7.00"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.003     | 55 | Woods, Good, HSG B            |
| 0.088     | 61 | >75% Grass cover, Good, HSG B |
| * 0.050   | 96 | Stone Dust Path, HSG B        |
| 0.141     | 73 | Weighted Average              |
| 0.141     |    | 100.00% Pervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

**Summary for Subcatchment PDA-2: PDA-2**

Runoff = 0.86 cfs @ 12.09 hrs, Volume= 0.062 af, Depth> 2.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-100yr Rainfall=7.00"



| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.081     | 55 | Woods, Good, HSG B            |
| 0.164     | 61 | >75% Grass cover, Good, HSG B |
| * 0.022   | 96 | Stone Dust Path, HSG B        |
| 0.267     | 62 | Weighted Average              |
| 0.267     |    | 100.00% Pervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

### Summary for Subcatchment PDA-3: PDA-3

Runoff = 0.46 cfs @ 12.09 hrs, Volume= 0.033 af, Depth> 2.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr Middlesex-100yr Rainfall=7.00"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.039     | 55 | Woods, Good, HSG B            |
| 0.092     | 61 | >75% Grass cover, Good, HSG B |
| * 0.005   | 96 | Stone Dust Path, HSG B        |
| * 0.007   | 98 | Impervious Surface, HSG B     |
| 0.143     | 62 | Weighted Average              |
| 0.136     |    | 95.10% Pervious Area          |
| 0.007     |    | 4.90% Impervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description           |
|-------------|------------------|------------------|----------------------|-------------------|-----------------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, Tc Min. |

### Summary for Reach DP-1: Central Street

Inflow Area = 0.799 ac, 17.65% Impervious, Inflow Depth > 0.68" for Middlesex-100yr event  
Inflow = 0.57 cfs @ 12.15 hrs, Volume= 0.045 af  
Outflow = 0.57 cfs @ 12.15 hrs, Volume= 0.045 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Summary for Reach DP-2: Railroad Street

Inflow Area = 0.267 ac, 0.00% Impervious, Inflow Depth > 2.80" for Middlesex-100yr event  
Inflow = 0.86 cfs @ 12.09 hrs, Volume= 0.062 af  
Outflow = 0.86 cfs @ 12.09 hrs, Volume= 0.062 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Summary for Reach DP-3: Front Street**

Inflow Area = 0.143 ac, 4.90% Impervious, Inflow Depth > 2.80" for Middlesex-100yr event  
 Inflow = 0.46 cfs @ 12.09 hrs, Volume= 0.033 af  
 Outflow = 0.46 cfs @ 12.09 hrs, Volume= 0.033 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Summary for Pond Pavers: Pavers**

Inflow Area = 0.164 ac, 72.56% Impervious, Inflow Depth > 6.17" for Middlesex-100yr event  
 Inflow = 1.09 cfs @ 12.08 hrs, Volume= 0.084 af  
 Outflow = 0.33 cfs @ 12.40 hrs, Volume= 0.084 af, Atten= 70%, Lag= 18.9 min  
 Discarded = 0.12 cfs @ 11.61 hrs, Volume= 0.059 af  
 Primary = 0.21 cfs @ 12.40 hrs, Volume= 0.025 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 199.89' @ 12.40 hrs Surf.Area= 5,190 sf Storage= 810 cf

Plug-Flow detention time= 16.1 min calculated for 0.084 af (100% of inflow)  
 Center-of-Mass det. time= 15.9 min ( 784.2 - 768.2 )

| Volume              | Invert               | Avail.Storage | Storage Description  |                           |
|---------------------|----------------------|---------------|--|---------------------------|
| #1                  | 199.37'              | 1,448 cf      | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |                           |
| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Voids<br>(%)  | Inc.Store<br>(cubic-feet)                                  | Cum.Store<br>(cubic-feet) |
| 199.37              | 5,190                | 0.0           | 0  | 0                         |
| 199.38              | 5,190                | 30.0          | 16   | 16                        |
| 200.30              | 5,190                | 30.0          | 1,432  | 1,448                     |

| Device | Routing   | Invert  | Outlet Devices  |
|--------|-----------|---------|---|
| #1     | Discarded | 199.37' | <b>1.020 in/hr Exfiltration over Surface area</b>   |
| #2     | Primary   | 199.30' | <b>4.0" Round Culvert</b> L= 17.0' Ke= 1.000<br>Inlet / Outlet Invert= 199.30' / 198.90' S= 0.0235 '/' Cc= 0.900<br>n= 0.020 Corrugated PE, corrugated interior, Flow Area= 0.09 sf |

**Discarded OutFlow** Max=0.12 cfs @ 11.61 hrs HW=199.38' (Free Discharge)  
 ↑**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

**Primary OutFlow** Max=0.21 cfs @ 12.40 hrs HW=199.89' (Free Discharge)  
 ↑**2=Culvert** (Inlet Controls 0.21 cfs @ 2.35 fps)

**Summary for Pond RG-1: Rain Garden-1**

Inflow Area = 0.276 ac, 43.12% Impervious, Inflow Depth > 2.19" for Middlesex-100yr event  
 Inflow = 0.50 cfs @ 12.10 hrs, Volume= 0.050 af  
 Outflow = 0.43 cfs @ 12.18 hrs, Volume= 0.050 af, Atten= 15%, Lag= 4.7 min  
 Discarded = 0.04 cfs @ 12.18 hrs, Volume= 0.022 af  
 Primary = 0.39 cfs @ 12.18 hrs, Volume= 0.027 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 198.94' @ 12.18 hrs Surf.Area= 712 sf Storage= 296 cf

Plug-Flow detention time= 46.4 min calculated for 0.050 af (98% of inflow)  
 Center-of-Mass det. time= 36.9 min ( 846.0 - 809.1 )

| Volume              | Invert               | Avail.Storage | Storage Description  |                           |
|---------------------|----------------------|---------------|--|---------------------------|
| #1                  | 195.74'              | 339 cf        | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |                           |
| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Voids<br>(%)  | Inc.Store<br>(cubic-feet)                                  | Cum.Store<br>(cubic-feet) |
| 195.74              | 202                  | 0.0           | 0  | 0                         |
| 195.75              | 202                  | 30.0          | 1  | 1                         |
| 196.75              | 202                  | 30.0          | 61   | 61                        |
| 196.76              | 202                  | 10.0          | 0  | 61                        |
| 198.50              | 202                  | 10.0          | 35   | 97                        |
| 198.51              | 202                  | 100.0         | 2  | 99                        |
| 199.00              | 780                  | 100.0         | 241  | 339                       |

| Device | Routing   | Invert  | Outlet Devices   |      |      |      |      |      |      |      |      |      |      |  |
|--------|-----------|---------|--|------|------|------|------|------|------|------|------|------|------|--|
| #1     | Discarded | 195.74' | <b>2.410 in/hr Exfiltration over Surface area</b>              |      |      |      |      |      |      |      |      |      |      |  |
| #2     | Primary   | 198.80' | <b>3.0' long x 4.0' breadth Broad-Crested Rectangular Weir</b> |      |      |      |      |      |      |      |      |      |      |  |
|        |           |         | Head (feet)  | 0.20 | 0.40 | 0.60 | 0.80 | 1.00 | 1.20 | 1.40 | 1.60 | 1.80 | 2.00 |  |
|        |           |         |  | 2.50 | 3.00 | 3.50 | 4.00 | 4.50 | 5.00 | 5.50 |      |      |      |  |
|        |           |         | Coef. (English)  | 2.38 | 2.54 | 2.69 | 2.68 | 2.67 | 2.67 | 2.65 | 2.66 | 2.66 |      |  |
|        |           |         |  | 2.68 | 2.72 | 2.73 | 2.76 | 2.79 | 2.88 | 3.07 | 3.32 |      |      |  |

**Discarded OutFlow** Max=0.04 cfs @ 12.18 hrs HW=198.94' (Free Discharge)

↑ **1=Exfiltration** (Exfiltration Controls 0.04 cfs)

**Primary OutFlow** Max=0.38 cfs @ 12.18 hrs HW=198.94' (Free Discharge)

↑ **2=Broad-Crested Rectangular Weir** (Weir Controls 0.38 cfs @ 0.90 fps)

### Summary for Pond RG-2: Rain Garden-2

Inflow Area = 0.334 ac, 2.69% Impervious, Inflow Depth > 3.20" for Middlesex-100yr event  
 Inflow = 1.25 cfs @ 12.09 hrs, Volume= 0.089 af  
 Outflow = 0.17 cfs @ 12.77 hrs, Volume= 0.085 af, Atten= 87%, Lag= 40.6 min  
 Discarded = 0.17 cfs @ 12.77 hrs, Volume= 0.085 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 201.39' @ 12.77 hrs Surf.Area= 2,978 sf Storage= 1,547 cf

Plug-Flow detention time= 139.7 min calculated for 0.085 af (95% of inflow)  
 Center-of-Mass det. time= 113.1 min ( 952.1 - 838.9 )

| Volume | Invert  | Avail.Storage | Storage Description  |  |
|--------|---------|---------------|--|--|
| #1     | 197.74' | 1,891 cf      | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |  |

| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Voids<br>(%) | Inc.Store<br>(cubic-feet) | Cum.Store<br>(cubic-feet) |
|---------------------|----------------------|--------------|---------------------------|---------------------------|
| 197.74              | 561                  | 0.0          | 0                         | 0                         |
| 197.75              | 561                  | 30.0         | 2                         | 2                         |
| 198.75              | 561                  | 30.0         | 168                       | 170                       |
| 198.76              | 561                  | 10.0         | 1                         | 171                       |
| 200.50              | 561                  | 10.0         | 98                        | 268                       |
| 200.51              | 561                  | 100.0        | 6                         | 274                       |
| 201.00              | 1,248                | 100.0        | 443                       | 717                       |
| 201.50              | 3,450                | 100.0        | 1,175                     | 1,891                     |

| Device | Routing   | Invert  | Outlet Devices                                    |
|--------|-----------|---------|---|
| #1     | Discarded | 197.74' | <b>2.410 in/hr Exfiltration over Surface area</b> |

**Discarded OutFlow** Max=0.17 cfs @ 12.77 hrs HW=201.39' (Free Discharge)

↑**1=Exfiltration** (Exfiltration Controls 0.17 cfs)

### Summary for Pond RG-3: Rain Garden-3

Inflow Area = 0.141 ac, 0.00% Impervious, Inflow Depth > 3.93" for Middlesex-100yr event  
 Inflow = 0.65 cfs @ 12.09 hrs, Volume= 0.046 af  
 Outflow = 0.12 cfs @ 12.56 hrs, Volume= 0.046 af, Atten= 82%, Lag= 28.0 min  
 Discarded = 0.12 cfs @ 12.56 hrs, Volume= 0.046 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 202.31' @ 12.56 hrs Surf.Area= 2,129 sf Storage= 749 cf

Plug-Flow detention time= 88.3 min calculated for 0.046 af (100% of inflow)  
 Center-of-Mass det. time= 85.7 min ( 909.2 - 823.5 )

| Volume | Invert  | Avail.Storage | Storage Description  |
|--------|---------|---------------|--|
| #1     | 199.04' | 944 cf        | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |

| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Voids<br>(%) | Inc.Store<br>(cubic-feet) | Cum.Store<br>(cubic-feet) |
|---------------------|----------------------|--------------|---------------------------|---------------------------|
| 199.04              | 301                  | 0.0          | 0                         | 0                         |
| 199.05              | 301                  | 30.0         | 1                         | 1                         |
| 200.05              | 301                  | 30.0         | 90                        | 91                        |
| 200.06              | 301                  | 10.0         | 0                         | 92                        |
| 201.80              | 301                  | 10.0         | 52                        | 144                       |
| 201.81              | 301                  | 100.0        | 3                         | 147                       |
| 202.00              | 945                  | 100.0        | 118                       | 265                       |
| 202.40              | 2,450                | 100.0        | 679                       | 944                       |

| Device | Routing   | Invert  | Outlet Devices                                    |
|--------|-----------|---------|---|
| #1     | Discarded | 199.04' | <b>2.410 in/hr Exfiltration over Surface area</b> |

**Discarded OutFlow** Max=0.12 cfs @ 12.56 hrs HW=202.31' (Free Discharge)

↑**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

**Attachment 3**  
**Recharge and Drawdown Calculations**

---



# BEALS + THOMAS

## Standard 3: Groundwater Recharge

### Groundwater Recharge Volume Required:

$R_v = F \times \text{Impervious Area}$ , where:

$R_v$  = Required Recharge Volume [Ac-ft]

$F$  = Target Depth Factor associated with each Hydrologic Soil Group (HSG) [in]

**Impervious Area** = Total Impervious Area Under Proposed Conditions [Ac]

- Notes:** 1) Goal to provide maximum recharge based on an HSG A soil, given in-situ testing  
2) Permeable pavers broken out separately and not fully impervious

|  | Impervious Area<br>[Acres] | Required Recharge<br>Volume [Ac-ft] |                             |
|--|----------------------------|-------------------------------------|-----------------------------|
| HSG "A", use F = 0.6 in                                    | 0.029                      | 0.001                               |                             |
|  | 0.119                      | 0.006                               | * For Perm. Paver Footprint |
| <b>Total Required Recharge Volume (<math>R_v</math>) =</b> | <b>0.007</b>               | <b>Ac-ft</b>                        |                             |

### Capture Area Adjustment: (Ref: DEP Handbook V.3 Ch.1 P.27-28)

|  |                    |
|--|--------------------|
| Total Site Impervious Area (Total) =                                   | 0.148 Acres        |
| Impervious Area Draining to Infiltrative BMPs (infil) =                | 0.128 Acres        |
| Percent Imp. Area Draining to Infiltrative BMPs =                      | 86.5%              |
| Capture Area Adjustment Factor = (Total)/(Infil) = $C_a$ =             | 1.16               |
| <b>Adjusted Required Recharge Volume = <math>C_a \times R_v</math></b> | <b>0.009 Ac-ft</b> |

### Groundwater Recharge Volume Provided :

| BMP                                     | Provided Recharge<br>Volume [Ac-ft] |
|---|-------------------------------------|
| Permeable Pavers                        | 0.033                               |
| Rain Garden - 1                         | 0.005                               |
| Rain Garden - 2                         | 0.043                               |
| Rain Garden - 3                         | 0.021                               |
| <b>Total Provided Recharge Volume =</b> | <b>0.102 Ac-ft</b>                  |

**PROVIDED GROUNDWATER RECHARGE VOLUME IS GREATER THAN OR EQUAL TO THE REQUIRED RECHARGE VOLUME,  
THEREFORE PROPOSED STORMWATER MANAGEMENT DESIGN IS IN COMPLIANCE WITH STANDARD 3.**

JOB NO. 1439.03  
JOB: Blair Square

COMPUTED BY: NBB  
DATE: 09/02/21

CHECKED BY: JRM  
DATE: 09/03/21



# BEALS + THOMAS

## Standard 3: Drawdown

$$\text{Drawdown Time} = \frac{R_v}{(K) (\text{Bottom Area})}$$

where:

$R_v$  = Storage Volume Below Outlet [Ac-ft]

$K$  = Infiltration Rate [in/hr]

Bottom Area = Bottom Area of Recharge System [Ac]

### Permeable Pavers

$R_v$  = 0.033 Ac-ft

$K$  = 1.020 in/hr

Bottom Area = 0.119 Acres

Drawdown Time = 3.262 Hours

< 72 Hours, Design is in compliance with the standard.

### Rain Garden - 1

$R_v$  = 0.005 Ac-ft

$K$  = 2.410 in/hr

Bottom Area = 0.005 Acres

Drawdown Time = 4.979 Hours

< 72 Hours, Design is in compliance with the standard.

### Rain Garden - 2

$R_v$  = 0.043 Ac-ft

$K$  = 2.410 in/hr

Bottom Area = 0.013 Acres

Drawdown Time = 16.470 Hours

< 72 Hours, Design is in compliance with the standard.

### Rain Garden - 3

$R_v$  = 0.021 Ac-ft

$K$  = 2.410 in/hr

Bottom Area = 0.007 Acres

Drawdown Time = 14.938 Hours

< 72 Hours, Design is in compliance with the standard.

Note:

1. The infiltration BMPs have been designed to fully drain within 72 hours, therefore the proposed stormwater management design is in compliance with Standard 3 .

2. Infiltration Rate based on Volume 3, Chapter 1, Table 2.3.3 *Rawls Rates* from the 2008 MA DEP Stormwater Management Handbook.

JOB NO. 1439.03

COMPUTED BY: NBB

CHECKED BY: JRM

JOB: Blair Square

DATE: 09/02/21

DATE: 09/03/21

**143903HC001***Type III 24-hr Middlesex-100yr Rainfall=7.00"*

Prepared by Beals and Thomas, Inc.

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**Stage-Area-Storage for Pond Pavers: Pavers**

| Elevation<br>(feet) | Surface<br>(acres) | Storage<br>(acre-feet) | Elevation<br>(feet) | Surface<br>(acres) | Storage<br>(acre-feet) |
|---------------------|--------------------|------------------------|---------------------|--------------------|------------------------|
| 199.37              | <b>0.119</b>       | 0.000                  | 199.89              | 0.119              | 0.019                  |
| 199.38              | 0.119              | 0.000                  | 199.90              | 0.119              | 0.019                  |
| 199.39              | 0.119              | 0.001                  | 199.91              | 0.119              | 0.019                  |
| 199.40              | 0.119              | 0.001                  | 199.92              | 0.119              | 0.020                  |
| 199.41              | 0.119              | 0.001                  | 199.93              | 0.119              | 0.020                  |
| 199.42              | 0.119              | 0.002                  | 199.94              | 0.119              | 0.020                  |
| 199.43              | 0.119              | 0.002                  | 199.95              | 0.119              | 0.021                  |
| 199.44              | 0.119              | 0.003                  | 199.96              | 0.119              | 0.021                  |
| 199.45              | 0.119              | 0.003                  | 199.97              | 0.119              | 0.021                  |
| 199.46              | 0.119              | 0.003                  | 199.98              | 0.119              | 0.022                  |
| 199.47              | 0.119              | 0.004                  | 199.99              | 0.119              | 0.022                  |
| 199.48              | 0.119              | 0.004                  | 200.00              | 0.119              | 0.023                  |
| 199.49              | 0.119              | 0.004                  | 200.01              | 0.119              | 0.023                  |
| 199.50              | 0.119              | 0.005                  | 200.02              | 0.119              | 0.023                  |
| 199.51              | 0.119              | 0.005                  | 200.03              | 0.119              | 0.024                  |
| 199.52              | 0.119              | 0.005                  | 200.04              | 0.119              | 0.024                  |
| 199.53              | 0.119              | 0.006                  | 200.05              | 0.119              | 0.024                  |
| 199.54              | 0.119              | 0.006                  | 200.06              | 0.119              | 0.025                  |
| 199.55              | 0.119              | 0.006                  | 200.07              | 0.119              | 0.025                  |
| 199.56              | 0.119              | 0.007                  | 200.08              | 0.119              | 0.025                  |
| 199.57              | 0.119              | 0.007                  | 200.09              | 0.119              | 0.026                  |
| 199.58              | 0.119              | 0.008                  | 200.10              | 0.119              | 0.026                  |
| 199.59              | 0.119              | 0.008                  | 200.11              | 0.119              | 0.026                  |
| 199.60              | 0.119              | 0.008                  | 200.12              | 0.119              | 0.027                  |
| 199.61              | 0.119              | 0.009                  | 200.13              | 0.119              | 0.027                  |
| 199.62              | 0.119              | 0.009                  | 200.14              | 0.119              | 0.028                  |
| 199.63              | 0.119              | 0.009                  | 200.15              | 0.119              | 0.028                  |
| 199.64              | 0.119              | 0.010                  | 200.16              | 0.119              | 0.028                  |
| 199.65              | 0.119              | 0.010                  | 200.17              | 0.119              | 0.029                  |
| 199.66              | 0.119              | 0.010                  | 200.18              | 0.119              | 0.029                  |
| 199.67              | 0.119              | 0.011                  | 200.19              | 0.119              | 0.029                  |
| 199.68              | 0.119              | 0.011                  | 200.20              | 0.119              | 0.030                  |
| 199.69              | 0.119              | 0.011                  | 200.21              | 0.119              | 0.030                  |
| 199.70              | 0.119              | 0.012                  | 200.22              | 0.119              | 0.030                  |
| 199.71              | 0.119              | 0.012                  | 200.23              | 0.119              | 0.031                  |
| 199.72              | 0.119              | 0.013                  | 200.24              | 0.119              | 0.031                  |
| 199.73              | 0.119              | 0.013                  | 200.25              | 0.119              | 0.031                  |
| 199.74              | 0.119              | 0.013                  | 200.26              | 0.119              | 0.032                  |
| 199.75              | 0.119              | 0.014                  | 200.27              | 0.119              | 0.032                  |
| 199.76              | 0.119              | 0.014                  | 200.28              | 0.119              | 0.033                  |
| 199.77              | 0.119              | 0.014                  | 200.29              | 0.119              | 0.033                  |
| 199.78              | 0.119              | 0.015                  | <b>200.30</b>       | <b>0.119</b>       | <b>0.033</b>           |
| 199.79              | 0.119              | 0.015                  |                     |                    |                        |
| 199.80              | 0.119              | 0.015                  |                     |                    |                        |
| 199.81              | 0.119              | 0.016                  |                     |                    |                        |
| 199.82              | 0.119              | 0.016                  |                     |                    |                        |
| 199.83              | 0.119              | 0.016                  |                     |                    |                        |
| 199.84              | 0.119              | 0.017                  |                     |                    |                        |
| 199.85              | 0.119              | 0.017                  |                     |                    |                        |
| 199.86              | 0.119              | 0.018                  |                     |                    |                        |
| 199.87              | 0.119              | 0.018                  |                     |                    |                        |
| 199.88              | 0.119              | 0.018                  |                     |                    |                        |



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**Stage-Area-Storage for Pond RG-1: Rain Garden-1**

| Elevation<br>(feet) | Surface<br>(acres) | Storage<br>(acre-feet) | Elevation<br>(feet) | Surface<br>(acres) | Storage<br>(acre-feet) |
|---------------------|--------------------|------------------------|---------------------|--------------------|------------------------|
| 195.74              | 0.005              | 0.000                  | 198.34              | 0.005              | 0.002                  |
| 195.79              | 0.005              | 0.000                  | 198.39              | 0.005              | 0.002                  |
| 195.84              | 0.005              | 0.000                  | 198.44              | 0.005              | 0.002                  |
| 195.89              | 0.005              | 0.000                  | 198.49              | 0.005              | 0.002                  |
| 195.94              | 0.005              | 0.000                  | 198.54              | 0.005              | 0.002                  |
| 195.99              | 0.005              | 0.000                  | 198.59              | 0.007              | 0.003                  |
| 196.04              | 0.005              | 0.000                  | 198.64              | 0.008              | 0.003                  |
| 196.09              | 0.005              | 0.000                  | 198.69              | 0.010              | 0.004                  |
| 196.14              | 0.005              | 0.001                  | 198.74              | 0.011              | 0.004                  |
| 196.19              | 0.005              | 0.001                  | 198.79              | 0.012              | 0.005                  |
| 196.24              | 0.005              | 0.001                  | 198.84              | 0.014              | 0.005                  |
| 196.29              | 0.005              | 0.001                  | 198.89              | 0.015              | 0.006                  |
| 196.34              | 0.005              | 0.001                  | 198.94              | 0.016              | 0.007                  |
| 196.39              | 0.005              | 0.001                  | 198.99              | 0.018              | 0.008                  |
| 196.44              | 0.005              | 0.001                  |                     |                    |                        |
| 196.49              | 0.005              | 0.001                  |                     |                    |                        |
| 196.54              | 0.005              | 0.001                  |                     |                    |                        |
| 196.59              | 0.005              | 0.001                  |                     |                    |                        |
| 196.64              | 0.005              | 0.001                  |                     |                    |                        |
| 196.69              | 0.005              | 0.001                  |                     |                    |                        |
| 196.74              | 0.005              | 0.001                  |                     |                    |                        |
| 196.79              | 0.005              | 0.001                  |                     |                    |                        |
| 196.84              | 0.005              | 0.001                  |                     |                    |                        |
| 196.89              | 0.005              | 0.001                  |                     |                    |                        |
| 196.94              | 0.005              | 0.001                  |                     |                    |                        |
| 196.99              | 0.005              | 0.002                  |                     |                    |                        |
| 197.04              | 0.005              | 0.002                  |                     |                    |                        |
| 197.09              | 0.005              | 0.002                  |                     |                    |                        |
| 197.14              | 0.005              | 0.002                  |                     |                    |                        |
| 197.19              | 0.005              | 0.002                  |                     |                    |                        |
| 197.24              | 0.005              | 0.002                  |                     |                    |                        |
| 197.29              | 0.005              | 0.002                  |                     |                    |                        |
| 197.34              | 0.005              | 0.002                  |                     |                    |                        |
| 197.39              | 0.005              | 0.002                  |                     |                    |                        |
| 197.44              | 0.005              | 0.002                  |                     |                    |                        |
| 197.49              | 0.005              | 0.002                  |                     |                    |                        |
| 197.54              | 0.005              | 0.002                  |                     |                    |                        |
| 197.59              | 0.005              | 0.002                  |                     |                    |                        |
| 197.64              | 0.005              | 0.002                  |                     |                    |                        |
| 197.69              | 0.005              | 0.002                  |                     |                    |                        |
| 197.74              | 0.005              | 0.002                  |                     |                    |                        |
| 197.79              | 0.005              | 0.002                  |                     |                    |                        |
| 197.84              | 0.005              | 0.002                  |                     |                    |                        |
| 197.89              | 0.005              | 0.002                  |                     |                    |                        |
| 197.94              | 0.005              | 0.002                  |                     |                    |                        |
| 197.99              | 0.005              | 0.002                  |                     |                    |                        |
| 198.04              | 0.005              | 0.002                  |                     |                    |                        |
| 198.09              | 0.005              | 0.002                  |                     |                    |                        |
| 198.14              | 0.005              | 0.002                  |                     |                    |                        |
| 198.19              | 0.005              | 0.002                  |                     |                    |                        |
| 198.24              | 0.005              | 0.002                  |                     |                    |                        |
| 198.29              | 0.005              | 0.002                  |                     |                    |                        |

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**Stage-Area-Storage for Pond RG-2: Rain Garden-2**

| Elevation<br>(feet) | Surface<br>(acres) | Storage<br>(acre-feet) | Elevation<br>(feet) | Surface<br>(acres) | Storage<br>(acre-feet) |
|---------------------|--------------------|------------------------|---------------------|--------------------|------------------------|
| 197.74              | 0.013              | 0.000                  | 200.34              | 0.013              | 0.006                  |
| 197.79              | 0.013              | 0.000                  | 200.39              | 0.013              | 0.006                  |
| 197.84              | 0.013              | 0.000                  | 200.44              | 0.013              | 0.006                  |
| 197.89              | 0.013              | 0.001                  | 200.49              | 0.013              | 0.006                  |
| 197.94              | 0.013              | 0.001                  | 200.54              | 0.014              | 0.007                  |
| 197.99              | 0.013              | 0.001                  | 200.59              | 0.015              | 0.007                  |
| 198.04              | 0.013              | 0.001                  | 200.64              | 0.017              | 0.008                  |
| 198.09              | 0.013              | 0.001                  | 200.69              | 0.019              | 0.009                  |
| 198.14              | 0.013              | 0.002                  | 200.74              | 0.020              | 0.010                  |
| 198.19              | 0.013              | 0.002                  | 200.79              | 0.022              | 0.011                  |
| 198.24              | 0.013              | 0.002                  | 200.84              | 0.024              | 0.012                  |
| 198.29              | 0.013              | 0.002                  | 200.89              | 0.025              | 0.014                  |
| 198.34              | 0.013              | 0.002                  | 200.94              | 0.027              | 0.015                  |
| 198.39              | 0.013              | 0.003                  | 200.99              | 0.028              | 0.016                  |
| 198.44              | 0.013              | 0.003                  | 201.04              | 0.033              | 0.018                  |
| 198.49              | 0.013              | 0.003                  | 201.09              | 0.038              | 0.019                  |
| 198.54              | 0.013              | 0.003                  | 201.14              | 0.043              | 0.021                  |
| 198.59              | 0.013              | 0.003                  | 201.19              | 0.048              | 0.024                  |
| 198.64              | 0.013              | 0.003                  | 201.24              | 0.053              | 0.026                  |
| 198.69              | 0.013              | 0.004                  | 201.29              | 0.058              | 0.029                  |
| 198.74              | 0.013              | 0.004                  | 201.34              | 0.063              | 0.032                  |
| 198.79              | 0.013              | 0.004                  | 201.39              | 0.068              | 0.035                  |
| 198.84              | 0.013              | 0.004                  | 201.44              | 0.073              | 0.039                  |
| 198.89              | 0.013              | 0.004                  | <b>201.49</b>       | <b>0.078</b>       | <b>0.043</b>           |
| 198.94              | 0.013              | 0.004                  |                     |                    |                        |
| 198.99              | 0.013              | 0.004                  |                     |                    |                        |
| 199.04              | 0.013              | 0.004                  |                     |                    |                        |
| 199.09              | 0.013              | 0.004                  |                     |                    |                        |
| 199.14              | 0.013              | 0.004                  |                     |                    |                        |
| 199.19              | 0.013              | 0.004                  |                     |                    |                        |
| 199.24              | 0.013              | 0.005                  |                     |                    |                        |
| 199.29              | 0.013              | 0.005                  |                     |                    |                        |
| 199.34              | 0.013              | 0.005                  |                     |                    |                        |
| 199.39              | 0.013              | 0.005                  |                     |                    |                        |
| 199.44              | 0.013              | 0.005                  |                     |                    |                        |
| 199.49              | 0.013              | 0.005                  |                     |                    |                        |
| 199.54              | 0.013              | 0.005                  |                     |                    |                        |
| 199.59              | 0.013              | 0.005                  |                     |                    |                        |
| 199.64              | 0.013              | 0.005                  |                     |                    |                        |
| 199.69              | 0.013              | 0.005                  |                     |                    |                        |
| 199.74              | 0.013              | 0.005                  |                     |                    |                        |
| 199.79              | 0.013              | 0.005                  |                     |                    |                        |
| 199.84              | 0.013              | 0.005                  |                     |                    |                        |
| 199.89              | 0.013              | 0.005                  |                     |                    |                        |
| 199.94              | 0.013              | 0.005                  |                     |                    |                        |
| 199.99              | 0.013              | 0.005                  |                     |                    |                        |
| 200.04              | 0.013              | 0.006                  |                     |                    |                        |
| 200.09              | 0.013              | 0.006                  |                     |                    |                        |
| 200.14              | 0.013              | 0.006                  |                     |                    |                        |
| 200.19              | 0.013              | 0.006                  |                     |                    |                        |
| 200.24              | 0.013              | 0.006                  |                     |                    |                        |
| 200.29              | 0.013              | 0.006                  |                     |                    |                        |

**143903HC001***Type III 24-hr Middlesex-100yr Rainfall=7.00"*

Prepared by Beals and Thomas, Inc.

Printed 9/2/2021

HydroCAD® 10.10-5a s/n 04493 © 2020 HydroCAD Software Solutions LLC

**Stage-Area-Storage for Pond RG-3: Rain Garden-3**

| Elevation<br>(feet) | Surface<br>(acres) | Storage<br>(acre-feet) | Elevation<br>(feet) | Surface<br>(acres) | Storage<br>(acre-feet) |
|---------------------|--------------------|------------------------|---------------------|--------------------|------------------------|
| 199.04              | 0.007              | 0.000                  | 201.64              | 0.007              | 0.003                  |
| 199.09              | 0.007              | 0.000                  | 201.69              | 0.007              | 0.003                  |
| 199.14              | 0.007              | 0.000                  | 201.74              | 0.007              | 0.003                  |
| 199.19              | 0.007              | 0.000                  | 201.79              | 0.007              | 0.003                  |
| 199.24              | 0.007              | 0.000                  | 201.84              | 0.009              | 0.004                  |
| 199.29              | 0.007              | 0.001                  | 201.89              | 0.013              | 0.004                  |
| 199.34              | 0.007              | 0.001                  | 201.94              | 0.017              | 0.005                  |
| 199.39              | 0.007              | 0.001                  | 201.99              | 0.021              | 0.006                  |
| 199.44              | 0.007              | 0.001                  | 202.04              | 0.025              | 0.007                  |
| 199.49              | 0.007              | 0.001                  | 202.09              | 0.029              | 0.008                  |
| 199.54              | 0.007              | 0.001                  | 202.14              | 0.034              | 0.010                  |
| 199.59              | 0.007              | 0.001                  | 202.19              | 0.038              | 0.012                  |
| 199.64              | 0.007              | 0.001                  | 202.24              | 0.042              | 0.014                  |
| 199.69              | 0.007              | 0.001                  | 202.29              | 0.047              | 0.016                  |
| 199.74              | 0.007              | 0.001                  | 202.34              | 0.051              | 0.018                  |
| 199.79              | 0.007              | 0.002                  | <b>202.39</b>       | <b>0.055</b>       | <b>0.021</b>           |
| 199.84              | 0.007              | 0.002                  |                     |                    |                        |
| 199.89              | 0.007              | 0.002                  |                     |                    |                        |
| 199.94              | 0.007              | 0.002                  |                     |                    |                        |
| 199.99              | 0.007              | 0.002                  |                     |                    |                        |
| 200.04              | 0.007              | 0.002                  |                     |                    |                        |
| 200.09              | 0.007              | 0.002                  |                     |                    |                        |
| 200.14              | 0.007              | 0.002                  |                     |                    |                        |
| 200.19              | 0.007              | 0.002                  |                     |                    |                        |
| 200.24              | 0.007              | 0.002                  |                     |                    |                        |
| 200.29              | 0.007              | 0.002                  |                     |                    |                        |
| 200.34              | 0.007              | 0.002                  |                     |                    |                        |
| 200.39              | 0.007              | 0.002                  |                     |                    |                        |
| 200.44              | 0.007              | 0.002                  |                     |                    |                        |
| 200.49              | 0.007              | 0.002                  |                     |                    |                        |
| 200.54              | 0.007              | 0.002                  |                     |                    |                        |
| 200.59              | 0.007              | 0.002                  |                     |                    |                        |
| 200.64              | 0.007              | 0.003                  |                     |                    |                        |
| 200.69              | 0.007              | 0.003                  |                     |                    |                        |
| 200.74              | 0.007              | 0.003                  |                     |                    |                        |
| 200.79              | 0.007              | 0.003                  |                     |                    |                        |
| 200.84              | 0.007              | 0.003                  |                     |                    |                        |
| 200.89              | 0.007              | 0.003                  |                     |                    |                        |
| 200.94              | 0.007              | 0.003                  |                     |                    |                        |
| 200.99              | 0.007              | 0.003                  |                     |                    |                        |
| 201.04              | 0.007              | 0.003                  |                     |                    |                        |
| 201.09              | 0.007              | 0.003                  |                     |                    |                        |
| 201.14              | 0.007              | 0.003                  |                     |                    |                        |
| 201.19              | 0.007              | 0.003                  |                     |                    |                        |
| 201.24              | 0.007              | 0.003                  |                     |                    |                        |
| 201.29              | 0.007              | 0.003                  |                     |                    |                        |
| 201.34              | 0.007              | 0.003                  |                     |                    |                        |
| 201.39              | 0.007              | 0.003                  |                     |                    |                        |
| 201.44              | 0.007              | 0.003                  |                     |                    |                        |
| 201.49              | 0.007              | 0.003                  |                     |                    |                        |
| 201.54              | 0.007              | 0.003                  |                     |                    |                        |
| 201.59              | 0.007              | 0.003                  |                     |                    |                        |

**Attachment 4**  
**Site Owner's Manual**

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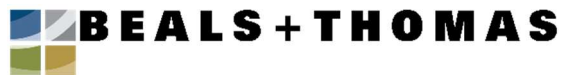
# Site Owner's Manual

## BLAIR SQUARE SITE IMPROVEMENTS

### **0 Railroad Bed Holliston, Massachusetts**

*Prepared for:*  
**Holliston Planning Board  
703 Washington Street  
Holliston, MA 01746**

*Prepared by:*



**September 3, 2021**

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## 1.0 INTRODUCTION

The Site Owner's Manual complies with the Long-Term Pollution Prevention Plan (Standard 4) and the Long-Term Operation and Maintenance Plan (Standard 9) requirements of the 2008 Massachusetts Department of Environmental Protection (DEP) Stormwater Handbook. The Manual outlines source control and pollution prevention measures and maintenance requirements of stormwater best management practices (BMPs) associated with the proposed development.

## 2.0 **SITE OWNER'S AGREEMENT**

### 2.1 **Operation and Maintenance Compliance Statement**

Site Owner:           Town of Holliston  
                              703 Washington Street  
                              Holliston, MA 01746

Responsible Party:   Town of Holliston

The Town of Holliston shall maintain ownership of the on-site stormwater management system as well as the responsibility for operation and maintenance during the post-development stages of the project. The site has been inspected for erosion and appropriate measures have been taken to permanently stabilize any eroded areas. All aspects of stormwater best management practices (BMPs) have been inspected for damage, wear and malfunction, and appropriate steps have been taken to repair or replace the system or portions of the system so that the stormwater at the site may be managed in accordance with the Stormwater Management Standards. Future responsible parties shall be notified of their continuing legal responsibility to operate and maintain the BMPs. The operation and maintenance plan for the stormwater BMPs is being implemented.

---

Responsible Party Signature

---

Date

### 2.2 **Stormwater Maintenance Easements**

There are no off-site areas utilized for stormwater control, therefore no stormwater management easements are required. The Site Owner will have access to all stormwater practices for inspection and maintenance, including direct maintenance access by heavy equipment to structures requiring regular maintenance.

### 2.3 **Record Keeping**

The Site Owner shall maintain a rolling log in which all inspections and maintenance activities for the past three years shall be recorded. The Operation and Maintenance Log includes information pertaining to inspections, repairs, and disposal relevant to the project's stormwater management system. The Log is located in Appendix A.

The Operation and Maintenance Log shall be made available to the Conservation Commission and the DEP upon request. The Conservation Commission and the DEP shall be allowed to enter and inspect the premises to evaluate and ensure that the responsible party complies with the maintenance requirements for each BMP.



## 2.4 Training

Employees involved in grounds maintenance and emergency response will be educated on the general concepts of stormwater management and groundwater protection. The Site Owner's Manual will be reviewed with the maintenance staff. The staff will be trained on the proper course of action for specific events expected to be incurred during routine maintenance or emergency situations.

### **3.0 LONG-TERM POLLUTION PREVENTION PLAN**

In compliance with Standard 4 of the 2008 DEP Stormwater Management Handbook, this section outlines source control and pollution prevention measures to be employed on-site after construction.

#### **3.1 Storage of Materials and Waste**

The site shall be kept clear of trash and debris at all times. Certain materials and waste products shall be stored inside or outside upon an impervious surface and covered, as required by local and state regulations.

#### **3.2 Vehicle Washing**

No commercial vehicle washing shall take place on site.

#### **3.3 Routine Inspections and Maintenance of Stormwater BMPs**

See Section 4.0 Long-Term Operation and Maintenance Plan, for routine inspection and maintenance requirements for all proposed stormwater BMPs.

#### **3.4 Spill Prevention and Response**

A contingency plan shall be implemented to address the spill or release of petroleum products and hazardous materials and will include the following measures:

1. Equipment necessary to quickly attend to inadvertent spills or leaks shall be stored on-site in a secure but accessible location. Such equipment shall include but not be limited to the following: safety goggles, chemically resistant gloves and overshoe boots, water and chemical fire extinguishers, sand and shovels, suitable absorbent materials, storage containers and first aid equipment (i.e. Indian Valley Industries, Inc. 55-gallon Spill Containment kit or approved equivalent).
2. Spills or leaks shall be treated properly according to material type, volume of spillage and location of spill. Mitigation shall include preventing further spillage, containing the spilled material in the smallest practical area, removing spilled material in a safe and environmentally-friendly manner, and remediation of any damage to the environment.
3. For large spills, Massachusetts DEP Hazardous Waste Incident Response Group shall be notified immediately at 888-304-1133 and an emergency response contractor shall be consulted.

### **3.5 Maintenance of Lawns, Gardens, and other Landscaped Areas**

Lawns, gardens, and other landscaped areas shall be maintained regularly by the site owner. Vegetated and landscaped BMPs will be maintained as outlined in Section 4.0.

### **3.6 Storage and Use of Fertilizers, Herbicides, and Pesticides**

All fertilizers, herbicides, and pesticides shall be stored in accordance with local, state, and federal regulations. The application rate and use of fertilizers, herbicides, and pesticides on the site shall at no time exceed local, state, or federal specifications.

### **3.7 Pet Waste Management**

Pet owners shall be required to pick up after their animals and dispose of waste in the trash.

### **3.8 Snow and Deicing Chemical Management**

Snow removal at the proposed development shall comply with the following requirements:

- Plowed snow shall be placed in the areas outside of stormwater best management practices. The following maintenance measures shall be undertaken at all snow disposal sites:
  - Debris shall be cleared from an area prior to using it for snow disposal.
  - Debris and accumulated sediments shall be cleared from the site and properly disposed of at the end of the snow season and no later than May 15.
  - Sanding shall not be performed on permeable paver surface as this will clog the pore space within the stone aggregate.

## 4.0 LONG-TERM OPERATION AND MAINTENANCE PLAN

This section outlines the stormwater best management practices (BMPs) associated with the proposed stormwater management system and identifies the long-term inspection and maintenance requirements for each BMP.

### 4.1 Stormwater Management System Components

The following table outlines the type and quantity of the BMPs and their general location. Please reference the site plan(s) provided in the Figures section for exact location.

| BMP Type         | Quantity | Location                          |
|------------------|----------|-----------------------------------|
| Permeable Pavers | 1        | Northeastern portion of the site. |
| Rain Garden      | 3        | Throughout the site.              |

## 4.2 Inspection and Maintenance Schedules

### 4.2.1 Rain Gardens

Annual maintenance of all rain garden components, including plants, soil, and mulch, shall be performed to ensure the overall success. Specific maintenance activities and their required frequency are outlined below:

- Vegetation shall be watered at the end of the day for 14 consecutive days after planting.
- Trash shall be removed from the surface monthly.
- The soil surface shall be inspected on a monthly basis and any observed erosion shall be repaired.
- All void areas within the bioretention area shall be remulched on an annual basis. If the existing mulch layer has deteriorated, it shall be removed prior to applying the new layer.
- All dead and diseased vegetation shall be removed and replaced on an annual basis. Diseased trees and shrubs shall be treated as necessary.
- Inlet and outlet pipes shall be inspected every 6 months and after major storm events (rainfall totals greater than 2.5 inches in 24 hours) for evidence of clogging.
- During and after major storm, the length of time standing water remains in the rain garden area shall be recorded:
  - If the time is greater than 72 hours, thoroughly inspect the basin for signs of clogging.

- A corrective action plan shall be developed by a qualified professional to restore infiltrative function. The Site Owner shall take immediate action to implement these corrective measures.

#### 4.2.2 Permeable Pavers

Frequent cleaning and maintenance of permeable pavers is critical to prevent clogging. Required operation and maintenance measures include the following:

- Informational signs identifying permeable paver areas shall be posted.
- No winter sanding shall be conducted on the permeable pavers.
- Salt use during winter months shall be minimized.
- Adjacent landscaped areas shall be well maintained to prevent soil from being transported onto pavement.
- Surface of permeable pavers shall be cleaned using vacuum sweeping machines monthly.
- Permeable paver areas shall be monitored regularly to ensure proper drainage after storm events.
- Permeable pavers shall never be resealed or repaved with impermeable materials.
- Surface shall be inspected annually for deterioration.

#### 4.3 Estimated Operation and Maintenance Budget

An operations and maintenance budget was prepared to approximate the annual cost of the inspections required in compliance with the DEP Stormwater Management Policy. The table below estimates the annual cost to inspect and maintain each proposed BMP, based on the requirements in Section 4.2.

| BMP Type         | # of BMPS | Annual O&M Cost (per BMP) <sup>1</sup> | Total Cost          |
|------------------|-----------|--|---------------------|
| Rain Gardens     | 3         | \$200-\$400                            | \$600-\$1200        |
| Permeable Pavers | 1         | \$300-\$400                            | \$300-\$400         |
| <b>Total</b>     |           |  | <b>\$900-\$1600</b> |

#### 4.4 Public Safety Features

Appropriate signage will be provided within the premises for public safety.

<sup>1</sup> Annual maintenance cost is based on estimate of the cost to complete all inspection and maintenance measures outlined in Section 4.2. For BMPs that require sediment removal at regular intervals (i.e. every 5 or 10 years), the annual cost includes the annual percentage of that cost.

## Figures

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Figure 1: Site Plans (attached separately)

## Appendices

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## Appendix A

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### Operation and Maintenance Log



## **OPERATION AND MAINTENANCE LOG**

This template is intended to comply with the operation and maintenance log requirements of the 2008 DEP Stormwater Management Handbook. Copies of this log should be made for all inspections and kept on file for three years from the inspection date.

|   |
|---|
| <b>Name/Company of Inspector:</b>   |
| <b>Date/Time of Inspection:</b>   |
| <b>Weather Conditions:</b><br>(Note current weather and<br>any recent precipitation events) |

| Stormwater BMP | Inspection Observations | Actions Required |
|----------------|-------------------------|------------------|
|                |                         |                  |
|                |                         |                  |
|                |                         |                  |
|                |                         |                  |
|                |                         |                  |
|                |                         |                  |
|                |                         |                  |

## Appendix B

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### List of Emergency Contacts

### List of Emergency Contacts

Massachusetts DEP Hazardous Waste Incident Response Group  
(617) 792-7653

Town of Holliston Fire Department  
Emergencies: Dial 911  
59 Central Street  
Holliston, MA 01746  
Tel: (508) 429-4631  
Fire Chief: Michael R. Cassidy

Town of Holliston Police Department  
Emergencies: Dial 911  
550 Washington Street (Rt. 16)  
Holliston, MA 01746  
Tel: (508) 429-1212  
Police Chief: Matthew Stone

**Attachment 5**  
**Construction Period Erosion Pollution Prevention Plan**

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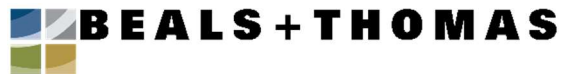
# Construction Sediment, Erosion & Pollution Prevention Plan

## BLAIR SQUARE SITE IMPROVEMENTS

**0 Railroad Bed  
Holliston, Massachusetts**

*Prepared for:*  
**Holliston Planning Board  
703 Washington Street  
Holliston, MA 01746**

*Presented by:*



**September 3, 2021**

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## 1.0 SITE EVALUATION, ASSESSMENT, AND PLANNING

The Construction Erosion, Sediment & Pollution Prevention Plan complies with the requirements of Standard 8 of the 2008 Massachusetts Department of Environmental Protection (DEP) Stormwater Handbook. The Plan outlines source control and pollution prevention measures, and maintenance requirements for the erosion and sediment control measures associated with the construction of the proposed project.

The proposed project will disturb just under 1 acre.

### 1.1 Responsible Party

Name of persons or entity responsible for Plan compliance, to be determined prior to construction.

|            |  |        |  |           |  |
|------------|--|--------|--|-----------|--|
| Company:   |  |        |  |           |  |
| Name:      |  |        |  |           |  |
| Address:   |  |        |  |           |  |
| City:      |  | State: |  | ZIP Code: |  |
| Telephone: |  | Fax:   |  |           |  |

### 1.2 Construction Sequencing Plan

**Before any site grading activities begin:**

1. Stake Limit of Construction. Workers shall be informed that no construction activity is to occur beyond this limit at any time.
2. Clear trees and vegetation as necessary as shown on the site preparation plan.
3. Grub the areas where trees are being removed, including stumps and roots as necessary. The existing ground surface shall be disturbed as little as possible prior to the start of construction.
4. Install erosion control barriers as shown on the plans. An adequate stockpile of erosion control materials shall be on site at all times for emergency or routine replacement and shall include materials to repair erosion controls, or any other devices planned for use during construction.
5. Construct staging and materials storage area.
6. Install temporary sanitary facilities and dumpsters.
7. Install temporary inlet protection in catch basins adjacent to site.

**Site grading:**

1. Establish soil stockpiles as necessary.
2. Install silt fences around stockpile and cover stockpiles. Disturbed areas where construction will cease for more than 14 days shall be stabilized with erosion controls.
3. Prepare subgrades for various improvements and install materials per specifications.
4. Monitor perimeter controls for sediment accumulation.
5. Sweep site entrance as needed to prevent sediment tracking onto street.

**Improvements:**

1. Install proposed park improvement features.

**Final stabilization and landscaping:**

1. Remove all temporary control BMPs and stabilize any areas disturbed by their removal with erosion controls.
2. Prepare final seeding and landscaping.
3. Monitor stabilized areas until final stabilization is reached.

**1.3 Erosion and Sediment Control BMPs**

This plan contains a listing of the erosion and sediment control best management practices (BMPs) that will be implemented to control pollutants in stormwater discharges. The BMPs are categorized under one of the areas of BMP activity as described below:

- 1.3.1** Minimize disturbed area and protect natural features and soil.
- 1.3.2** Control stormwater flowing onto and through the project.
- 1.3.3** Stabilize soils.
- 1.3.4** Establish perimeter controls and sediment barriers.



## 1.4 Minimize Disturbed Area and Protect Natural Features and Soil

### 1.4.1 Preserve Existing Vegetation

|                             |  |
|-----------------------------|--|
| Description:                | Preserved areas of existing vegetation as identified on the Site Plans and Sitework Specifications.  |
| Installation Schedule:      | Install temporary tree protection as identified on the Site Plans.   |
| Maintenance and Inspection: | The area shall be inspected weekly to ensure the protective measures are intact and functioning as intended. During construction, preserved areas of existing vegetation shall be clearly marked at all times. |

### 1.4.2 Stockpiling Soil Materials

|                             |  |
|-----------------------------|--|
| Description:                | Soil stockpiles shall be contained within the proposed limit of work.  |
| Installation Schedule:      | Soil stockpiles shall be established during grading activities. A silt fence and temporary erosion controls shall be installed immediately after the stockpile has been established.               |
| Maintenance and Inspection: | Stockpile areas shall be inspected weekly for erosion and immediately after storm events. Areas on or around the stockpile that have eroded shall be stabilized immediately with erosion controls. |

## 1.5 Control Stormwater Flowing Onto and Through the Project

The Contractor shall be responsible for controlling the flow of stormwater through the project site throughout the construction period. This may be accomplished through the implementation of temporary sediment basins, berms, swales, etc. These stormwater control measures shall be monitored after significant rainfall events and corrective actions taken if needed to ensure that sediment is being appropriately contained within the limits of work without detrimental impacts to adjacent resource areas or properties.

## 1.6 Stabilize Soil

### 1.6.1 Temporary Stabilization

|                             |  |
|-----------------------------|--|
| Description:                | Temporary vegetative cover shall be established using hydroseeding for areas of exposed soil (including stockpiles) where construction will cease for more than 14 days and seeded surfaces.   |
| Installation Schedule:      | Temporary stabilization measures shall be applied to portions of the site where construction activities will temporarily cease for more than 14 days.  |
| Maintenance and Inspection: | Stabilized areas shall be inspected weekly and after storm events until a dense cover of vegetation has become established. If failure is noticed at the seeded area, the area shall be reseeded, fertilized, and mulched immediately. |

### 1.6.2 Permanent Stabilization

|                             |  |
|-----------------------------|--|
| Description:                | Permanent stabilization shall be done immediately after the final design grades are achieved but no later than 14 days after construction ceases. Native species of plants shall be used to establish vegetative cover on exposed soils.   |
| Installation Schedule:      | Portions of the site where construction activities have permanently ceased shall be stabilized, as soon as possible but no later than 14 days after construction ceases.   |
| Maintenance and Inspection: | All seeded areas shall be inspected weekly during construction activities and after storm events until a dense cover of vegetation has been established. If failure is noticed at the seeded area, the area shall be reseeded, fertilized, and mulched immediately. After construction is completed at the site, permanently stabilized areas shall be monitored until final stabilization is reached. |

## 1.7 Establish Perimeter Controls and Sediment Barriers

### 1.7.1 Erosion Control Barrier

☐ Permanent

☒ Temporary

|                             |   |
|-----------------------------|---|
| Description:                | An erosion control barrier, consisting of a silt fence and straw bales shall be installed along the down gradient side of the proposed project to decrease the velocity of sheet flows and intercept and detain small amounts of sediment from disturbed areas.   |
| Installation Schedule:      | Erosion Control Barrier shall be installed prior to clearing and grubbing.  |
| Maintenance and Inspection: | Erosion Control Barrier shall be inspected weekly, following storms, and daily during rainy periods. Damaged ECB shall be replaced. Concentrated flows shall be intercepted and rerouted. Sediment accumulations shall be removed when reaching a depth of 6-inches. Deteriorated fencing material shall be replaced. Used fencing shall be properly disposed of. |

## 2.0 INSPECTION SCHEDULE AND PROCEDURES

Inspections of the site will be performed once every 7 days and within 24 hours of the end of a storm event of one-half inch or greater unless otherwise specified. The inspections will verify that all BMPs are implemented, maintained and effectively minimizing erosion and preventing stormwater contamination from construction materials.

Inspections shall include all areas of the site disturbed by construction activity and areas used for storage of materials that are exposed to precipitation. Inspectors shall look for evidence of, or the potential for, pollutants entering the storm water conveyance system. Sedimentation and erosion control measures identified in the plan shall be observed to ensure proper operation. Discharge locations shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to resource areas, where accessible. Where discharge locations are inaccessible, nearby downstream locations shall be inspected to the extent that such inspections are practicable. Locations where vehicles enter or exit the site shall be inspected for evidence of off-site sediment tracking.

If corrective actions are identified during the inspection, he/she shall notify and submit a copy of the inspection report to the project managers. For corrective actions identified, the project managers shall be responsible for initiating the corrective action within 24 hours of the report and completing maintenance as soon as possible or before the next storm event.

### **3.0 FINAL STABILIZATION**

Stabilization measures shall be initiated as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased. The following sections detail the management practices proposed to achieve final stabilization of the site.

#### **3.1 Permanent Seeding**

|                             |  |
|-----------------------------|--|
| Description:                | Permanent seeding shall be applied immediately after the final design grades are achieved on portions of the site but no later than 14 days after construction activities have permanently ceased. After the entire site is stabilized, any sediment that has accumulated shall be removed and hauled off-site for disposal at an approved landfill. Construction debris, trash and temporary BMPs (including silt fences, material storage areas, sanitary toilets, and inlet protection) shall also be removed and any areas disturbed during removal shall be seeded immediately. |
| Installation Schedule:      | Seeding shall occur at portions of the site where construction activities have permanently ceased shall be stabilized, as soon as possible but no later than 14 days after construction ceases.  |
| Maintenance and Inspection: | All seeded areas shall be inspected weekly during construction activities for failure and after storm events until a dense cover of vegetation has been established. If failure is noticed at the seeded area, the area shall be reseeded, fertilized, and mulched immediately. After construction is completed at the site, permanently stabilized areas shall be monitored until final stabilization is reached.   |

## **Appendix A**

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Site Plans Showing Erosion and Sediment  
Control Measures  
(Site Plans Attached Separately)

## **Appendix B**

### **Inspection and Maintenance Log**

Inspections under this Plan shall be conducted in accordance with each installed BMP's recommended maintenance requirements. This inspection frequency may be reduced to at least once every month if: a) the entire site is temporarily stabilized, b) runoff is unlikely due to winter conditions (e.g. site is covered with snow, ice, or the ground is frozen), or c) construction is occurring during seasonal arid periods in arid areas and semi-arid areas. If an inspection report is filed according to this modified schedule it shall be noted at the end of the report under the "NOTES" section.

The following four pages should be copied and completed for each inspection. All inspection forms should be compiled in a binder to prove compliance with this Plan.

## Construction Erosion, Sediment and Pollution Prevention Plan: Inspection Checklist

| General Information   |  |                |  |
|---|--|----------------|--|
| Project Name  |  |                |  |
| Location  |  |                |  |
| Date of Inspection  |  | Start/End Time |  |
| Inspector's Name(s)   |  |                |  |
| Inspector's Title(s)  |  |                |  |
| Inspector's Contact Information   |  |                |  |
| Inspector's Qualifications  |  |                |  |
| Describe present phase of construction  |  |                |  |
| <b>Type of Inspection:</b><br><input type="checkbox"/> Regular <input type="checkbox"/> Pre-storm event <input type="checkbox"/> During storm event <input type="checkbox"/> Post-storm event   |  |                |  |
| Weather Information   |  |                |  |
| <b>Has there been a storm event since the last inspection?</b> <input type="checkbox"/> Yes <input type="checkbox"/> No<br><b>If yes, provide:</b><br>Storm Start Date & Time: _____ Storm Duration (hrs): _____<br><br>Approx. Amount of Precipitation (in): _____   |  |                |  |
| <b>Weather at time of this inspection?</b><br><input type="checkbox"/> Clear <input type="checkbox"/> Cloudy <input type="checkbox"/> Rain <input type="checkbox"/> Sleet <input type="checkbox"/> Fog <input type="checkbox"/> Snowing <input type="checkbox"/> High Winds<br><input type="checkbox"/> Other: _____ Temperature: _____ |  |                |  |
| <b>Have any discharges occurred since the last inspection?</b> <input type="checkbox"/> Yes <input type="checkbox"/> No<br><b>If yes, describe:</b> _____   |  |                |  |
| <b>Are there any discharges at the time of inspection?</b> <input type="checkbox"/> Yes <input type="checkbox"/> No<br><b>If yes, describe:</b> _____   |  |                |  |

### Site-specific BMPs

- *Number the structural and non-structural BMPs identified on your site plan and list them below (add as many BMPs as necessary). Carry a copy of the numbered site map with you during your inspections. This list will ensure that you are inspecting all required BMPs at your site.*

| BMP | BMP<br>Installed?  | BMP<br>Maintenance<br>Required?                          | Corrective Action Needed and Notes |
|-----|--|--|------------------------------------|
|     | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
|     | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
|     | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
|     | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
|     | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
|     | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
|     | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
|     | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
|     | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
|     | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
|     | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
|     | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
|     | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
|     | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
|     | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
|     | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
|     | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
|     | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
|     | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
|     | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
|     | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |



### Overall Site Issues

*Below are some general site issues that should be assessed during inspections. Customize this list as needed for conditions at your site.*

| BMP/activity   | Implemented?   | Maintenance Required?                                    | Corrective Action Needed and Notes |
|--|--|--|------------------------------------|
| Are all slopes and disturbed areas not actively being worked properly stabilized?  | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
| Are natural resource areas (e.g., streams, wetlands, mature trees, etc.) protected with barriers or similar BMPs?            | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
| Are perimeter controls and sediment barriers adequately installed (keyed into substrate) and maintained?                     | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
| Are discharge points and receiving waters free of any sediment deposits?   | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
| Are storm drain inlets properly protected?   | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
| Is the construction exit preventing sediment from being tracked into the street?   | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
| Is trash/litter from work areas collected and placed in covered dumpsters?   | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
| Are washout facilities (e.g., paint, stucco, concrete) available, clearly marked, and maintained?                            | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
| Are vehicle and equipment fueling, cleaning, and maintenance areas free of spills, leaks, or any other deleterious material? | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |

| BMP/activity   | Implemented?   | Maintenance Required?                                    | Corrective Action Needed and Notes |
|--|--|--|------------------------------------|
| Are materials that are potential stormwater contaminants stored inside or under cover? | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
| Are non-stormwater discharges (e.g., wash water, dewatering) properly controlled?      | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |
| (Other)  | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |                                    |

#### Non-Compliance

|   |
|---|
| Describe any incidents of non-compliance not described above: |
|---|

#### CERTIFICATION STATEMENT

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

**Print name and title:**

\_\_\_\_\_

**Signature:** \_\_\_\_\_

**Date:** \_\_\_\_\_