ALLEN & MAJOR ASSOCIATES, INC.

May 26, 2023

Kathleen Colwell
Planning Division, Director
41 Pleasant Street
Methuen, MA 01844

RE: Taco John's
Drainage Summary Letter
436 Broadway
Methuen, MA 01844
Parcel No.: 610-123-47A
Revision 1

Dear Ms. Colwell:

On behalf of our client, Shri Swamine, LLC, Allen & Major Associates, Inc. (A&M) is pleased to provide this drainage summary in support of the Site Plan application for the proposed Taco John's fast-food restaurant within the existing Village Mall Plaza at 436 Broadway (Route 28). This analysis will demonstrate that the proposed project will match or reduce the rate and volume of runoff for all design storm events.

Existing Conditions

The site is located on the west side of Massachusetts Route 28, approximately 1,000± feet north of Massachusetts Route 213, Exit 2. It is comprised of a single parcel, identified on Tax Map 610, Block 123, Lot 47A. The site is currently developed with a multi-tenant building of approximately 97,200± square feet and 562 parking spaces. The parcel is abutted by various restaurants with Dunkin' Donuts to the north and Texas Roadhouse to the southeast. Elevations on site range from a high elevation of 148 in the southeast corner of the parcel, to a low elevation of 109 in the northwest corner of the parcel.

Stormwater flows on site are captured within various series of deep sump catch basins, discharging through multiple outlet pipes along the southern and western property lines. Stormwater from the front portion of the building is collected by a series of catch basins in the parking lot and is directed to a 30" reinforced concrete pipe located in the northwestern property corner, discharging offsite. Stormwater at the rear of the existing building sheet flows with the pavement grade, flowing offsite along the southern property line; The collected roof water is also discharged along the southern property line through a 12" metal outlet pipe. Stormwater generated within the depressed loading area and the drive aisle located west of the existing building is routed through various catch basins which outlet to an existing 24" reinforced concrete pipe that discharges along the western property line. A review of the NRCS soil report for Essex County indicates that the soil on site is primarily "Urban Land". The primary soil type for the undeveloped portions of the site is "Canton" fine sandy loam which is classified as Hydrologic Soil Group Type "B" soil. Copies of the NRCS soils report and the Existing Watershed Plan, sheet EWS-1, are included with this summary.

Proposed Conditions

The project proposes to construct a 2,200 square foot Taco John's fast-food restaurant with a drive-through. The proposed site work will produce substantially less pavement area on the overall parcel,

mitigating the rate of runoff and volume leaving the site. Many of the existing drainage structures within the system are to remain the same within the limit of disturbance, utilizing the existing drainpipes, manholes and catch basins within the project area. Two bioretention areas will also be introduced, providing treatment and infiltration for a portion of the runoff generated within the development. The project reduces the amount of parking on site, lessening the amount of impervious surface within the parcel while still maintaining an adequate number of parking spaces for all uses within the plaza.

Stormwater runoff was analyzed at the two study points to ensure that the project does not result in an increase in the peak rate and volume of runoff. Runoff generated within the redeveloped area will be captured and routed through the existing drainage network or routed through the Rain Guardian – Foxhole curb inlets to one of the bioretention areas. Runoff from the roof area will be captured within roof scuppers and directed to an existing manhole, discharging to the existing drainage system on-site. Please see the table below for the existing and proposed runoff rates and volumes generated within the project site. Copies of the HydroCAD worksheets and watershed plans are attached to this summary.

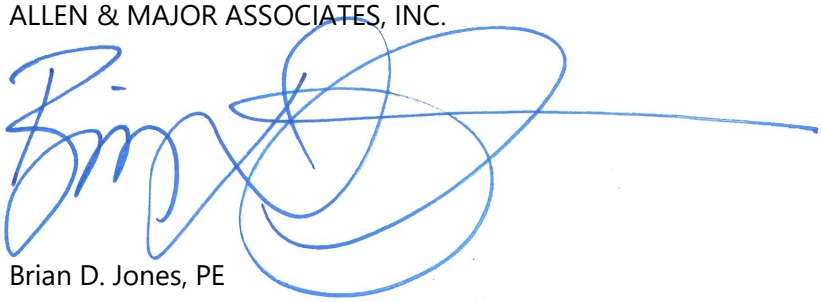
STUDY POINT #1 (Flow to Existing Drainage Network)				
	2-Year	10-Year	25-Year	100-Year
Existing Flow (CFS)	4.36	7.37	9.22	12.06
Proposed Flow (CFS)	3.28	6.49	8.58	11.55
Change (CFS)	**-1.08**	**-0.88**	**-0.64**	**-0.51**
Existing Volume (CF)	14,316	24,996	31,687	42,137
Proposed Volume (CF)	10,787	20,769	27,224	37,497
Change (CF)	**-3,529**	**-4,227**	**-4,463**	**-4,640**

STUDY POINT #2 (Flow to 450 Broadway)				
	2-Year	10-Year	25-Year	100-Year
Existing Flow (CFS)	0.09	0.29	0.44	0.69
Proposed Flow (CFS)	0.04	0.17	0.27	0.45
Change (CFS)	**-0.05**	**-0.12**	**-0.17**	**-0.24**
Existing Volume (CF)	339	949	1,400	2,170
Proposed Volume (CF)	188	589	898	1,436
Change (CF)	**-151**	**-360**	**-502**	**-734**

Summary

As shown in the table above, the proposed project will have a positive impact on the surrounding stormwater system by reducing the peak rate and volume of runoff leaving the site for all design storm events.

Very truly yours,
ALLEN & MAJOR ASSOCIATES, INC.



Brian D. Jones, PE
Senior Project Manager

Attachments:

1. NOAA Atlas 14 Precipitation Tables
2. NRCS Soil Report for Essex County
3. Existing HydroCAD worksheets
4. Proposed HydroCAD worksheets
5. Existing Watershed Plan, Sheet EWS-1
6. Proposed Watershed Plan, Sheet PWS-1

ALLEN & MAJOR ASSOCIATES, INC.

OPERATION & MAINTENANCE PLAN

Introduction

In accordance with the standards set forth by the Stormwater Management Policy issued by the Massachusetts Department of Environmental Protection (MassDEP), Allen & Major Associates, Inc. has prepared the following Operations & Maintenance (O&M) Plan for the existing development at 436 Broadway, Methuen, MA.

The plan is broken down into three major sections. The first section describes construction-related erosion and sedimentation controls (Demolition & Construction Maintenance Plan). The second section describes the long-term pollution prevention measures (Long Term Pollution Prevention Plan). The third section is a post-construction operation and maintenance plan designed to address the long-term maintenance needs of the stormwater management system (Long-Term Maintenance Plan – Facilities Description).

Notification Procedures for Change of Responsibility for O&M

The Stormwater Management System (SMS) for this project is owned by Shri Swamine LLC (owner). The owner shall be legally responsible for the long-term operation and maintenance of this SMS as outlined in this Operation and Maintenance Plan.

The owner shall submit an annual summary report and the completed Operation & Maintenance Schedule & Checklist to the Conservation Commission (via email or print copy), highlighting inspection and maintenance activities including performances of BMPs. Should ownership of the SMS change, the owner will continue to be responsible until the succeeding owner shall notify the Commission that the succeeding owner has assumed such responsibility. Upon subsequent transfers, the responsibility shall continue to be that of transferring owner until the transferee owner notifies the Commission of its assumption of responsibility.

In the event the SMS will serve multiple lots/owners, such as the subdivision of the existing parcel or creation of lease areas, the owner(s) shall establish an association on other legally enforceable arrangements under which the association or a single party shall have legal responsibility for the operation and maintenance of the entire SMS. The legal instrument creating such responsibility shall be recorded with the Registry of Deeds and promptly following its recording, a copy thereof shall be furnished to the Commission.

Contact Information

Stormwater Management System Owner:	Shri Swamine LLC PO Box 2022 Danvers, MA Phone: (617) 719-8591

Emergency Contact Information:

Shri Swamine (Owner/Operator)	Phone: (617) 719-8591
Allen & Major Associates, Inc. (Site Civil Engineer)	Phone: (781) 935-6889
Methuen Department of Public Works	Phone: (978) 983-8545
Methuen Conservation Commission	Phone: (978) 983-8650
Methuen Fire Department (non-emergency line)	Phone: (978) 983-8940
MassDEP Emergency Response	Phone: (888) 304-1133
Clean Harbors Inc (24-Hour Line)	Phone: (800) 645-8265

Demolition & Construction Maintenance Plan

1. Call Digsafe: 1-888-344-7233
2. Contact the City of Methuen at least three (3) days prior to start of demolition and/or construction activities.
3. Install Erosion Control measures as shown on the Plans prepared by A&M. The City shall review the installation of tubular barriers and silt sacks prior to the start of any site demolition work. Install Construction fencing if determined to be necessary at the commencement of construction.
4. Install construction entrances, tubular barriers, and silt sacks at the locations shown on the Site Preparation Plan prepared by A&M.
5. Site access shall be achieved only from the designated construction entrances.
6. Cut and clear trees in construction areas only (within the limit of work; see plans).
7. Stockpiles of materials subject to erosion shall be stabilized with erosion control matting or temporary seeding whenever practicable, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased.
8. Install silt sacks and straw bales around each drain inlet prior to any demolition and or construction activities.

9. All erosion control measures shall be inspected weekly and after every rainfall event. Records of these inspections shall be kept on-site for review.
10. All erosion control measures shall be maintained, repaired, or replaced as required or at the direction of the owner's engineer or the City.
11. Sediment accumulation up-gradient of the tubular barrier greater than 6" in depth shall be removed and disposed of in accordance with all applicable regulations.
12. If it appears that sediment is exiting the site, silt sacks shall be installed in all catch basins adjacent to the site. Sediment accumulation on all adjacent catch basin inlets shall be removed and the silt sack replaced if torn or damaged.
13. Install stone check dams on-site during construction as needed. Refer to the erosion control details. Temporary sediment basins combined with stone check damns shall be installed on-site during construction to control and collect runoff from upland areas of this site during demolition and construction activities.
14. The contractor shall comply with the Sedimentation and Erosion Control Notes as shown on the Site Development Plans and Specifications.
15. The stabilized construction entrances shall be inspected weekly and records of inspections kept. The entrances shall be maintained by adding additional clean, angular, durable stone to remove the soil from the construction vehicle's tires when exiting the site. If soil is still leaving the site via the construction vehicle tires, adjacent roadways shall be kept clean by street sweeping.
16. Dust pollution shall be controlled using on-site water trucks and/or an approved soil stabilization product.
17. During demolition and construction activities, Status Reports on compliance with this O&M Document shall be submitted weekly. The report shall document any deficiencies and corrective actions taken by the applicant.

Long-Term Pollution Prevention Plan

Standard #4 from the MassDEP Stormwater Management Handbook requires that a Long-Term Pollution Prevention Plan (LTPPP) be prepared and incorporated as part of the Operation and Maintenance Plan of the Stormwater Management System. The purpose of the LTPPP is to identify potential sources of pollution that may affect the quality of stormwater discharges, and to describe the implementation of practices to reduce the pollutants in stormwater discharges. The following items describe the source control and proper procedures of the LTPPP.

- Housekeeping
  The existing development has been designed to maintain a high level of water quality treatment for all stormwater discharge to the wetland areas. An Operation and Maintenance (O&M) plan has been prepared and is included in this section of the report. The owner (or its designee) is responsible for adherence to the O&M plan in a strict and complete manner.

- Storing of Materials & Water Products
  The trash and waste program for the site includes exterior dumpsters. There is a trash contractor used to pick up the waste material in the dumpsters. The stormwater drainage system has water quality inlets designed to capture trash and debris.

- Vehicle Washing
  Outdoor vehicle washing has the potential to result in high loads of nutrients, metals, and hydrocarbons during dry weather conditions, as the detergent-rich water used to wash the grime off the vehicle enters the stormwater drainage system. The existing development does not include any designated vehicle washing areas, nor is it expected that any vehicle washing will take place on-site.

- Spill Prevention & Response
  Sources of potential spill hazards include vehicle fluids, liquid fuels, pesticides, paints, solvents, and liquid cleaning products. The majority of the spill hazards would likely occur within the buildings and would not enter the stormwater drainage system. However, there are spill hazards from vehicle fluids or liquid fuels located outside of the buildings. These exterior spill hazards have the potential to enter the stormwater drainage system and are to be addressed as follows:

  1. Spill hazards of pesticides, paints, and solvents shall be remediated using the Manufacturers' recommended spill cleanup protocol.
  2. Vehicle fluids and liquid fuel spill shall be remediated according to the local and state regulations governing fuel spills.
  3. The owner shall have the following equipment and materials on hand to address a spill clean-up: brooms, dust pans, mops, rags, gloves, absorptive material, sand, sawdust, plastic and metal trash containers.
  4. All spills shall be cleaned up immediately after discovery.
  5. Spills of toxic or hazardous material shall be reported, regardless of size, to the Massachusetts Department of Environmental Protection at (888) 304-1333.

6. Should a spill occur, the pollution prevention plan will be adjusted to include measures to prevent another spill of a similar nature. A description of the spill, along with the causes and cleanup measures will be included in the updated pollution prevention plan.

- Maintenance of Lawns, Gardens, and Other Landscaped Areas

  It should be recognized that this is a general guideline towards achieving high quality and well-groomed landscaped areas. The grounds staff/landscape contractor must recognize the shortcomings of a general maintenance plan such as this, and modify and/or augment it based on weekly, monthly, and yearly observations. In order to assure the highest quality conditions, the staff must also recognize and appreciate the need to be aware of the constantly changing conditions of the landscaping and be able to respond to them on a proactive basis. No trees shall be planted over the drain lines or recharge area, and that only shallow rooted plants and shrubs will be allowed.

  - Fertilizer

    Maintenance practices should be aimed at reducing environmental, mechanical and pest stresses to promote healthy and vigorous growth. When necessary, pest outbreaks should be treated with the most sensitive control measure available. Synthetic chemical controls should be used only as a last resort to organic and biological control methods. Fertilizer, synthetic chemical controls and pest management applications (when necessary) shall be performed only by licensed applicators in accordance with the manufacturer's label instructions when environmental conditions are conducive to controlled product application.

    Only slow-release organic fertilizers should be used in the planting and mulch areas to limit the amount of nutrients that could enter downstream resource areas. Fertilization of the planting and mulch areas will be performed within manufacturers labeling instructions and shall not exceed an NPK ration of 1:1:1 (i.e. Triple 10 fertilizer mix), considered a low nitrogen mixture. Fertilizers approved for the use under this O&M Plan are as follows:

    Type: LESCO® 28-0-12 (Lawn Fertilizer)
    MERIT® 0.2 Plus Turf Fertilizer
    MOMENTUM™ Force Weed & Feed

  - Suggested Aeration Program

    In-season aeration of lawn areas is good cultural practice, and is recommended whenever feasible. It should be accomplished with a solid thin tine aeration method to reduce disruption to the use of the area. The

depth of solid tine aeration is similar to core type, but should be performed when the soil is somewhat drier for a greater overall effect.

Depending on the intensity of use, it can be expected that all landscaped lawn areas will need aeration to reduce compaction at least once per year. The first operation should occur in late May following the spring season. Methods of reducing compaction will vary based on the nature of the compaction. Compaction on newly established landscaped areas is generally limited to the top 2-3" and can be alleviated using hollow core or thin tine aeration methods.

The spring aeration should consist of two passes at opposite directions with 1/4" hollow core tines penetrating 3-5" into the soil profile. Aeration should occur when the soil is moist but not saturated. The soil cores should be shattered in place and dragged or swept back into the turf to control thatch. If desired the cores may also be removed and the area top-dressed with sand or sandy loam. If the area drains on average too slowly, the topdressing should contain a higher percentage of sand. If it is draining on average too quickly, the top dressing should contain a higher percentage of soil and organic matter.

- Landscape Maintenance Program Practices:
  - Lawn
    1. Mow a minimum of once a week in spring, to a height of 2" to 2 1/2" high. Mowing should be frequent enough so that no more than 1/3 of grass blade is removed at each mowing. The top growth supports the roots; the shorter the grass is cute, the less the roots will grow. Short cutting also dries out the soil and encourages weeds to germinate.
    2. Mow approximately once every two weeks from July 1st to August 15th depending on lawn growth.
    3. Mow on a ten-day cycle in fall, when growth is stimulated by cooler nights and increased moisture.
    4. Do not remove grass clippings after mowing.
    5. Keep mower blades sharp to prevent ragged cuts on grass leaves, which cause a brownish appearance and increase the chance for disease to enter a leaf.
  - Shrubs
    1. Mulch not more than 3" depth with shredded pine or fir bark.

2. Hand prune annually, immediately after blooming, to remove 1/3 of the above-ground biomass (older stems). Stem removals are to occur within 6" of the ground to open up shrub and maintain two-year wood (the blooming wood).
3. Hand-prune evergreen shrubs only as needed to remove dead and damaged wood and to maintain the naturalistic form of the shrub. Never mechanically shear evergreen shrubs.

- Trees
  1. Provide aftercare of new tree plantings for the first three years.
  2. Do not fertilize trees, it artificially stimulates them (unless tree health warrants).
  3. Water once a week for the first year; twice a month for the second; once a month for the third year.
  4. Prune trees on a four-year cycle.
- Invasive Species
  1. Inform the Conservation Commission Agent prior to the removal of invasive species proposed either through hand work or through chemical removal.

- Storage and Use of Herbicides and Pesticides

  Integrated Pest Management is the combination of all methods (of pest control) which may prevent, reduce, suppress, eliminate, or repel an insect population. The main requirements necessary to support any pest population are food, shelter and water, and any upset of the balance of these will assist in controlling a pest population. Scientific pest management is the knowledgeable use of all pest control methods (sanitation, mechanical, chemical) to benefit mankind's health, welfare, comfort, property and food. A Pest Management Professional (PMP) should be retained who is licensed with the Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs, Department of Agricultural Resources.

  The site manager will be provided with approved bulletin before entering into or renewing an agreement to apply pesticides for the control of indoor household or structural pests, refer to 333 CMR 13.08.

  Before beginning each application, the applicator must post a Department approved notice on all of the entrances to the treated room or area. The applicator must leave such notices posted after the application. The notice will be posted at conspicuous point(s) of access to the area treated. The location and number of

signs will be determined by the configuration of the area to be treated based on the applicator's best judgment. It is intended to give sufficient notice so that no one comes into an area being treated unaware that the applicator is working and pesticides are being applied. However, if the contracting entity does not want the signs posted, he/she may sign a Department approved waiver indicating this.

The applicator or employer will provide to any person upon their request the following information on previously conducted applications:

1. Name and phone number of pest control company;
2. Date and time of the application;
3. Name and license number of the applicator;
4. Target pests; and
5. Name and EPA Registration Number of pesticide products applied.

- Pet Waste Management
  The owner's landscape crew (or designee) shall remove any obvious pet waste that has been left behind by pet owners within the development. The pet waste shall be disposed of in accordance with local and state regulations.

- Management of Deicing Chemicals and Snow
  Snow will be stockpiled on site until the accumulated snow becomes a hazard to the daily operations of the site. It will be the responsibility of the snow removal contractor to properly dispose of transported snow according to MassDEP, Bureau of Resource Protection – Snow Disposal Guideline #BRPG01-01, governing the proper disposal of snow. It will be the responsibility of the snow removal contractor to follow these guidelines and all applicable laws and regulations

  The owner's maintenance staff (or its designee) will be responsible for the clearing of the sidewalk and building entrances. The owner may be required to use a de-icing agent such as potassium chloride to maintain a safe walking surface. If used, the de-icing agent for the walkways and building entrances will be kept within the storage rooms located within the building. If used, de-icing agents will not be stored outside. The owner's maintenance staff will limit the application of sand.

Long-Term Maintenance Plan – Facilities Description

A maintenance log will be kept (i.e. report) summarizing inspections, maintenance, and any corrective actions taken. The log will include the date on which each inspection or maintenance task was performed, a description of the inspection findings or maintenance completed, and the name of the inspector or maintenance personnel performing the task. If a maintenance task requires the clean-out of any sediments or debris, the location where the sediment and debris was disposed after removal will be indicated. The log will

be made accessible to department staff and a copy provided to the department upon request.

The following is a description of the Stormwater Management System for the project site.

Stormwater Collection System – On-Site:

The stormwater collection system is a series of inlets located at low points within the limits of the paved area. All of the proposed on-site catch basins incorporate a deep sump and hooded outlet. The catch basins are connected by a closed gravity pipe network. Rain Guardian Turrets are utilized at curb inlets to direct stormwater to various bioretention areas.

Structural Pretreatment BMPs: Regular maintenance of these BMPs is especially critical because they typically receive the highest concentration of suspended solids during the first flush of a storm event.

Deep Sump Catch Basin:
The deep sump catch basins consist of a man-hole type structure that contains inlet and or outlet pipes to further advance stormwater through the proposed drainage system. The size of the pipes used and invert elevations vary throughout the project site. The catch basins use the inlet grate that is flush to grade to capture runoff and sediment, moving the water through the system and capturing the sediment to be removed. The sediment that accumulates within the bottom of the structure needs to be cleaned periodically.

Rain Guardian - Turret:

It is recommended that the Rain Guardian - Turret be inspected at least twice a year. If observed, remove trash and debris at each inspection. Replace the grate if damaged by inspection.

Nyloplast Area Drain:

It is recommended that the beehive grate and outlet pipe be inspected at least twice a year. If observed, remove trash and debris at each inspection. Replace the beehive grate if damaged by inspection.

Treatment BMPs:

Bioretention Area:

It is recommended that the bioretention areas be inspected at least twice a year and with any rainfall event exceeding 2.5 inches in a 24-hour period. Trash and debris observed in the bioretention area (if any) shall be removed.

Other Maintenance Activity:

- Mosquito Control - Both above ground and underground stormwater BMPs have the potential to serve as mosquito breeding areas. Good design, proper operation and maintenance, and treatment with larvicides can minimize this potential. See the supplemental information for Mosquito Control in Stormwater Management Practices, and the Operation and Maintenance Plan Schedule for inspection schedule.
- Street Sweeping - Clear accumulations of winter sand in parking lots and along roadways at least once a year, preferably in the spring. Accumulations on pavement may be removed by pavement sweeping. Accumulations of sand along road shoulders may be removed by grading excess sand to the pavement edge and removing it manually or by a front-end loader.

Inspection and Maintenance Frequency and Corrective Measures

In accordance with MA DEP Stormwater Handbook: Volume 2, Chapter 2; the previously described BMPs will be inspected and the identified deficiencies will be corrected. Clean-out must include the removal and legal disposal of any accumulated sediments, trash, and debris. In any and all cases, operations, inspections, and maintenance activities shall utilize best practical measures to avoid and minimize impacts to wetland resource areas outside the footprint of the SMS.

NOAA Atlas 14, Volume 10, Version 3
Location name: Methuen, Massachusetts, USA*
Latitude: 42.7361°, Longitude: -71.1962°
Elevation: 137 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.310** (0.242-0.390)	**0.369** (0.287-0.465)	**0.466** (0.362-0.589)	**0.546** (0.422-0.695)	**0.657** (0.491-0.871)	**0.740** (0.542-1.00)	**0.827** (0.587-1.16)	**0.923** (0.622-1.33)	**1.06** (0.687-1.58)	**1.17** (0.742-1.78)
10-min	**0.439** (0.342-0.553)	**0.523** (0.407-0.659)	**0.660** (0.512-0.835)	**0.774** (0.597-0.983)	**0.930** (0.695-1.23)	**1.05** (0.767-1.42)	**1.17** (0.832-1.64)	**1.31** (0.882-1.88)	**1.50** (0.974-2.24)	**1.66** (1.05-2.52)
15-min	**0.517** (0.403-0.650)	**0.615** (0.479-0.775)	**0.776** (0.602-0.981)	**0.910** (0.703-1.16)	**1.10** (0.818-1.45)	**1.23** (0.903-1.67)	**1.38** (0.979-1.94)	**1.54** (1.04-2.21)	**1.77** (1.15-2.63)	**1.95** (1.24-2.96)
30-min	**0.712** (0.555-0.896)	**0.848** (0.660-1.07)	**1.07** (0.830-1.35)	**1.25** (0.968-1.60)	**1.51** (1.13-2.00)	**1.70** (1.24-2.30)	**1.90** (1.35-2.66)	**2.12** (1.43-3.05)	**2.43** (1.58-3.62)	**2.69** (1.70-4.08)
60-min	**0.907** (0.707-1.14)	**1.08** (0.841-1.36)	**1.36** (1.06-1.72)	**1.60** (1.23-2.03)	**1.92** (1.44-2.55)	**2.16** (1.58-2.93)	**2.42** (1.72-3.39)	**2.70** (1.82-3.88)	**3.10** (2.01-4.61)	**3.42** (2.17-5.20)
2-hr	**1.16** (0.912-1.45)	**1.39** (1.09-1.75)	**1.77** (1.39-2.23)	**2.09** (1.62-2.64)	**2.52** (1.90-3.34)	**2.84** (2.10-3.86)	**3.19** (2.30-4.50)	**3.60** (2.44-5.16)	**4.23** (2.75-6.26)	**4.76** (3.02-7.17)
3-hr	**1.34** (1.06-1.67)	**1.61** (1.27-2.02)	**2.06** (1.62-2.58)	**2.44** (1.90-3.07)	**2.95** (2.23-3.90)	**3.33** (2.47-4.51)	**3.74** (2.71-5.28)	**4.25** (2.88-6.06)	**5.02** (3.27-7.41)	**5.69** (3.62-8.56)
6-hr	**1.70** (1.35-2.11)	**2.06** (1.64-2.56)	**2.66** (2.10-3.31)	**3.15** (2.48-3.95)	**3.83** (2.92-5.04)	**4.33** (3.24-5.84)	**4.88** (3.56-6.87)	**5.56** (3.78-7.88)	**6.62** (4.32-9.71)	**7.54** (4.81-11.3)
12-hr	**2.13** (1.70-2.62)	**2.60** (2.08-3.21)	**3.38** (2.69-4.18)	**4.02** (3.18-5.00)	**4.90** (3.76-6.42)	**5.55** (4.18-7.44)	**6.26** (4.60-8.76)	**7.14** (4.88-10.1)	**8.51** (5.58-12.4)	**9.69** (6.20-14.4)
24-hr	**2.51** (2.02-3.08)	**3.11** (2.51-3.82)	**4.10** (3.29-5.05)	**4.92** (3.92-6.09)	**6.04** (4.67-7.88)	**6.87** (5.21-9.18)	**7.78** (5.75-10.9)	**8.92** (6.11-12.5)	**10.7** (7.04-15.5)	**12.3** (7.87-18.1)
2-day	**2.81** (2.28-3.42)	**3.55** (2.88-4.32)	**4.75** (3.84-5.81)	**5.75** (4.62-7.08)	**7.13** (5.56-9.26)	**8.13** (6.22-10.8)	**9.25** (6.91-12.9)	**10.7** (7.35-14.9)	**13.0** (8.58-18.8)	**15.1** (9.71-22.1)
3-day	**3.08** (2.52-3.74)	**3.87** (3.16-4.70)	**5.16** (4.19-6.29)	**6.23** (5.03-7.64)	**7.70** (6.03-9.98)	**8.78** (6.74-11.7)	**9.98** (7.48-13.9)	**11.5** (7.95-16.0)	**14.0** (9.28-20.2)	**16.3** (10.5-23.8)
4-day	**3.35** (2.74-4.05)	**4.16** (3.40-5.04)	**5.49** (4.47-6.68)	**6.59** (5.34-8.06)	**8.11** (6.37-10.5)	**9.22** (7.10-12.2)	**10.5** (7.85-14.5)	**12.1** (8.33-16.7)	**14.6** (9.69-21.0)	**16.9** (10.9-24.7)
7-day	**4.08** (3.36-4.91)	**4.92** (4.05-5.94)	**6.30** (5.16-7.62)	**7.44** (6.06-9.06)	**9.02** (7.11-11.6)	**10.2** (7.86-13.4)	**11.4** (8.61-15.7)	**13.1** (9.08-18.0)	**15.7** (10.4-22.4)	**18.0** (11.7-26.2)
10-day	**4.74** (3.92-5.69)	**5.61** (4.63-6.74)	**7.02** (5.78-8.48)	**8.20** (6.70-9.95)	**9.82** (7.76-12.5)	**11.0** (8.52-14.4)	**12.3** (9.25-16.8)	**14.0** (9.72-19.2)	**16.5** (11.0-23.5)	**18.8** (12.2-27.2)
20-day	**6.63** (5.53-7.92)	**7.59** (6.32-9.07)	**9.15** (7.59-11.0)	**10.5** (8.61-12.6)	**12.2** (9.70-15.4)	**13.6** (10.5-17.4)	**15.0** (11.2-20.0)	**16.6** (11.6-22.6)	**18.9** (12.7-26.6)	**20.8** (13.5-29.9)
30-day	**8.21** (6.88-9.77)	**9.25** (7.73-11.0)	**10.9** (9.11-13.1)	**12.3** (10.2-14.8)	**14.3** (11.3-17.8)	**15.7** (12.2-20.0)	**17.2** (12.8-22.6)	**18.8** (13.2-25.5)	**20.9** (14.1-29.4)	**22.6** (14.7-32.4)
45-day	**10.2** (8.60-12.1)	**11.3** (9.53-13.5)	**13.2** (11.0-15.7)	**14.7** (12.2-17.6)	**16.8** (13.4-20.8)	**18.4** (14.3-23.2)	**20.0** (14.8-26.0)	**21.6** (15.2-29.1)	**23.5** (15.9-32.9)	**25.0** (16.3-35.7)
60-day	**11.9** (10.1-14.1)	**13.1** (11.1-15.5)	**15.1** (12.7-17.9)	**16.7** (13.9-19.9)	**18.9** (15.1-23.3)	**20.6** (16.0-25.9)	**22.3** (16.5-28.8)	**23.9** (16.9-32.1)	**25.8** (17.4-35.9)	**27.1** (17.7-38.6)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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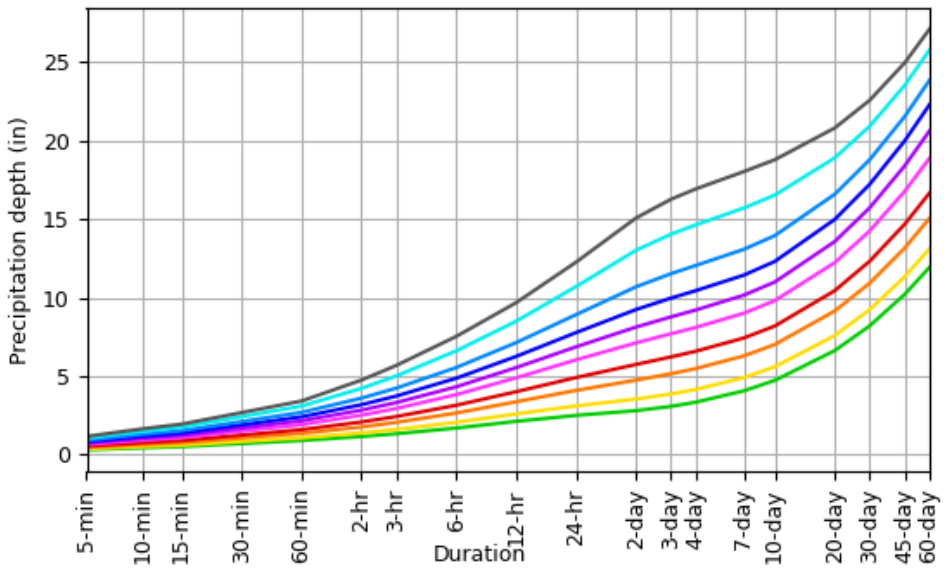
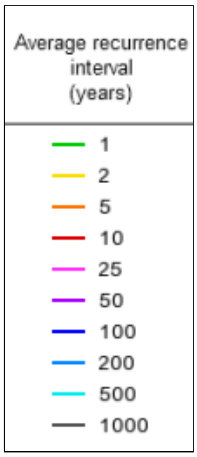
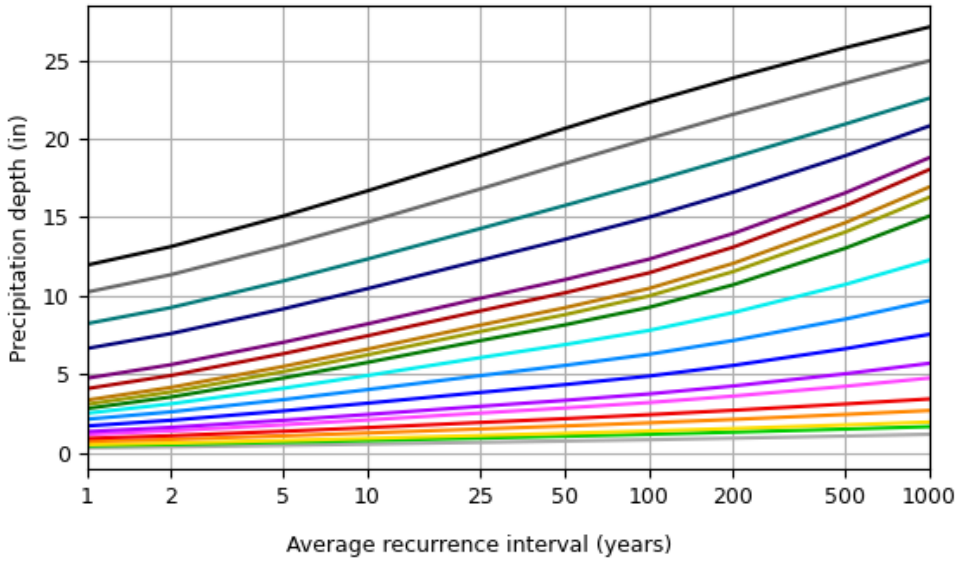
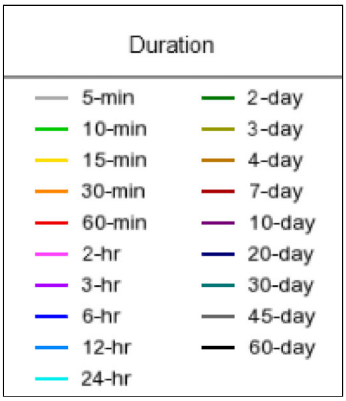
PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 42.7361°, Longitude: -71.1962°









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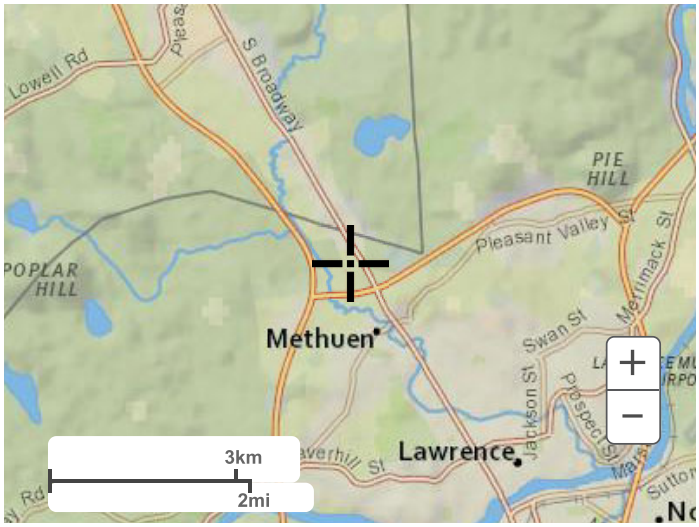
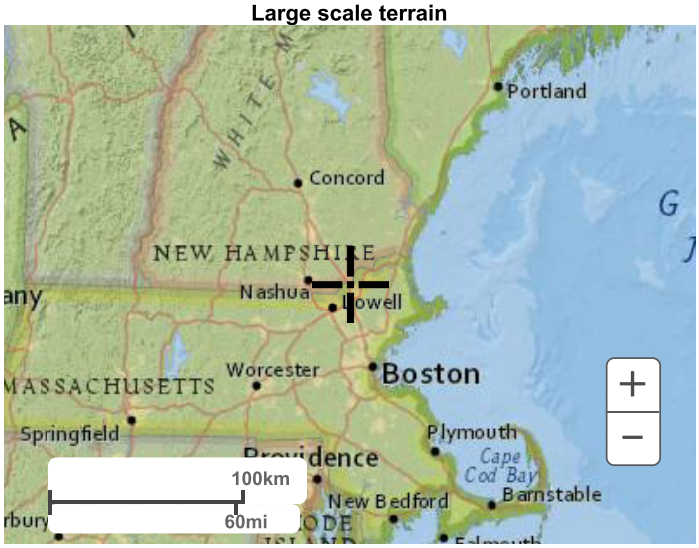
Maps & aerials

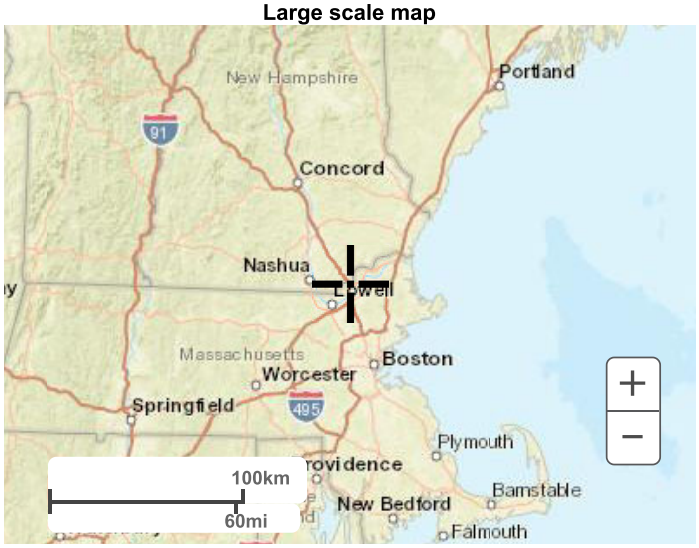
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

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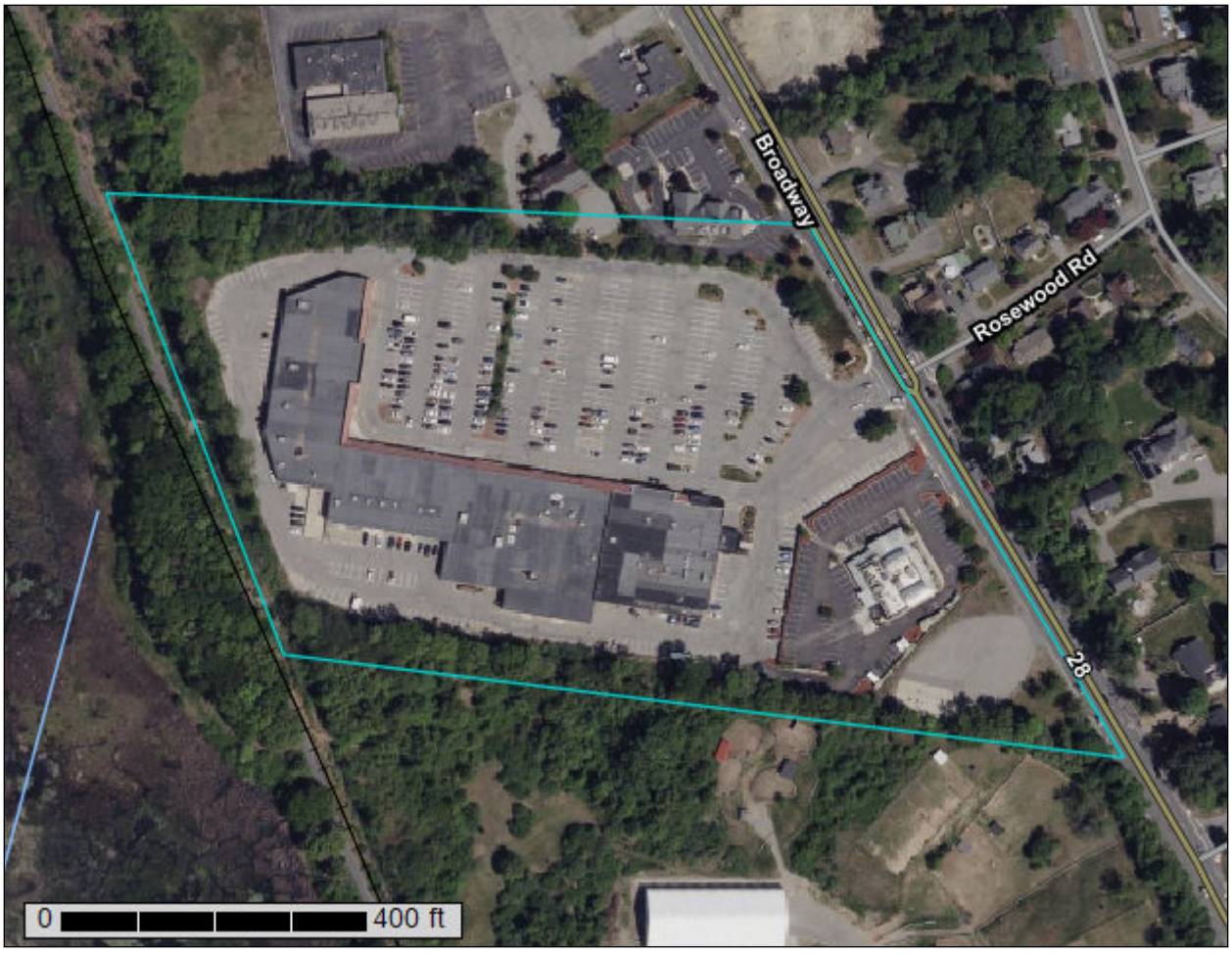
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Essex County, Massachusetts, Northern Part



March 16, 2023

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:2,230 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 100 200 400 600

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

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: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 18, Sep 9, 2022

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

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
256A	Deerfield loamy fine sand, 0 to 3 percent slopes	0.3	2.4%
421C	Canton fine sandy loam, 8 to 15 percent slopes, very stony	1.6	10.9%
602	Urban land	9.9	68.9%
713A	Limerick and Rumney soils, 0 to 3 percent slopes, frequently flooded	0.1	0.4%
717E	Rock outcrop-Charlton-Hollis complex, 15 to 35 percent slopes	2.5	17.4%
Totals for Area of Interest		**14.4**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it

was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Essex County, Massachusetts, Northern Part

256A—Deerfield loamy fine sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2xfg8
Elevation: 0 to 1,100 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Deerfield and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Deerfield

Setting

Landform: Outwash terraces, outwash deltas, outwash plains, kame terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Parent material: Sandy outwash derived from granite, gneiss, and/or quartzite

Typical profile

Ap - 0 to 9 inches: loamy fine sand
Bw - 9 to 25 inches: loamy fine sand
BC - 25 to 33 inches: fine sand
Cg - 33 to 60 inches: sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: About 15 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Sodium adsorption ratio, maximum: 11.0
Available water supply, 0 to 60 inches: Moderate (about 6.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: A
Ecological site: F144AY027MA - Moist Sandy Outwash
Hydric soil rating: No

Minor Components

Windsor

Percent of map unit: 7 percent
Landform: Outwash terraces, kame terraces, outwash deltas, outwash plains
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Wareham

Percent of map unit: 5 percent
Landform: Drainageways, depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Sudbury

Percent of map unit: 2 percent
Landform: Outwash plains, kame terraces, outwash deltas, outwash terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Ninigret

Percent of map unit: 1 percent
Landform: Kame terraces, outwash plains, outwash terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex, linear
Across-slope shape: Convex, concave
Hydric soil rating: No

421C—Canton fine sandy loam, 8 to 15 percent slopes, very stony

Map Unit Setting

National map unit symbol: 2w814
Elevation: 0 to 1,160 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Canton, very stony, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Canton, Very Stony

Setting

Landform: Moraines, ridges, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy melt-out till derived from gneiss, granite, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 5 inches: fine sandy loam
Bw1 - 5 to 16 inches: fine sandy loam
Bw2 - 16 to 22 inches: gravelly fine sandy loam
2C - 22 to 67 inches: gravelly loamy sand

Properties and qualities

Slope: 8 to 15 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: 19 to 39 inches to strongly contrasting textural stratification
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Minor Components

Montauk, very stony

Percent of map unit: 6 percent
Landform: Recessionial moraines, ground moraines, hills, drumlins
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Scituate, very stony

Percent of map unit: 5 percent
Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope

Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Chatfield, very stony

Percent of map unit: 3 percent
Landform: Hills, ridges
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Swansea

Percent of map unit: 1 percent
Landform: Marshes, depressions, bogs, swamps, kettles
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

602—Urban land

Map Unit Setting

National map unit symbol: vjx3
Frost-free period: 125 to 165 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Parent material: Excavated and filled land

Minor Components

Udorthents

Percent of map unit: 10 percent
Hydric soil rating: No

Hinckley

Percent of map unit: 2 percent
Hydric soil rating: No

Charlton

Percent of map unit: 2 percent
Hydric soil rating: No

Windsor
Percent of map unit: 2 percent
Hydric soil rating: No

Merrimac
Percent of map unit: 2 percent
Hydric soil rating: No

Paxton
Percent of map unit: 2 percent
Hydric soil rating: No

713A—Limerick and Rumney soils, 0 to 3 percent slopes, frequently flooded

Map Unit Setting
National map unit symbol: 2zvfc
Elevation: 10 to 2,000 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition
Limerick and similar soils: 60 percent
Rumney and similar soils: 25 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Limerick

Setting
Landform: Alluvial flats
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Coarse-silty alluvium derived from mica schist over friable sandy alluvium derived from mica schist

Typical profile
H1 - 0 to 13 inches: silt loam
H2 - 13 to 25 inches: silt loam
H3 - 25 to 60 inches: very fine sandy loam

Properties and qualities
Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)

Depth to water table: About 6 to 10 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very high (about 13.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: B/D
Ecological site: F144AY015NY - Wet Silty Low Floodplain
Hydric soil rating: Yes

Description of Rumney

Setting

Landform: Alluvial flats
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Coarse-loamy alluvium over sandy alluvium

Typical profile

O - 0 to 2 inches: muck
H2 - 2 to 7 inches: fine sandy loam
H3 - 7 to 31 inches: fine sandy loam
H4 - 31 to 60 inches: stratified gravelly sand to loamy sand to coarse sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: NoneFrequent
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A/D
Ecological site: F144AY014CT - Wet Sandy Low Floodplain
Hydric soil rating: Yes

Minor Components

Winooski

Percent of map unit: 10 percent
Hydric soil rating: No

Saco variant

Percent of map unit: 5 percent
Landform: Alluvial flats
Hydric soil rating: Yes

717E—Rock outcrop-Charlton-Hollis complex, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: vjrb
Elevation: 0 to 260 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 125 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Rock outcrop: 40 percent
Charlton and similar soils: 30 percent
Hollis and similar soils: 15 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rock Outcrop

Setting

Parent material: Granite and gneiss

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: Unranked

Description of Charlton

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Friable coarse-loamy eolian deposits over friable coarse-loamy basal till derived from granite and gneiss

Typical profile

H1 - 0 to 4 inches: fine sandy loam
H2 - 4 to 28 inches: gravelly fine sandy loam
H3 - 28 to 60 inches: gravelly fine sandy loam

Properties and qualities

Slope: 15 to 25 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent

Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Description of Hollis

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Shallow, friable loamy eolian deposits over granite and gneiss

Typical profile

O - 0 to 1 inches: muck
H2 - 1 to 6 inches: fine sandy loam
H3 - 6 to 17 inches: gravelly fine sandy loam
H4 - 17 to 20 inches: unweathered bedrock

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 10 to 60 inches to lithic bedrock
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: F144AY033MA - Shallow Dry Till Uplands
Hydric soil rating: No

Minor Components

Sutton

Percent of map unit: 5 percent
Hydric soil rating: No

Chatfield

Percent of map unit: 5 percent

Hydric soil rating: No

Leicester

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Physical Properties

Soil Physical Properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

Saturated Hydraulic Conductivity (Ksat)

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity is considered in the design of soil drainage systems and septic tank absorption fields.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

The numeric Ksat values have been grouped according to standard Ksat class limits.

Custom Soil Resource Report
Map—Saturated Hydraulic Conductivity (Ksat)

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

<= 9.1700

> 9.1700 and <= 52.0359

> 52.0359 and <= 100.0000

Not rated or not available

Soil Rating Lines

<= 9.1700

> 9.1700 and <= 52.0359

> 52.0359 and <= 100.0000

Not rated or not available

Soil Rating Points

<= 9.1700

> 9.1700 and <= 52.0359

> 52.0359 and <= 100.0000

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

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: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 18, Sep 9, 2022

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

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

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.

Table—Saturated Hydraulic Conductivity (Ksat)

Map unit symbol	Map unit name	Rating (micrometers per second)	Acres in AOI	Percent of AOI
256A	Deerfield loamy fine sand, 0 to 3 percent slopes	100.0000	0.3	2.4%
421C	Canton fine sandy loam, 8 to 15 percent slopes, very stony	52.0359	1.6	10.9%
602	Urban land		9.9	68.9%
713A	Limerick and Rumney soils, 0 to 3 percent slopes, frequently flooded	9.1700	0.1	0.4%
717E	Rock outcrop-Charlton-Hollis complex, 15 to 35 percent slopes		2.5	17.4%
Totals for Area of Interest			**14.4**	**100.0%**

Rating Options—Saturated Hydraulic Conductivity (Ksat)

Units of Measure: micrometers per second

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Fastest

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): Depth Range (Weighted Average)

Top Depth: 1

Bottom Depth: 100

Units of Measure: Inches

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

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.

Custom Soil Resource Report
Map—Hydrologic Soil Group

Map Scale: 1:2,230 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 100 200 400 600

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

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

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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: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 18, Sep 9, 2022

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

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

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.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
256A	Deerfield loamy fine sand, 0 to 3 percent slopes	A	0.3	2.4%
421C	Canton fine sandy loam, 8 to 15 percent slopes, very stony	B	1.6	10.9%
602	Urban land		9.9	68.9%
713A	Limerick and Rumney soils, 0 to 3 percent slopes, frequently flooded	B/D	0.1	0.4%
717E	Rock outcrop-Charlton-Hollis complex, 15 to 35 percent slopes		2.5	17.4%
Totals for Area of Interest			**14.4**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

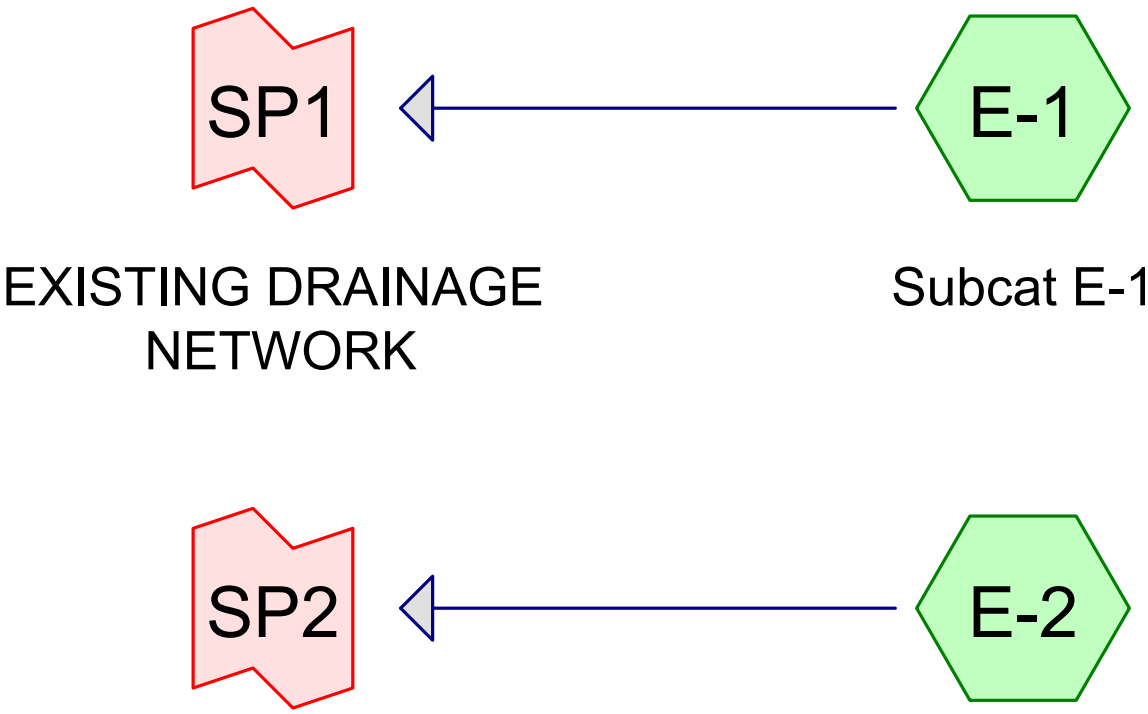
United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf



Subcat Reach Pond Link

Routing Diagram for 3115-01A - Existing HydroCAD
Prepared by Allen & Major Associates, Inc, Printed 5/30/2023

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-year	Type III 24-hr		Default	24.00	1	3.11	2
2	10-year	Type III 24-hr		Default	24.00	1	4.92	2
3	25-year	Type III 24-hr		Default	24.00	1	6.04	2
4	100-year	Type III 24-hr		Default	24.00	1	7.78	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
14,893	61	>75% Grass cover, Good, HSG B (E-1, E-2)
64,724	98	Paved parking, HSG B (E-1, E-2)

Summary for Subcatchment E-1: Subcat E-1

Runoff = 4.36 cfs @ 12.09 hrs, Volume= 14,316 cf, Depth= 2.36"
Routed to Link SP1 : EXISTING DRAINAGE NETWORK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.11"

Area (sf)	CN	Description
8,929	61	>75% Grass cover, Good, HSG B
63,885	98	Paved parking, HSG B
72,814	93	Weighted Average
8,929		12.26% Pervious Area
63,885		87.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	33	0.0200	0.13		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.11"
0.2	12	0.0400	1.17		**Sheet Flow, B-C** Smooth surfaces n= 0.011 P2= 3.11"
2.0	332	0.0180	2.72		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
6.3	377	Total			

Summary for Subcatchment E-2: Subcat E-2

Runoff = 0.09 cfs @ 12.11 hrs, Volume= 339 cf, Depth= 0.60"
Routed to Link SP2 : 450 BROADWAY

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.11"

Area (sf)	CN	Description
5,964	61	>75% Grass cover, Good, HSG B
839	98	Paved parking, HSG B
6,802	66	Weighted Average
5,964		87.67% Pervious Area
839		12.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	50	0.0600	0.23		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.11"
1.2	91	0.0330	1.27		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
4.9	141	Total, Increased to minimum Tc = 6.0 min			

Summary for Link SP1: EXISTING DRAINAGE NETWORK

Inflow Area = 72,814 sf, 87.74% Impervious, Inflow Depth = 2.36" for 2-year event
Inflow = 4.36 cfs @ 12.09 hrs, Volume= 14,316 cf
Primary = 4.36 cfs @ 12.09 hrs, Volume= 14,316 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP2: 450 BROADWAY

Inflow Area = 6,802 sf, 12.33% Impervious, Inflow Depth = 0.60" for 2-year event
Inflow = 0.09 cfs @ 12.11 hrs, Volume= 339 cf
Primary = 0.09 cfs @ 12.11 hrs, Volume= 339 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Subcatchment E-1: Subcat E-1

Runoff = 7.37 cfs @ 12.09 hrs, Volume= 24,996 cf, Depth= 4.12"
Routed to Link SP1 : EXISTING DRAINAGE NETWORK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.92"

Area (sf)	CN	Description
8,929	61	>75% Grass cover, Good, HSG B
63,885	98	Paved parking, HSG B
72,814	93	Weighted Average
8,929		12.26% Pervious Area
63,885		87.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	33	0.0200	0.13		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.11"
0.2	12	0.0400	1.17		**Sheet Flow, B-C** Smooth surfaces n= 0.011 P2= 3.11"
2.0	332	0.0180	2.72		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
6.3	377	Total			

Summary for Subcatchment E-2: Subcat E-2

Runoff = 0.29 cfs @ 12.10 hrs, Volume= 949 cf, Depth= 1.67"
Routed to Link SP2 : 450 BROADWAY

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.92"

Area (sf)	CN	Description
5,964	61	>75% Grass cover, Good, HSG B
839	98	Paved parking, HSG B
6,802	66	Weighted Average
5,964		87.67% Pervious Area
839		12.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	50	0.0600	0.23		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.11"
1.2	91	0.0330	1.27		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
4.9	141	Total, Increased to minimum Tc = 6.0 min			

Summary for Link SP1: EXISTING DRAINAGE NETWORK

Inflow Area = 72,814 sf, 87.74% Impervious, Inflow Depth = 4.12" for 10-year event
Inflow = 7.37 cfs @ 12.09 hrs, Volume= 24,996 cf
Primary = 7.37 cfs @ 12.09 hrs, Volume= 24,996 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP2: 450 BROADWAY

Inflow Area = 6,802 sf, 12.33% Impervious, Inflow Depth = 1.67" for 10-year event
Inflow = 0.29 cfs @ 12.10 hrs, Volume= 949 cf
Primary = 0.29 cfs @ 12.10 hrs, Volume= 949 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Subcatchment E-1: Subcat E-1

Runoff = 9.22 cfs @ 12.09 hrs, Volume= 31,687 cf, Depth= 5.22"
Routed to Link SP1 : EXISTING DRAINAGE NETWORK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-year Rainfall=6.04"

Area (sf)	CN	Description
8,929	61	>75% Grass cover, Good, HSG B
63,885	98	Paved parking, HSG B
72,814	93	Weighted Average
8,929		12.26% Pervious Area
63,885		87.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	33	0.0200	0.13		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.11"
0.2	12	0.0400	1.17		**Sheet Flow, B-C** Smooth surfaces n= 0.011 P2= 3.11"
2.0	332	0.0180	2.72		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
6.3	377	Total			

Summary for Subcatchment E-2: Subcat E-2

Runoff = 0.44 cfs @ 12.10 hrs, Volume= 1,400 cf, Depth= 2.47"
Routed to Link SP2 : 450 BROADWAY

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-year Rainfall=6.04"

Area (sf)	CN	Description
5,964	61	>75% Grass cover, Good, HSG B
839	98	Paved parking, HSG B
6,802	66	Weighted Average
5,964		87.67% Pervious Area
839		12.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	50	0.0600	0.23		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.11"
1.2	91	0.0330	1.27		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
4.9	141	Total, Increased to minimum Tc = 6.0 min			

Summary for Link SP1: EXISTING DRAINAGE NETWORK

Inflow Area = 72,814 sf, 87.74% Impervious, Inflow Depth = 5.22" for 25-year event
Inflow = 9.22 cfs @ 12.09 hrs, Volume= 31,687 cf
Primary = 9.22 cfs @ 12.09 hrs, Volume= 31,687 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP2: 450 BROADWAY

Inflow Area = 6,802 sf, 12.33% Impervious, Inflow Depth = 2.47" for 25-year event
Inflow = 0.44 cfs @ 12.10 hrs, Volume= 1,400 cf
Primary = 0.44 cfs @ 12.10 hrs, Volume= 1,400 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Subcatchment E-1: Subcat E-1

Runoff = 12.06 cfs @ 12.09 hrs, Volume= 42,137 cf, Depth= 6.94"
Routed to Link SP1 : EXISTING DRAINAGE NETWORK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=7.78"

Area (sf)	CN	Description
8,929	61	>75% Grass cover, Good, HSG B
63,885	98	Paved parking, HSG B
72,814	93	Weighted Average
8,929		12.26% Pervious Area
63,885		87.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	33	0.0200	0.13		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.11"
0.2	12	0.0400	1.17		**Sheet Flow, B-C** Smooth surfaces n= 0.011 P2= 3.11"
2.0	332	0.0180	2.72		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
6.3	377	Total			

Summary for Subcatchment E-2: Subcat E-2

Runoff = 0.69 cfs @ 12.09 hrs, Volume= 2,170 cf, Depth= 3.83"
Routed to Link SP2 : 450 BROADWAY

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=7.78"

Area (sf)	CN	Description
5,964	61	>75% Grass cover, Good, HSG B
839	98	Paved parking, HSG B
6,802	66	Weighted Average
5,964		87.67% Pervious Area
839		12.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	50	0.0600	0.23		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.11"
1.2	91	0.0330	1.27		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
4.9	141	Total, Increased to minimum Tc = 6.0 min			

Summary for Link SP1: EXISTING DRAINAGE NETWORK

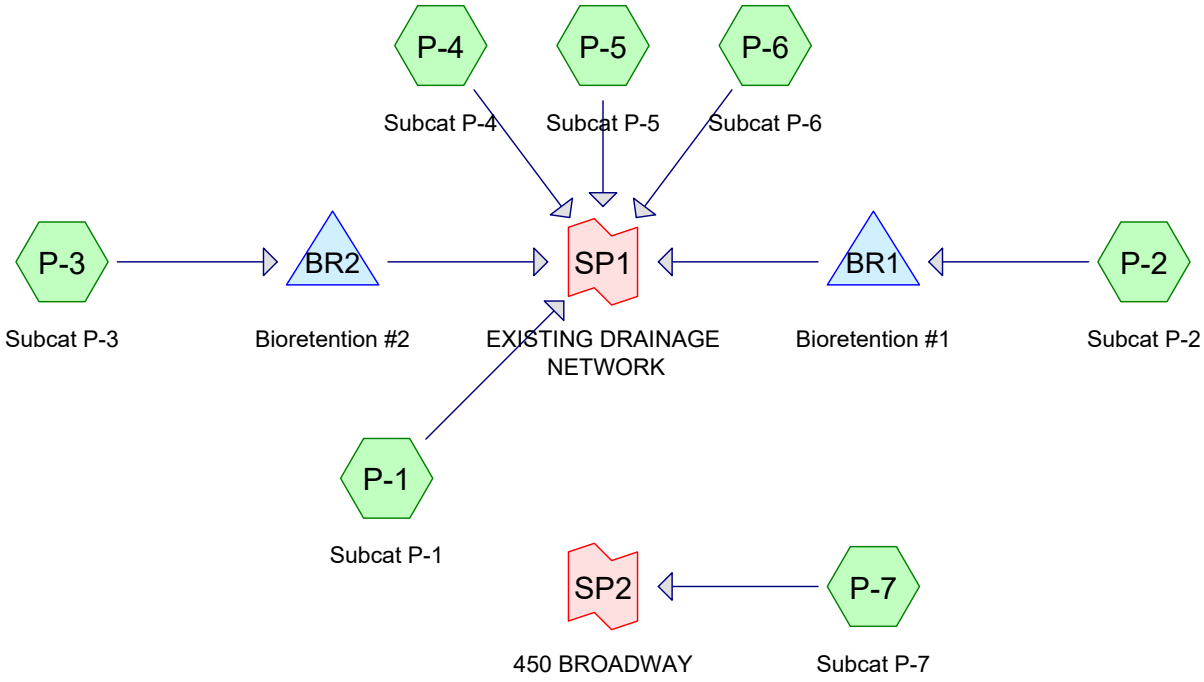
Inflow Area = 72,814 sf, 87.74% Impervious, Inflow Depth = 6.94" for 100-year event
Inflow = 12.06 cfs @ 12.09 hrs, Volume= 42,137 cf
Primary = 12.06 cfs @ 12.09 hrs, Volume= 42,137 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP2: 450 BROADWAY

Inflow Area = 6,802 sf, 12.33% Impervious, Inflow Depth = 3.83" for 100-year event
Inflow = 0.69 cfs @ 12.09 hrs, Volume= 2,170 cf
Primary = 0.69 cfs @ 12.09 hrs, Volume= 2,170 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs



Subcat Reach Pond Link

Routing Diagram for 3115-01A - Proposed HydroCAD
Prepared by Allen & Major Associates, Inc, Printed 5/30/2023

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-year	Type III 24-hr		Default	24.00	1	3.11	2
2	10-year	Type III 24-hr		Default	24.00	1	4.92	2
3	100-year	Type III 24-hr		Default	24.00	1	7.78	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
25,103	61	>75% Grass cover, Good, HSG B (P-2, P-3, P-4, P-5, P-6, P-7)
52,282	98	Paved parking, HSG B (P-2, P-3, P-4, P-5, P-6, P-7)
2,232	98	Roofs, HSG B (P-1)

Summary for Subcatchment P-1: Subcat P-1

Runoff = 0.15 cfs @ 12.09 hrs, Volume= 535 cf, Depth= 2.88"
Routed to Link SP1 : EXISTING DRAINAGE NETWORK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.11"

Area (sf)	CN	Description
2,232	98	Roofs, HSG B
2,232		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, TR-55 min.**

Summary for Subcatchment P-2: Subcat P-2

Runoff = 0.19 cfs @ 12.10 hrs, Volume= 612 cf, Depth= 1.03"
Routed to Pond BR1 : Bioretention #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.11"

Area (sf)	CN	Description
4,414	61	>75% Grass cover, Good, HSG B
2,690	98	Paved parking, HSG B
7,104	75	Weighted Average
4,414		62.13% Pervious Area
2,690		37.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	50	0.0400	0.19		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.11"
0.1	18	0.1100	2.32		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
4.4	68	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment P-3: Subcat P-3

Runoff = 0.25 cfs @ 12.09 hrs, Volume= 792 cf, Depth= 1.61"
Routed to Pond BR2 : Bioretention #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.11"

Area (sf)	CN	Description
2,250	61	>75% Grass cover, Good, HSG B
3,660	98	Paved parking, HSG B
5,910	84	Weighted Average
2,250		38.07% Pervious Area
3,660		61.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	40	0.0380	0.18		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.11"
0.2	10	0.0150	0.76		**Sheet Flow, B-C** Smooth surfaces n= 0.011 P2= 3.11"
0.1	19	0.0150	2.49		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.9	51	0.0200	0.99		**Shallow Concentrated Flow, D-E** Short Grass Pasture Kv= 7.0 fps
4.9	120	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment P-4: Subcat P-4

Runoff = 2.56 cfs @ 12.09 hrs, Volume= 8,133 cf, Depth= 2.00"
Routed to Link SP1 : EXISTING DRAINAGE NETWORK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.11"

Area (sf)	CN	Description
11,314	61	>75% Grass cover, Good, HSG B
37,492	98	Paved parking, HSG B
48,806	89	Weighted Average
11,314		23.18% Pervious Area
37,492		76.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	50	0.0400	0.19		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.11"
1.0	83	0.0360	1.33		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.3	74	0.0400	4.06		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
5.6	207	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment P-5: Subcat P-5

Runoff = 0.13 cfs @ 12.09 hrs, Volume= 434 cf, Depth= 2.77"
Routed to Link SP1 : EXISTING DRAINAGE NETWORK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.11"

Area (sf)	CN	Description
38	61	>75% Grass cover, Good, HSG B
1,845	98	Paved parking, HSG B
1,884	97	Weighted Average
38		2.04% Pervious Area
1,845		97.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0300	1.39		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.11"
0.1	24	0.0400	4.06		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.7	74	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment P-6: Subcat P-6

Runoff = 0.45 cfs @ 12.09 hrs, Volume= 1,432 cf, Depth= 2.00"
Routed to Link SP1 : EXISTING DRAINAGE NETWORK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.11"

Area (sf)	CN	Description
2,077	61	>75% Grass cover, Good, HSG B
6,517	98	Paved parking, HSG B
8,594	89	Weighted Average
2,077		24.17% Pervious Area
6,517		75.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	19	0.0150	0.87		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.11"
3.3	31	0.0300	0.16		**Sheet Flow, B-C** Grass: Short n= 0.150 P2= 3.11"
0.3	24	0.0400	1.40		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
0.3	58	0.0200	2.87		**Shallow Concentrated Flow, D-E** Paved Kv= 20.3 fps
4.3	132	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment P-7: Subcat P-7

Runoff = 0.04 cfs @ 12.12 hrs, Volume= 188 cf, Depth= 0.44"
Routed to Link SP2 : 450 BROADWAY

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.11"

Area (sf)	CN	Description
5,009	61	>75% Grass cover, Good, HSG B
77	98	Paved parking, HSG B
5,086	62	Weighted Average
5,009		98.49% Pervious Area
77		1.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	50	0.0400	0.19		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.11"
0.2	27	0.1100	2.32		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
4.5	77	Total, Increased to minimum Tc = 6.0 min			

Summary for Pond BR1: Bioretention #1

Exfiltration rate used is derived from the Rawls rate for fine sandy loam being 1.02 in/hr.

Inflow Area = 7,104 sf, 37.87% Impervious, Inflow Depth = 1.03" for 2-year event
Inflow = 0.19 cfs @ 12.10 hrs, Volume= 612 cf
Outflow = 0.02 cfs @ 13.44 hrs, Volume= 612 cf, Atten= 90%, Lag= 80.5 min
Discarded = 0.01 cfs @ 13.44 hrs, Volume= 591 cf
Primary = 0.01 cfs @ 13.44 hrs, Volume= 21 cf
Routed to Link SP1 : EXISTING DRAINAGE NETWORK

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 137.70' @ 13.44 hrs Surf.Area= 473 sf Storage= 272 cf
Flood Elev= 138.00' Surf.Area= 553 sf Storage= 424 cf

Plug-Flow detention time= 260.2 min calculated for 611 cf (100% of inflow)
Center-of-Mass det. time= 260.1 min (1,120.7 - 860.6)

Volume	Invert	Avail.Storage	Storage Description
#1	137.00'	424 cf	**Surface Storage (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
137.00	307	73.0	0	0	307
138.00	553	92.0	424	424	570

Device	Routing	Invert	Outlet Devices
#1	Discarded	137.00'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 130.00' Phase-In= 0.01'
#2	Primary	134.20'	**8.0" Round Culvert** L= 103.0' Ke= 0.500 Inlet / Outlet Invert= 134.20' / 132.14' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#3	Device 2	137.70'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.01 cfs @ 13.44 hrs HW=137.70' (Free Discharge)
└**1=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 13.44 hrs HW=137.70' (Free Discharge)
└**2=Culvert** (Passes 0.00 cfs of 2.33 cfs potential flow)
└**3=Orifice/Grate** (Weir Controls 0.00 cfs @ 0.19 fps)

Summary for Pond BR2: Bioretention #2

Exfiltration rate used is derived from the Rawls rate for fine sandy loam being 1.02 in/hr.

Inflow Area = 5,910 sf, 61.93% Impervious, Inflow Depth = 1.61" for 2-year event
Inflow = 0.25 cfs @ 12.09 hrs, Volume= 792 cf
Outflow = 0.11 cfs @ 12.33 hrs, Volume= 792 cf, Atten= 57%, Lag= 14.0 min
Discarded = 0.01 cfs @ 12.33 hrs, Volume= 560 cf
Primary = 0.10 cfs @ 12.33 hrs, Volume= 232 cf
Routed to Link SP1 : EXISTING DRAINAGE NETWORK

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 137.62' @ 12.33 hrs Surf.Area= 489 sf Storage= 251 cf
Flood Elev= 138.00' Surf.Area= 608 sf Storage= 457 cf

Plug-Flow detention time= 145.7 min calculated for 791 cf (100% of inflow)
Center-of-Mass det. time= 145.7 min (976.6 - 830.9)

Volume	Invert	Avail.Storage	Storage Description
#1	137.00'	457 cf	**Surface Storage (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
137.00	322	86.0	0	0	322
138.00	608	105.0	457	457	626

Device	Routing	Invert	Outlet Devices
#1	Discarded	137.00'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 130.00' Phase-In= 0.01'
#2	Primary	134.00'	**8.0" Round Culvert** L= 15.0' Ke= 0.500 Inlet / Outlet Invert= 134.00' / 133.70' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#3	Device 2	137.50'	**24.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.01 cfs @ 12.33 hrs HW=137.62' (Free Discharge)
└**1=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.09 cfs @ 12.33 hrs HW=137.62' (Free Discharge)
└**2=Culvert** (Passes 0.09 cfs of 3.05 cfs potential flow)
└**3=Orifice/Grate** (Orifice Controls 0.09 cfs @ 1.19 fps)

Summary for Link SP1: EXISTING DRAINAGE NETWORK

Inflow Area = 74,530 sf, 73.04% Impervious, Inflow Depth = 1.74" for 2-year event
Inflow = 3.28 cfs @ 12.09 hrs, Volume= 10,787 cf
Primary = 3.28 cfs @ 12.09 hrs, Volume= 10,787 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP2: 450 BROADWAY

Inflow Area = 5,086 sf, 1.51% Impervious, Inflow Depth = 0.44" for 2-year event
Inflow = 0.04 cfs @ 12.12 hrs, Volume= 188 cf
Primary = 0.04 cfs @ 12.12 hrs, Volume= 188 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Subcatchment P-1: Subcat P-1

Runoff = 0.24 cfs @ 12.09 hrs, Volume= 871 cf, Depth= 4.68"
Routed to Link SP1 : EXISTING DRAINAGE NETWORK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.92"

Area (sf)	CN	Description
2,232	98	Roofs, HSG B
2,232		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, TR-55 min.**

Summary for Subcatchment P-2: Subcat P-2

Runoff = 0.45 cfs @ 12.09 hrs, Volume= 1,412 cf, Depth= 2.38"
Routed to Pond BR1 : Bioretention #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.92"

Area (sf)	CN	Description
4,414	61	>75% Grass cover, Good, HSG B
2,690	98	Paved parking, HSG B
7,104	75	Weighted Average
4,414		62.13% Pervious Area
2,690		37.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	50	0.0400	0.19		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.11"
0.1	18	0.1100	2.32		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
4.4	68	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment P-3: Subcat P-3

Runoff = 0.49 cfs @ 12.09 hrs, Volume= 1,575 cf, Depth= 3.20"
Routed to Pond BR2 : Bioretention #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.92"

Area (sf)	CN	Description
2,250	61	>75% Grass cover, Good, HSG B
3,660	98	Paved parking, HSG B
5,910	84	Weighted Average
2,250		38.07% Pervious Area
3,660		61.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	40	0.0380	0.18		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.11"
0.2	10	0.0150	0.76		**Sheet Flow, B-C** Smooth surfaces n= 0.011 P2= 3.11"
0.1	19	0.0150	2.49		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.9	51	0.0200	0.99		**Shallow Concentrated Flow, D-E** Short Grass Pasture Kv= 7.0 fps
4.9	120	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment P-4: Subcat P-4

Runoff = 4.61 cfs @ 12.09 hrs, Volume= 15,030 cf, Depth= 3.70"
Routed to Link SP1 : EXISTING DRAINAGE NETWORK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.92"

Area (sf)	CN	Description
11,314	61	>75% Grass cover, Good, HSG B
37,492	98	Paved parking, HSG B
48,806	89	Weighted Average
11,314		23.18% Pervious Area
37,492		76.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	50	0.0400	0.19		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.11"
1.0	83	0.0360	1.33		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.3	74	0.0400	4.06		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
5.6	207	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment P-5: Subcat P-5

Runoff = 0.20 cfs @ 12.09 hrs, Volume= 717 cf, Depth= 4.57"
Routed to Link SP1 : EXISTING DRAINAGE NETWORK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.92"

Area (sf)	CN	Description
38	61	>75% Grass cover, Good, HSG B
1,845	98	Paved parking, HSG B
1,884	97	Weighted Average
38		2.04% Pervious Area
1,845		97.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0300	1.39		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.11"
0.1	24	0.0400	4.06		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.7	74	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment P-6: Subcat P-6

Runoff = 0.81 cfs @ 12.09 hrs, Volume= 2,647 cf, Depth= 3.70"
Routed to Link SP1 : EXISTING DRAINAGE NETWORK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.92"

Area (sf)	CN	Description
2,077	61	>75% Grass cover, Good, HSG B
6,517	98	Paved parking, HSG B
8,594	89	Weighted Average
2,077		24.17% Pervious Area
6,517		75.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	19	0.0150	0.87		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.11"
3.3	31	0.0300	0.16		**Sheet Flow, B-C** Grass: Short n= 0.150 P2= 3.11"
0.3	24	0.0400	1.40		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
0.3	58	0.0200	2.87		**Shallow Concentrated Flow, D-E** Paved Kv= 20.3 fps
4.3	132	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment P-7: Subcat P-7

Runoff = 0.17 cfs @ 12.10 hrs, Volume= 589 cf, Depth= 1.39"
Routed to Link SP2 : 450 BROADWAY

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.92"

Area (sf)	CN	Description
5,009	61	>75% Grass cover, Good, HSG B
77	98	Paved parking, HSG B
5,086	62	Weighted Average
5,009		98.49% Pervious Area
77		1.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	50	0.0400	0.19		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.11"
0.2	27	0.1100	2.32		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
4.5	77	Total, Increased to minimum Tc = 6.0 min			

Summary for Pond BR1: Bioretention #1

Exfiltration rate used is derived from the Rawls rate for fine sandy loam being 1.02 in/hr.

Inflow Area = 7,104 sf, 37.87% Impervious, Inflow Depth = 2.38" for 10-year event
Inflow = 0.45 cfs @ 12.09 hrs, Volume= 1,412 cf
Outflow = 0.43 cfs @ 12.15 hrs, Volume= 1,412 cf, Atten= 4%, Lag= 3.4 min
Discarded = 0.01 cfs @ 12.15 hrs, Volume= 763 cf
Primary = 0.41 cfs @ 12.15 hrs, Volume= 649 cf
Routed to Link SP1 : EXISTING DRAINAGE NETWORK

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 137.77' @ 12.15 hrs Surf.Area= 491 sf Storage= 306 cf
Flood Elev= 138.00' Surf.Area= 553 sf Storage= 424 cf

Plug-Flow detention time= 155.1 min calculated for 1,410 cf (100% of inflow)
Center-of-Mass det. time= 155.4 min (991.1 - 835.7)

Volume	Invert	Avail.Storage	Storage Description
#1	137.00'	424 cf	**Surface Storage (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
137.00	307	73.0	0	0	307
138.00	553	92.0	424	424	570

Device	Routing	Invert	Outlet Devices
#1	Discarded	137.00'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 130.00' Phase-In= 0.01'
#2	Primary	134.20'	**8.0" Round Culvert** L= 103.0' Ke= 0.500 Inlet / Outlet Invert= 134.20' / 132.14' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#3	Device 2	137.70'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.01 cfs @ 12.15 hrs HW=137.77' (Free Discharge)
└**1=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.41 cfs @ 12.15 hrs HW=137.77' (Free Discharge)
└**2=Culvert** (Passes 0.41 cfs of 2.35 cfs potential flow)
└**3=Orifice/Grate** (Weir Controls 0.41 cfs @ 0.89 fps)

Summary for Pond BR2: Bioretention #2

Exfiltration rate used is derived from the Rawls rate for fine sandy loam being 1.02 in/hr.

Inflow Area = 5,910 sf, 61.93% Impervious, Inflow Depth = 3.20" for 10-year event
Inflow = 0.49 cfs @ 12.09 hrs, Volume= 1,575 cf
Outflow = 0.43 cfs @ 12.14 hrs, Volume= 1,575 cf, Atten= 12%, Lag= 3.0 min
Discarded = 0.01 cfs @ 12.14 hrs, Volume= 720 cf
Primary = 0.42 cfs @ 12.14 hrs, Volume= 855 cf
Routed to Link SP1 : EXISTING DRAINAGE NETWORK

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 137.76' @ 12.14 hrs Surf.Area= 531 sf Storage= 321 cf
Flood Elev= 138.00' Surf.Area= 608 sf Storage= 457 cf

Plug-Flow detention time= 101.9 min calculated for 1,573 cf (100% of inflow)
Center-of-Mass det. time= 102.1 min (913.3 - 811.2)

Volume	Invert	Avail.Storage	Storage Description
#1	137.00'	457 cf	**Surface Storage (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
137.00	322	86.0	0	0	322
138.00	608	105.0	457	457	626

Device	Routing	Invert	Outlet Devices
#1	Discarded	137.00'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 130.00' Phase-In= 0.01'
#2	Primary	134.00'	**8.0" Round Culvert** L= 15.0' Ke= 0.500 Inlet / Outlet Invert= 134.00' / 133.70' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#3	Device 2	137.50'	**24.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.01 cfs @ 12.14 hrs HW=137.76' (Free Discharge)
└**1=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.41 cfs @ 12.14 hrs HW=137.76' (Free Discharge)
└**2=Culvert** (Passes 0.41 cfs of 3.11 cfs potential flow)
└**3=Orifice/Grate** (Orifice Controls 0.41 cfs @ 1.73 fps)

Summary for Link SP1: EXISTING DRAINAGE NETWORK

Inflow Area = 74,530 sf, 73.04% Impervious, Inflow Depth = 3.34" for 10-year event
Inflow = 6.49 cfs @ 12.10 hrs, Volume= 20,769 cf
Primary = 6.49 cfs @ 12.10 hrs, Volume= 20,769 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP2: 450 BROADWAY

Inflow Area = 5,086 sf, 1.51% Impervious, Inflow Depth = 1.39" for 10-year event
Inflow = 0.17 cfs @ 12.10 hrs, Volume= 589 cf
Primary = 0.17 cfs @ 12.10 hrs, Volume= 589 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Subcatchment P-1: Subcat P-1

Runoff = 0.38 cfs @ 12.09 hrs, Volume= 1,403 cf, Depth= 7.54"
Routed to Link SP1 : EXISTING DRAINAGE NETWORK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=7.78"

Area (sf)	CN	Description
2,232	98	Roofs, HSG B
2,232		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, TR-55 min.**

Summary for Subcatchment P-2: Subcat P-2

Runoff = 0.90 cfs @ 12.09 hrs, Volume= 2,867 cf, Depth= 4.84"
Routed to Pond BR1 : Bioretention #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=7.78"

Area (sf)	CN	Description
4,414	61	>75% Grass cover, Good, HSG B
2,690	98	Paved parking, HSG B
7,104	75	Weighted Average
4,414		62.13% Pervious Area
2,690		37.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	50	0.0400	0.19		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.11"
0.1	18	0.1100	2.32		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
4.4	68	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment P-3: Subcat P-3

Runoff = 0.89 cfs @ 12.09 hrs, Volume= 2,898 cf, Depth= 5.88"
Routed to Pond BR2 : Bioretention #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=7.78"

Area (sf)	CN	Description
2,250	61	>75% Grass cover, Good, HSG B
3,660	98	Paved parking, HSG B
5,910	84	Weighted Average
2,250		38.07% Pervious Area
3,660		61.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	40	0.0380	0.18		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.11"
0.2	10	0.0150	0.76		**Sheet Flow, B-C** Smooth surfaces n= 0.011 P2= 3.11"
0.1	19	0.0150	2.49		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.9	51	0.0200	0.99		**Shallow Concentrated Flow, D-E** Short Grass Pasture Kv= 7.0 fps
4.9	120	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment P-4: Subcat P-4

Runoff = 7.84 cfs @ 12.09 hrs, Volume= 26,319 cf, Depth= 6.47"
Routed to Link SP1 : EXISTING DRAINAGE NETWORK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=7.78"

Area (sf)	CN	Description
11,314	61	>75% Grass cover, Good, HSG B
37,492	98	Paved parking, HSG B
48,806	89	Weighted Average
11,314		23.18% Pervious Area
37,492		76.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	50	0.0400	0.19		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.11"
1.0	83	0.0360	1.33		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.3	74	0.0400	4.06		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
5.6	207	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment P-5: Subcat P-5

Runoff = 0.32 cfs @ 12.09 hrs, Volume= 1,165 cf, Depth= 7.42"
Routed to Link SP1 : EXISTING DRAINAGE NETWORK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=7.78"

Area (sf)	CN	Description
38	61	>75% Grass cover, Good, HSG B
1,845	98	Paved parking, HSG B
1,884	97	Weighted Average
38		2.04% Pervious Area
1,845		97.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0300	1.39		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.11"
0.1	24	0.0400	4.06		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
0.7	74	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment P-6: Subcat P-6

Runoff = 1.38 cfs @ 12.09 hrs, Volume= 4,634 cf, Depth= 6.47"
Routed to Link SP1 : EXISTING DRAINAGE NETWORK

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=7.78"

Area (sf)	CN	Description
2,077	61	>75% Grass cover, Good, HSG B
6,517	98	Paved parking, HSG B
8,594	89	Weighted Average
2,077		24.17% Pervious Area
6,517		75.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	19	0.0150	0.87		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.11"
3.3	31	0.0300	0.16		**Sheet Flow, B-C** Grass: Short n= 0.150 P2= 3.11"
0.3	24	0.0400	1.40		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
0.3	58	0.0200	2.87		**Shallow Concentrated Flow, D-E** Paved Kv= 20.3 fps
4.3	132	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment P-7: Subcat P-7

Runoff = 0.45 cfs @ 12.10 hrs, Volume= 1,436 cf, Depth= 3.39"
Routed to Link SP2 : 450 BROADWAY

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=7.78"

Area (sf)	CN	Description
5,009	61	>75% Grass cover, Good, HSG B
77	98	Paved parking, HSG B
5,086	62	Weighted Average
5,009		98.49% Pervious Area
77		1.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	50	0.0400	0.19		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.11"
0.2	27	0.1100	2.32		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
4.5	77	Total, Increased to minimum Tc = 6.0 min			

Summary for Pond BR1: Bioretention #1

Exfiltration rate used is derived from the Rawls rate for fine sandy loam being 1.02 in/hr.

Inflow Area = 7,104 sf, 37.87% Impervious, Inflow Depth = 4.84" for 100-year event
Inflow = 0.90 cfs @ 12.09 hrs, Volume= 2,867 cf
Outflow = 0.90 cfs @ 12.10 hrs, Volume= 2,867 cf, Atten= 1%, Lag= 0.8 min
Discarded = 0.01 cfs @ 12.11 hrs, Volume= 914 cf
Primary = 0.88 cfs @ 12.10 hrs, Volume= 1,954 cf
Routed to Link SP1 : EXISTING DRAINAGE NETWORK

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 137.82' @ 12.11 hrs Surf.Area= 504 sf Storage= 330 cf
Flood Elev= 138.00' Surf.Area= 553 sf Storage= 424 cf

Plug-Flow detention time= 95.4 min calculated for 2,867 cf (100% of inflow)
Center-of-Mass det. time= 95.3 min (910.5 - 815.3)

Volume	Invert	Avail.Storage	Storage Description
#1	137.00'	424 cf	**Surface Storage (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
137.00	307	73.0	0	0	307
138.00	553	92.0	424	424	570

Device	Routing	Invert	Outlet Devices
#1	Discarded	137.00'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 130.00' Phase-In= 0.01'
#2	Primary	134.20'	**8.0" Round Culvert** L= 103.0' Ke= 0.500 Inlet / Outlet Invert= 134.20' / 132.14' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#3	Device 2	137.70'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.01 cfs @ 12.11 hrs HW=137.82' (Free Discharge)
└**1=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.87 cfs @ 12.10 hrs HW=137.82' (Free Discharge)
└**2=Culvert** (Passes 0.87 cfs of 2.36 cfs potential flow)
└**3=Orifice/Grate** (Weir Controls 0.87 cfs @ 1.14 fps)

Summary for Pond BR2: Bioretention #2

Exfiltration rate used is derived from the Rawls rate for fine sandy loam being 1.02 in/hr.

Inflow Area = 5,910 sf, 61.93% Impervious, Inflow Depth = 5.88" for 100-year event
Inflow = 0.89 cfs @ 12.09 hrs, Volume= 2,898 cf
Outflow = 0.82 cfs @ 12.12 hrs, Volume= 2,898 cf, Atten= 8%, Lag= 2.1 min
Discarded = 0.01 cfs @ 12.12 hrs, Volume= 876 cf
Primary = 0.80 cfs @ 12.12 hrs, Volume= 2,022 cf
Routed to Link SP1 : EXISTING DRAINAGE NETWORK

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 137.86' @ 12.12 hrs Surf.Area= 564 sf Storage= 378 cf
Flood Elev= 138.00' Surf.Area= 608 sf Storage= 457 cf

Plug-Flow detention time= 72.8 min calculated for 2,894 cf (100% of inflow)
Center-of-Mass det. time= 73.2 min (867.2 - 794.1)

Volume	Invert	Avail.Storage	Storage Description
#1	137.00'	457 cf	**Surface Storage (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
137.00	322	86.0	0	0	322
138.00	608	105.0	457	457	626

Device	Routing	Invert	Outlet Devices
#1	Discarded	137.00'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 130.00' Phase-In= 0.01'
#2	Primary	134.00'	**8.0" Round Culvert** L= 15.0' Ke= 0.500 Inlet / Outlet Invert= 134.00' / 133.70' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#3	Device 2	137.50'	**24.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.01 cfs @ 12.12 hrs HW=137.86' (Free Discharge)
└**1=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.78 cfs @ 12.12 hrs HW=137.86' (Free Discharge)
└**2=Culvert** (Passes 0.78 cfs of 3.16 cfs potential flow)
└**3=Orifice/Grate** (Orifice Controls 0.78 cfs @ 2.04 fps)

Summary for Link SP1: EXISTING DRAINAGE NETWORK

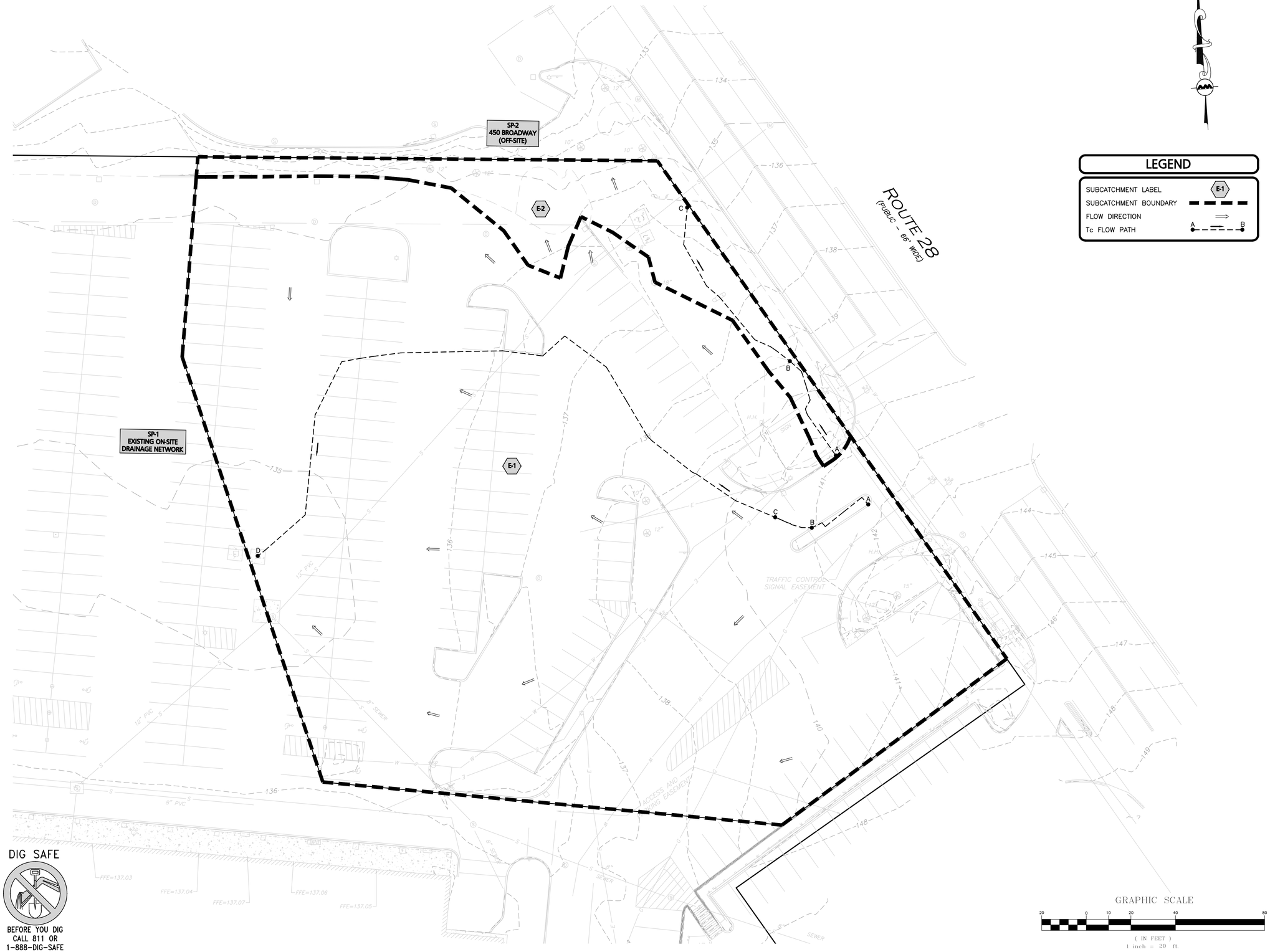
Inflow Area = 74,530 sf, 73.04% Impervious, Inflow Depth = 6.04" for 100-year event
Inflow = 11.55 cfs @ 12.09 hrs, Volume= 37,497 cf
Primary = 11.55 cfs @ 12.09 hrs, Volume= 37,497 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP2: 450 BROADWAY

Inflow Area = 5,086 sf, 1.51% Impervious, Inflow Depth = 3.39" for 100-year event
Inflow = 0.45 cfs @ 12.10 hrs, Volume= 1,436 cf
Primary = 0.45 cfs @ 12.10 hrs, Volume= 1,436 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs



LEGEND

SUBCATCHMENT LABEL	E-1
SUBCATCHMENT BOUNDARY	
FLOW DIRECTION	
Tc FLOW PATH	A — B

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)
1 inch = 20 ft.

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PROFESSIONAL ENGINEER FOR
ALLEN & MAJOR ASSOCIATES, INC.

REV	DATE	DESCRIPTION
1	05-26-23	REVISION 1

APPLICANT\OWNER:

SHRI SWAMINE LLC
PO BOX 2022
DANVERS, MA 01923

PROJECT:

TACO JOHN'S
436 BROADWAY
THE VILLAGE MALL
METHUEN, MA

PROJECT NO.	3115-01A	DATE:	03/31/2023
SCALE:	1" = 20'	DWG. NAME:	C-3115-01A
DESIGNED BY:	JRG	CHECKED BY:	BDJ

PREPARED BY:

ALLEN & MAJOR ASSOCIATES, INC.
civil engineering ◆ land surveying
environmental consulting ◆ landscape architecture
www.allenmajor.com
100 COMMERCE WAY, SUITE 5
WOBURN MA 01801
TEL: (781) 935-6889
FAX: (781) 935-2896
WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

DRAWING TITLE:

EXISTING WATERSHED PLAN

SHEET No.

EWS-1

LEGEND

SUBCATCHMENT LABEL	P-1
SUBCATCHMENT BOUNDARY	
FLOW DIRECTION	
Tc FLOW PATH	A — B

DIG SAFE

BEFORE YOU DIG
CALL 811 OR
1-888-DIG-SAFE
1-888-344-7233

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)
1 inch = 20 ft.

R:\PROJECTS\3115-01A\CIVIL\DRAWINGS\CURRENT\C-3115-01A_WATERSHED-PROPOSED.DWG

PROFESSIONAL ENGINEER FOR
ALLEN & MAJOR ASSOCIATES, INC.

REV	DATE	DESCRIPTION
1	05-26-23	REVISION 1

APPLICANT\OWNER:

SHRI SWAMINE LLC
PO BOX 2022
DANVERS, MA 01923

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PROPOSED WATERSHED PLAN

SHEET No.

PWS-1