STORMWATER MANAGEMENT REPORT

RESIDENCES AT BEAVER BROOK
SITE REDEVELOPMENT
MAP 32 BLOCK 245 LOTS 1 & 1.1 &
MAP 32 BLOCK 0 LOT 66
88, 91, & 101 MILL STREET
DRACUT, MASSACHUSETTS

GPI

44 Stiles Road, Suite One
Salem, NH 03079
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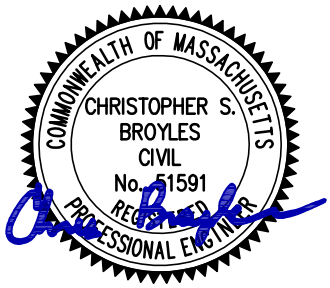

Prepared For:

Beaver Brook Holdings, LLC
P.O. Box 895
Dracut, MA 01826

May 21, 2025

(GPI Project No.: NEX-2021147)

Residences at Beaver Brook
Beaver Brook Holdings, LLC
Stormwater Management Report

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STORMWATER MANAGEMENT REPORT

APPENDICES

EXECUTIVE SUMMARY SECTION 1

This report contains a stormwater management analysis for the proposed site redevelopment of Beaver Brook Mill (aka Beaver Brook Village), located at 88, 91, and 101 Mill Street in Dracut, Massachusetts. The analysis includes both pre- and post-development calculations of stormwater runoff rates at specific locations on the project site.

This analysis has been prepared in accordance with the Town of Dracut Stormwater Management Rules and Regulations and the Stormwater Management Standards of the Massachusetts Department of Environmental Protection (MassDEP) Massachusetts Stormwater Policy.

The project site consists of three parcels identified as Map 32 Block 245 Lots 1 & 1.1, and Map 32 Block 0 Lot 66 with a combined area of approximately 7.88 acres. The project site is bordered by Mill Street and private residences to the west, Lakeview Avenue to the north, Beaver Brook to the east, and a condominium complex to the south.

The applicant, Beaver Brook Holdings, LLC, is proposing to redevelop the site by remodeling and reconstructing six existing buildings and constructing a new 6-story multifamily residential building including 2-stories of parking garage. The development will also include site grading, repaved parking lot and driveways, erosion control measures, new utility connections, and improvements to the existing stormwater management system.

In order to mitigate peak discharge rates and quality of stormwater runoff, a comprehensive stormwater management system has been designed that includes deep sump catch basins with hooded outlets, yard drains, and a First Defense hydrodynamic particle separator unit. The BMPs included in the proposed stormwater system are designed in accordance with MassDEP Stormwater Management Standards to improve stormwater quality at the design point.

Based on site topography and discharge points, two design points are identified for the purposes of this analysis. Design Point #1 represents Beaver Brook, which receives runoff from the eastern portion of the development including a majority of the proposed redevelopment area. Design Point #2 represents the canal to the west of the primary existing building which receives runoff from the western portion of the development, including Mill Street and the existing parking areas on Lot 66.

The tables below summarize the comparative pre- and post-development peak rates and volumes of stormwater runoff at the design points.

TABLE 1: PEAK RATE ANALYSIS SUMMARY

Design Storm	Pre-Development (cfs)	Post-Development (cfs)	Change (cfs)
Design Point #1 – Beaver Brook			
2-year	9.4	9.4	0.0
10-year	15.3	15.3	0.0
25-year	20.0	20.0	0.0
100-year	29.5	29.5	0.0
Design Point #2 – Canal			
2-year	5.6	5.6	0.0
10-year	9.3	9.3	0.0
25-year	12.3	12.3	0.0
100-year	18.1	18.1	0.0

(All values shown are peak rates in CFS, cubic feet per second)

TABLE 2: VOLUME ANALYSIS SUMMARY

Design Storm	Pre-Development (cf)	Post-Development (cf)	Change (cf)
Design Point #1 – Beaver Brook			
2-year	30,734	30,734	0
10-year	51,258	51,258	0
25-year	67,986	67,986	0
100-year	102,329	102,329	0
Design Point #1 – Canal			
2-year	17,175	17,175	0
10-year	29,220	29,220	0
25-year	39,045	39,045	0
100-year	59,202	59,202	0

(All values shown are volumes in CF, cubic feet)

In conclusion, by reducing on-site impervious surfaces and incorporating a new on-site stormwater management system that includes provisions for stormwater treatment, there will be no change in the peak rates and volumes of stormwater runoff leaving the property at the design points during all storms analyzed.

Implementing the maintenance procedures outlined in the attached Operation and Maintenance Plan (O&M) will ensure the long-term performance of the system.

EXISTING CONDITIONS SECTION 2

The project site consists of three parcels identified as Map 32 Block 245 Lots 1 & 1.1, and Map 32 Block 0 Lot 66 with a combined area of approximately 7.88 acres. The project site is bordered by Mill Street and private residences to the west, Lakeview Avenue to the north, Beaver Brook to the east, and a condominium complex to the south.

The site is currently developed with commercial and residential buildings with a combined footprint of 75,353 square-feet. Lot 1 is located toward the east and contains predominantly buildings and parking areas, with minimal pervious surfaces in the form of landscape islands. Lot 1.1 is located to the north of the site and contains the remainder of the building footprint and some pervious surfaces including maintained grassed areas and some trees. Lot 66 is across Mill Street to the west and contains a parking lot with some landscaped islands.

Site topography is variable, with slopes generally ranging between 1%-9% within the parking areas. To the south of the lot, steep slopes in excess of 33% can be found on a ridge separating the adjacent property up to a high elevation of 128 feet. The low elevation within the study area is the Beaver Brook adjacent property edge, at a low elevation of 95 feet.

Currently, there are existing catch basins and manholes conveying runoff to Beaver Brook and the canal. Runoff from most of the impervious surfaces on Lots 1 and 1.1 flows to a drainage network before discharging east into Beaver Brook. Most of the on-site pervious surface to the southeast sheet flows into Beaver Brook directly. The remaining portion of the site to the west flows through a drainage network into the canal.

The limits of the bank of Beaver Brook were delineated by Norse Environmental Services on April 3, 2024 and located by this office. The approximate resource boundary and its associated 100-foot buffer zone are shown on the site plans by this office for reference.

Test pits were performed by Greenman-Pedersen, Inc. on May 14, 2025 and locations are shown on the Grading & Drainage Plans prepared by this office. The test pits encountered fine sand, fill, and sand & gravel with depths to estimated seasonal high water table (ESHWT) of between 72 and 96 inches below ground. Refusal was not encountered in any of the pits. Test pit logs are included in Appendix D.

The NRCS Web Soil Survey identifies on-site soils as Rippowam fine sandy loam, Scituate fine sandy loam, and Canton fine sandy loam, with Hydrologic Soil Group (HSG) classifications of A/D, D, and B respectively. refer to Appendix C for additional information.

The site is located in a special flood hazard area (100-year flood) per current Flood Insurance Rate Map Number 25017C0136F, with a revised preliminary date of June 8, 2023.

PROPOSED CONDITIONS SECTION 3

The applicant, Beaver Brook Holdings, LLC, is proposing to redevelop the site by remodeling and reconstructing six existing buildings and constructing a new 6-story multifamily residential building including 2-stories of parking garage. Currently, the property contains 74,500 square feet of commercial space with 47 residential units. The redevelopment of this property proposes converting and expanding some currently underutilized commercial space into new residential units and adding a new multi-family residential building within the large parking field on the south end of the property. The site will continue to be accessed through the existing full-access connections to Mill Street and Lakeview Avenue. The development will also include site grading, repaved parking lot and driveways, erosion control measures, new utility connections, and improvements to the existing stormwater management system.

The project results in a decrease in impervious coverage of approximately 1,157 square feet, therefore, this project is considered a redevelopment under the MassDEP Stormwater Policy Standards.

In order to mitigate peak discharge rates and quality of stormwater runoff, a comprehensive stormwater management system has been designed that includes deep sump catch basins with hooded outlets, yard drains, and a First Defense hydrodynamic particle separator unit. The BMPs included in the proposed stormwater system are designed in accordance with MassDEP Stormwater Management Standards to improve stormwater quality at the design points.

Stormwater runoff from the majority of paved parking areas will be captured in catch basins with deep sumps and hooded outlets and then directed through a hydrodynamic separator before discharging to Beaver Brook. Refer to Appendix G for more information. Several existing catch basins on-site to remain will be retrofitted with outlet hoods to improve sediment and floatables removal.

The proposed hydrodynamic separator is an on-line unit with internal bypass weir and is sized to provide treatment of the water quality flow of its contributing area by removing sediment, debris, and floatable hydrocarbons. The proposed FD-4HC unit is NJCAT certified to provide water quality treatment for up to 1.50 cfs. Refer to Appendix G for more information.

In accordance with the performance standards for redevelopment sites contained in the Town of Dracut Stormwater Management Rules and Regulations, the proposed stormwater management system is designed to achieve 80% Total Suspended Solids (TSS) and 50% Total Phosphorus (TP) removal rates to the maximum extent practicable.

TSS removal rates of greater than 80% are expected to be achieved via street sweeping, deep-sump catch basins with hooded outlets, and the First Defense hydrodynamic particle separator. Refer to Standard 4 within Section 4.

TP is expected to be reduced in part due to the significant change in cover type from pavement, which is subject to pollutants from vehicles and run-on of grass clippings and mulch, to roof, which is considered clean. The implementation of a new hydrodynamic particle separator, although not specifically designed to provide TP removal, can be expected to provide some reduction of TP as it separates particles to which phosphorus may bind. Implementing additional BMPs to further reduce TP was explored during design, however, this was deemed infeasible for the site given the significant site constraints including numerous existing and proposed underground utilities, limited space not occupied by buildings and steep grades, the

retaining wall along Beaver Brook, and the encroachment of the 100-year flood zone AE associated with Beaver Brook.

To prevent erosion and discharge of sediment during construction, Best Management Practices including catch basin inlet protection, silt fence, compost filter sock, stabilized construction exit, mulch and seeding have been incorporated into the construction sequence.

The total area of disturbance related to the proposed site, and stormwater management system construction is approximately 118,000 square-feet therefore the project will require an EPA Construction General Permit under the NPDES program.

COMPLIANCE WITH MASSDEP STORMWATER STANDARDS SECTION 4

Standard #1: Untreated Stormwater
No new untreated stormwater discharges directly to wetlands or waters of the Commonwealth are proposed.

Standard #2: Post Development Peak Discharge Rates
The proposed decrease in impervious surfaces will result in no increase in post-development peak flow rates of runoff compared with pre-development rates for the 2-year and 10-year design storms. Refer to Table 1 in Section 1.

Standard #3: Groundwater Recharge
The project proposes a net decrease of impervious coverage of 1,157 sf, therefore annual groundwater re-charge is increased via the increased pervious areas on-site.

Standard #4: TSS Removal
The proposed First Defense treatment unit is designed to treat the water quality flow from its contributing paved impervious surfaces. Portions of the paved parking lot will continue to be captured by existing catch basins, however, new outlet hoods will be installed to enhance pretreatment of these structures.

TABLE 3: TSS REMOVAL RATES SUMMARY

BMP	TSS Removal Rate
Street Sweeping	5%
Deep Sump Catch Basin	25%
Hydrodynamic Particle Separator	80%

TABLE 4: TSS REMOVAL CALCULATIONS

Treatment Train 'A'				
BMP	**Starting TSS Load**	**TSS Removal Rate**	**Amount Removed**	**Remaining Load**
Street Sweeping	1.00	0.05	0.05	0.95
Deep Sump Catch Basin	0.95	0.25	0.24	0.71
Hydrodynamic Particle Separator	0.71	0.80	0.57	0.14
			TSS Removal Rate=	**86%**
Treatment Train 'B'				
BMP	**Starting TSS Load**	**TSS Removal Rate**	**Amount Removed**	**Remaining Load**
Street Sweeping	1.00	0.05	0.05	0.95
Hydrodynamic Particle Separator	0.95	0.80	0.76	0.19
			TSS Removal Rate=	**81%**

Standard #5: Land Uses with Higher Potential Pollutant Loads (LUHPPL)
The project is classified as a land use with higher potential pollutant loads as a high use parking lot. BMPs capable of removing increased contaminant loads have been selected to mitigate any risk associated with the proposed traffic increase. The long-term pollution plan includes good housekeeping practices, preventative maintenance procedures and regular inspections.

Standard #6: Protection of Critical Areas
The site is not located within or near a Zone II of a public water supply or other critical area.

Standard #7: Redevelopment Projects
The site reduces impervious coverage and is considered a redevelopment. The project is subject to Standard 2, and the pretreatment and structural best management practice requirements of Standards 4 and 5 to the maximum extent practicable.

As shown in the standards above, the project complies with the Stormwater Management Standard as a redevelopment.

Standard #8: Erosion and Sediment Control
Erosion and sediment controls are incorporated into the project design to prevent erosion. An Erosion & Sediment Control Plan is included within the site plan set.

Standard #9: Operation and Maintenance Plan
An Operation and Maintenance Plan (O&M) meeting the requirements of this standard has been prepared and is included as a separate document.

Standard #10: Illicit Discharges
To the best of our knowledge, the site does not contain any illicit discharges. An illicit discharge statement is included in Appendix G.

STORMWATER MODELING METHODOLOGY SECTION 5

The drainage system for this project was modeled using HydroCAD, a stormwater modeling computer program that analyzes the hydrology, and hydraulics of stormwater runoff. HydroCAD is based largely on the hydrology techniques developed by the Soil Conservation Service (SCS/NRCS), combined with other hydrology and hydraulics calculations. For a given rainfall event, these techniques are used to generate hydrographs throughout a watershed. This provides verification that a given drainage system is adequate for the area under consideration, or to predict where flooding or erosion is likely to occur.

In HydroCAD, each watershed is modeled as a subcatchment, streams and culverts as a Reach (or Pond, depending on available storage capacity), and large wetlands and other natural or artificial storage areas as a Pond. SCS hydrograph generation and routing procedures were used to model both Pre-development and Post-development runoff conditions.

The Pre-development and Post-development watershed limits and the subcatchment characteristics were determined using both USGS and on-the-ground topographic survey information and through visual, on-site inspection. Conservative estimates were used at all times in estimating the hydrologic characteristics of each watershed or subcatchment.

The analysis utilizes rainfall amounts from the Northeast Regional Climate Center (NRCC) Extreme Precipitation Tables for the project site location. Rainfall depths for each 24-hour design storm are summarized below.

TABLE 5: RAINFALL SUMMARY

2-Year (in)	10-Year (in)	25-Year (in)	100-Year (in)
2.42	3.67	4.67	6.70

LIST OF APPENDICIES

APPENDIX A

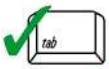
MASSDEP CHECKLIST FOR STORMWATER REPORT

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

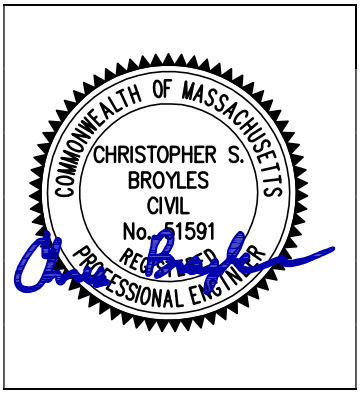
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



Signature and Date

Checklist

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

☐ New development

☒ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

☒ No disturbance to any Wetland Resource Areas

☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)

☒ Reduced Impervious Area (Redevelopment Only)

☒ Minimizing disturbance to existing trees and shrubs

☐ LID Site Design Credit Requested:

- ☐ Credit 1
- ☐ Credit 2
- ☐ Credit 3

☐ Use of "country drainage" versus curb and gutter conveyance and pipe

☐ Bioretention Cells (includes Rain Gardens)

☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

☐ Treebox Filter

☐ Water Quality Swale

☐ Grass Channel

☐ Green Roof

☐ Other (describe): _____

Standard 1: No New Untreated Discharges

☒ No new untreated discharges

☐ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth

☐ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☐ Required Recharge Volume calculation provided.

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

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

☐ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

☐ Site is comprised solely of C and D soils and/or bedrock at the land surface

☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000

☐ Solid Waste Landfill pursuant to 310 CMR 19.000

☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

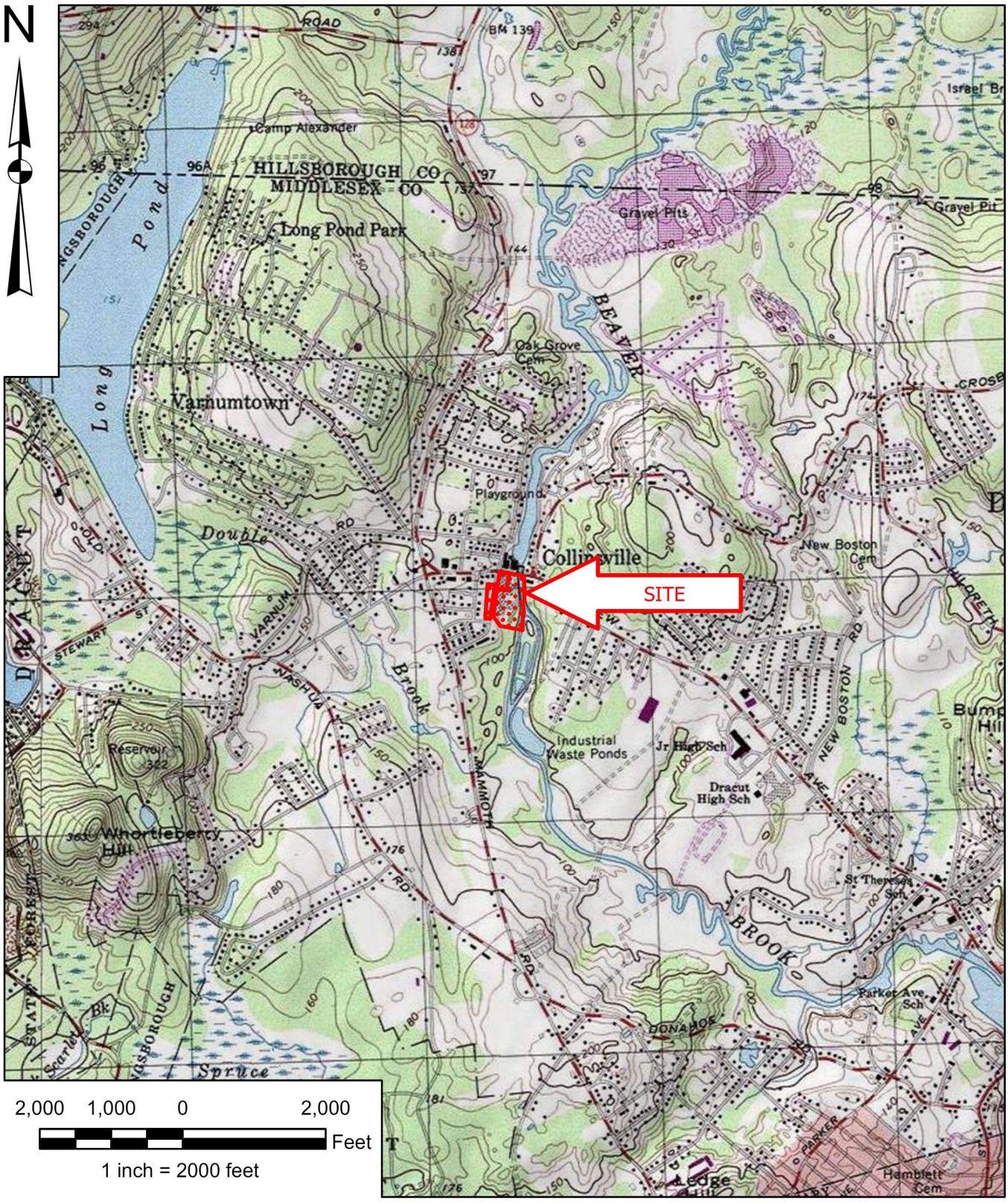
☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☒ An Illicit Discharge Compliance Statement is attached;

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

APPENDIX B

FIGURES



USGS MAP

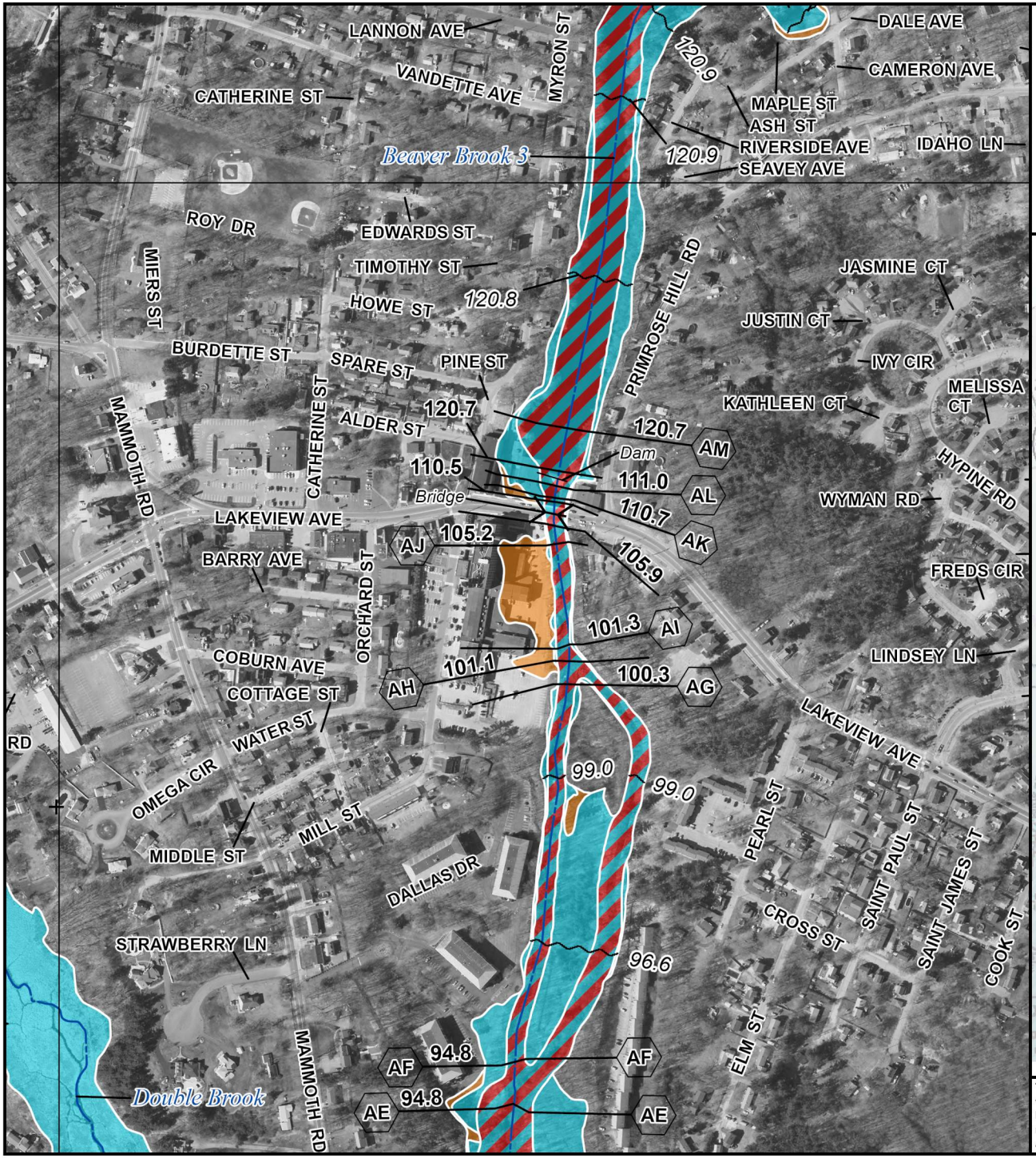
FOR BEAVER BROOK HOLDINGS, LLC
91 MILL STREET
DRACUT, MA

GPI Engineering Design Planning Construction Management
603.893.0720 GPINET.COM
Greenman-Pedersen, Inc.
44 Stiles Road, Suite One
Salem, NH 03079

DRAWN BY: DJT
PROJECT #: NEX-2021147

DATE: 3/27/2025

FIGURE 1



Map Projection:
NAD 1983 State Plane, Massachusetts Mainland
Western Hemisphere; Vertical Datum: NAVD 88

1 inch = 500 feet

0 500 1,000

FEMA

National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

MIDDLESEX COUNTY, MASSACHUSETTS
(All Jurisdictions)

PANEL 0136 OF 0656

FEMA

Panel Contains:

COMMUNITY	NUMBER	PANEL	SUFFIX
DRACUT, TOWN OF	250190	0136	F
LOWELL, CITY OF	250201	0136	F
TYNGSBOROUGH, TOWN OF	250220	0136	F

VERSION NUMBER
2.6.3.6

MAP NUMBER
25017C0136F

MAP REVISED
July 8, 2025

APPENDIX C

SOILS INFORMATION

United States Department of Agriculture

NRCS

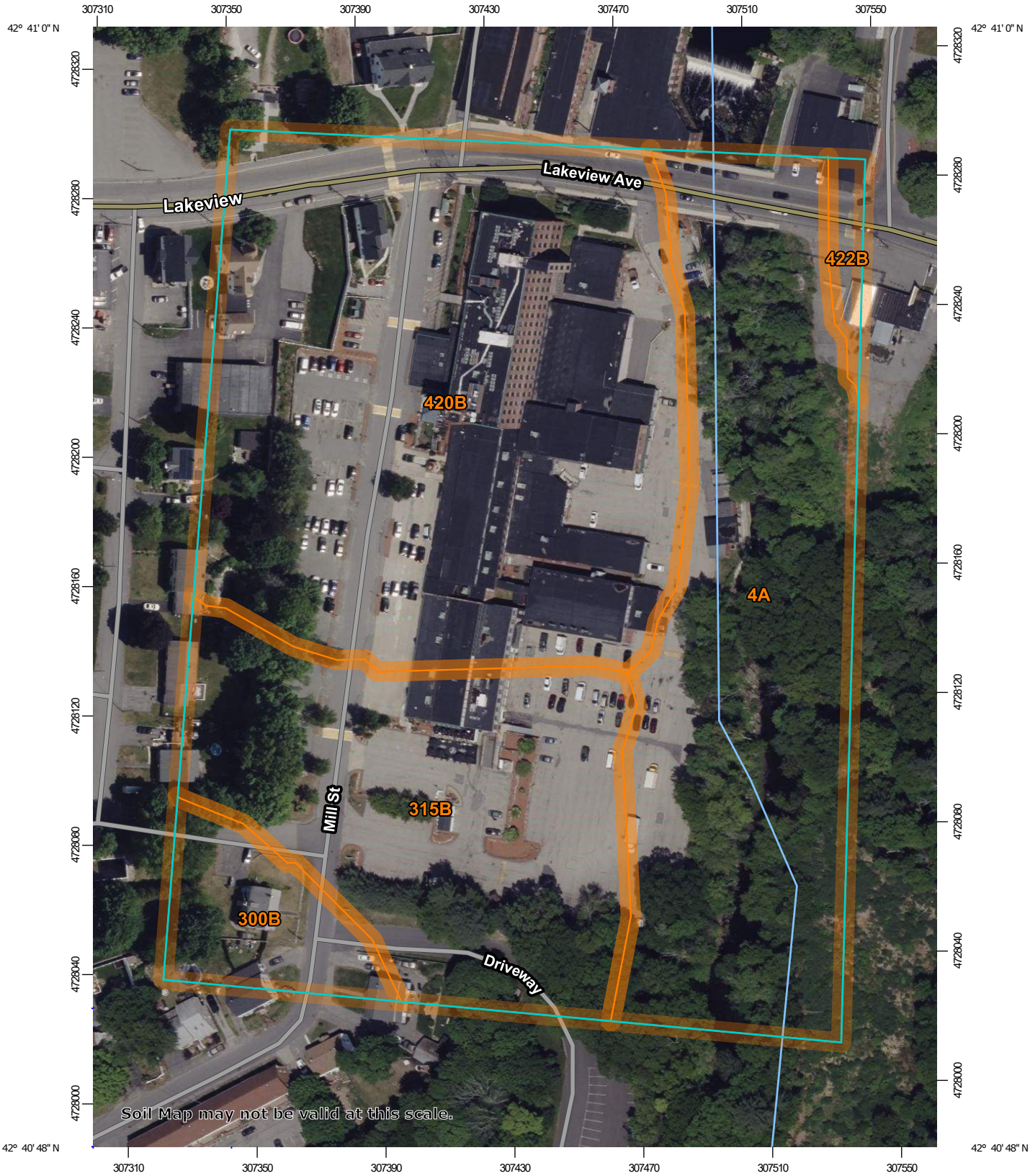
Natural Resources Conservation Service

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 Middlesex County, Massachusetts

March 27, 2025

Custom Soil Resource Report
Soil Map



Map Scale: 1:1,690 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

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 1:24,000.

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

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

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

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

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

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

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 24, Aug 27, 2024

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
4A	Rippowam fine sandy loam, 0 to 3 percent slopes, frequently flooded	4.0	29.4%
300B	Montauk fine sandy loam, 3 to 8 percent slopes	0.7	5.0%
315B	Scituate fine sandy loam, 3 to 8 percent slopes	3.0	22.4%
420B	Canton fine sandy loam, 3 to 8 percent slopes	5.7	42.2%
422B	Canton fine sandy loam, 0 to 8 percent slopes, extremely stony	0.2	1.1%
Totals for Area of Interest		**13.6**	**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.

Middlesex County, Massachusetts

4A—Rippowam fine sandy loam, 0 to 3 percent slopes, frequently flooded

Map Unit Setting

National map unit symbol: 2zvd6
Elevation: 50 to 1,180 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

Rippowam and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rippowam

Setting

Landform: Alluvial flats
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Loamy alluvium over sandy and gravelly alluvium derived from granite and gneiss

Typical profile

H1 - 0 to 7 inches: fine sandy loam
H2 - 7 to 18 inches: fine sandy loam
H3 - 18 to 40 inches: sandy loam
H4 - 40 to 65 inches: stratified sand to fine 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 6 to 18 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Ecological site: F144AY014CT - Wet Sandy Low Floodplain
Hydric soil rating: Yes

Minor Components

Saco

Percent of map unit: 10 percent
Landform: Terraces, alluvial flats
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: Yes

Limerick

Percent of map unit: 5 percent
Landform: Terraces, alluvial flats
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: Yes

Pootatuck

Percent of map unit: 5 percent
Landform: Flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

300B—Montauk fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2tyrh
Elevation: 0 to 1,030 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: All areas are prime farmland

Map Unit Composition

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

Description of Montauk

Setting

Landform: Recessionial moraines, ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest

Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 4 inches: fine sandy loam
Bw1 - 4 to 26 inches: fine sandy loam
Bw2 - 26 to 34 inches: sandy loam
2Cd - 34 to 72 inches: gravelly loamy sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 1.42 in/hr)
Depth to water table: About 18 to 37 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 5.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: C
Ecological site: F144AY007CT - Well Drained Dense Till Uplands
Hydric soil rating: No

Minor Components

Scituate

Percent of map unit: 6 percent
Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Canton

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Ridgebury

Percent of map unit: 4 percent
Landform: Depressions, ground moraines, hills, drainageways
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave

Across-slope shape: Concave
Hydric soil rating: Yes

315B—Scituate fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: vqqw
Elevation: 70 to 1,120 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: All areas are prime farmland

Map Unit Composition

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

Description of Scituate

Setting

Landform: Hillslopes, depressions
Landform position (two-dimensional): Summit, toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Friable loamy eolian deposits over dense sandy lodgment till derived from granite and gneiss

Typical profile

H1 - 0 to 8 inches: fine sandy loam
H2 - 8 to 20 inches: sandy loam
H3 - 20 to 27 inches: loamy fine sand
H4 - 27 to 65 inches: gravelly loamy sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 18 to 33 inches to densic material
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: D
Ecological site: F144AY037MA - Moist Dense Till Uplands

Hydric soil rating: No

Minor Components

Woodbridge

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Shoulder, toeslope
Landform position (three-dimensional): Nose slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: No

Montauk

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Head slope, nose slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Ridgebury

Percent of map unit: 5 percent
Landform: Drainageways, depressions
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

420B—Canton fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2w81b
Elevation: 0 to 1,180 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: All areas are prime farmland

Map Unit Composition

Canton and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Canton

Setting

Landform: Hills, moraines, ridges
Landform position (two-dimensional): Summit, shoulder, backslope

Landform position (three-dimensional): Nose slope, side slope, crest
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

Ap - 0 to 7 inches: fine sandy loam
Bw1 - 7 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: gravelly fine sandy loam
2C - 26 to 65 inches: gravelly loamy sand

Properties and qualities

Slope: 3 to 8 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
Available water supply, 0 to 60 inches: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: B
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Minor Components

Scituate

Percent of map unit: 10 percent
Landform: Hills, drumlins, ground moraines
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Montauk

Percent of map unit: 5 percent
Landform: Moraines, ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Charlton

Percent of map unit: 4 percent
Landform: Ridges, ground moraines, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest

Down-slope shape: Convex, linear
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

422B—Canton fine sandy loam, 0 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w818
Elevation: 0 to 1,180 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: Not prime farmland

Map Unit Composition

Canton, extremely stony, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Canton, Extremely Stony

Setting

Landform: Moraines, hills, ridges
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest
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: 0 to 8 percent
Surface area covered with cobbles, stones or boulders: 9.0 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): 7s
Hydrologic Soil Group: B
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Minor Components

Charlton, extremely stony

Percent of map unit: 6 percent
Landform: Ridges, ground moraines, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Scituate, extremely stony

Percent of map unit: 6 percent
Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Montauk, extremely stony

Percent of map unit: 4 percent
Landform: Recessionial moraines, ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Swansea

Percent of map unit: 4 percent
Landform: Marshes, depressions, bogs, swamps, kettles
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

APPENDIX D

TEST PIT LOGS

TEST PIT DATA

Client: Beaver Brook Holdings, LLC
Project Address: 88, 91 and 101 Mill Street
Town, State: Dracut, MA
Job Number: 2021147
Date: May 14, 2025
Performed by: Diane Pantermoller (MASE #1835)

Test Pit No. **1** SCS Soil: Rippowam Fine Sandy Loam

ESHWT: 72” Standing Water: 92”
Refusal: >109” Roots: 72”

Depth	Horizon	Soil Texture	Color	Consistence	Layer Description (Gravel, Stones, Fill, etc)
0-18”	Fill/A	Loamy Sand	10yr 3/2	Friable	Trash
18-48”	B	Loamy Sand	10yr 6/8	Friable	
48-109”	C	Sand & Gravel	2.5y 7/4	Loose/Granular	

Test Pit No. **2** SCS Soil: Rippowam Fine Sandy Loam

ESHWT: 96” Standing Water: 96”
Refusal: >106” Roots: None

Depth	Horizon	Soil Texture	Color	Consistence	Layer Description (Gravel, Stones, Fill, etc)
0-72”	Fill/A	Fill	10yr 3/2		Trash, Old Pipe, Clay Pipe, Large Boulders

Test Pit No. **3** SCS Soil: Rippowam Fine Sandy Loam

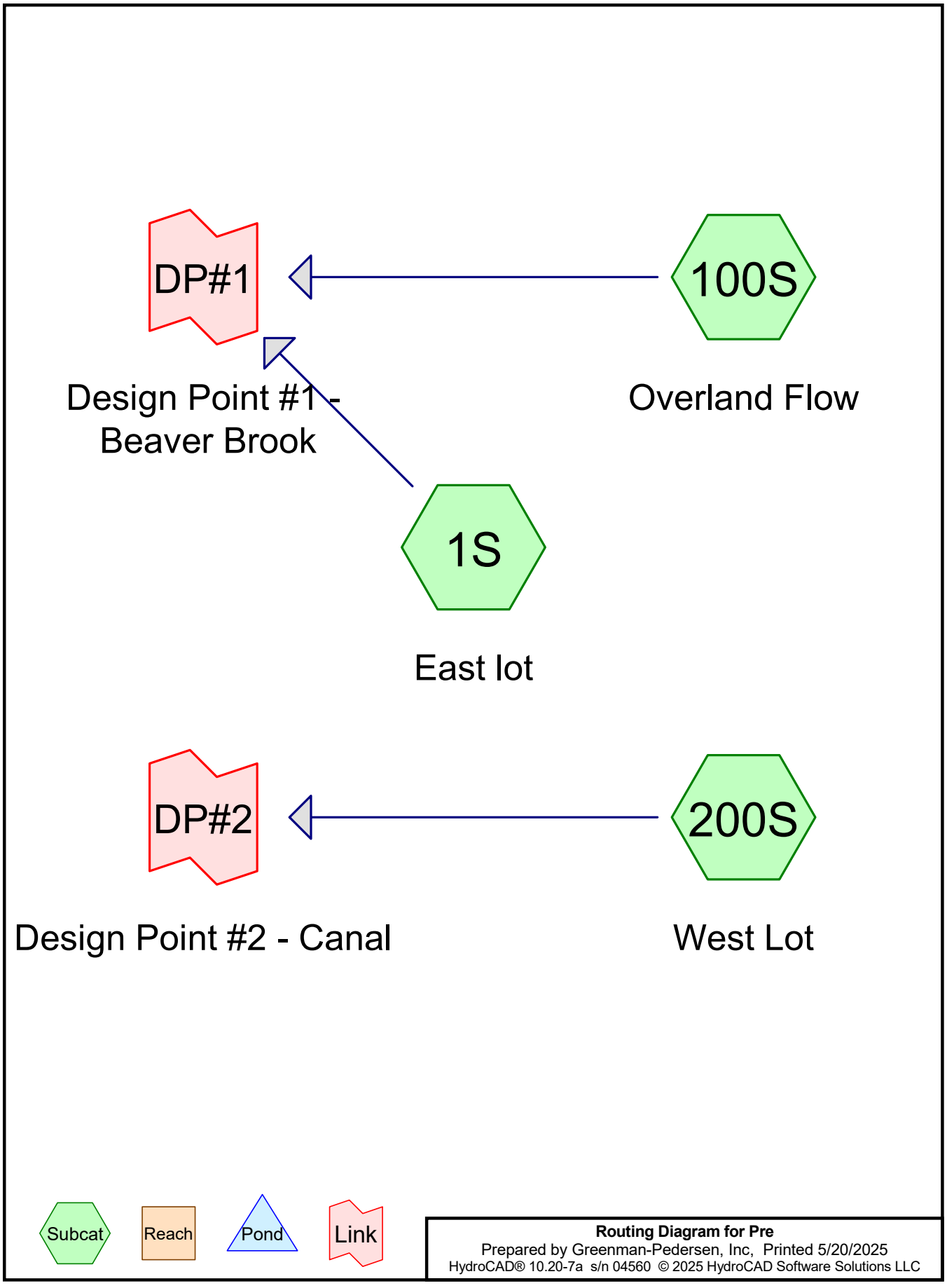
ESHWT: 84” Standing Water: 84”
Refusal: >108” Roots: 72”

Depth	Horizon	Soil Texture	Color	Consistence	Layer Description (Gravel, Stones, Fill, etc)
0-72”	Fill/A	Fill	10yr 3/2		Trash, Old Pipes, Plastic, Large Boulders
72-84”	B	Loamy Sand	10yr 6/5	Friable	
84-108”	C	Fine Sand	2.5y 7/4	Loose/Granular	

NOTES

APPENDIX E

PRE-DEVELOPMENT HYDROCAD COMPUTATIONS



Routing Diagram for Pre
Prepared by Greenman-Pedersen, Inc, Printed 5/20/2025

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
15,575	61	>75% Grass cover, Good, HSG B (1S, 200S)
8	74	>75% Grass cover, Good, HSG C (200S)
17,839	80	>75% Grass cover, Good, HSG D (1S, 100S, 200S)
241	96	Gravel surface, HSG B (1S)
1,507	96	Gravel surface, HSG D (1S, 100S)
86,080	98	Paved parking, HSG B (1S, 200S)
574	98	Paved parking, HSG C (200S)
104,084	98	Paved parking, HSG D (1S, 100S, 200S)
69,328	98	Roofs, HSG B (1S, 200S)
6,900	98	Roofs, HSG D (1S, 200S)
2,019	98	Water Surface, HSG B (200S)
3,119	55	Woods, Good, HSG B (200S)
20,486	77	Woods, Good, HSG D (1S, 100S, 200S)
327,760	**94**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
176,363	HSG B	1S, 200S
583	HSG C	200S
150,815	HSG D	1S, 100S, 200S
0	Other	
327,760		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Su Nu
0	15,575	8	17,839	0	33,422	>75% Grass cover, Good	
0	241	0	1,507	0	1,748	Gravel surface	
0	86,080	574	104,084	0	190,739	Paved parking	
0	69,328	0	6,900	0	76,228	Roofs	
0	2,019	0	0	0	2,019	Water Surface	
0	3,119	0	20,486	0	23,605	Woods, Good	
0	**176,363**	**583**	**150,815**	**0**	**327,760**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	1S	0.00	0.00	12.0	0.0487	0.012	0.0	12.0	0.0	
2	1S	0.00	0.00	61.0	0.0948	0.012	0.0	12.0	0.0	
3	1S	0.00	0.00	123.0	0.0416	0.012	0.0	12.0	0.0	
4	1S	0.00	0.00	123.0	0.0184	0.012	0.0	12.0	0.0	
5	1S	0.00	0.00	157.0	0.0005	0.012	0.0	12.0	0.0	

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: East lot Runoff Area=188,340 sf 88.98% Impervious Runoff Depth=1.89"
Flow Length=631' Tc=6.5 min CN=95 Runoff=9.05 cfs 29,599 cf

Subcatchment 100S: Overland Flow Runoff Area=18,484 sf 0.12% Impervious Runoff Depth=0.74"
Flow Length=168' Tc=3.3 min CN=78 Runoff=0.38 cfs 1,135 cf

Subcatchment 200S: West Lot Runoff Area=120,937 sf 83.83% Impervious Runoff Depth=1.70"
Flow Length=107' Tc=5.2 min CN=93 Runoff=5.62 cfs 17,175 cf

Link DP#1: Design Point #1 - Beaver Brook Inflow=9.39 cfs 30,734 cf
Primary=9.39 cfs 30,734 cf

Link DP#2: Design Point #2 - Canal Inflow=5.62 cfs 17,175 cf
Primary=5.62 cfs 17,175 cf

Total Runoff Area = 327,760 sf Runoff Volume = 47,909 cf Average Runoff Depth = 1.75"
17.93% Pervious = 58,775 sf 82.07% Impervious = 268,986 sf

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: East lot Runoff Area=188,340 sf 88.98% Impervious Runoff Depth=3.11"
Flow Length=631' Tc=6.5 min CN=95 Runoff=14.50 cfs 48,751 cf

Subcatchment 100S: Overland Flow Runoff Area=18,484 sf 0.12% Impervious Runoff Depth=1.63"
Flow Length=168' Tc=3.3 min CN=78 Runoff=0.89 cfs 2,507 cf

Subcatchment 200S: West Lot Runoff Area=120,937 sf 83.83% Impervious Runoff Depth=2.90"
Flow Length=107' Tc=5.2 min CN=93 Runoff=9.32 cfs 29,220 cf

Link DP#1: Design Point #1 - Beaver Brook Inflow=15.28 cfs 51,258 cf
Primary=15.28 cfs 51,258 cf

Link DP#2: Design Point #2 - Canal Inflow=9.32 cfs 29,220 cf
Primary=9.32 cfs 29,220 cf

Total Runoff Area = 327,760 sf Runoff Volume = 80,478 cf Average Runoff Depth = 2.95"
17.93% Pervious = 58,775 sf 82.07% Impervious = 268,986 sf

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: East lot Runoff Area=188,340 sf 88.98% Impervious Runoff Depth=4.09"
Flow Length=631' Tc=6.5 min CN=95 Runoff=18.80 cfs 64,237 cf

Subcatchment 100S: Overland Flow Runoff Area=18,484 sf 0.12% Impervious Runoff Depth=2.43"
Flow Length=168' Tc=3.3 min CN=78 Runoff=1.34 cfs 3,749 cf

Subcatchment 200S: West Lot Runoff Area=120,937 sf 83.83% Impervious Runoff Depth=3.87"
Flow Length=107' Tc=5.2 min CN=93 Runoff=12.25 cfs 39,045 cf

Link DP#1: Design Point #1 - Beaver Brook Inflow=19.98 cfs 67,986 cf
Primary=19.98 cfs 67,986 cf

Link DP#2: Design Point #2 - Canal Inflow=12.25 cfs 39,045 cf
Primary=12.25 cfs 39,045 cf

Total Runoff Area = 327,760 sf Runoff Volume = 107,031 cf Average Runoff Depth = 3.92"
17.93% Pervious = 58,775 sf 82.07% Impervious = 268,986 sf

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: East lot Runoff Area=188,340 sf 88.98% Impervious Runoff Depth=6.11"
Flow Length=631' Tc=6.5 min CN=95 Runoff=27.46 cfs 95,854 cf

Subcatchment 100S: Overland Flow Runoff Area=18,484 sf 0.12% Impervious Runoff Depth=4.20"
Flow Length=168' Tc=3.3 min CN=78 Runoff=2.30 cfs 6,475 cf

Subcatchment 200S: West Lot Runoff Area=120,937 sf 83.83% Impervious Runoff Depth=5.87"
Flow Length=107' Tc=5.2 min CN=93 Runoff=18.14 cfs 59,202 cf

Link DP#1: Design Point #1 - Beaver Brook Inflow=29.46 cfs 102,329 cf
Primary=29.46 cfs 102,329 cf

Link DP#2: Design Point #2 - Canal Inflow=18.14 cfs 59,202 cf
Primary=18.14 cfs 59,202 cf

Total Runoff Area = 327,760 sf Runoff Volume = 161,531 cf Average Runoff Depth = 5.91"
17.93% Pervious = 58,775 sf 82.07% Impervious = 268,986 sf

Summary for Subcatchment 1S: East lot

[47] Hint: Peak is 170% of capacity of segment #4
[47] Hint: Peak is 122% of capacity of segment #5
[47] Hint: Peak is 184% of capacity of segment #6
[47] Hint: Peak is 277% of capacity of segment #7
[47] Hint: Peak is 1680% of capacity of segment #8

Runoff = 14.50 cfs @ 12.09 hrs, Volume= 48,751 cf, Depth= 3.11"
Routed to Link DP#1 : Design Point #1 - Beaver Brook

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=3.67"

Area (sf)	CN	Description
7,617	61	>75% Grass cover, Good, HSG B
9,822	80	>75% Grass cover, Good, HSG D
241	96	Gravel surface, HSG B
899	96	Gravel surface, HSG D
32,158	98	Paved parking, HSG B
84,928	98	Paved parking, HSG D
44,903	98	Roofs, HSG B
5,598	98	Roofs, HSG D
2,172	77	Woods, Good, HSG D
188,340	95	Weighted Average
20,752		11.02% Pervious Area
167,588		88.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	25	0.0330	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
0.5	35	0.0330	1.27		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	95	0.0638	5.13		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.0	12	0.0487	10.84	8.52	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
0.1	61	0.0948	15.13	11.88	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Corrugated PP, smooth interior
0.2	123	0.0416	10.02	7.87	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Corrugated PP, smooth interior
0.3	123	0.0184	6.67	5.24	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Corrugated PP, smooth interior
2.4	157	0.0005	1.10	0.86	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Corrugated PP, smooth interior

6.5 631 Total

Summary for Subcatchment 100S: Overland Flow

Runoff = 0.89 cfs @ 12.05 hrs, Volume= 2,507 cf, Depth= 1.63"
Routed to Link DP#1 : Design Point #1 - Beaver Brook

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=3.67"

Area (sf)	CN	Description
2,626	80	>75% Grass cover, Good, HSG D
608	96	Gravel surface, HSG D
21	98	Paved parking, HSG D
15,229	77	Woods, Good, HSG D
18,484	78	Weighted Average
18,463		99.88% Pervious Area
21		0.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	19	0.3400	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
1.4	149	0.1190	1.72		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.3	168	Total			

Summary for Subcatchment 200S: West Lot

Runoff = 9.32 cfs @ 12.07 hrs, Volume= 29,220 cf, Depth= 2.90"
Routed to Link DP#2 : Design Point #2 - Canal

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=3.67"

Area (sf)	CN	Description
7,958	61	>75% Grass cover, Good, HSG B
8	74	>75% Grass cover, Good, HSG C
5,390	80	>75% Grass cover, Good, HSG D
53,922	98	Paved parking, HSG B
574	98	Paved parking, HSG C
19,135	98	Paved parking, HSG D
24,425	98	Roofs, HSG B
1,301	98	Roofs, HSG D
2,019	98	Water Surface, HSG B
3,119	55	Woods, Good, HSG B
3,084	77	Woods, Good, HSG D
120,937	93	Weighted Average
19,560		16.17% Pervious Area
101,376		83.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.2	23	0.0180	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
2.0	84	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.2	107	Total			

Summary for Link DP#1: Design Point #1 - Beaver Brook

Inflow Area = 206,824 sf, 81.04% Impervious, Inflow Depth = 2.97" for 10-Year event
Inflow = 15.28 cfs @ 12.09 hrs, Volume= 51,258 cf
Primary = 15.28 cfs @ 12.09 hrs, Volume= 51,258 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

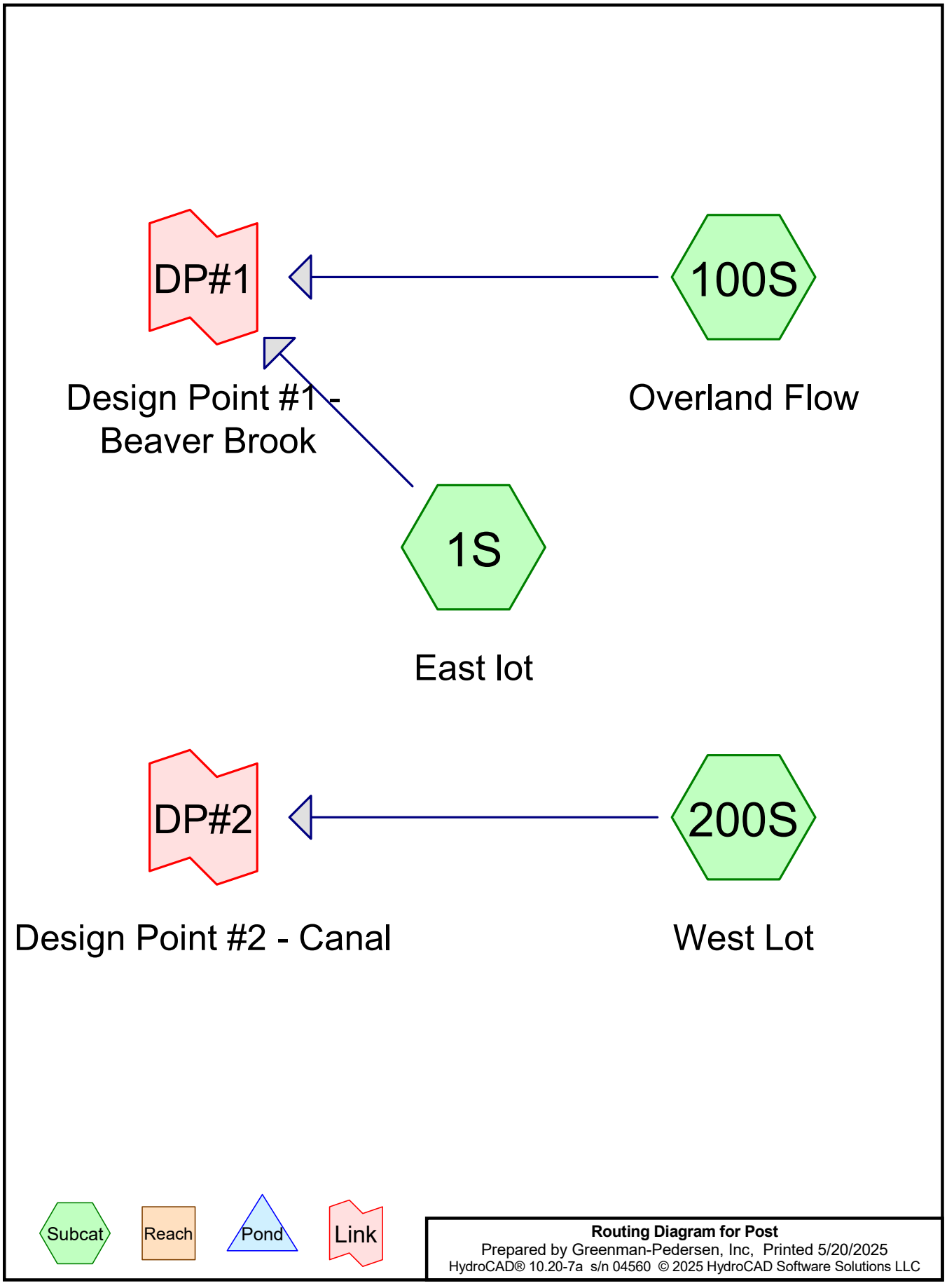
Summary for Link DP#2: Design Point #2 - Canal

Inflow Area = 120,937 sf, 83.83% Impervious, Inflow Depth = 2.90" for 10-Year event
Inflow = 9.32 cfs @ 12.07 hrs, Volume= 29,220 cf
Primary = 9.32 cfs @ 12.07 hrs, Volume= 29,220 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

APPENDIX F

POST-DEVELOPMENT HYDROCAD COMPUTATIONS



Routing Diagram for Post
Prepared by Greenman-Pedersen, Inc, Printed 5/20/2025

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
17,756	61	>75% Grass cover, Good, HSG B (1S, 200S)
8	74	>75% Grass cover, Good, HSG C (200S)
17,130	80	>75% Grass cover, Good, HSG D (1S, 100S, 200S)
1,507	96	Gravel surface, HSG D (1S, 100S)
85,781	98	Paved parking, HSG B (1S, 200S)
574	98	Paved parking, HSG C (200S)
75,280	98	Paved parking, HSG D (1S, 100S, 200S)
67,687	98	Roofs, HSG B (1S, 200S)
36,488	98	Roofs, HSG D (1S, 200S)
2,019	98	Water Surface, HSG B (200S)
3,119	55	Woods, Good, HSG B (200S)
20,411	77	Woods, Good, HSG D (1S, 100S, 200S)
327,760	**93**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
176,363	HSG B	1S, 200S
583	HSG C	200S
150,815	HSG D	1S, 100S, 200S
0	Other	
327,760		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Su Nu
0	17,756	8	17,130	0	34,895	>75% Grass cover, Good	
0	0	0	1,507	0	1,507	Gravel surface	
0	85,781	574	75,280	0	161,635	Paved parking	
0	67,687	0	36,488	0	104,175	Roofs	
0	2,019	0	0	0	2,019	Water Surface	
0	3,119	0	20,411	0	23,530	Woods, Good	
0	**176,363**	**583**	**150,815**	**0**	**327,760**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	1S	0.00	0.00	12.0	0.0487	0.012	0.0	12.0	0.0	
2	1S	0.00	0.00	61.0	0.0948	0.012	0.0	12.0	0.0	
3	1S	0.00	0.00	123.0	0.0416	0.012	0.0	12.0	0.0	
4	1S	0.00	0.00	123.0	0.0184	0.012	0.0	12.0	0.0	
5	1S	0.00	0.00	157.0	0.0005	0.012	0.0	12.0	0.0	

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: East lot Runoff Area=188,340 sf 88.32% Impervious Runoff Depth=1.89"
Flow Length=631' Tc=6.5 min CN=95 Runoff=9.05 cfs 29,599 cf

Subcatchment 100S: Overland Flow Runoff Area=18,484 sf 0.12% Impervious Runoff Depth=0.74"
Flow Length=168' Tc=3.3 min CN=78 Runoff=0.38 cfs 1,135 cf

Subcatchment 200S: West Lot Runoff Area=120,937 sf 83.90% Impervious Runoff Depth=1.70"
Flow Length=107' Tc=5.2 min CN=93 Runoff=5.62 cfs 17,175 cf

Link DP#1: Design Point #1 - Beaver Brook Inflow=9.39 cfs 30,734 cf
Primary=9.39 cfs 30,734 cf

Link DP#2: Design Point #2 - Canal Inflow=5.62 cfs 17,175 cf
Primary=5.62 cfs 17,175 cf

Total Runoff Area = 327,760 sf Runoff Volume = 47,909 cf Average Runoff Depth = 1.75"
18.29% Pervious = 59,931 sf 81.71% Impervious = 267,829 sf

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: East lot Runoff Area=188,340 sf 88.32% Impervious Runoff Depth=3.11"
Flow Length=631' Tc=6.5 min CN=95 Runoff=14.50 cfs 48,751 cf

Subcatchment 100S: Overland Flow Runoff Area=18,484 sf 0.12% Impervious Runoff Depth=1.63"
Flow Length=168' Tc=3.3 min CN=78 Runoff=0.89 cfs 2,507 cf

Subcatchment 200S: West Lot Runoff Area=120,937 sf 83.90% Impervious Runoff Depth=2.90"
Flow Length=107' Tc=5.2 min CN=93 Runoff=9.32 cfs 29,220 cf

Link DP#1: Design Point #1 - Beaver Brook Inflow=15.28 cfs 51,258 cf
Primary=15.28 cfs 51,258 cf

Link DP#2: Design Point #2 - Canal Inflow=9.32 cfs 29,220 cf
Primary=9.32 cfs 29,220 cf

Total Runoff Area = 327,760 sf Runoff Volume = 80,478 cf Average Runoff Depth = 2.95"
18.29% Pervious = 59,931 sf 81.71% Impervious = 267,829 sf

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: East lot Runoff Area=188,340 sf 88.32% Impervious Runoff Depth=4.09"
Flow Length=631' Tc=6.5 min CN=95 Runoff=18.80 cfs 64,237 cf

Subcatchment 100S: Overland Flow Runoff Area=18,484 sf 0.12% Impervious Runoff Depth=2.43"
Flow Length=168' Tc=3.3 min CN=78 Runoff=1.34 cfs 3,749 cf

Subcatchment 200S: West Lot Runoff Area=120,937 sf 83.90% Impervious Runoff Depth=3.87"
Flow Length=107' Tc=5.2 min CN=93 Runoff=12.25 cfs 39,045 cf

Link DP#1: Design Point #1 - Beaver Brook Inflow=19.98 cfs 67,986 cf
Primary=19.98 cfs 67,986 cf

Link DP#2: Design Point #2 - Canal Inflow=12.25 cfs 39,045 cf
Primary=12.25 cfs 39,045 cf

Total Runoff Area = 327,760 sf Runoff Volume = 107,031 cf Average Runoff Depth = 3.92"
18.29% Pervious = 59,931 sf 81.71% Impervious = 267,829 sf

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: East lot Runoff Area=188,340 sf 88.32% Impervious Runoff Depth=6.11"
Flow Length=631' Tc=6.5 min CN=95 Runoff=27.46 cfs 95,854 cf

Subcatchment 100S: Overland Flow Runoff Area=18,484 sf 0.12% Impervious Runoff Depth=4.20"
Flow Length=168' Tc=3.3 min CN=78 Runoff=2.30 cfs 6,475 cf

Subcatchment 200S: West Lot Runoff Area=120,937 sf 83.90% Impervious Runoff Depth=5.87"
Flow Length=107' Tc=5.2 min CN=93 Runoff=18.14 cfs 59,202 cf

Link DP#1: Design Point #1 - Beaver Brook Inflow=29.46 cfs 102,329 cf
Primary=29.46 cfs 102,329 cf

Link DP#2: Design Point #2 - Canal Inflow=18.14 cfs 59,202 cf
Primary=18.14 cfs 59,202 cf

Total Runoff Area = 327,760 sf Runoff Volume = 161,531 cf Average Runoff Depth = 5.91"
18.29% Pervious = 59,931 sf 81.71% Impervious = 267,829 sf

Summary for Subcatchment 1S: East lot

[47] Hint: Peak is 170% of capacity of segment #4
[47] Hint: Peak is 122% of capacity of segment #5
[47] Hint: Peak is 184% of capacity of segment #6
[47] Hint: Peak is 277% of capacity of segment #7
[47] Hint: Peak is 1680% of capacity of segment #8

Runoff = 14.50 cfs @ 12.09 hrs, Volume= 48,751 cf, Depth= 3.11"
Routed to Link DP#1 : Design Point #1 - Beaver Brook

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=3.67"

Area (sf)	CN	Description
9,798	61	>75% Grass cover, Good, HSG B
9,132	80	>75% Grass cover, Good, HSG D
899	96	Gravel surface, HSG D
31,859	98	Paved parking, HSG B
56,030	98	Paved parking, HSG D
43,262	98	Roofs, HSG B
35,186	98	Roofs, HSG D
2,172	77	Woods, Good, HSG D
188,340	95	Weighted Average
22,002		11.68% Pervious Area
166,338		88.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	25	0.0330	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
0.5	35	0.0330	1.27		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	95	0.0638	5.13		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.0	12	0.0487	10.84	8.52	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
0.1	61	0.0948	15.13	11.88	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Corrugated PP, smooth interior
0.2	123	0.0416	10.02	7.87	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Corrugated PP, smooth interior
0.3	123	0.0184	6.67	5.24	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Corrugated PP, smooth interior
2.4	157	0.0005	1.10	0.86	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Corrugated PP, smooth interior
6.5	631	Total			

Summary for Subcatchment 100S: Overland Flow

Runoff = 0.89 cfs @ 12.05 hrs, Volume= 2,507 cf, Depth= 1.63"
Routed to Link DP#1 : Design Point #1 - Beaver Brook

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=3.67"

Area (sf)	CN	Description
2,701	80	>75% Grass cover, Good, HSG D
608	96	Gravel surface, HSG D
21	98	Paved parking, HSG D
15,155	77	Woods, Good, HSG D
18,484	78	Weighted Average
18,463		99.88% Pervious Area
21		0.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	19	0.3400	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
1.4	149	0.1190	1.72		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.3	168	Total			

Summary for Subcatchment 200S: West Lot

Runoff = 9.32 cfs @ 12.07 hrs, Volume= 29,220 cf, Depth= 2.90"
Routed to Link DP#2 : Design Point #2 - Canal

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=3.67"

Area (sf)	CN	Description
7,958	61	>75% Grass cover, Good, HSG B
8	74	>75% Grass cover, Good, HSG C
5,297	80	>75% Grass cover, Good, HSG D
53,922	98	Paved parking, HSG B
574	98	Paved parking, HSG C
19,228	98	Paved parking, HSG D
24,425	98	Roofs, HSG B
1,301	98	Roofs, HSG D
2,019	98	Water Surface, HSG B
3,119	55	Woods, Good, HSG B
3,084	77	Woods, Good, HSG D
120,937	93	Weighted Average
19,467		16.10% Pervious Area
101,470		83.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.2	23	0.0180	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
2.0	84	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.2	107	Total			

Summary for Link DP#1: Design Point #1 - Beaver Brook

Inflow Area = 206,824 sf, 80.44% Impervious, Inflow Depth = 2.97" for 10-Year event
Inflow = 15.28 cfs @ 12.09 hrs, Volume= 51,258 cf
Primary = 15.28 cfs @ 12.09 hrs, Volume= 51,258 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Link DP#2: Design Point #2 - Canal

Inflow Area = 120,937 sf, 83.90% Impervious, Inflow Depth = 2.90" for 10-Year event
Inflow = 9.32 cfs @ 12.07 hrs, Volume= 29,220 cf
Primary = 9.32 cfs @ 12.07 hrs, Volume= 29,220 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

APPENDIX G

SUPPLEMENTAL CALCULATIONS AND BACKUP DATA

May 21, 2025

Town of Dracut Planning Board
62 Arlington Street
Dracut, MA 01826

Re: 88, 91, 101 Mill Street
Assessors Map 32 Block 245 Lots 1 & 1.1, Assessors Map 32 Block 0 Lot 66
Sub: Illicit Discharge Statement
Standard #10

Dear Board Members:

On behalf of our client, Beaver Brook Holdings, LLC, we hereby state that to the best of our knowledge, no illicit discharges exist on the above referenced site and none are proposed with the site development plans. Implementing the pollution prevention plan measures outlined in the site development plans will prevent illicit discharges to the stormwater management system, including wastewater discharges and discharges of stormwater contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, oil, or grease. Refer to the Grading & Drainage Plan from the site plan set for additional information.

Sincerely,
Greenman-Pedersen, Inc.

Christopher Broyles, P.E.
Project Manager

Extreme Precipitation Tables

Northeast Regional Climate Center

Data represents point estimates calculated from partial duration series. All precipitation amounts are displayed in inches.

Metadata for Point	
Smoothing	Yes
State	
Location	
Latitude	42.682 degrees North
Longitude	71.35 degrees West
Elevation	30 feet
Date/Time	Thu Apr 03 2025 09:02:57 GMT-0400 (Eastern Daylight Time)

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.28	0.42	0.52	0.69	0.86	1.08	**1yr**	0.74	1.02	1.25	1.58	1.99	2.52	2.75	**1yr**	2.23	2.65	3.09	3.78	4.41	**1yr**
2yr	0.34	0.52	0.64	0.85	1.06	1.34	**2yr**	0.92	1.23	1.55	1.93	2.42	3.02	3.34	**2yr**	2.67	3.21	3.72	4.45	5.06	**2yr**
5yr	0.40	0.62	0.77	1.04	1.33	1.69	**5yr**	1.15	1.54	1.96	2.46	3.06	3.82	4.25	**5yr**	3.38	4.08	4.71	5.60	6.34	**5yr**
10yr	0.45	0.70	0.89	1.21	1.57	2.01	**10yr**	1.35	1.82	2.34	2.94	3.67	4.56	5.10	**10yr**	4.04	4.90	5.63	6.67	7.51	**10yr**
25yr	0.53	0.84	1.07	1.48	1.96	2.53	**25yr**	1.69	2.28	2.96	3.73	4.67	5.78	6.49	**25yr**	5.11	6.24	7.13	8.40	9.42	**25yr**
50yr	0.59	0.96	1.23	1.72	2.32	3.04	**50yr**	2.00	2.70	3.56	4.50	5.60	6.91	7.80	**50yr**	6.12	7.50	8.53	10.00	11.17	**50yr**
100yr	0.68	1.11	1.43	2.02	2.75	3.62	**100yr**	2.38	3.20	4.25	5.38	6.70	8.27	9.37	**100yr**	7.32	9.01	10.21	11.92	13.26	**100yr**
200yr	0.78	1.27	1.65	2.36	3.27	4.33	**200yr**	2.82	3.80	5.10	6.45	8.04	9.90	11.27	**200yr**	8.76	10.83	12.22	14.21	15.75	**200yr**
500yr	0.94	1.54	2.01	2.92	4.10	5.47	**500yr**	3.54	4.76	6.47	8.20	10.22	12.57	14.38	**500yr**	11.12	13.83	15.50	17.93	19.78	**500yr**

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.23	0.36	0.44	0.59	0.72	0.81	**1yr**	0.62	0.80	1.09	1.34	1.69	2.34	2.57	**1yr**	2.07	2.47	2.78	3.08	4.11	**1yr**
2yr	0.32	0.49	0.60	0.82	1.01	1.21	**2yr**	0.87	1.18	1.39	1.82	2.33	2.94	3.24	**2yr**	2.60	3.12	3.63	4.34	4.92	**2yr**
5yr	0.37	0.56	0.70	0.96	1.22	1.44	**5yr**	1.05	1.41	1.65	2.14	2.73	3.58	3.96	**5yr**	3.17	3.81	4.39	5.23	5.96	**5yr**
10yr	0.40	0.62	0.77	1.07	1.38	1.63	**10yr**	1.19	1.59	1.85	2.41	3.08	4.15	4.59	**10yr**	3.68	4.42	5.06	6.03	6.85	**10yr**
25yr	0.46	0.70	0.87	1.24	1.63	1.91	**25yr**	1.41	1.87	2.17	2.84	3.58	5.05	5.58	**25yr**	4.47	5.37	6.13	7.28	8.24	**25yr**
50yr	0.50	0.76	0.95	1.37	1.84	2.17	**50yr**	1.59	2.12	2.45	3.22	4.03	5.84	6.49	**50yr**	5.17	6.24	7.09	8.40	9.45	**50yr**
100yr	0.55	0.83	1.04	1.51	2.07	2.45	**100yr**	1.78	2.40	2.77	3.54	4.54	6.42	7.54	**100yr**	5.68	7.25	8.19	9.70	10.86	**100yr**
200yr	0.61	0.92	1.16	1.68	2.35	2.78	**200yr**	2.02	2.72	3.11	4.00	5.13	7.37	8.75	**200yr**	6.52	8.42	9.49	11.19	12.46	**200yr**
500yr	0.70	1.04	1.33	1.94	2.76	3.30	**500yr**	2.38	3.22	3.66	4.71	6.06	8.81	10.71	**500yr**	7.79	10.30	11.53	13.53	14.94	**500yr**

Upper Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.31	0.48	0.58	0.78	0.96	1.12	**1yr**	0.83	1.10	1.28	1.68	2.13	2.70	2.93	**1yr**	2.39	2.82	3.32	4.06	4.74	**1yr**
2yr	0.35	0.55	0.67	0.91	1.12	1.32	**2yr**	0.97	1.29	1.51	1.96	2.51	3.12	3.45	**2yr**	2.76	3.31	3.84	4.59	5.22	**2yr**
5yr	0.44	0.68	0.84	1.15	1.46	1.69	**5yr**	1.26	1.66	1.93	2.48	3.12	4.05	4.56	**5yr**	3.59	4.38	5.04	5.99	6.74	**5yr**
10yr	0.53	0.81	1.01	1.41	1.82	2.07	**10yr**	1.57	2.02	2.35	2.98	3.72	5.00	5.65	**10yr**	4.43	5.43	6.20	7.34	8.21	**10yr**
25yr	0.68	1.04	1.29	1.85	2.43	2.69	**25yr**	2.10	2.63	3.06	3.79	4.66	6.58	7.50	**25yr**	5.82	7.21	8.18	9.62	10.72	**25yr**
50yr	0.83	1.26	1.57	2.25	3.04	3.29	**50yr**	2.62	3.22	3.74	4.56	5.54	8.10	9.32	**50yr**	7.17	8.96	10.06	11.80	13.10	**50yr**
100yr	1.01	1.53	1.91	2.76	3.79	4.03	**100yr**	3.27	3.94	4.57	5.63	6.59	10.31	11.56	**100yr**	9.12	11.12	12.39	14.50	16.01	**100yr**
200yr	1.23	1.85	2.35	3.40	4.74	4.92	**200yr**	4.09	4.81	5.57	6.79	7.84	12.78	14.35	**200yr**	11.31	13.80	15.27	17.81	19.63	**200yr**
500yr	1.61	2.39	3.08	4.47	6.35	6.41	**500yr**	5.48	6.27	7.28	8.72	9.86	16.99	19.06	**500yr**	15.04	18.33	20.12	23.38	25.62	**500yr**

Powered by ACIS Northeast Regional Climate Center

Hydro International

First Defense® High Capacity

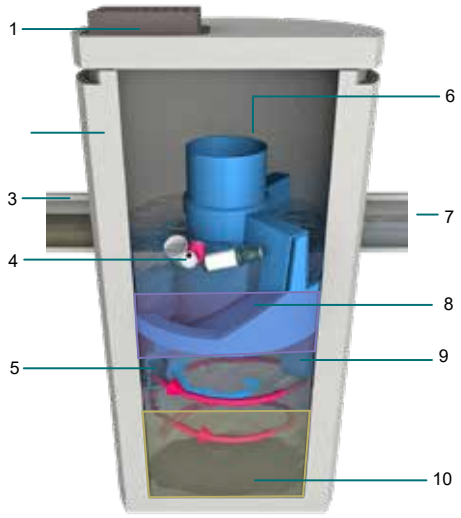
Advanced Hydrodynamic Separator

Product Summary

A Simple Solution for your Trickiest Sites

First Defense® High Capacity is a versatile stormwater separator with some of the highest approved flow rates in the United States, enabling engineers and contractors to save site space and projects costs by using the smallest possible footprint. It also works with single and multiple inlet pipes and inlet grates has an internal bypass to convey infrequent peak flows directly to the outlet.

Fig.1 The First Defense® High Capacity has internal components designed to efficiently capture pollutants and prevent washout at



Product Profile

1. Inlet Grate (optional)
2. Precast chamber
3. Inlet Pipe (optional)
4. Floatables Draw Off Slot (not pictured)
5. Inlet Chute
6. Internal Bypass
7. Outlet pipe
8. Oil and Floatables Storage
9. Outlet chute
10. Sediment Storage Sump

Applications

- Areas requiring a minimum of 50% TSS removal
- Stormwater treatment at the point of entry into the drainage line
- Sites constrained by space, topography or drainage profiles with limited slope and depth of cover
- Highways, car parks, industrial areas and urban developments
- Pre-treatment to ponds, storage systems, green infrastructure

How it Works

Highest Flow through the Smallest Footprint

Contaminated stormwater runoff enters the inlet chute from a surface grate and/or inlet pipe. The inlet chute introduces flow into the chamber tangentially to create a low energy vortex flow regime (magenta arrow) that directs sediment into the sump while oils, floating trash and debris rise to the surface.

Treated stormwater exits through a submerged outlet chute located opposite to the direction of the rotating flow (blue arrow). Enhanced vortex separation is provided by forcing the rotating flow within the vessel to follow the longest path possible rather than directly from inlet to outlet.

Higher flows bypass the treatment chamber to prevent turbulence and washout of captured pollutants. An internal bypass conveys infrequent peak flows directly to the outlet eliminating the need for, and expense of, external bypass control structures. A floatables draw off slot functions to convey floatables into the treatment chamber prior to bypass.

Benefits

Small & Simple

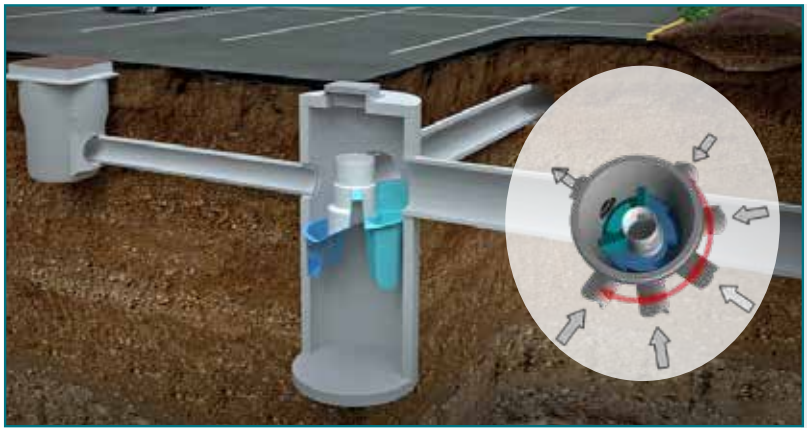
- Cut footprint size, cut costs: First Defense® provides space-saving, easy-to-install surface water treatment in standard sized chambers/ manholes.
- Adapt to site limitations: Variable configuratoins will help you effectively slip First Defense® into a tight spot. It also works well with large pipes, multiple inlet pipes and inlet grates.
- Save installation time: Every First Defense® unit is delivered to site pre-assembled and ready for installation – so installation is as easy as fitting any chamber/manhole.

Stormwater Solutions

→ hydro-int.com/firstdefense

Sizing & Design

This adaptable online treatment system works easily with large pipes, multiple inlet pipes, inlet grates and now, contains a high capacity bypass for the conveyance of large peak flows. Designed with site flexibility in mind, the First Defense® High Capacity allows engineers to maximize available site space without compromising treatment level.



Free Sizing Tool

This simple online tool will recommend the best separator, model size and online/offline arrangement based on site-specific data entered by the user.

Go to hydro-int.com/sizing to access the tool.

First Defense® High Capacity Model Number	Diameter	Typical TSS Treatment Flow Rates		Peak Online Flow Rate	Maximum Pipe Diameter[1]	Oil Storage Capacity	Typical Sediment Storage Capacity[2]	Minimum Distance from Outlet Invert to Top of Rim[3]	Standard Distance from Outlet Invert to Sump Floor
		NJDEP Certified	110µm						
	(ft / m)	(cfs / L/s)	(cfs / L/s)	(cfs / L/s)	(in / mm)	(gal / L)	(yd^3 / m^3)	(ft / m)	(ft / m)
FD-3HC	3 / 0.9	0.84 / 23.7	1.06 / 30.0	15 / 424	18 / 450	125 / 473	0.4 / 0.3	2.0 - 3.5 / 0.6 - 1.0	3.71 / 1.13
FD-4HC	4 / 1.2	1.50 / 42.4	1.88 / 53.2	18 / 510	24 / 600	191 / 723	0.7 / 0.5	2.3 - 3.9 / 0.7 - 1.2	4.97 / 1.5
FD-5HC	5 / 1.5	2.35 / 66.2	2.94 / 83.2	20 / 566	24 / 600	300 / 1135	1.1 / .84	2.5 - 4.5 / 0.7 - 1.3	5.19 / 1.5
FD-6HC	6 / 1.8	3.38 / 95.7	4.23 / 119.8	32 / 906	30 / 750	496 / 1,878	1.6 / 1.2	3.0 - 5.1 / 0.9 - 1.6	5.97 / 1.8
FD-8HC	8 / 2.4	6.00 / 169.9	7.52 / 212.9	50 / 1415	48 / 1200	1120 / 4239	2.8 / 2.1	3.0 - 6.0 / 0.9 -1.8	7.40 / 2.2
FD-10HC	10 / 3.0	9.38 / 265.6	11.75 / 332.7	50 / 1415	48 / 1200	1742 / 6594	4.4 / 3.3	6.5 -8.0 / 2.0 - 2.4	10.25 / 3.12

[1]Contact Hydro International when larger pipe sizes are required.
[2]Contact Hydro International when custom sediment storage capacity is required.
[3]Minimum distance for models depends on pipe diameter.

Maintenance

Easy vactor hose access through the center shaft of the system makes for quick, simple sump cleanout while trash and floatables can be fished out from the surface with a net.

Nobody maintains our systems better than we do. To ensure optimal, ongoing device performance, be sure to recommend Hydro International as a preferred service and maintenance provider to your clients.

Hydro International

Hydro International, 94 Hutchins Drive, Portland, ME 04102
Tel: (207) 756-6200
Email: stormwaterinquiry@hydro-int.com
Web: www.hydro-int.com/firstdefense

FD_SS_B_2105

Download Drawings!

→ hydro-int.com/fddrawings

Access the Operation & Maintenance Manual

→ hydro-int.com/fd-om

Technical Abstract

First Defense® - High Capacity

NJCAT Verified 80% TSS Removal & Sizing - “Down to 50 microns”

Abstract

Hydro International has a state-of-the-art hydraulics and test facility that is used both to develop products and to evaluate performance. Through controlled testing using industry standard test protocols, Hydro’s treatment products are evaluated under varying hydraulic and sediment load conditions. With a known drainage area or water quality flow rate, these test results are used to benchmark treatment objectives and to select the correct model size.

A common performance expectation for hydrodynamic stormwater separators is to remove 80% of Total Suspended Solids (TSS). To support this approach, Hydro International has completed efficiency tests for a range of flow rates and particle size ranges. All tests are conducted with an independent observer present and use industry accepted protocols. All analytics are completed by externally certified laboratories. The test procedures and results have been reviewed and verified by New Jersey Corporation for Advanced Technology (NJCAT).

First Defense

The FDHC (Figure 1) has patented flow-modifying internal components that create a gentle swirling flow path within the Vortex Chamber. The rotating flow creates low energy vortex forces that supplement gravitational settling forces to enhance separation of pollutants

The internal components are designed to fit into standard precast manholes and are installed to collect runoff as part of typical drainage network system. During a rain event, flow enters either from a surface inlet grate or inlet pipe. As flow enters the manhole, components divert flow and pollutants into a Vortex Chamber beneath a separation module, that includes both Inlet\Outlet Chutes and Bypass Weirs. The internal Bypass Weirs divert peak flows over the separation module and away from the Vortex Chamber where pollutants are collecting. This prevents high velocities from re-suspending captured pollutants during infrequent but large storm events.

Capable of providing high pollutant removals for a wide range of flow rates and pipe sizes, the FDHC can be installed ether online or offline depending on pipes and peak flows. Its efficiency and simplicity make it economical to install and maintain.

Fine Sediment Removal Test Material

The feed sediment used for the removal efficiency testing was high purity silica (SiO2 99.8%) supplied by two different commercial silica suppliers, blended in the proportions to produce a wide range of particle sizes distributed from less than 10 µm to over 1000 µm, with a D_{50} = 63 µm. This provides a loading bias towards finer particle sizes and produces more conservative results. In the presence of an independent observer, composited samples were sealed, signed, and packaged for independent transport to the outside laboratory for analysis.

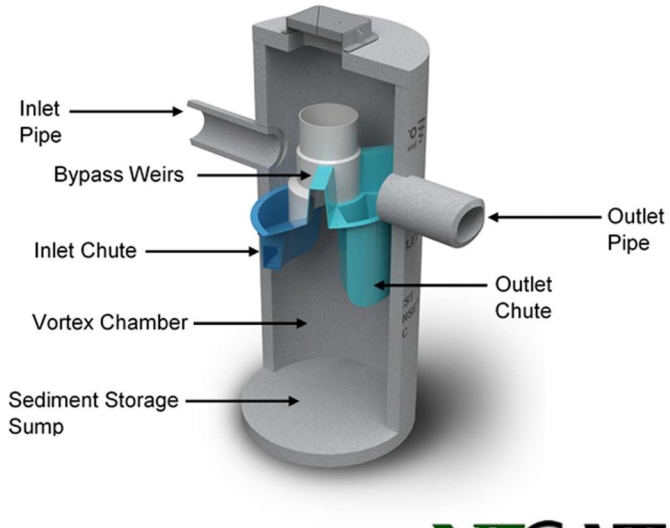


Figure 1 – First Defense High Capacity

The independent laboratory, GeoTesting Express, analyzed the three test sand samples for particle size distribution (PSD) using ASTM D 422-63. The particle size results were averaged to produce an overall measure of the test sediment. Because the goal was to verify the removal rate of the First Defense for various PSD ranges, the test sand was also graded into subset PSD ranges shown in Figure 2. Each subset is expressed as a separate PSD “Down To” the smallest particle size in that subset, as a fraction of subset’s total mass.

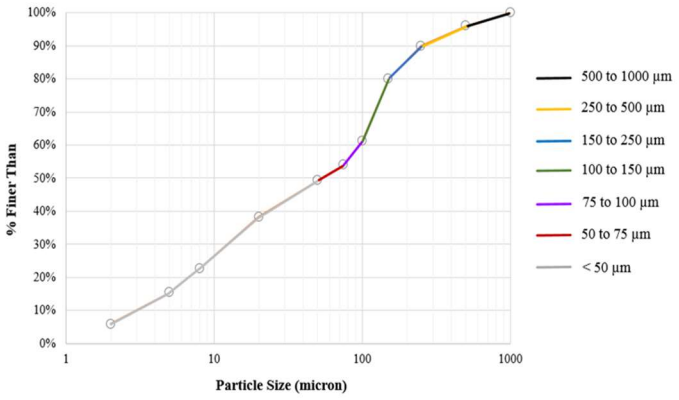


Figure 2 - Particle Size Distribution of Test Sediment

First Defense®

Laboratory Testing Arrangement

The laboratory setup consisted of a recirculating closed loop system with an 8-inch (200 mm) submersible Flygt pump that conveyed water from a 23,000 gal (87,064 L) reservoir through a PVC pipe network to the 4-ft (1.2m) First Defense (Fig.3). The flow rate of the pump was controlled by a GE Fuji Electric AF-300 P11 Adjustable Frequency Drive and measured by an EMCO Flow Systems 4411e Electromagnetic Flow Transmitter.

The sediment storage sump of the First Defense measures 18 inches (457 mm) in height. But it was fitted with a false bottom positioned 9 inches (229 mm) above the floor of the sump to simulate a 50% full condition during testing to ensure a conservative test result.

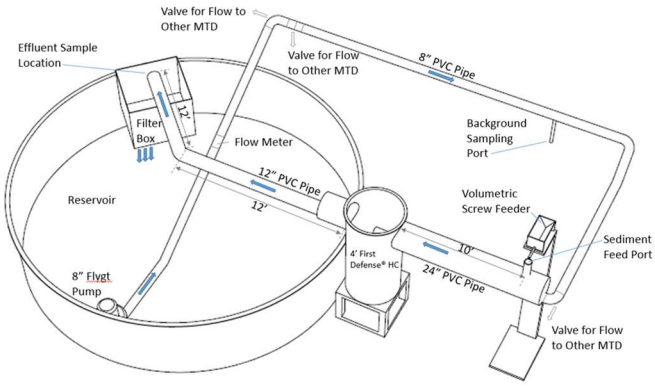


Figure 3 - Set-up of the Portland, Maine hydraulic testing facility

Performance Test Procedures

Removal efficiency testing was conducted in accordance with Section 5 of the NJDEP Laboratory Protocol for HDS MTDs. Particle sizes were determined for both the inlet feed and captured sediment removed from the sump between each test run.

A total of 15 evenly spaced effluent samples were taken at five flow rates: 0.38 cfs (10.8 L/s), 0.54 cfs (15.3 L/s), 0.82 cfs (23.2 L/s), 1.07 cfs (30.3 L/s), and 1.38 cfs (39.1 L/s).

Duplicate effluent samples were also takes at the first, middle and last sample at each flow. These were composited and analyzed for particle size distribution using laser diffraction. Background concentrations were also taken to ensure the recirculation and filter system kept background concentration below 20 mg/L.

To determine the effluent concentration within a specific particle size range, the percentage of particles in the particle size band was multiplied by the overall adjusted average effluent concentration. Removal efficiencies were calculated using the average influent concentration and average effluent concentration adjusted for background concentrations.

These results are summarized below and the full report can be viewed at: FDHC_PSD_Removal_Verification_Report_9-16.pdf

Performance Results

The First Defense performed well under the full range of tested flow rates showing high removal rates across a broad range of particle sizes. For all particles from 50 µm to 1,000 µm, the FDHC removed greater than 90% TSS for all tested flow rates up to 1.88 cfs, or 1.5 cfs with a safety factor of 1.25.

The results for all tests were plotted on a flow vs. removal efficiency graph and a best fit curve produced (Figure 4).

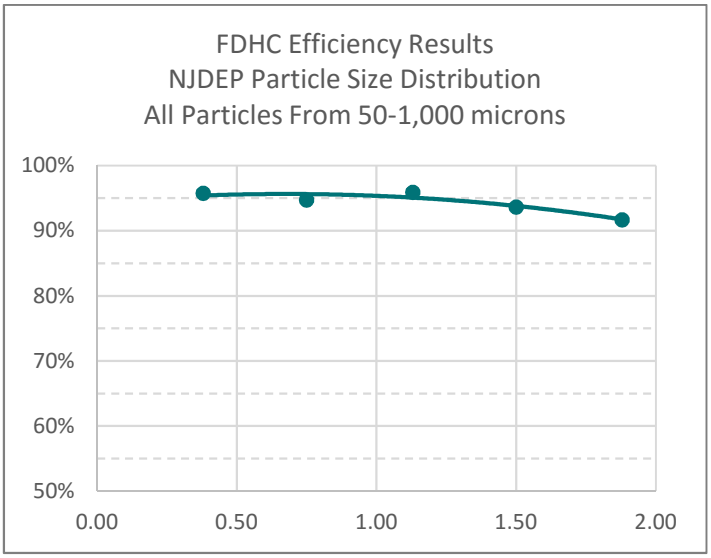


Figure 4 - Removal Efficiency Results of the 4-ft First Defense

First Defense Sizing for > 80% TSS Removal

Table 1 includes the treatment flow rates for different First Defense models based on surface loading rate scaling of the test unit, for greater than 80% TSS removal down to 50 microns. The treatment flow rates include a safety factor of 1.25 and actual removals from test results were greater than 90%.

For design purposes, the selected model's Treatment Flow Rate must be equal or greater to the site's required Water Quality Flow Rate.

The peak flow rate and maximum pipe size must be considered to determine whether an online or offline configuration is appropriate.

Refer to the First Defense product information brochure for visit www.hydro-int.com/us for more information.

Table 1. First Defense verified flow rates for greater than 80% TSS* removal with safety factor of 1.25.

Model:	FD-3HC	FD-4HC	FD-6HC	FD-8HC
Size:	3 ft (900 mm)	4 ft (1.2 m)	6 ft (1.8 m)	8 ft (2.4m)
cfs:	0.85	1.5	3.38	6.00
L/s:	24.0	42.5	95.7	170.0

**Actual removals for all particles down to 50µm were > 90%.*

Hydro International. 94 Hutchins Drive. Portland. ME 04102
Tel: 207.756.6200 Fax: 207.756.6212
Email: stormwaterinquiry@hydro-int.com Web: www.hydro-int.com

Stormwater Solutions

APPENDIX H

DRAINAGE AREA PLANS

WATERSHED LEGEND

SUB	SUBCATCHMENT	A RELATIVELY HOMOGENEOUS AREA OF LAND THAT DRAINS INTO A SINGLE REACH OR POND. EACH SUBCATCHMENT GENERATES A RUNOFF HYDROGRAPH. (A SUBCATCHMENT MAY ALSO BE USED TO ACCOUNT FOR THE RAIN FALLING DIRECTLY ON THE SURFACE OF A POND.)
REACH	REACH	A UNIFORM STREAM, CHANNEL, OR PIPE THAT CONVEYS WATER FROM ONE POINT TO ANOTHER REACH OR POND. THE OUTFLOW OF EACH REACH IS DETERMINED BY A HYDROGRAPH ROUTING CALCULATION.
POND	POND	A POND, SWAMP, DAM, OR OTHER IMPOUNDMENT THAT FILLS WITH WATER FROM ONE OR MORE SOURCES AND EMPTIES IN A MANNER DETERMINED BY A WEIR, CULVERT, OR OTHER DEVICE(S) AT ITS OUTLET. THE OUTFLOW(S) OF EACH POND IS DETERMINED BY A HYDROGRAPH ROUTING CALCULATION. THE PRIMARY AND/OR SECONDARY OUTFLOW MAY DRAIN INTO A REACH OR INTO ANOTHER POND.
DP	DESIGN POINT	
	TIME OF CONCENTRATION PATH (Tc)	
	WATERSHED DIVIDE LINE	

SOIL LEGEND

420B	SOIL TYPE DESIGNATION
	SOIL BOUNDARY

N

DP#1
DESIGN POINT #1 - BEAVER BROOK

DP#2
DESIGN POINT #2 - CANAL

100S
200S
1S
4A
315B
420B
300B

MAP 32
BLOCK 245
LOT 1.1
29,388 Sq.Ft.
0.674 Ac.±
(#101 MILL ST.)
AKA LOT 1–D

MAP 32
BLOCK 245
LOT 1
272,793 Sq.Ft.
6.262 Ac.±
(#91 MILL ST.)
AKA LOT 1–A

MAP 32 BLOCK 0
LOT 66
40,997 Sq.Ft.
0.941 Ac.±
(#88 MILL ST.)
AKA LOT 1–C

1–STORY BUILDING (GARAGE/MAINTENANCE)

Tc FLOW PATH (TYP.)

0 30 60 100
SCALE: 1" = 30'

811 DigSafe MA-ME-NH-RI-VT

F:\Projects\NEX-2021147 - Dracut, MA - 91-101 Mill St - McGovern\Drainage\Drainage Area Plans (CAD)\Pre.dwg Pre 5/20/25 5:12pm cmeson

GPI Engineering Design Planning Construction Inspection
603.893.0720 GPINET.COM
Greenman-Pedersen, Inc.
44 Stiles Road
Salem, NH 03079

PREPARED FOR:
BEAVER BROOK HOLDINGS, LLC
P.O. BOX 895
DRACUT, MA 01850

RESIDENCES AT BEAVER BROOK
ASSESSORS MAP 32 BLOCK 245 LOTS 1 & 1.1
ASSESSORS MAP 32 BLOCK 0 LOT 66
88, 91, 101 MILL STREET
DRACUT, MASSACHUSETTS

REVISIONS		
NO.	REVISION	DATE

MAY 21, 2025

DRAWN/DESIGN BY	CHECKED BY
DJT	CSB/CNM

PRE - DEVELOPMENT DRAINAGE AREA PLAN

SCALE: 1"=30'

PROJECT NO. NEX-2021147

WATERSHED LEGEND

SUB — SUBCATCHMENT: A RELATIVELY HOMOGENEOUS AREA OF LAND THAT DRAINS INTO A SINGLE REACH OR POND. EACH SUBCATCHMENT GENERATES A RUNOFF HYDROGRAPH. (A SUBCATCHMENT MAY ALSO BE USED TO ACCOUNT FOR THE RAIN FALLING DIRECTLY ON THE SURFACE OF A POND.)

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DP — DESIGN POINT

TIME OF CONCENTRATION PATH (Tc)

WATERSHED DIVIDE LINE

SOIL LEGEND

420B — SOIL TYPE DESIGNATION

SOIL BOUNDARY

N

1-STORY BUILDING (GARAGE/MAINTENANCE)

BLDG-F
EXIST. 1-STORY GARAGE/MAINTENANCE BUILDING
PROP. 3-STORY MIXED USE BUILDING
GROUND FLOOR COMMERCIAL AND 3 RESIDENTIAL UNITS

DP#1
DESIGN POINT #1 - BEAVER BROOK

100S

4A

1S

315B

BLDG-E
PROP. 6-STORY MULTI-FAMILY RESIDENTIAL BUILDING
(4-FLOORS RESIDENTIAL)
(2-FLOORS PARKING)
86 RESIDENTIAL UNITS
133 PARKING SPACES

BLDG-A
EXIST. 2-STORY BUILDING
(COMMUNITY ROOM / GYM FOR 47 UNITS)
PROP. 3-STORY MIXED USE BUILDING
4 RESIDENTIAL UNITS
COMMUNITY ROOM/GYM

BLDG-B1
EXIST. 1-STORY COMMERCIAL BUILDING
PROP. 3-STORY TOWNHOUSE STYLE BUILDING
6 RESIDENTIAL UNITS
6 TANDEM GARAGES (12 SPACES)

BLDG-B2
EXIST. 2-STORY COMMERCIAL BUILDING
PROP. 3-STORY TOWNHOUSE STYLE BUILDING
6 RESIDENTIAL UNITS
4 GARAGES

BLDG-C
EXIST. 1-STORY COMMERCIAL BUILDING
PROP. 3-STORY TOWNHOUSE STYLE BUILDING
5 RESIDENTIAL UNITS
7 GARAGES

BLDG-D
EXIST. 2-STORY COMMERCIAL BUILDING
PROP. 3-STORY
16 UNIT APARTMENT BUILDING
13 TANDEM GARAGES
(26 SPACES)

EXIST. 1-STORY COMMERCIAL BUILDING

EXIST. 2-STORY COMMERCIAL BUILDING

EXIST. 1-STORY COMMERCIAL BUILDING

1-STORY COMMERCIAL BUILDING

MAP 32 BLOCK 245 LOT 1
272,793 Sq.Ft.
6.262 Ac.±
(#91 MILL ST.)
AKA LOT 1–A

MAP 32 BLOCK 245 LOT 1.1
29,388 Sq.Ft.
0.674 Ac.±
(#101 MILL ST.)
AKA LOT 1–D

EXIST. 5-STORY RESIDENTIAL BUILDING (45 UNITS)

EXIST. 1-STORY RESIDENTIAL BUILDING (2 UNITS)

DP#2
DESIGN POINT #2 - CANAL

Tc FLOW PATH (TYP.)

200S

420B

300B

MAP 32 BLOCK 0 LOT 66
40,997 Sq.Ft.
0.941 Ac.±
(#88 MILL ST.)
AKA LOT 1–C

0 30 60 100
SCALE: 1" = 30'

811 DigSafe MA-ME-NH-RI-VT

F:\Projects\NEX-2021147 - Drocut, MA - 91-101 Mill St - McGowan\Drainage\Drainage Area Plans (CAD)\Post.dwg Post 5/20/25 5:12pm cmeson

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ASSESSORS MAP 32 BLOCK 245 LOTS 1 & 1.1
ASSESSORS MAP 32 BLOCK 0 LOT 66
88, 91, 101 MILL STREET
DRACUT, MASSACHUSETTS

REVISIONS

NO.	REVISION	DATE

MAY 21, 2025

DRAWN/DESIGN BY	CHECKED BY
DJT	CSB/CNM

POST - DEVELOPMENT DRAINAGE AREA PLAN

SCALE: 1"=30'

PROJECT NO. NEX-2021147

(UNDER SEPARATE COVER)

OPERATION AND MAINTENANCE PLAN FOR STORMWATER MANAGEMENT SYSTEMS (O&M)