STORMWATER MANAGEMENT REPORT

Proposed Development Project
Franklin Crossing

380 King Street
Franklin MA 02038

Assessors Plat 303, Lot 042
Zoned Commercial II
Issued 5/12/25
Rev. 1 9/18/25

NEI
Narragansett
Engineering Inc.
Civil · Survey · Structural · Environmental · Design
3102 East Main Road, Portsmouth RI 02871
Tel. 401.683.6630   www.nei-cds.com

COMMONWEALTH OF MASSACHUSETTS
JOSEPH W. MALO
CIVIL
NO. 51565
REGISTERED
PROFESSIONAL ENGINEER

NEI Job Number: 24.0168

Prepared by: Joe Malo, P.E.

Narragansett Engineering, Inc. 3102 East Main St, Portsmouth, RI 02871

TABLE OF CONTENTS

PROJECT DESCRIPTION

Introduction

The proposed subdivision comprises of reallocating parcel boundaries of like-owned land plots to accommodate the construction of a new 30 – unit residential housing complex. The development will be serviced by a walkway and parking along three sides of the newly defined lot. Accessible routes are proposed onsite as well as regrading and resurfacing the travel drives. The project area encompasses approximately 1.26 acres and is bound by the King Street Café development at 390 King St to the west, Sierra's Brick Oven Pizza at 370 King St to the east, King Street to the south and Spruce Pond Road to the south.

Methodology

Hydrologic calculations for existing and proposed conditions were performed using HydroCAD Version 10.20-5C software, which uses TR-55 methodology to calculate runoff and TR-20 methodology for storm routing through the stormwater detention facilities. Site hydrology was evaluated for the water quality storm (WQ), 2-, 10-, 25-, and 100-year storms. Existing and Proposed Watershed Maps, indicating the subwatersheds and associated stormwater flow paths can be found in Appendix C.

The stormwater drainage design was developed in accordance with the February 2008 Massachusetts Stormwater Handbook and Stormwater Standards with revisions to the Wetlands regulations, 310 CMR 10.00 and Water Quality Regulations 314.

Existing Conditions

The watershed area analyzed for the project consists of the Limit of Disturbance (LOD) with a total area of 1.26 acres. This area includes the unimproved lot, landscaping patches throughout, paved parking areas and paved access drives along the north and south borders of the site. The Pre-DA map, which depicts the limits of the existing condition hydrology, can be found in Appendix C. The topography of the site slopes due east, towards the southern side of the 370 King Street lot (approximate elevation 334) from the elevation (approximate 346).

According to the Soil Survey of Massachusetts (US Department of Agriculture Soil Conservation Service 1981), the soils at the project site includes Woodbridge fine sandy loam. The on-site soils are classified within Hydrologic Group "C/D" by the Soil Survey.

Test pits were excavated on November 26th, 2024 to review below grade conditions on the site. The test pit information is provided in Appendix A. The on-site soils are generally comprised of sandy loams in most areas. The estimated seasonal high groundwater table (SHGWT) varies across the site from 79" to 91" below existing grade. Percolation tests were preformed in each of the three test holes and resulted in an average percolation rate of 5.36 inches/hour. To be conservative, we used a permeability rate of 1.02 inches/hour for sandy loam soils.

The existing site contains approximately 0.36 acres (28%) of impervious area within the LOD, which consists of unimproved lot, landscaping patches throughout, paved parking areas and paved access drives along the north and south borders of the site. Stormwater generated on the site flows in an easterly direction captured by existing drainage structures offsite which directs runoff to Spruce Pond. Offsite stormwater flows from the upgradient 370 King Street onto the site. This runoff is primarily within the southern and western portions of the neighboring parking lot. See the existing watershed map in Appendix C.

According to the Massachusetts Integrated Lists of Waters, Spruce Pond does not have any current or upcoming Total Maximum Daily Loads (TMDLs) associated with the waterbody. Regardless, a pollutant loading calculation has been provided in Appendix B.

Under existing conditions, three sub-watersheds were analyzed, EDA-1, EDA-2, and EDA-3. EDA-1 is comprised of the site south of the cross travel way adjacent to King Street and the southern portions of the parking area of 370 King Street. This includes the existing unimproved parking area, paved access drive to the southeast, south parking area of 370 King Street and adjacent landscaped areas. EDA-1 drains easterly to the design point "Spruce Pond". Stormwater structures exist in EDA-1 in the form of catch basins in the easterly portion of the sub watershed directing flow to the existing conveyance system. EDA-2 is comprised of the pervious areas due south of King Street as well as the northly access drive onsite. EDA-2 drains easterly to the design point "Spruce Pond". Stormwater structures within EDA-2 allow runoff to gather within the existing stormwater conveyance system. EDA-3 is comprised of the paved egress off of King Street that serves the site and landscape areas within the general vicinity of said paved egress. EDA-3 drains to the north to the design point "King St System".

Proposed Conditions

The proposed development of this site includes the construction of the 30 – unit residential complex with associated parking and landscaped areas throughout. Site improvements include the construction of walkways, landscaping features, underground stormwater facilities with at grade conveyance structures among other utility improvements. The existing paved parking areas shall be resurfaced within the parcel along with construction activities to the southwest of the site at the southern access drive within the adjacent parcel. This development within the neighboring parcel shall provide steady grading and an opportunity to direct runoff off the roadway by installing at grade structures in designated locations. The proposed condition has approximately 0.97 acres of impervious area within the project limits.

The project will include three subsurface infiltration systems to treat and mitigate peak runoff rates and volumes. Onsite drainage structures will convey stormwater runoff to the best management practices (BMP's), which are designed to reduce the peak flow rate discharged from the site and provide total suspended solids (TSS) removal. Three subsurface infiltration systems have been designed to convey stormwater while mitigating peak flows and volumes when compared to existing conditions.

The subsurface BMP's have been designed in accordance with Massachusetts Stormwater Standards to mitigate the peak flow rate and promote the settling of total suspended solids. The inflow to each system is directed by overland flow to catch basins and convey it to the BMPs for

treatment. Any runoff directed to the BMPs receive pretreatment via the isolator rows by use of diversion manhole structures. These structures divert WQv-level storms to the isolator rows to receive pretreatment. The remainder of stormwater from larger storms circumvent this diversion leading straight to the infiltrating chambers of the BMP. The isolator rows are lined to make them impermeable as compared to the rest of the system and provides TSS removal, allowing runoff within the remainder of the system for infiltration. The outlets of the BMP's include outlet control devices which are designed to control the peak flow and volumes of larger storm events out of the system. The primary outlet is located at the bottom of the outlet control devices allowing for stedy flow out of the system during any storm event. The outflow of each BMP is directed to the remainder of the existing drainage system east of the site to the final design point of Spruce Pond.

Under proposed conditions, the site was divided into a total of six sub watersheds: PDA-1 through PDA-6.

PDA-1 encompasses the southern parking area with associated sidewalks and the southern portion of the eastern parking area. PDA-1 also includes the eastern wheelchair ramp and stairwell access, adjoining sidewalks and landscaped areas. See Appendix C for precise sub watershed boundaries. This design directs flow to the southeast of the parking facility by surface grades and contains the runoff by precast concrete curbing throughout. The parking lot consists of at grade drainage structures to convey runoff to the subsurface BMP within this sub watershed. The subsurface BMP is designed with an isolator row to provide pretreatment and then provides storage for peak volumes and slowly infiltrates reducing peak flows. Runoff overflow is directed out back to the drainage system which directs flows to the design point "Spruce Pond".

The parking lot consists of at grade drainage structures to convey runoff to the subsurface BMP within this sub watershed. PDA-2 includes the subwatersheds of the catch basins diverting stormwater flow to the BMP of this subwatershed. See the catch basin subwatershed map in Appendix C for more precise subwatershed boundaries. The subsurface BMP is designed with an isolator row to provide pretreatment and provides storage for peak volumes and slowly infiltrates reducing peak flows. Runoff overflow is directed out back to the existing drainage system which directs flows to the design point "Spruce Pond".

PDA-3 includes the landscaped areas of the closed entrance and proposed sidewalk along King Street. Due to various site constraints, this area couldn't be captured and directed to a stormwater BMP. This area will retain its existing flow path and will discharge to the design point "King Street".

PDA-4 includes the housing complex, access drive to be resurfaced within the adjacent parcel to the west, and a sizeable portion of the upgradient neighboring parcel. The proposed housing development shall incorporate its runoff flow via downspout collection piping to discharge to the landscaped areas to the west ultimately reaching the BMP within this sub watershed. The access drive consists of at grade drainage structures at their terminus to convey runoff from the paved areas directing flow to this subwatershed to the subsurface BMP. The subsurface BMP is designed with an isolator row to provide pretreatment and then provides storage for peak volumes and slowly infiltrates reducing peak flows. Runoff overflow is directed out back to the drainage system which directs flows to the design point "Spruce Pond".

PDA-5 includes the southeasterly section of the existing paved access drive to be closed and surrounding areas. This area is within the limit of disturbance of this project and thus within this analysis. Due to various site constraints, this area couldn't be captured and directed to a stormwater BMP. These areas will retain their existing flow path and will discharge to the design point "Spruce Pond".

PDA-6 includes the portion of the northeastern access drive adjacent to 390 King Street and immediate surrounding landscaped areas. Due to various site constraints, this area couldn't be captured and directed to a stormwater BMP. Runoff from this subwatershed ultimately reaches the design point "Spruce Pond".

The hydrologic model has been routed to analysis key points within the existing drainage discharge as well as the ultimate discharge points of this proposed development. The existing drainage conveyance system has a 12" pipe along the south side and an 18" pipe along the north end that both discharge to Spruce Pond. BMP-1 and BMP-2 discharge to the existing 12" pipe. BMP-3 discharges to the existing 18" pipe prior to discharging to Spruce Pond. These two pipes along with the Spruce Pond Design Point and the King Street Design Point have been analyzed to ensure peak flows and volume do not increase by the proposed development. The analysis shows a decrease in the peak flow rate and volume offsite at each design storm and at each design point. Tables 1 through 4 below provided a summary of the peak flow rates for the existing and proposed conditions at both design points.

Proposed Hydrologic Model & Peak Flow Rates
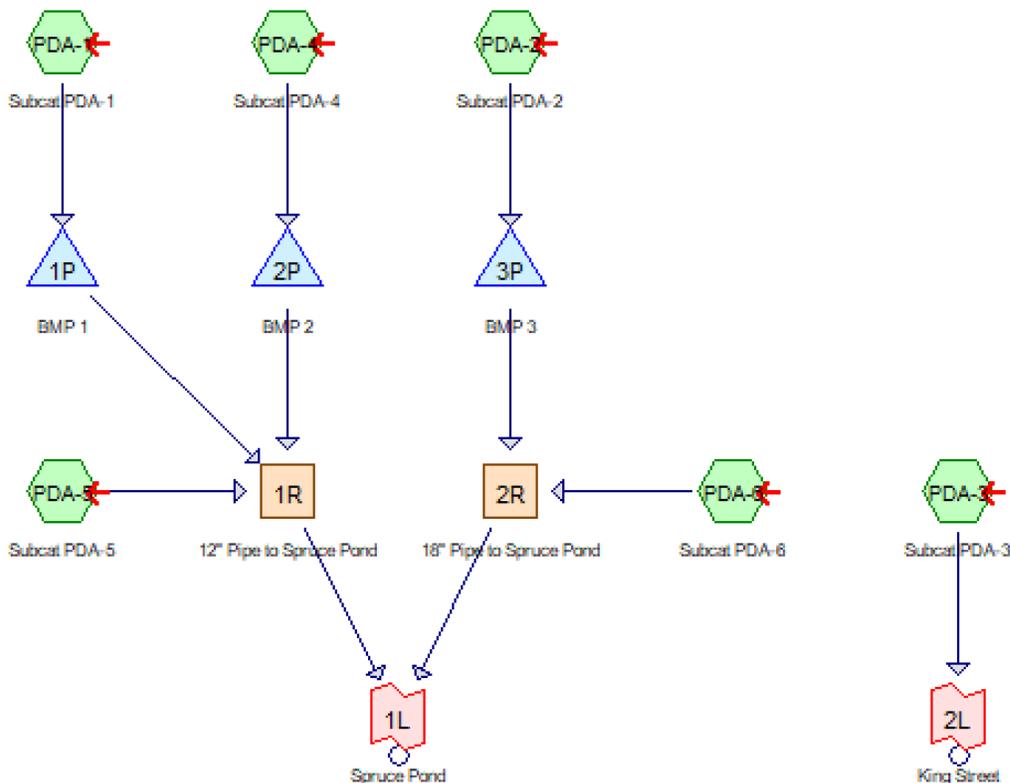
Peak Flow Rates and Volumes

Table 1: Peak Flow Rate & Volume – 12" Pipe – Spruce Pond

Design Point - 12" Pipe - Spruce Pond			
Peak Flow Rate (cfs)			
Design Storm	Existing	Proposed	Change
WQ Storm (1")	0.08	0.00	-0.08
2 - Year	0.95	0.88	-0.07
10 - Year	1.86	1.50	-0.36
25 - Year	2.43	2.35	-0.08
100 - Year	3.34	3.14	-0.20
Peak Volume (cf)			
Design Storm	Existing	Proposed	Change
WQ Storm (1")	967	47	-920
2 - Year	7,652	4,645	-3,007
10 - Year	14,823	11,286	-3,537
25 - Year	19,489	15,648	-3,841
100 - Year	26,887	22,616	-4,271

Table 2: Peak Flow Rate & Volume – 18" Pipe – Spruce Pond

Design Point - 18" Pipe - Spruce Pond			
Peak Flow Rate (cfs)			
Design Storm	Existing	Proposed	Change
WQ Storm (1")	0.07	0.02	-0.05
2 - Year	0.35	0.12	-0.23
10 - Year	0.60	0.55	-0.05
25 - Year	0.75	0.63	-0.12
100 - Year	0.99	0.97	-0.02
Peak Volume (cf)			
Design Storm	Existing	Proposed	Change
WQ Storm (1")	590	155	-435
2 - Year	2,819	1,234	-1,585
10 - Year	4,910	3,421	-1,489
25 - Year	6,225	4,743	-1,482
100 - Year	8,287	6,995	-1,292

Table 3: Peak Flow Rate & Volume – King St. Drainage System

Design Point - King St System			
Peak Flow Rate (cfs)			
Design Storm	Existing	Proposed	Change
WQ Storm (1")	0.00	0.00	0.00
2 - Year	0.01	0.01	0.00
10 - Year	0.02	0.01	-0.01
25 - Year	0.03	0.02	-0.01
100 - Year	0.04	0.02	-0.02
Peak Volume (cf)			
Design Storm	Existing	Proposed	Change
WQ Storm (1")	25	21	-4
2 - Year	112	68	-44
10 - Year	192	108	-84
25 - Year	243	133	-110
100 - Year	322	172	-150

Table 4: Peak Flow Rate & Volume – Spruce Pond

Design Point - Spruce Pond			
Peak Flow Rate (cfs)			
Design Storm	Existing	Proposed	Change
WQ Storm (1")	0.15	0.02	-0.13
2 - Year	1.29	1.00	-0.29
10 - Year	2.45	1.92	-0.53
25 - Year	3.18	2.88	-0.30
100 - Year	4.32	4.10	-0.22
Peak Volume (cf)			
Design Storm	Existing	Proposed	Change
WQ Storm (1")	1,557	202	-1,355
2 - Year	10,471	5,879	-4,592
10 - Year	19,733	14,707	-5,026
25 - Year	25,714	20,391	-5,323
100 - Year	35,219	29,661	-5,558

<u>Water Quality</u>

The proposed stormwater management system has been designed to remove a net 85% total suspended solids from the runoff collected from the proposed site. Several best management practices are proposed to enhance total suspended solids removal. The required WQv to be treated was calculated at 3,442 cubic feet. The proposed design is capable of providing 3,775 cubic feet of WQ volume. The proposed areas within the development unable to be treated has

such been supplemented by upgradient stormwater runoff from the adjacent site that is subsequently being treated by the proposed design. The subsurface infiltration systems have been designed to detain the water quality volume from upstream areas to allow total suspended solids to settle. See Appendix B for water quality calculations for the stormwater facilities.

Since the separation between the bottom of the underground infiltration system and the seasonal high ground water table is less than four feet, a mounding analysis has been completed and can be found in Appendix B. The Hantush model was used and demonstrates the mounding does not break out in the surrounding surfaces or reach the bottom of the infiltration system. The analysis also indicated the systems fully drain within 72 hours of the storm event.

Minimum Stormwater Management Standards

1. Minimum Standard 1: No New Untreated Discharges

"Applicants must demonstrate that there are no new untreated discharges. To demonstrate that all new discharges are adequately treated, applicants may rely on the computations required to demonstrate compliance with Standards 4 through 6. No additional computations are required"

Refer to the calculations in Appendix B for compliance under this standard.

2. Minimum Standard 2: Peak Flow Attenuation

"Show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year storms."

Refer to the calculations in Appendix B for compliance under this standard.

3. Minimum Standard 3: Groundwater Recharge

"Loss of annual recharge to groundwater shall be eliminated or minimized through the use of environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance."

See Recharge Calculation in Appendix B.

Landscape areas and the subsurface infiltration practices are allowed to infiltrate and meet the recharge requirements.

4. Minimum Standard 4: Water Quality

"Stormwater management systems shall be designed to remove 80% of average annual post-construction load of total suspended solids (TSS)."

Pre-treatment: Pre-treatment equal to 25% of the water quality volume is required for parking lots, driveways, and sidewalks; no pre-treatment is required for stormwater generated from the building

roofs entering infiltration systems. For the parking lot, access drives, and sidewalks pre-treatment is achieved using isolator rows prior to entry to the subsurface infiltration practices.

Due to the existing site constraints, it is not feasible to infiltrate or treat the WQV along some portions of the proposed impervious covers. To make up for this deficit, the proposed BMP's have been designed to treat the impervious areas of the proposed site as well as portions of the neighboring site that produces runoff to the proposed facility. See the BMP sizing calculations in Appendix B for more details.

Accordingly, the pre-treatment and treatment requirements of Minimum Standard 3 have been satisfied.

5. <u>Minimum Standard 5: Land Uses with Higher Potential Pollutant Loads</u>

"Source controls and pollution prevention measures to minimize or eliminate the expose of any LUHPPLs to rain, snow, snow melt, and runoff must be identified in the Long-Term Pollution Prevention Plan"

In accordance with the *Massachusetts Stormwater Handbook* definition, the project is not considered a "land use with higher potential pollutant loads;" therefore Minimum Standard 5 is not applicable to this project.

6. <u>Minimum Standard 6: Critical Areas</u>

"Standard 6 applies to discharges within Zone II, Interim Wellhead Protection Areas or near or to other Critical Areas: Shellfish Growing Areas, Bathing Beaches, Outstanding Resource Waters, Special Resource Waters, and Cold-Water Fisheries."

In accordance with the *Massachusetts Stormwater Handbook* definition, the project is not within a "critical area" therefore Minimum Standard 6 is not applicable to this project.

7. <u>Minimum Standard 7:</u> Redevelopment

"Redevelopments and other projects subject to the Standards only to the maximum extent practicable"

This project is not considered a redevelopment project due to the nature of the proposed work when compared to existing conditions of the site.

8. <u>Minimum Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control</u>

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

A construction activity NPDES Stormwater Pollution Prevention Plan has been prepared and included in Appendix D.

9. <u>Minimum Standard 9: Operation and Maintenance Plan</u>

"Operation and Maintenance Plan as required by Standard 9 must be submitted"

A drainage system Operations and Maintenance Plan (O&M) has been prepared and included in Appendix D.

10. <u>Minimum Standard 10: Prohibition of Illicit Discharges</u>

"Measures to prevent illicit discharges must be included in Pollution Prevention Plan."

There are no existing or proposed illicit discharges to the stormwater management system; therefore standard 10 is not applicable to this project.

<u>Conclusion</u>

In conclusion, the proposed stormwater management system provides reductions in peak runoff rates and volumes within the hydrologic analysis area for the design storm events evaluated. Additionally, the stormwater management system has been designed to promote total suspended solids removal and to improve the overall water quality to downstream resources and offsite areas.

This project has been designed in accordance with the latest edition of the Massachusetts Stormwater Handbook and Stormwater Standards along with the Town of Franklin Stormwater Management Documents.

APPENDIX A

Town of Franklin, MA

1 inch = 800 Feet

January 3, 2025

www.cai-tech.com

CAI Technologies
Precision Mapping. Geospatial Solutions.

0   800   1600   2400

Parmenter Elementary School

Spruce Pond

495

King St

Legend:
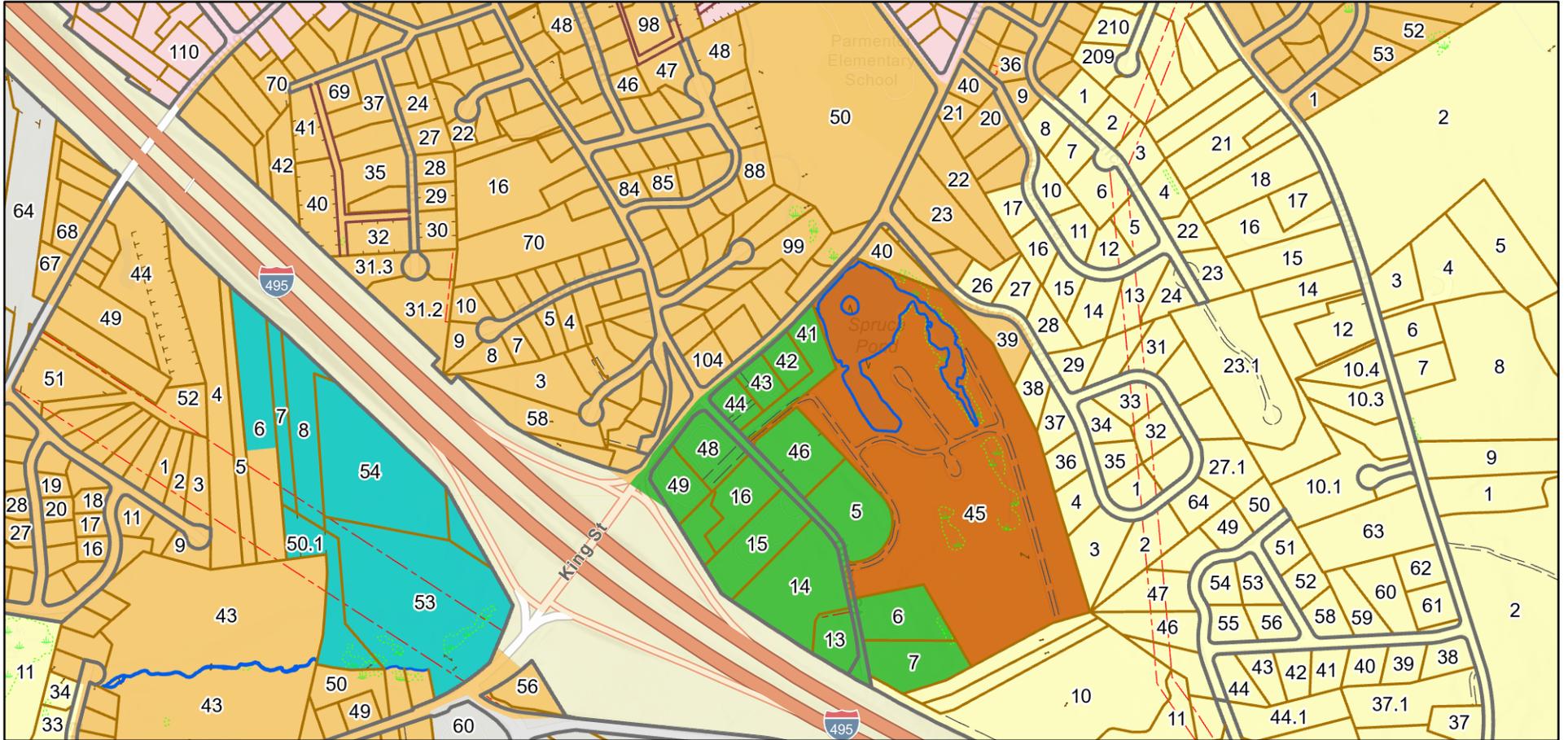
TownPoly	Undeveloped Public Road	Wetland
PWater	Property Hook	Private Road ROW
Private Road	Property TIC	Right of Way
Property Line	RoadNotPar	Utility
Public Road	Travel Way	Shadow

Wet Areas	Rural Residential I	
Business	Single Family III	
Commercial II	Single Family IV	
Industrial		
Residential VI		

This information is believed to be correct but is subject to change and is not warrantied.

PDS-based depth-duration-frequency (DDF) curves
Latitude: 42.3621°, Longitude: -72.1625°

Precipitation depth (in)

Duration

Average recurrence interval (years)

— 1
— 2
— 5
— 10
— 25
— 50
— 100
— 200
— 500
— 1000
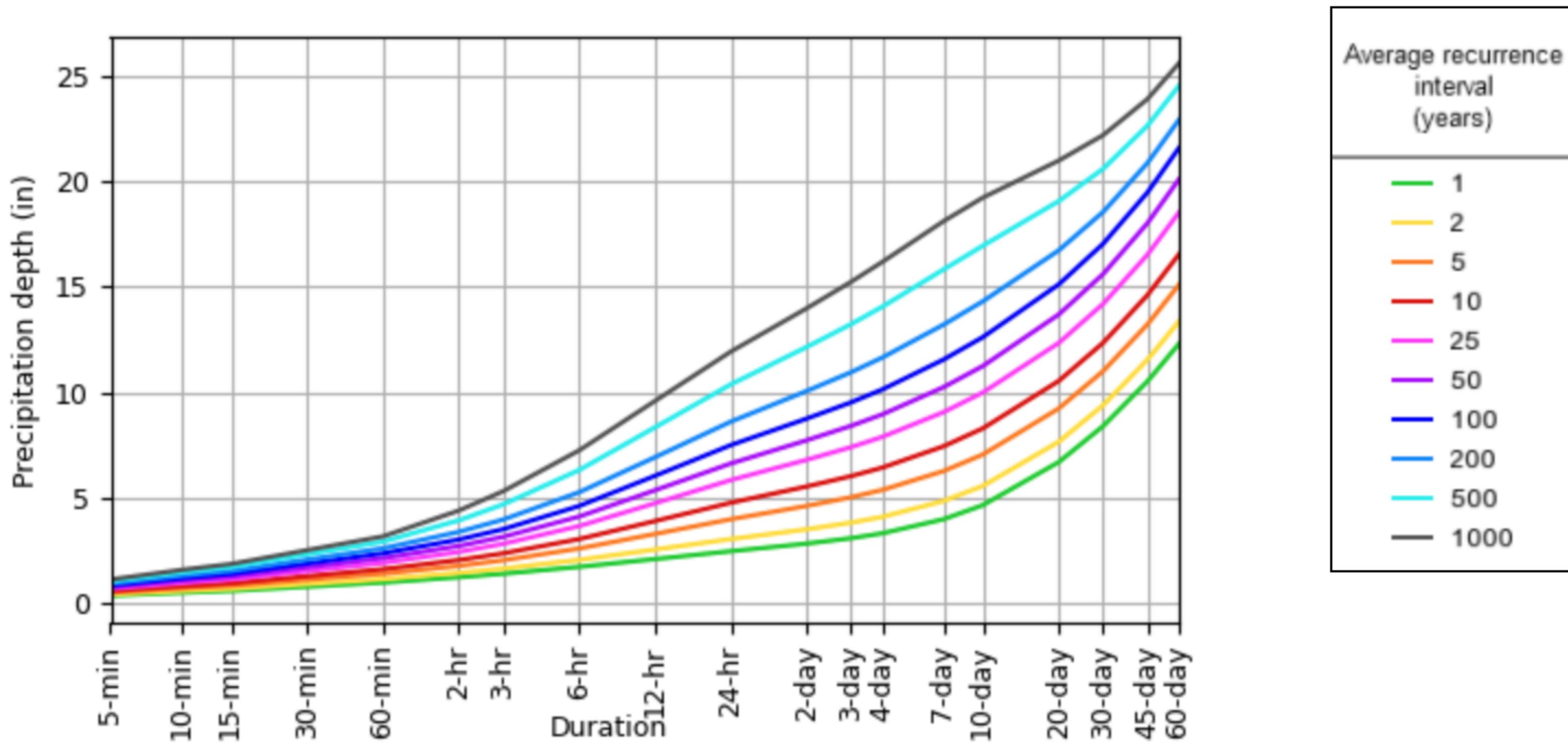
PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.322 (0.255-0.402)	0.392 (0.310-0.490)	0.507 (0.399-0.636)	0.602 (0.471-0.760)	0.733 (0.554-0.969)	0.832 (0.615-1.12)	0.935 (0.668-1.31)	1.05 (0.709-1.51)	1.21 (0.783-1.80)	1.33 (0.844-2.04)
10-min	0.456 (0.361-0.570)	0.555 (0.439-0.694)	0.717 (0.566-0.900)	0.852 (0.667-1.08)	1.04 (0.784-1.37)	1.18 (0.870-1.59)	1.32 (0.946-1.86)	1.48 (1.00-2.14)	1.71 (1.11-2.56)	1.89 (1.20-2.89)
15-min	0.537 (0.425-0.670)	0.654 (0.517-0.817)	0.845 (0.666-1.06)	1.00 (0.786-1.27)	1.22 (0.923-1.61)	1.39 (1.02-1.88)	1.56 (1.11-2.19)	1.75 (1.18-2.52)	2.01 (1.30-3.01)	2.22 (1.41-3.40)
30-min	0.736 (0.583-0.919)	0.896 (0.709-1.12)	1.16 (0.912-1.45)	1.37 (1.08-1.73)	1.67 (1.26-2.21)	1.90 (1.40-2.57)	2.13 (1.53-3.00)	2.39 (1.62-3.45)	2.76 (1.79-4.13)	3.05 (1.93-4.67)
60-min	0.935 (0.740-1.17)	1.14 (0.900-1.42)	1.47 (1.16-1.84)	1.75 (1.37-2.20)	2.12 (1.61-2.81)	2.41 (1.78-3.26)	2.71 (1.94-3.81)	3.04 (2.06-4.38)	3.50 (2.27-5.24)	3.88 (2.45-5.93)
2-hr	1.20 (0.956-1.48)	1.47 (1.17-1.83)	1.92 (1.53-2.39)	2.29 (1.81-2.87)	2.81 (2.14-3.70)	3.19 (2.38-4.31)	3.60 (2.61-5.08)	4.09 (2.77-5.86)	4.82 (3.14-7.18)	5.45 (3.46-8.28)
3-hr	1.39 (1.11-1.71)	1.71 (1.37-2.11)	2.24 (1.78-2.77)	2.67 (2.12-3.33)	3.27 (2.51-4.31)	3.72 (2.79-5.02)	4.20 (3.07-5.93)	4.79 (3.26-6.85)	5.70 (3.72-8.45)	6.49 (4.13-9.82)
6-hr	1.79 (1.45-2.19)	2.20 (1.78-2.70)	2.87 (2.31-3.52)	3.42 (2.74-4.23)	4.18 (3.24-5.47)	4.74 (3.59-6.36)	5.36 (3.95-7.53)	6.12 (4.18-8.69)	7.31 (4.78-10.8)	8.34 (5.32-12.5)
12-hr	2.29 (1.87-2.78)	2.79 (2.27-3.39)	3.61 (2.93-4.40)	4.29 (3.46-5.27)	5.22 (4.07-6.77)	5.92 (4.51-7.86)	6.67 (4.93-9.28)	7.59 (5.21-10.7)	9.01 (5.92-13.2)	10.2 (6.55-15.3)
24-hr	2.74 (2.25-3.30)	3.36 (2.76-4.05)	4.37 (3.58-5.29)	5.22 (4.24-6.35)	6.37 (5.00-8.20)	7.23 (5.55-9.54)	8.16 (6.08-11.3)	9.31 (6.42-13.0)	11.1 (7.31-16.1)	12.6 (8.10-18.7)

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Marguerite Family Trust
Owner Name

380 King Street   303/42
Street Address   Map/Lot #

Franklin   Massachusetts   02038
City   State   Zip Code

B. Site Information

1. (Check one)   ☒ New Construction   ☐ Upgrade

2. Soil Survey   USDA-NRCS   310B   Woodbridge
                   Source   Soil Map Unit   Soil Series

   Drumlin, footslope   depth to saturated zone
   Landform   Soil Limitations

   lodgement till with eolian mantle
   Soil Parent material

3. Surficial Geological Report   Mass GIS December 2024   sd-c
                                 Year Published/Source   Map Unit

   glacial stratified deposits, coarse
   Description of Geologic Map Unit:

4. Flood Rate Insurance Map   Within a regulatory floodway?   ☐ Yes   ☒ No

5. Within a velocity zone?   ☐ Yes   ☒ No

6. Within a Mapped Wetland Area?   ☐ Yes   ☒ No   If yes, MassGIS Wetland Data Layer:

                                                                          Wetland Type

7. Current Water Resource Conditions (USGS):   Range: ☐ Above Normal   ☐ Normal   ☐ Below Normal
                                        Month/Day/ Year

8. Other references reviewed:
   (Zone II, IWPA, Zone A, EEA Data Portal, etc.)

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area*)

Deep Observation Hole Number: 1   11/26/24   9 AM   rain 32 degrees F   42.06757   -71.39720

     Hole #   Date   Time   Weather   Latitude   Longitude

1. Land Use   vacant lot   a few shrubs   none   0-3

     (e.g., woodland, agricultural field, vacant lot, etc.)   Vegetation   Surface Stones (e.g., cobbles, stones, boulders, etc.)   Slope (%)

Description of Location: vacant lot at 380 King St, between King St Cafe and Sierra's Pizza

2. Soil Parent Material: lodgement till   drumlin   FS

     Landform   Position on Landscape (SU, SH, BS, FS, TS, Plain)

3. Distances from: Open Water Body   202   feet   Drainage Way _____ feet   Wetlands _____ feet

     Property Line   49   feet   Drinking Water Well _____ feet   Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No   If Yes: ☒ Disturbed Soil/Fill Material   ☐ Weathered/Fractured Rock   ☐ Bedrock

5. Groundwater Observed: ☐ Yes   ☒ No   If yes: _____ Depth to Weeping in Hole   _____ Depth to Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
-49 - -22	^C1	SL	10YR 5/4	--	Cnc : -- / Dpl: --	--	15	5	--	FR	fill
-22 - 0	^C2	FSL	25Y 4/1	--	Cnc : -- / Dpl: --	--	20	0	--	FI	fill
0 - 3	Ab	FSL	10YR 3/2	--	Cnc : -- / Dpl: --	--	0	0	1 FGR	FR	
3 - 17	Bwb	FSL	10YR 5/4	--	Cnc : -- / Dpl: --	--	5	0	1 MSBK	FR	
17 - 47	Cd1	S	10YR 5/3	24	Cnc : -- / Dpl: 2.5Y 6/2	2	25	5	0 MA	VFI	Dp1 occurred as line 2-3" thick
47 - 71	Cd2	S	10YR 5/3	--	Cnc : -- / Dpl: --	--	25	5	0 MA	FI	

Additional Notes:

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area*)

Deep Observation Hole Number: 2   11/26/24   9 AM   rain 32 degrees F   42.067404   -71.39703

      Hole #   Date   Time   Weather   Latitude   Longitude

1. **Land Use:** vacant lot   a few shrubs   none   0-3

    (e.g., woodland, agricultural field, vacant lot, etc.)   Vegetation   Surface Stones (e.g., cobbles, stones, boulders, etc.)   Slope (%)

    Description of Location: vacant lot at 380 King St, between King St Cafe and Sierra's Pizza

2. **Soil Parent Material:** lodgement till   drumlin   FS

                                        Landform   Position on Landscape (SU, SH, BS, FS, TS, Plain)

3. **Distances from:**   Open Water Body 178 feet   Drainage Way _____ feet   Wetlands _____ feet

                        Property Line 43 feet   Drinking Water Well _____ feet   Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No   If Yes: ☒ Disturbed Soil/Fill Material   ☐ Weathered/Fractured Rock   ☐ Bedrock

5. Groundwater Observed: ☐ Yes   ☒ No   If yes: _____ Depth to Weeping in Hole   _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
-32 - -11	^C1	SL	10YR 5/4	--	Cnc : -- / Dpl: --	--	15	5	--	FR	fill
-11 - 0	^C2	FSL	2.5Y 4/1	--	Cnc : -- / Dpl: --	--	20	2	--	F1	fill
0 - 2	Ab	FSL	10YR 3/2	--	Cnc : -- / Dpl: --	--	0	0	1 FGR	FR	
2 - 13	Bwb	FSL	10YR 5/4	10	Cnc : -- / Dpl: 2.5Y 6/2	2	5	0	1 MSBK	FR	
13 - 57	Cd1	S	10YR 5/3	--	Cnc : -- / Dpl: --	--	25	5	0 MA	VFI	Dp1 line 2" thick
57 - 88	Cd2	S	10YR 5/3	--	Cnc : -- / Dpl: --	--	25	5	0 MA	FI	

Additional Notes:

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area*)

Deep Observation Hole Number: 3
Hole #

11/26/24
Date

9 AM
Time

rain 32 degrees F
Weather

42.067297
Latitude

-71.397083
Longitude

1. Land Use: vacant lot
(e.g., woodland, agricultural field, vacant lot, etc.)

a few shrubs
Vegetation

none
Surface Stones (e.g., cobbles, stones, boulders, etc.)

0-3
Slope (%)

Description of Location: vacant lot at 380 King St, between King St Cafe and Sierra's Pizza

2. Soil Parent Material: lodgement till

drumlin
Landform

FS
Position on Landscape (SU, SH, BS, FS, TS, Plain)

3. Distances from: Open Water Body 208 feet   Drainage Way ____ feet   Wetlands ____ feet

Property Line 29 feet   Drinking Water Well ____ feet   Other ____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No   If Yes: ☒ Disturbed Soil/Fill Material   ☐ Weathered/Fractured Rock   ☐ Bedrock

5. Groundwater Observed: ☒ Yes   ☐ No   If yes: ____ Depth to Weeping in Hole   ____ Depth to Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
-26 - -16	^C1	SL	10YR 5/4	– –	Cnc : -- / Dpl: --	--	15	5	--	FR	fill
-16 - 0	^C2	FSL	2.5Y 4/1	--	Cnc : -- / Dpl: --	--	20	0	--	FI	fill
0 - 2	Ab	FSL	10YR 3/2	--	Cnc : -- / Dpl: --	--	0	0	1 FGR	FR	
2 - 17	Bwb	FSL	10YR 5/4	2	Cnc : 7.5YR 5/6 / Dpl: --	<2	5	0	1 MSBK	FR	
17 - 82	Cd	S	10YR 5/3	24	Cnc : 75YR 5/6 / Dpl: 2.5Y 6/2	5	25	5	0 MA	FI	
					Cnc : / Dpl:						

Additional Notes:

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used (Choose one):

   Obs. Hole #__1__   Obs. Hole #__2__   Hole 3

   ☒ Depth to soil redoximorphic features

   __24__ inches   __24__ inches   24 inches

   ☐ Depth to observed standing water in observation hole

   _____ inches   _____ inches

   ☐ Depth to adjusted seasonal high groundwater (S_h)
   (USGS methodology)

   _____ inches   _____ inches

   _____   _____
   Index Well Number   Reading Date

   $S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$

   Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

   a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

   ☒ Yes   ☐ No

   b. If yes, at what depth was it observed (exclude O, A, and E Horizons)?   Upper boundary: __3 (o.g.)__   Lower boundary: __71 - 88 (o.g.)__
   inches   inches

   c. If no, at what depth was impervious material observed?   Upper boundary: _____   Lower boundary: _____
   inches   inches

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

3 January 2025

Signature of Soil Evaluator | Date

Amber K. Hardy, M.S. | D4098

Typed or Printed Name of Soil Evaluator / License # | Expiration Date of License

Name of Approving Authority Witness | Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

130 ft Angle: 210.99 °

TH1
7 ft
perc1

7 ft Angle: 147 °

perc2
TH2
200 °

143 ft Angle: 259.14 °

perc3
TH3
42 ft Angle: 200

PERMEABILITY TEST

Location:	380 King Street - Franklin, MA		Job No.	24.0168
Soil Description:	Loamy Sand			
Test No.:	TP-1		Date	11/26/2024
Depth:	35" exist grade to top hole		Tested By	AH
Sample No.:	none		Checked By	
			Start Time	9:00 AM

Falling Head Perc Test

Test No. TP-1

Field Data

Time (min)	Elevation (inch)	
9:00	0"	START PRESOAK
9:15	0"	END PRESOAK
9:20	1"	
9:25	1.875"	
9:30	2.875"	
9:41	3.75"	
9:50	4.5"	
10:00	5.25"	
13.33		RATE (MIN/INCH)

PERMEABILITY TEST

Location:	380 King Street - Franklin, MA	Job No.	24.0168
Soil Description:	Loamy Sand		
Test No.:	TP-2	Date	11/26/2024
Depth:	33" exist grade to top hole	Tested By	AH
Sample No.:	none	Checked By	
		Start Time	10:00 AM

Falling Head Perc Test

Test No. TP-2

Field Data

Time (min)	Elevation (inch)	
10:00	0"	START PRESOAK
10:15	0"	END PRESOAK
10:20	0.75"	
10:25	1.5"	
10:30	2.25"	
10:41	3.0"	
10:50	3.75"	
11:00	4.5"	
14.67		RATE (MIN/INCH)

PERMEABILITY TEST

Location:	380 King Street - Franklin, MA	Job No.	24.0168
Soil Description:	Loamy Sand		
Test No.:	TP-3	Date	11/26/2024
Depth:	32" exist grade to top hole	Tested By	AH
Sample No.:	none	Checked By	
		Start Time	11:00 AM

Falling Head Perc Test

Test No. TP-3

Field Data

Time (min)	Elevation (inch)	
11:00	0"	START PRESOAK
11:15	0"	END PRESOAK
11:22	3.5"	
11:27	4.75"	
11:36	6.5"	
11:46	7.75"	
11:56	9.375"	
12:06	10.75"	

8	RATE (MIN/INCH)

APPENDIX B

![NEI Narragansett Engineering Inc. logo]

Civil ▪ Survey ▪ Structural ▪ Environmental ▪ Design
3102 East Main Road, Portsmouth RI 02871
Tel. 401.683.6630   www.nei-cds.com

PROJECT	Franklin Crossing	PROJECT NUMBER	24.0168
SUBJECT	Underground Infiltration		

COMPUTATIONS BY	CB	DATE	
CHECK BY	JM	DATE	9/17/2025

Site Water Quality Calculations

Total Site Water Quality Calculations

Total Area Site =	55,709	SF
Total Impervious of treated site area =	41,300	SF
Water Quality Required for Site =	**3,442**	**CF**
Water Quality Provided by BMP 1 =	1,267	CF
Water Quality Provided by BMP 2 =	1,435	CF
Water Quality Provided by BMP 3 =	1,073	CF
Water Quality Provided by ADS system =	**3,775**	**CF**

Water quality provided is greater than the water quality required

PROJECT	Franklin Crossing	PROJECT NUMBER	24.0168
SUBJECT	Underground Infiltration		

COMPUTATIONS BY	CB	DATE	
CHECK BY	JM	DATE	9/17/2025

NEI
Narragansett
Engineering Inc.
Civil • Survey • Structural • Environmental • Design
3102 East Main Road, Portsmouth RI 02871
Tel. 401.683.6630   www.nei-cds.com

Infiltration System Calculations

Total Area to Infiltration (PDA - 1) =	15,193	SF
Total Impervious Area =	13,753	SF

Cell Volume shall be larger than Recharge Volume and Water Quality Volume

Recharge Volume - Rev

Total Impervious Area within Hydrologic Group "C" Soils =	13,753	SF
F (from MA Stormwater Stormwater Handbook Table 2.3.2) =	0.25	inches
Required Recharge Volume =	287	CF

Water Quality Volume (WQV)

WQV = Total Impervious Area x 1 inch =	1,146	CF
Required WQV Volume =	**1,146**	**CF**

Provided Water Quality Volume =	**1,267**	CF @ Elev. 333.30 (Volume below lowest outlet invert from HydroCAD)
Total Volume Provided =	**1,267**	**CF**

Filter Bed Area

$$A_f = (WQv)/[(d_t)+(k \cdot t_f)]$$

Where :
     A_f = Surface area of filter bed (ft^2)
     d_f = Filter bed depth (ft)
     k = Saturated hydraulic conductivity (ft/day)
     t_f = Allowable Drawdown (hours)

PDA -1 Water Quality Volume (WQV) =	1,146	cf
d_t=	1.5	ft
k=	0.17	inches/hour
t_f=	2.0	hours
A_f =	**623**	SF
Provided Surface Area =	**1,425**	SF

Area of System from HydroCAD

Pretreatment Volume

Water Quality Volume (WQV)

WQV = Impervious Area treated by Sediment Chamber x 1 inches =	1,146	CF
Pretreatment Volume = 25% WQV =	287	CF
Pretreatment Volume Provided =	**386**	CF

2 isolater rows (32CF per chamber - 6 chambers per row

Drawdown within 48 hours

Time = (Provided Volume) / (K x Bottom Area)		
Provided Volume =	**1,267**	CF
K = saturated hydraulic conductivity =	**0.17**	inches/hour (from Table 2.3.3 of the MA Stormwater Handbook)
Bottom Area (Average) =	**1,425**	SF
Time (hrs) =	**5**	hrs < 72 hrs

PROJECT Franklin Crossing PROJECT NUMBER 24.0168

SUBJECT Underground Infiltration

COMPUTATIONS BY CB DATE

CHECK BY JM DATE 9/17/2025

Narragansett Engineering Inc.
Civil • Survey • Structural • Environmental • Design
3102 East Main Road, Portsmouth RI 02871
Tel. 401.683.6630   www.nei-cds.com

Infiltration System Calculations

Total Area to Infiltration (PDA - 4) =	30,982	SF
Total Proposed Impervious Area	14,712	SF
Impervious Area from upgradient Site	9,346	SF
Total Impervious Area =	24,058	SF

Cell Volume shall be larger than Recharge Volume and Water Quality Volume

Recharge Volume - Rev

Total Impervious Area within Hydrologic Group "C" Soils =	24,058	SF
F (from MA Stormwater Stormwater Handbook Table 2.3.2) =	0.25	inches
Required Recharge Volume =	501	CF

Water Quality Volume (WQV)

WQV = Total Impervious Area x 1 inch =	1,226	CF	
Proposed Impervious WQ Volume =	**1,226**	**CF**	This is exsiting impervious from the abutting property (King St Café) not required to treat but treating 1/4"
WQV = Total Impervious Area x 1/4 inch =	195	CF	
Existing Impervious WQ Volume =	**195**	**CF**	
Total Required WQ Volume =	1,421	CF	
Provided Water Quality Volume =	**1,435**	CF @ Elev. 337.45 (Volume below lowest outlet invert from HydroCAD)	
Total Volume Provided =	**1,435**	**CF**	

Filter Bed Area

$$A_f = (WQv)/[(d_f)+(k*t_f)]$$

Where :

A_f = Surface area of filter bed (ft^2)
d_f = Filter bed depth (ft)
k = Saturated hydraulic conductivity (ft/day)
t_f = Allowable Drawdown (hours)

PDA -1 Water Quality Volume (WQV) =	1,226	cf
d_f=	1.5	ft
k=	0.17	inches/hour
t_f=	2.0	hours
A_f =	**666**	SF
Provided Surface Area =	**1,421**	SF

Area of System from HydroCAD

Pretreatment Volume

Water Quality Volume (WQV)

WQV = Impervious Area treated by Sediment Chamber x 1 inches =	2,005	CF
Pretreatment Volume = 25% WQV =	501	CF
Pretreatment Volume Provided =	**386**	CF

2 isolater rows (32CF per chamber - 6 chambers per row

Drawdown within 48 hours

Time = (Provided Volume) / (K x Bottom Area)

Provided Volume =	**1,435**	CF
K = saturated hydraulic conductivity =	**0.17**	inches/hour (from Table 2.3.3 of the MA Stormwater Handbook)
Bottom Area (Average) =	**1,421**	SF
Time (hrs) =	**6**	hrs < 72 hrs

Narragansett Engineering Inc.
Civil · Survey · Structural · Environmental · Design
3102 East Main Road, Portsmouth RI 02871
Tel. 401.683.6630   www.nei-cds.com

PROJECT	Franklin Crossing	PROJECT NUMBER	24.0168
SUBJECT	Underground Infiltration		
COMPUTATIONS BY	CB	DATE	
CHECK BY	JM	DATE	9/17/2025

Infiltration System Calculations

Total Area to Infiltration (PDA - 2) =	13,823	SF
Total Proposed Impervious Area =	10,126	SF
Impervious Area from upgradient Site	2,321	SF
Total Impervious Area =	12,447	SF

Cell Volume shall be larger than Recharge Volume and Water Quality Volume

Recharge Volume - Rev

Total Impervious Area within Hydrologic Group "C" Soils =	10,126	SF
F (from MA Stormwater Stormwater Handbook Table 2.3.2) =	0.25	inches
Required Recharge Volume =	211	CF

Water Quality Volume (WQV)

WQV = Total Impervious Area x 1 inch =	844	CF	
Proposed Impervious WQ Volume =	**844**	**CF**	This is exsiting impervious from the abutting property (King St Café) not required to treat but treating 1/4"
WQV = Total Impervious Area x 1/4 inch =	48	CF	
Existing Impervious WQ Volume =	**48**	**CF**	
Required WQV Volume =	**892**	**CF**	
Provided Water Quality Volume =	**1,073**	CF @ Elev. 337.50 (Volume below lowest outlet invert from HydroCAD)	
Total Volume Provided =	**1,073**	**CF**	

Filter Bed Area

$$A_f = (WQv)/[(dt)+(k \cdot tf)]$$

Where :
- A_f = Surface area of filter bed (ft^2)
- d_f = Filter bed depth (ft)
- k = Saturated hydraulic conductivity (ft/day)
- t_f = Allowable Drawdown (hours)

PDA -1 Water Quality Volume (WQV) =	892	cf
d_t =	1.0	ft
k =	0.17	inches/hour
t_f =	2.0	hours
A_f =	**666**	SF
Provided Surface Area =	**1,653**	SF

Area of System from HydroCAD

Pretreatment Volume

Water Quality Volume (WQV)

WQV = Impervious Area treated by Sediment Chamber x 1 inches =	844	CF
Pretreatment Volume = 25% WQV =	211	CF
Pretreatment Volume Provided =	**290**	CF

2 isolater rows (20.7CF per chamber - 7 chambers per row

Drawdown within 48 hours

Time = (Provided Volume) / (K x Bottom Area)

Provided Volume =	**1,073**	CF
K = saturated hydraulic conductivity =	**0.17**	inches/hour (from Table 2.3.3 of the MA Stormwater Handbook)
Bottom Area (Average) =	**1,653**	SF
Time (hrs) =	**4**	hrs

< 72 hrs

Pollutant Loading Calculations

Franklin Crossing
9/17/2025

Pollutant Loading Rates

Pollutant, mg/l	Residential	Commercial	Industrial	Highways	Undev.
TSS	100	75	120	150	51
TP	0.3	0.2	0.25	0.25	0.11
TN	2.1	2.1	2.1	2.3	1.74
Cu	0.005	0.096	0.002	0.001	-
Pb	0.012	0.018	0.026	0.035	-
Zn	0.073	0.059	0.112	0.051	-
BOD	9.0	11.0	9.0	8.0	3.0
COD	54.5	58.0	58.6	100.0	27.0
Bacteria (#col/100 ml)	7,000	4,600	2,400	1,700	300

Notes:

1. Pollutant Loading Units: lbs or billion colonies per year

2. Pollutant Loading = P x Pj x (Rv/12) x C x A x 2.72 (P = 50 in, Pj = 0.9, Rv = 0.05 + 0.009 x Percent Impervious)

3. Pollutant Loading for Bacteria = 1.03 x 10^-3 x P x Pj x Rv x C x A

Existing Development Pollutant Loading

	Subcatchment Area	1	Total
	Land Use	Residential	
	Area, ac	1.54	
Site Info	Imp. Area, ac	1.23	
	Percent Imp.	79.8%	
	Rv	0.768	
	TSS	908.00	908.00
	TP	2.42	2.42
	TN	25.42	25.42
Untreated Pollutant Loading	Cu	1.16	1.16
	Pb	0.22	0.22
	Zn	0.71	0.71
	BOD	133.17	133.17
	COD	702.19	702.19
	Bacteria	253.06	253.06

Franklin Crossing
9/17/2025

Proposed Development Pollutant Loading

	Subcatchment Area	Subsurface Infiltration	Untreated	Total
Site Info	Land Use	Residential	Residential	
	Area, ac	1.26	0.05	
	Imp. Area, ac	0.97	0.05	
	Percent Imp.	77.0%	100.0%	
	Rv	0.743	0.950	
Untreated Pollutant Loading	TSS	954.96	34.74	989.69
	TP	2.86	0.09	2.96
	TN	20.05	0.97	21.03
	Cu	0.05	0.04	0.09
	Pb	0.11	0.01	0.12
	Zn	0.70	0.03	0.72
	BOD	85.95	5.09	91.04
	COD	520.45	26.86	547.31
	Bacteria	303.76	9.68	313.44
Treatment	Treatment	Infiltration	-	
	TSS	80%	-	
	TP	NA	-	
	TN	NA	-	
	Cu	NA	-	
	Pb	NA	-	
	Zn	NA	-	
	BOD	NA	-	
	COD	NA	-	
	Bacteria	NA	-	
Treated Pollutant Loading	TSS	190.99	34.74	225.73
	TP	2.86	0.09	2.96
	TN	20.05	0.97	21.03
	Cu	0.05	0.04	0.09
	Pb	0.11	0.01	0.12
	Zn	0.70	0.03	0.72
	BOD	85.95	5.09	91.04
	COD	520.45	26.86	547.31
	Bacteria	303.76	9.68	313.44

Summary

	Existing	Proposed	Change
TSS	908.00	225.73	-682.27
TP	2.42	2.96	0.54
TN	25.42	21.03	-4.40
Cu	1.16	0.09	-1.07
Pb	0.22	0.12	-0.09
Zn	0.71	0.72	0.01
BOD	133.17	91.04	-42.13
COD	702.19	547.31	-154.87
Bacteria	253.06	313.44	60.38

PROJECT	Franklin Crossing	PROJECT NUMBER	24.0168
SUBJECT	Pipe Sizing		
COMPUTATIONS BY	EB	DATE	4/28/2025
CHECK BY	JM	DATE	9/18/2025

NEI
Narragansett
Engineering Inc.
Civil ▪ Survey ▪ Structural ▪ Environmental ▪ Design
3102 East Main Road, Portsmouth RI 02871
Tel. 401.683.6630   www.nei-cds.com

Pipe Flow using Manning's Equation - Q = CIA - 25 Year Storm

Q = Peak rate of runoff in cubic feet per second (cfs)
A = Area (acres)
I = Rainfall intensity (in/hr)
C = Runoff coefficient
Q = Peak rate of runoff in cubic feet per second (cfs)

I (25 year storm Intensity) =   6.37
                    C =   **0.98**

Pipe CB-1 - DMH-1

A =   3163   SF
             0.07   Acres
Q_{25} =   **0.45**   **CFS**

$Q = 1.49/n AR_N^{2/3} S^{1/2}$

Pipe Size (inches)	Pipe Size (feet)	Area (sq. ft.)	Circum., Pw (ft)	Rh, Full Flow (ft)	Slope (ft/ft)	Manning's 'n'	Velocity (fps)	Q, Flow (cfs)
12	1.000	0.785	3.14	0.25	0.013	0.012	5.62	4.41

0.45 CFS < 4.41   Use 12" Pipe

Pipe CB-2 - DMH-1

C =   **0.96**
A =   1917   SF
             0.04   Acres
Q_{25} =   **0.27**   **CFS**

$Q = 1.49/n AR_N^{2/3} S^{1/2}$

Pipe Size (inches)	Pipe Size (feet)	Area (sq. ft.)	Circum., Pw (ft)	Rh, Full Flow (ft)	Slope (ft/ft)	Manning's 'n'	Velocity (fps)	Q, Flow (cfs)
12	1.000	0.785	3.14	0.25	0.050	0.012	11.02	8.65

0.27 CFS < 8.65   Use 12" Pipe

Pipe CB-3 - DMH-1

C =   **0.91**
A =   5349   SF
             0.12   Acres
Q_{25} =   **0.71**   **CFS**

$Q = 1.49/n AR_N^{2/3} S^{1/2}$

Pipe Size (inches)	Pipe Size (feet)	Area (sq. ft.)	Circum., Pw (ft)	Rh, Full Flow (ft)	Slope (ft/ft)	Manning's 'n'	Velocity (fps)	Q, Flow (cfs)
12	1.000	0.785	3.14	0.25	0.019	0.012	6.79	5.33

0.71 CFS < 5.33   Use 12" Pipe

Pipe Flow using Manning's Equation - Q = CIA - 25 Year Storm

Q = Peak rate of runoff in cubic feet per second (cfs)

A = Area (acres)

I = Rainfall intensity (in/hr)

C = Runoff coefficient

Q = Peak rate of runoff in cubic feet per second (cfs)

I (25 year storm Intensity) =   6.37

C =   **0.95**

Pipe DMH-1 - DMH-2

A =   10429   SF

0.24   Acres

Q_{25} =   **1.45**   **CFS**

$Q = 1.49/n A R_N^{2/3} S^{1/2}$

Pipe Size (inches)	Pipe Size (feet)	Area (sq. ft.)	Circum., Pw (ft)	Rh, Full Flow (ft)	Slope (ft/ft)	Manning's 'n'	Velocity (fps)	Q, Flow (cfs)
12	1.000	0.785	3.14	0.25	0.010	0.012	4.93	3.87

1.45 CFS < 3.87   Use 12" Pipe

Pipe CB-4 - DMH-2

C =   **0.95**

A =   4822   SF

0.11   Acres

Q_{25} =   **0.67**   **CFS**

$Q = 1.49/n A R_N^{2/3} S^{1/2}$

Pipe Size (inches)	Pipe Size (feet)	Area (sq. ft.)	Circum., Pw (ft)	Rh, Full Flow (ft)	Slope (ft/ft)	Manning's 'n'	Velocity (fps)	Q, Flow (cfs)
12	1.000	0.785	3.14	0.25	0.050	0.012	11.02	8.65

0.67 CFS < 8.65   Use 12" Pipe

Pipe Flow using Manning's Equation - Q = CIA - 25 Year Storm

Q = Peak rate of runoff in cubic feet per second (cfs)
A = Area (acres)

I = Rainfall intensity (in/hr)
C = Runoff coefficient
Q = Peak rate of runoff in cubic feet per second (cfs)

I (25 year storm Intensity) =   6.37
                          C =   **0**

Pipe BMP-1 - DMH-3

                  A =   0   SF
                             0.00   Acres
           Q_{25} =   **0.62**   **CFS**   CFS taken from HydroCAD

$Q = 1.49/n A R_N^{2/3} S^{1/2}$

Pipe Size (inches)	Pipe Size (feet)	Area (sq. ft.)	Circum., Pw (ft)	Rh, Full Flow (ft)	Slope (ft/ft)	Manning's 'n'	Velocity (fps)	Q, Flow (cfs)
8	0.667	0.349	2.09	0.17	0.030	0.012	6.51	2.27

.62 CFS < 2.27   Use 8" Pipe

Pipe DMH-3 - DMH-4

                  C =   **0**
                  A =   0   SF
                             0.00   Acres
           Q_{25} =   **0.62**   **CFS**   CFS taken from HydroCAD

$Q = 1.49/n A R_N^{2/3} S^{1/2}$

Pipe Size (inches)	Pipe Size (feet)	Area (sq. ft.)	Circum., Pw (ft)	Rh, Full Flow (ft)	Slope (ft/ft)	Manning's 'n'	Velocity (fps)	Q, Flow (cfs)
12	1.000	0.785	3.14	0.25	0.032	0.012	8.81	6.92

.62 CFS < 6.92   Use 12" Pipe

Pipe DMH-4 - DMH-8

                  C =   **0**
                  A =   0   SF
                             0.00   Acres
           Q_{25} =   **0.62**   **CFS**   CFS taken from HydroCAD

$Q = 1.49/n A R_N^{2/3} S^{1/2}$

Pipe Size (inches)	Pipe Size (feet)	Area (sq. ft.)	Circum., Pw (ft)	Rh, Full Flow (ft)	Slope (ft/ft)	Manning's 'n'	Velocity (fps)	Q, Flow (cfs)
12	1.000	0.785	3.14	0.25	0.033	0.012	8.95	7.03

.62 CFS < 7.03   Use 12" Pipe

Pipe Flow using Manning's Equation - Q = CIA - 25 Year Storm

Q = Peak rate of runoff in cubic feet per second (cfs)
A = Area (acres)
I = Rainfall intensity (in/hr)
C = Runoff coefficient
Q = Peak rate of runoff in cubic feet per second (cfs)

I (25 year storm Intensity) =   6.37
C =   **0.98**

Pipe CB-5 - DMH-5

A =   1002   SF
0.02   Acres
Q_{25} =   **0.14**   **CFS**

$Q = 1.49/n AR_N^{2/3} S^{1/2}$

Pipe Size (inches)	Pipe Size (feet)	Area (sq. ft.)	Circum., Pw (ft)	Rh, Full Flow (ft)	Slope (ft/ft)	Manning's 'n'	Velocity (fps)	Q, Flow (cfs)
12	1.000	0.785	3.14	0.25	0.015	0.012	6.04	4.74

0.14 CFS < 4.74   Use 12" Pipe

Pipe CB-6 - DMH-5

C =   **0.96**
A =   8677   SF
0.20   Acres
Q_{25} =   **1.22**   **CFS**

$Q = 1.49/n AR_N^{2/3} S^{1/2}$

Pipe Size (inches)	Pipe Size (feet)	Area (sq. ft.)	Circum., Pw (ft)	Rh, Full Flow (ft)	Slope (ft/ft)	Manning's 'n'	Velocity (fps)	Q, Flow (cfs)
12	1.000	0.785	3.14	0.25	0.036	0.012	9.35	7.34

1.22 CFS < 7.34   Use 12" Pipe

Pipe CB-7 - DMH-5

C =   **0.6**
A =   9523   SF
0.22   Acres
Q_{25} =   **0.84**   **CFS**

$Q = 1.49/n AR_N^{2/3} S^{1/2}$

Pipe Size (inches)	Pipe Size (feet)	Area (sq. ft.)	Circum., Pw (ft)	Rh, Full Flow (ft)	Slope (ft/ft)	Manning's 'n'	Velocity (fps)	Q, Flow (cfs)
12	1.000	0.785	3.14	0.25	0.019	0.012	6.79	5.33

0.84 CFS < 5.33   Use 12" Pipe

Narragansett Engineering Inc.
nei-cds.com
Civil · Survey · Structural · Environmental · Design
3102 East Main Road, Portsmouth RI 02871
Tel. 401.683.6630   www.nei-cds.com

Pipe Flow using Manning's Equation - Q = CIA - 25 Year Storm

Q = Peak rate of runoff in cubic feet per second (cfs)
A = Area (acres)
I = Rainfall intensity (in/hr)
C = Runoff coefficient
Q = Peak rate of runoff in cubic feet per second (cfs)

I (25 year storm Intensity) = 6.37
C = **0.8**

Pipe DMH-5 - DMH-6

A = 19202 SF
0.44 Acres
Q_{25} = **2.25** **CFS**

$Q = 1.49/n A R_N^{2/3} S^{1/2}$

Pipe Size (inches)	Pipe Size (feet)	Area (sq. ft.)	Circum., Pw (ft)	Rh, Full Flow (ft)	Slope (ft/ft)	Manning's 'n'	Velocity (fps)	Q, Flow (cfs)
12	1.000	0.785	3.14	0.25	0.360	0.012	29.57	23.22

2.25 CFS < 23.22   Use 12" Pipe

Pipe BULD - DMH-6

C = **0.98**
A = 11618 SF
0.27 Acres
Q_{25} = **1.66** **CFS**

$Q = 1.49/n A R_N^{2/3} S^{1/2}$

Pipe Size (inches)	Pipe Size (feet)	Area (sq. ft.)	Circum., Pw (ft)	Rh, Full Flow (ft)	Slope (ft/ft)	Manning's 'n'	Velocity (fps)	Q, Flow (cfs)
10	0.833	0.545	2.62	0.21	0.010	0.012	4.36	2.38

1.66 CFS < 2.38   Use 10" Pipe

Narragansett Engineering Inc.
Civil • Survey • Structural • Environmental • Design
3102 East Main Road, Portsmouth RI 02871
Tel. 401.683.6630   www.nei-cds.com

Pipe Flow using Manning's Equation - Q = CIA - 25 Year Storm

Q = Peak rate of runoff in cubic feet per second (cfs)
A = Area (acres)
I = Rainfall intensity (in/hr)
C = Runoff coefficient
Q = Peak rate of runoff in cubic feet per second (cfs)

I (25 year storm Intensity) =   6.37
                          C =   **0**

Pipe BMP-2 - DMH-7

          A =   0   SF
                        0.00   Acres
      Q_{25} =   **1.78**   **CFS**   Taken from HydroCAD

$Q = 1.49/nAR_N^{2/3}S^{1/2}$

Pipe Size (inches)	Pipe Size (feet)	Area (sq. ft.)	Circum., Pw (ft)	Rh, Full Flow (ft)	Slope (ft/ft)	Manning's 'n'	Velocity (fps)	Q, Flow (cfs)
12	1.000	0.785	3.14	0.25	0.005	0.012	3.48	2.74

          1.78 CFS < 2.74   Use 12" Pipe

Pipe DMH-7 - DMH-8

          C =   **0**
          A =   0   SF
                        0.00   Acres
      Q_{25} =   **1.78**   **CFS**

$Q = 1.49/nAR_N^{2/3}S^{1/2}$

Pipe Size (inches)	Pipe Size (feet)	Area (sq. ft.)	Circum., Pw (ft)	Rh, Full Flow (ft)	Slope (ft/ft)	Manning's 'n'	Velocity (fps)	Q, Flow (cfs)
12	1.000	0.785	3.14	0.25	0.049	0.012	10.91	8.57

          1.78 CFS < 8.57   Use 12" Pipe

Pipe CB-8 - DMH-9

          C =   **0.7**
          A =   1129   SF
                        0.03   Acres
      Q_{25} =   **0.12**   **CFS**

$Q = 1.49/nAR_N^{2/3}S^{1/2}$

Pipe Size (inches)	Pipe Size (feet)	Area (sq. ft.)	Circum., Pw (ft)	Rh, Full Flow (ft)	Slope (ft/ft)	Manning's 'n'	Velocity (fps)	Q, Flow (cfs)
12	1.000	0.785	3.14	0.25	0.007	0.012	4.12	3.24

          0.12 CFS < 3.24   Use 12" Pipe

Pipe Flow using Manning's Equation - Q = CIA - 25 Year Storm

Q = Peak rate of runoff in cubic feet per second (cfs)
A = Area (acres)
I = Rainfall intensity (in/hr)
C = Runoff coefficient
Q = Peak rate of runoff in cubic feet per second (cfs)

I (25 year storm Intensity) =   6.37
                             C =   **0.92**

Pipe CB-9 - DMH-9

A =   8665   SF
                 0.20   Acres
Q_{25} =   **1.17**   **CFS**

$Q = 1.49/n A R_N^{2/3} S^{1/2}$

Pipe Size (inches)	Pipe Size (feet)	Area (sq. ft.)	Circum., Pw (ft)	Rh, Full Flow (ft)	Slope (ft/ft)	Manning's 'n'	Velocity (fps)	Q, Flow (cfs)
12	1.000	0.785	3.14	0.25	0.014	0.012	5.83	4.58

1.17 CFS < 4.58   Use 12" Pipe

Pipe DMH-9 - DMH-10

C =   **0.89**
A =   9794   SF
                 0.22   Acres
Q_{25} =   **1.27**   **CFS**

$Q = 1.49/n A R_N^{2/3} S^{1/2}$

Pipe Size (inches)	Pipe Size (feet)	Area (sq. ft.)	Circum., Pw (ft)	Rh, Full Flow (ft)	Slope (ft/ft)	Manning's 'n'	Velocity (fps)	Q, Flow (cfs)
12	1.000	0.785	3.14	0.25	0.005	0.012	3.48	2.74

1.30 CFS < 2.74   Use 12" Pipe

Pipe CB-10 - DMH-10

C =   **0.98**
A =   3964   SF
                 0.09   Acres
Q_{25} =   **0.57**   **CFS**

$Q = 1.49/n A R_N^{2/3} S^{1/2}$

Pipe Size (inches)	Pipe Size (feet)	Area (sq. ft.)	Circum., Pw (ft)	Rh, Full Flow (ft)	Slope (ft/ft)	Manning's 'n'	Velocity (fps)	Q, Flow (cfs)
12	1.000	0.785	3.14	0.25	0.016	0.012	6.23	4.90

0.57 CFS < 4.90   Use 12" Pipe

PROJECT	Franklin Crossing		PROJECT NUMBER	24.0168
SUBJECT	Pipe Sizing			
COMPUTATIONS BY	EB		DATE	4/28/2025
CHECK BY			DATE	9/18/2025

Pipe Flow using Manning's Equation - Q = CIA - 25 Year Storm

Q = Peak rate of runoff in cubic feet per second (cfs)
A = Area (acres)
I = Rainfall intensity (in/hr)
C = Runoff coefficient
Q = Peak rate of runoff in cubic feet per second (cfs)

I (25 year storm Intensity) =   6.37
C =   **0.95**

Pipe BMP-3 - DMH-11
C =   **0.95**
A =   14041   SF
                0.32   Acres
Q_{25} =   **0.56**   **CFS**   Taken from HydroCAD

$Q = 1.49/n A R_N^{2/3} S^{1/2}$

Pipe Size (inches)	Pipe Size (feet)	Area (sq. ft.)	Circum., Pw (ft)	Rh, Full Flow (ft)	Slope (ft/ft)	Manning's 'n'	Velocity (fps)	Q, Flow (cfs)
8	0.667	0.349	2.09	0.17	0.025	0.012	5.95	2.08

.56 CFS < 2.08   Use 8" Pipe

Pipe DMH-11 - DMH-12
C =   **0.95**
A =   14041   SF
                0.32   Acres
Q_{25} =   **0.56**   **CFS**   Taken from HydroCAD

$Q = 1.49/n A R_N^{2/3} S^{1/2}$

Pipe Size (inches)	Pipe Size (feet)	Area (sq. ft.)	Circum., Pw (ft)	Rh, Full Flow (ft)	Slope (ft/ft)	Manning's 'n'	Velocity (fps)	Q, Flow (cfs)
12	1.000	0.785	3.14	0.25	0.043	0.012	10.22	8.03

.56 CFS < 8.03   Use 12" Pipe

Pipe DMH-12 - DMH-13
C =   **0**
A =   0   SF
                0.00   Acres
Q_{25} =   **0.56**   **CFS**   Taken from HydroCAD

$Q = 1.49/n A R_N^{2/3} S^{1/2}$

Pipe Size (inches)	Pipe Size (feet)	Area (sq. ft.)	Circum., Pw (ft)	Rh, Full Flow (ft)	Slope (ft/ft)	Manning's 'n'	Velocity (fps)	Q, Flow (cfs)
12	1.000	0.785	3.14	0.25	0.043	0.012	10.22	8.03

.56 CFS < 8.03   Use 12" Pipe

FLOW DIVERSION DESIGN (DMH-2)

DMH-2 directs the WQF to the isolator rows of the Underground Infiltration System No. 1 which diverts the remaining runoff to the unlined chambers.

Contributing Area

Total Area in Contributing Watershed =   0.3488   Acres

Impervious Area

Subcatchment	Area (SF)	Area (acres)
PDA-1	15,193	0.349

Water Quality Volume

Water Quality Volume (WQV) = 15,336 x 1" =   1,266 CF

Water Quality Flow (WQF)

Q =   WQV / Total Contributing Area =   0.083 FT
Q =   1.00 INCHES

P =   1.2 INCHES

CN = [1000] / [10 + 5xP + 10xQ - 10x(Q^2 + 1.25xQxP)^(1/2)]

$$CN = [1000] / [10 + 5xP + 10xQ - 10x(Q^2 + 1.25xQxP)^{(1/2)}]$$

CN =   96   From HydroCAD

Using TR-55 Table 4-1

Ia =   0.083 INCHES

Time of Concentration (Tc) =

Tc =   6 minutes
Tc =   0.10 hours

Ia / P =   0.069

Using TR-55 Exhibit 4-III

qu =   680 CSM / INCH

WQF = qu (CSM/INCH) x A (sq. miles) x Q (INCH)

WQF =	**0.37 CFS**

Area of Orifice

A = WQF / [Cx(2xgxh)^(1/2)]; A = pi() x r^2

$$A = WQF / [Cx(2xgxh)^{(1/2)}]; \quad A = pi() \times r^2$$

C = 0.60
g = 32.2 ft/s^2
h = 0.5 ft average height above orifice

A =   0.109 sf

Therefore Diameter is:

D =   0.37 ft

D =	**4.5 inches**

Provide 4.5" high weir wall

References:
-2015 Rhode Island Storm Water Design and Installation Standards Manual (Section 3.3.3.2)
-TR-55 Urban Hydrology for Small Watersheds, SCS, June 1986
-Civil Engineering Reference Manual 10th Edition, Lindeburg, Michael, 2006

PROJECT	Franklin Crossing	PROJECT NUMBER	24.0168
SUBJECT	Flow Diversion Design		
COMPUTATIONS BY	EB	DATE	5/7/2025
CHECK BY	JM	DATE	5/9/2025

FLOW DIVERSION DESIGN (DMH-6)

DMH-6 directs the WQF to the isolator rows of the Underground Infiltration System No. 2 which diverts the remaining runoff to the unlined chambers.

Contributing Area

Total Area in Contributing Watershed =   0.7112   Acres

Impervious Area

Subcatchment	Area (SF)	Area (acres)
PDA-4	30,982	0.711

Water Quality Volume

Water Quality Volume (WQV) = 20105 x 1" =   2,582 CF

Water Quality Flow (WQF)

Q =   WQV / Total Contributing Area =   0.083 FT
Q =   1.00 INCHES

P =   1.2 INCHES

CN = [1000] / [10 + 5xP + 10xQ - 10x(Q^2 + 1.25xQxP)^(1/2)]

CN =   93   From HydroCAD

Using TR-55 Table 4-1

Ia =   0.151 INCHES

Time of Concentration (Tc) =

Tc =   6 minutes
Tc =   0.10 hours

Ia / P =   0.126

Using TR-55 Exhibit 4-III

qu =   640 CSM / INCH

WQF = qu (CSM/INCH) x A (sq. miles) x Q (INCH)

WQF =	0.71 CFS

Area of Orifice

A = WQF / [Cx(2xgxh)^(1/2)]; A = pi() x r^2

C = 0.60
g = 32.2 ft/s^2
h = 0.5 ft average height above orifice

A =   0.209 sf

Therefore Diameter is:

D =   0.52 ft
D =	6.2 inches

Provide 6.2" high weir wall

References:
-2015 Rhode Island Storm Water Design and Installation Standards Manual (Section 3.3.3.2)
-TR-55 Urban Hydrology for Small Watersheds, SCS, June 1986
-Civil Engineering Reference Manual 10th Edition, Lindeburg, Michael, 2006

Narragansett Engineering Inc.
Civil · Survey · Structural · Environmental · Design
3102 East Main Road, Portsmouth RI 02871
Tel. 401.683.6630   www.nei-cds.com

FLOW DIVERSION DESIGN (DMH-10)

DMH-10 directs the WQF to the isolator rows of the Underground Infiltration System No. 3 which diverts the remaining runoff to the unlined chambers.

Contributing Area

Total Area in Contributing Watershed =   0.3223   Acres

Impervious Area

Subcatchment	Area (SF)	Area (acres)
PDA-2	13,823	0.317

Water Quality Volume

Water Quality Volume (WQV) = 12,807 x 1" =   1,152 CF

Water Quality Flow (WQF)

Q =   WQV / Total Contributing Area =   0.082 FT
Q =   0.98 INCHES

P =   1.2 INCHES

$CN = [1000] / [10 + 5xP + 10xQ - 10x(Q^2 + 1.25xQxP)^{(1/2)}]$

CN =   95   From HydroCAD

Using TR-55 Table 4-1

Ia =   0.105 INCHES

Time of Concentration (Tc) =

Tc =   6 minutes
Tc =   0.10 hours

Ia / P =   0.088

Using TR-55 Exhibit 4-III

qu =   690 CSM / INCH

WQF = qu (CSM/INCH) x A (sq. miles) x Q (INCH)

WQF =	0.34 CFS

Area of Orifice

$A = WQF / [Cx(2xgxh)^{(1/2)}]; A = pi() x r^2$

C = 0.60
g = 32.2 ft/s^2
h = 0.5 ft average height above orifice

A =   0.100 sf

Therefore Diameter is:

D =   0.36 ft

D =	4.3 inches

Provide 4.3" high weir wall

References:
-2015 Rhode Island Storm Water Design and Installation Standards Manual (Section 3.3.3.2)
-TR-55 Urban Hydrology for Small Watersheds, SCS, June 1986
-Civil Engineering Reference Manual 10th Edition, Lindeburg, Michael, 2006

INSTRUCTIONS:

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: Franklin Crossing 380 King St Franklin MA 02038

TSS Removal Calculation Worksheet

BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Subsurface Infiltration Structure	0.80	1.00	0.80	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20

Total TSS Removal = 80%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: 24.0168 Franklin Crossing

Prepared By: EB

Date: 4/14/2025

*Equals remaining load from previous BMP (E)

which enters the BMP

Non-automated TSS Calculation Sheet
must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.

Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

use consistent units (e.g. feet & days **or** inches & hours)

Conversion Table

Input Values				inch/hour	feet/day
0.3400	*R*	Recharge (infiltration) rate (feet/day)		0.67	1.33
0.210	Sy	Specific yield, Sy (dimensionless, between 0 and 1)			
3.40	K	Horizontal hydraulic conductivity, Kh (feet/day)*		2.00	4.00
24.500	x	1/2 length of basin (x direction, in feet)			
14.500	y	1/2 width of basin (y direction, in feet)		hours	days
0.208	t	duration of infiltration period (days)		36	1.50
10.000	hi(0)	initial thickness of saturated zone (feet)			

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

10.329	h(max)	maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
0.329	Δh(max)	maximum groundwater mounding (beneath center of basin at end of infiltration period)

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
0.329	0
0.267	20
0.003	40
0.000	50
0.000	60
0.000	70
0.000	80
0.000	90
0.000	100
0.000	120

Re-Calculate Now

Groundwater Mounding, in feet

Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.

Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

use consistent units (e.g. feet & days **or** inches & hours)

Conversion Table

			inch/hour	feet/day	
Input Values					
0.3400	*R*	Recharge (infiltration) rate (feet/day)	0.67	1.33	
0.210	Sy	Specific yield, Sy (dimensionless, between 0 and 1)			
3.40	K	Horizontal hydraulic conductivity, Kh (feet/day)*	2.00	4.00	In the report accompanying this spreadsheet
24.500	x	1/2 length of basin (x direction, in feet)			(USGS SIR 2010-5102), vertical soil permeability
14.500	y	1/2 width of basin (y direction, in feet)	hours	days	(ft/d) is assumed to be one-tenth horizontal
0.250	t	duration of infiltration period (days)	36	1.50	hydraulic conductivity (ft/d).
10.000	hi(0)	initial thickness of saturated zone (feet)			

10.390	h(max)	maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
0.390	Δh(max)	maximum groundwater mounding (beneath center of basin at end of infiltration period)

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
0.390	0
0.309	20
0.005	40
0.000	50
0.000	60
0.000	70
0.000	80
0.000	90
0.000	100
0.000	120

Re-Calculate Now

Groundwater Mounding, in feet

Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin.   More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin.   Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.

Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

use consistent units (e.g. feet & days **or** inches & hours)

Conversion Table

					inch/hour	feet/day
Input Values						
0.3400	*R*	Recharge (infiltration) rate (feet/day)			0.67	1.33
0.210	Sy	Specific yield, Sy (dimensionless, between 0 and 1)				
3.40	K	Horizontal hydraulic conductivity, Kh (feet/day)*			2.00	4.00
28.500	x	1/2 length of basin (x direction, in feet)				
14.500	y	1/2 width of basin (y direction, in feet)			hours	days
0.167	t	duration of infiltration period (days)			36	1.50
10.000	hi(0)	initial thickness of saturated zone (feet)				

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

10.266	h(max)	maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
0.266	Δh(max)	maximum groundwater mounding (beneath center of basin at end of infiltration period)

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
0.266	0
0.252	20
0.005	40
0.000	50
0.000	60
0.000	70
0.000	80
0.000	90
0.000	100
0.000	120

Re-Calculate Now

Groundwater Mounding, in feet

Disclaimer

APPENDIX C

EDA-1

Subcat EDA-1

EDA-2

Subcat EDA-2

EDA-3

Subcat EDA-3

2R

12" Pipe

1R

18" Pipe

1L

Spruce Pond

2L

King St System

Subcat   Reach   Pond   Link

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	WQv	Type III 24-hr		Default	24.00	1	1.20	2
2	2-Year	Type III 24-hr		Default	24.00	1	3.36	2
3	10-Year	Type III 24-hr		Default	24.00	1	5.22	2
4	25-Year	Type III 24-hr		Default	24.00	1	6.37	2
5	100-Year	Type III 24-hr		Default	24.00	1	8.16	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
2,320	74	>75% Grass cover, Good, HSG C (EDA-2, EDA-3)
9,564	89	Gravel roads, HSG C (EDA-1, EDA-2)
28,024	98	Paved parking, HSG C (EDA-1, EDA-2, EDA-3)
27,273	70	Woods, Good, HSG C (EDA-1, EDA-2)
67,182	**85**	**TOTAL AREA**

24.0168 PRE HydroCAD
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr WQv Rainfall=1.20"
Printed 9/18/2025
Page 4

Time span=0.00-48.00 hrs, dt=1.00 hrs, 49 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EDA-1: Subcat EDA-1   Runoff Area=52,630 sf   33.97% Impervious   Runoff Depth=0.22"
Flow Length=204' Tc=7.1 min CN=83 Runoff=0.09 cfs 965 cf

Subcatchment EDA-2: Subcat EDA-2   Runoff Area=14,015 sf   69.46% Impervious   Runoff Depth=0.50"
Tc=6.0 min CN=91 Runoff=0.07 cfs 589 cf

Subcatchment EDA-3: Subcat EDA-3   Runoff Area=536 sf   76.61% Impervious   Runoff Depth=0.56"
Tc=6.0 min CN=92 Runoff=0.00 cfs 25 cf

Reach 1R: 18" Pipe   Avg. Flow Depth=0.08' Max Vel=1.83 fps Inflow=0.07 cfs 589 cf
18.0" Round Pipe n=0.012 L=133.0' S=0.0105 '/' Capacity=11.68 cfs Outflow=0.07 cfs 590 cf

Reach 2R: 12" Pipe   Avg. Flow Depth=0.11' Max Vel=2.01 fps Inflow=0.09 cfs 965 cf
12.0" Round Pipe n=0.012 L=92.0' S=0.0104 '/' Capacity=3.94 cfs Outflow=0.08 cfs 967 cf

Link 1L: Spruce Pond   Inflow=0.15 cfs 1,557 cf
Primary=0.15 cfs 1,557 cf

Link 2L: King St System   Inflow=0.00 cfs 25 cf
Primary=0.00 cfs 25 cf

Total Runoff Area = 67,182 sf   Runoff Volume = 1,579 cf   Average Runoff Depth = 0.28"
58.29% Pervious = 39,157 sf   41.71% Impervious = 28,024 sf

24.0168 PRE HydroCAD
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr WQv Rainfall=1.20"
Printed 9/18/2025
Page 5

Summary for Subcatchment EDA-1: Subcat EDA-1

Runoff   =   0.09 cfs @ 12.19 hrs, Volume=   965 cf, Depth= 0.22"
    Routed to Reach 2R : 12" Pipe

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr WQv Rainfall=1.20"

Area (sf)	CN	Description
17,879	98	Paved parking, HSG C
25,644	70	Woods, Good, HSG C
9,107	89	Gravel roads, HSG C
52,630	83	Weighted Average
34,751	75	66.03% Pervious Area
17,879	98	33.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	7	0.0083	0.58		**Sheet Flow, Sheet Flow - Paved** Smooth surfaces n= 0.011 P2= 3.36"
5.6	47	0.1191	0.14		**Sheet Flow, Sheet Flow - Woods** Woods: Light underbrush n= 0.400 P2= 3.36"
0.5	46	0.0459	1.68		**Sheet Flow, Sheet Flow - Gravel** Smooth surfaces n= 0.011 P2= 3.36"
0.3	52	0.0418	3.29		**Shallow Concentrated Flow, Shallow Concentrated - Gravel** Unpaved Kv= 16.1 fps
0.5	52	0.0252	1.59		**Shallow Concentrated Flow, Shallow Concentrated - Woods** Nearly Bare & Untilled Kv= 10.0 fps
7.1	204	Total			

Summary for Subcatchment EDA-2: Subcat EDA-2

Runoff   =   0.07 cfs @ 12.08 hrs, Volume=   589 cf, Depth= 0.50"
    Routed to Reach 1R : 18" Pipe

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr WQv Rainfall=1.20"

Area (sf)	CN	Description
9,735	98	Paved parking, HSG C
1,629	70	Woods, Good, HSG C
2,194	74	>75% Grass cover, Good, HSG C
457	89	Gravel roads, HSG C
14,015	91	Weighted Average
4,280	74	30.54% Pervious Area
9,735	98	69.46% Impervious Area

24.0168 PRE HydroCAD
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr WQv Rainfall=1.20"
Printed 9/18/2025
Page 6

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins)**

Summary for Subcatchment EDA-3: Subcat EDA-3

Runoff   =   0.00 cfs @ 12.07 hrs, Volume=   25 cf, Depth= 0.56"
    Routed to Link 2L : King St System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr WQv Rainfall=1.20"

Area (sf)	CN	Description
411	98	Paved parking, HSG C
125	74	>75% Grass cover, Good, HSG C
536	92	Weighted Average
125	74	23.39% Pervious Area
411	98	76.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins)**

Summary for Reach 1R: 18" Pipe

Inflow Area =   14,015 sf, 69.46% Impervious, Inflow Depth =   0.50"   for WQv event
Inflow   =   0.07 cfs @ 12.08 hrs, Volume=   589 cf
Outflow   =   0.07 cfs @ 12.11 hrs, Volume=   590 cf, Atten= 4%, Lag= 1.8 min
    Routed to Link 1L : Spruce Pond

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Max. Velocity= 1.83 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 0.89 fps, Avg. Travel Time= 2.5 min

Peak Storage= 5 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.08' , Surface Width= 0.69'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 11.68 cfs

18.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 133.0'   Slope= 0.0105 '/'
Inlet Invert= 330.15', Outlet Invert= 328.75'
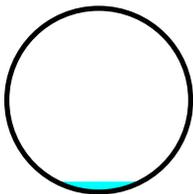
24.0168 PRE HydroCAD
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr WQv Rainfall=1.20"
Printed 9/18/2025
Page 7

Summary for Reach 2R: 12" Pipe

Inflow Area =   52,630 sf, 33.97% Impervious, Inflow Depth = 0.22"   for WQv event
Inflow   =   0.09 cfs @ 12.19 hrs, Volume=   965 cf
Outflow   =   0.08 cfs @ 12.22 hrs, Volume=   967 cf, Atten= 3%, Lag= 1.8 min
    Routed to Link 1L : Spruce Pond

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Max. Velocity= 2.01 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 1.17 fps, Avg. Travel Time= 1.3 min

Peak Storage= 4 cf @ 12.27 hrs
Average Depth at Peak Storage= 0.11' , Surface Width= 0.61'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.94 cfs

12.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 92.0' Slope= 0.0104 '/'
Inlet Invert= 330.10', Outlet Invert= 329.14'
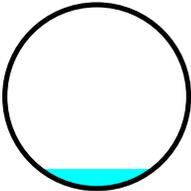
Summary for Link 1L: Spruce Pond

Inflow Area =   66,646 sf, 41.43% Impervious, Inflow Depth = 0.28"   for WQv event
Inflow   =   0.15 cfs @ 12.17 hrs, Volume=   1,557 cf
Primary   =   0.15 cfs @ 12.17 hrs, Volume=   1,557 cf, Atten= 0%, Lag= 0.0 min
    Routed to nonexistent node 3L

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs

Summary for Link 2L: King St System

Inflow Area =   536 sf, 76.61% Impervious, Inflow Depth = 0.56"   for WQv event
Inflow   =   0.00 cfs @ 12.07 hrs, Volume=   25 cf
Primary   =   0.00 cfs @ 12.07 hrs, Volume=   25 cf, Atten= 0%, Lag= 0.0 min
    Routed to nonexistent node 3L

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs

24.0168 PRE HydroCAD
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 2-Year Rainfall=3.36"
Printed 9/18/2025
Page 8

Time span=0.00-48.00 hrs, dt=1.00 hrs, 49 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EDA-1: Subcat EDA-1   Runoff Area=52,630 sf   33.97% Impervious   Runoff Depth=1.74"
Flow Length=204'   Tc=7.1 min   CN=83   Runoff=0.96 cfs 7,638 cf

Subcatchment EDA-2: Subcat EDA-2   Runoff Area=14,015 sf   69.46% Impervious   Runoff Depth=2.41"
Tc=6.0 min   CN=91   Runoff=0.36 cfs 2,813 cf

Subcatchment EDA-3: Subcat EDA-3   Runoff Area=536 sf   76.61% Impervious   Runoff Depth=2.50"
Tc=6.0 min   CN=92   Runoff=0.01 cfs 112 cf

Reach 1R: 18" Pipe   Avg. Flow Depth=0.18'   Max Vel=2.96 fps   Inflow=0.36 cfs 2,813 cf
18.0" Round Pipe   n=0.012   L=133.0'   S=0.0105 '/'   Capacity=11.68 cfs   Outflow=0.35 cfs 2,819 cf

Reach 2R: 12" Pipe   Avg. Flow Depth=0.34'   Max Vel=4.13 fps   Inflow=0.96 cfs 7,638 cf
12.0" Round Pipe   n=0.012   L=92.0'   S=0.0104 '/'   Capacity=3.94 cfs   Outflow=0.95 cfs 7,652 cf

Link 1L: Spruce Pond   Inflow=1.29 cfs 10,471 cf
Primary=1.29 cfs 10,471 cf

Link 2L: King St System   Inflow=0.01 cfs 112 cf
Primary=0.01 cfs 112 cf

Total Runoff Area = 67,182 sf   Runoff Volume = 10,563 cf   Average Runoff Depth = 1.89"
58.29% Pervious = 39,157 sf   41.71% Impervious = 28,024 sf

24.0168 PRE HydroCAD
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 2-Year Rainfall=3.36"
Printed 9/18/2025
Page 9

Summary for Subcatchment EDA-1: Subcat EDA-1

Runoff   =   0.96 cfs @ 12.06 hrs, Volume=   7,638 cf, Depth= 1.74"
   Routed to Reach 2R : 12" Pipe

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (sf)	CN	Description
17,879	98	Paved parking, HSG C
25,644	70	Woods, Good, HSG C
9,107	89	Gravel roads, HSG C
52,630	83	Weighted Average
34,751	75	66.03% Pervious Area
17,879	98	33.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	7	0.0083	0.58		**Sheet Flow, Sheet Flow - Paved**
					Smooth surfaces n= 0.011 P2= 3.36"
5.6	47	0.1191	0.14		**Sheet Flow, Sheet Flow - Woods**
					Woods: Light underbrush n= 0.400 P2= 3.36"
0.5	46	0.0459	1.68		**Sheet Flow, Sheet Flow - Gravel**
					Smooth surfaces n= 0.011 P2= 3.36"
0.3	52	0.0418	3.29		**Shallow Concentrated Flow, Shallow Concentrated - Gravel**
					Unpaved Kv= 16.1 fps
0.5	52	0.0252	1.59		**Shallow Concentrated Flow, Shallow Concentrated - Woods**
					Nearly Bare & Untilled Kv= 10.0 fps
7.1	204	Total			

Summary for Subcatchment EDA-2: Subcat EDA-2

Runoff   =   0.36 cfs @ 12.03 hrs, Volume=   2,813 cf, Depth= 2.41"
   Routed to Reach 1R : 18" Pipe

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (sf)	CN	Description
9,735	98	Paved parking, HSG C
1,629	70	Woods, Good, HSG C
2,194	74	>75% Grass cover, Good, HSG C
457	89	Gravel roads, HSG C
14,015	91	Weighted Average
4,280	74	30.54% Pervious Area
9,735	98	69.46% Impervious Area

24.0168 PRE HydroCAD
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 2-Year Rainfall=3.36"
Printed 9/18/2025
Page 10

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins)**

Summary for Subcatchment EDA-3: Subcat EDA-3

Runoff   =   0.01 cfs @ 12.03 hrs, Volume=   112 cf, Depth= 2.50"
    Routed to Link 2L : King St System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (sf)	CN	Description
411	98	Paved parking, HSG C
125	74	>75% Grass cover, Good, HSG C
536	92	Weighted Average
125	74	23.39% Pervious Area
411	98	76.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins)**

Summary for Reach 1R: 18" Pipe

Inflow Area =   14,015 sf, 69.46% Impervious, Inflow Depth = 2.41"   for 2-Year event
Inflow   =   0.36 cfs @ 12.03 hrs, Volume=   2,813 cf
Outflow   =   0.35 cfs @ 12.05 hrs, Volume=   2,819 cf, Atten= 3%, Lag= 1.0 min
    Routed to Link 1L : Spruce Pond

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Max. Velocity= 2.96 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.26 fps, Avg. Travel Time= 1.8 min

Peak Storage= 16 cf @ 12.06 hrs
Average Depth at Peak Storage= 0.18' , Surface Width= 0.97'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 11.68 cfs

18.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 133.0'   Slope= 0.0105 '/'
Inlet Invert= 330.15', Outlet Invert= 328.75'
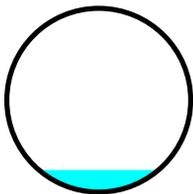
24.0168 PRE HydroCAD
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 2-Year Rainfall=3.36"
Printed 9/18/2025
Page 11

Summary for Reach 2R: 12" Pipe

Inflow Area =   52,630 sf, 33.97% Impervious, Inflow Depth =   1.74"   for 2-Year event
Inflow   =   0.96 cfs @   12.06 hrs, Volume=   7,638 cf
Outflow   =   0.95 cfs @   12.07 hrs, Volume=   7,652 cf, Atten= 1%, Lag= 0.5 min
    Routed to Link 1L : Spruce Pond

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Max. Velocity= 4.13 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.84 fps, Avg. Travel Time= 0.8 min

Peak Storage= 21 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.34' , Surface Width= 0.94'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.94 cfs

12.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 92.0'   Slope= 0.0104 '/'
Inlet Invert= 330.10', Outlet Invert= 329.14'
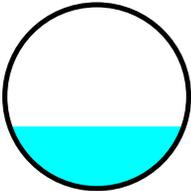
Summary for Link 1L: Spruce Pond

Inflow Area =   66,646 sf, 41.43% Impervious, Inflow Depth =   1.89"   for 2-Year event
Inflow   =   1.29 cfs @   12.07 hrs, Volume=   10,471 cf
Primary   =   1.29 cfs @   12.07 hrs, Volume=   10,471 cf, Atten= 0%, Lag= 0.0 min
    Routed to nonexistent node 3L

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs

Summary for Link 2L: King St System

Inflow Area =   536 sf, 76.61% Impervious, Inflow Depth =   2.50"   for 2-Year event
Inflow   =   0.01 cfs @   12.03 hrs, Volume=   112 cf
Primary   =   0.01 cfs @   12.03 hrs, Volume=   112 cf, Atten= 0%, Lag= 0.0 min
    Routed to nonexistent node 3L

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs

24.0168 PRE HydroCAD
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 10-Year Rainfall=5.22"
Printed 9/18/2025
Page 12

Time span=0.00-48.00 hrs, dt=1.00 hrs, 49 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EDA-1: Subcat EDA-1 Runoff Area=52,630 sf 33.97% Impervious Runoff Depth=3.37"
Flow Length=204' Tc=7.1 min CN=83 Runoff=1.88 cfs 14,797 cf

Subcatchment EDA-2: Subcat EDA-2 Runoff Area=14,015 sf 69.46% Impervious Runoff Depth=4.20"
Tc=6.0 min CN=91 Runoff=0.61 cfs 4,901 cf

Subcatchment EDA-3: Subcat EDA-3 Runoff Area=536 sf 76.61% Impervious Runoff Depth=4.30"
Tc=6.0 min CN=92 Runoff=0.02 cfs 192 cf

Reach 1R: 18" Pipe Avg. Flow Depth=0.23' Max Vel=3.48 fps Inflow=0.61 cfs 4,901 cf
18.0" Round Pipe n=0.012 L=133.0' S=0.0105 '/' Capacity=11.68 cfs Outflow=0.60 cfs 4,910 cf

Reach 2R: 12" Pipe Avg. Flow Depth=0.48' Max Vel=4.95 fps Inflow=1.88 cfs 14,797 cf
12.0" Round Pipe n=0.012 L=92.0' S=0.0104 '/' Capacity=3.94 cfs Outflow=1.86 cfs 14,823 cf

Link 1L: Spruce Pond Inflow=2.45 cfs 19,733 cf
Primary=2.45 cfs 19,733 cf

Link 2L: King St System Inflow=0.02 cfs 192 cf
Primary=0.02 cfs 192 cf

Total Runoff Area = 67,182 sf   Runoff Volume = 19,890 cf   Average Runoff Depth = 3.55"
58.29% Pervious = 39,157 sf   41.71% Impervious = 28,024 sf

24.0168 PRE HydroCAD
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 10-Year Rainfall=5.22"
Printed 9/18/2025
Page 13

Summary for Subcatchment EDA-1: Subcat EDA-1

Runoff   =   1.88 cfs @ 12.04 hrs, Volume=   14,797 cf, Depth= 3.37"
   Routed to Reach 2R : 12" Pipe

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 10-Year Rainfall=5.22"

Area (sf)	CN	Description
17,879	98	Paved parking, HSG C
25,644	70	Woods, Good, HSG C
9,107	89	Gravel roads, HSG C
52,630	83	Weighted Average
34,751	75	66.03% Pervious Area
17,879	98	33.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	7	0.0083	0.58		**Sheet Flow, Sheet Flow - Paved**
					Smooth surfaces n= 0.011 P2= 3.36"
5.6	47	0.1191	0.14		**Sheet Flow, Sheet Flow - Woods**
					Woods: Light underbrush n= 0.400 P2= 3.36"
0.5	46	0.0459	1.68		**Sheet Flow, Sheet Flow - Gravel**
					Smooth surfaces n= 0.011 P2= 3.36"
0.3	52	0.0418	3.29		**Shallow Concentrated Flow, Shallow Concentrated - Gravel**
					Unpaved Kv= 16.1 fps
0.5	52	0.0252	1.59		**Shallow Concentrated Flow, Shallow Concentrated - Woods**
					Nearly Bare & Untilled Kv= 10.0 fps
7.1	204	Total			

Summary for Subcatchment EDA-2: Subcat EDA-2

Runoff   =   0.61 cfs @ 12.02 hrs, Volume=   4,901 cf, Depth= 4.20"
   Routed to Reach 1R : 18" Pipe

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 10-Year Rainfall=5.22"

Area (sf)	CN	Description
9,735	98	Paved parking, HSG C
1,629	70	Woods, Good, HSG C
2,194	74	>75% Grass cover, Good, HSG C
457	89	Gravel roads, HSG C
14,015	91	Weighted Average
4,280	74	30.54% Pervious Area
9,735	98	69.46% Impervious Area

24.0168 PRE HydroCAD
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 10-Year Rainfall=5.22"
Printed 9/18/2025
Page 14

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins)**

Summary for Subcatchment EDA-3: Subcat EDA-3

Runoff   =   0.02 cfs @ 12.02 hrs, Volume=   192 cf, Depth= 4.30"
    Routed to Link 2L : King St System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 10-Year Rainfall=5.22"

Area (sf)	CN	Description
411	98	Paved parking, HSG C
125	74	>75% Grass cover, Good, HSG C
536	92	Weighted Average
125	74	23.39% Pervious Area
411	98	76.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins)**

Summary for Reach 1R: 18" Pipe

Inflow Area =   14,015 sf, 69.46% Impervious, Inflow Depth = 4.20"   for 10-Year event
Inflow   =   0.61 cfs @ 12.02 hrs, Volume=   4,901 cf
Outflow   =   0.60 cfs @ 12.04 hrs, Volume=   4,910 cf, Atten= 2%, Lag= 0.8 min
    Routed to Link 1L : Spruce Pond

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Max. Velocity= 3.48 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 1.43 fps, Avg. Travel Time= 1.5 min

Peak Storage= 23 cf @ 12.04 hrs
Average Depth at Peak Storage= 0.23' , Surface Width= 1.08'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 11.68 cfs

18.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 133.0'   Slope= 0.0105 '/'
Inlet Invert= 330.15', Outlet Invert= 328.75'
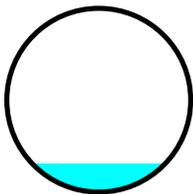
24.0168 PRE HydroCAD
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 10-Year Rainfall=5.22"
Printed 9/18/2025
Page 15

Summary for Reach 2R: 12" Pipe

Inflow Area =   52,630 sf, 33.97% Impervious, Inflow Depth = 3.37"   for 10-Year event
Inflow   =   1.88 cfs @ 12.04 hrs, Volume=   14,797 cf
Outflow   =   1.86 cfs @ 12.05 hrs, Volume=   14,823 cf, Atten= 1%, Lag= 0.4 min
     Routed to Link 1L : Spruce Pond

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Max. Velocity= 4.95 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.22 fps, Avg. Travel Time= 0.7 min

Peak Storage= 35 cf @ 12.06 hrs
Average Depth at Peak Storage= 0.48' , Surface Width= 1.00'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.94 cfs

12.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 92.0'   Slope= 0.0104 '/'
Inlet Invert= 330.10', Outlet Invert= 329.14'
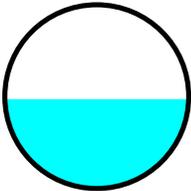
Summary for Link 1L: Spruce Pond

Inflow Area =   66,646 sf, 41.43% Impervious, Inflow Depth = 3.55"   for 10-Year event
Inflow   =   2.45 cfs @ 12.05 hrs, Volume=   19,733 cf
Primary   =   2.45 cfs @ 12.05 hrs, Volume=   19,733 cf, Atten= 0%, Lag= 0.0 min
     Routed to nonexistent node 3L

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs

Summary for Link 2L: King St System

Inflow Area =   536 sf, 76.61% Impervious, Inflow Depth = 4.30"   for 10-Year event
Inflow   =   0.02 cfs @ 12.02 hrs, Volume=   192 cf
Primary   =   0.02 cfs @ 12.02 hrs, Volume=   192 cf, Atten= 0%, Lag= 0.0 min
     Routed to nonexistent node 3L

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs

Time span=0.00-48.00 hrs, dt=1.00 hrs, 49 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EDA-1: Subcat EDA-1   Runoff Area=52,630 sf   33.97% Impervious   Runoff Depth=4.44"
Flow Length=204'   Tc=7.1 min   CN=83   Runoff=2.46 cfs 19,456 cf

Subcatchment EDA-2: Subcat EDA-2   Runoff Area=14,015 sf   69.46% Impervious   Runoff Depth=5.32"
Tc=6.0 min   CN=91   Runoff=0.77 cfs 6,213 cf

Subcatchment EDA-3: Subcat EDA-3   Runoff Area=536 sf   76.61% Impervious   Runoff Depth=5.43"
Tc=6.0 min   CN=92   Runoff=0.03 cfs 243 cf

Reach 1R: 18" Pipe   Avg. Flow Depth=0.26'   Max Vel=3.72 fps   Inflow=0.77 cfs 6,213 cf
18.0" Round Pipe   n=0.012   L=133.0'   S=0.0105 '/'   Capacity=11.68 cfs   Outflow=0.75 cfs 6,225 cf

Reach 2R: 12" Pipe   Avg. Flow Depth=0.57'   Max Vel=5.28 fps   Inflow=2.46 cfs 19,456 cf
12.0" Round Pipe   n=0.012   L=92.0'   S=0.0104 '/'   Capacity=3.94 cfs   Outflow=2.43 cfs 19,489 cf

Link 1L: Spruce Pond   Inflow=3.18 cfs 25,714 cf
Primary=3.18 cfs 25,714 cf

Link 2L: King St System   Inflow=0.03 cfs 243 cf
Primary=0.03 cfs 243 cf

Total Runoff Area = 67,182 sf   Runoff Volume = 25,912 cf   Average Runoff Depth = 4.63"
58.29% Pervious = 39,157 sf   41.71% Impervious = 28,024 sf

24.0168 PRE HydroCAD
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 25-Year Rainfall=6.37"
Printed 9/18/2025
Page 17

Summary for Subcatchment EDA-1: Subcat EDA-1

Runoff = 2.46 cfs @ 12.04 hrs, Volume= 19,456 cf, Depth= 4.44"
Routed to Reach 2R : 12" Pipe

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 25-Year Rainfall=6.37"

Area (sf)	CN	Description
17,879	98	Paved parking, HSG C
25,644	70	Woods, Good, HSG C
9,107	89	Gravel roads, HSG C
52,630	83	Weighted Average
34,751	75	66.03% Pervious Area
17,879	98	33.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	7	0.0083	0.58		**Sheet Flow, Sheet Flow - Paved**
					Smooth surfaces n= 0.011 P2= 3.36"
5.6	47	0.1191	0.14		**Sheet Flow, Sheet Flow - Woods**
					Woods: Light underbrush n= 0.400 P2= 3.36"
0.5	46	0.0459	1.68		**Sheet Flow, Sheet Flow - Gravel**
					Smooth surfaces n= 0.011 P2= 3.36"
0.3	52	0.0418	3.29		**Shallow Concentrated Flow, Shallow Concentrated - Gravel**
					Unpaved Kv= 16.1 fps
0.5	52	0.0252	1.59		**Shallow Concentrated Flow, Shallow Concentrated - Woods**
					Nearly Bare & Untilled Kv= 10.0 fps
7.1	204	Total			

Summary for Subcatchment EDA-2: Subcat EDA-2

Runoff = 0.77 cfs @ 12.02 hrs, Volume= 6,213 cf, Depth= 5.32"
Routed to Reach 1R : 18" Pipe

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 25-Year Rainfall=6.37"

Area (sf)	CN	Description
9,735	98	Paved parking, HSG C
1,629	70	Woods, Good, HSG C
2,194	74	>75% Grass cover, Good, HSG C
457	89	Gravel roads, HSG C
14,015	91	Weighted Average
4,280	74	30.54% Pervious Area
9,735	98	69.46% Impervious Area

24.0168 PRE HydroCAD
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 25-Year Rainfall=6.37"
Printed 9/18/2025
Page 18

Tc	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
6.0					**Direct Entry, Direct (Less than 6 Mins)**

Summary for Subcatchment EDA-3: Subcat EDA-3

Runoff   =   0.03 cfs @ 12.02 hrs, Volume=   243 cf, Depth= 5.43"
   Routed to Link 2L : King St System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 25-Year Rainfall=6.37"

Area (sf)	CN	Description
411	98	Paved parking, HSG C
125	74	>75% Grass cover, Good, HSG C
536	92	Weighted Average
125	74	23.39% Pervious Area
411	98	76.61% Impervious Area

Tc	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
6.0					**Direct Entry, Direct (Less than 6 Mins)**

Summary for Reach 1R: 18" Pipe

Inflow Area =   14,015 sf, 69.46% Impervious, Inflow Depth = 5.32"   for 25-Year event
Inflow   =   0.77 cfs @ 12.02 hrs, Volume=   6,213 cf
Outflow   =   0.75 cfs @ 12.03 hrs, Volume=   6,225 cf, Atten= 2%, Lag= 0.7 min
   Routed to Link 1L : Spruce Pond

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Max. Velocity= 3.72 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 1.51 fps, Avg. Travel Time= 1.5 min

Peak Storage= 27 cf @ 12.04 hrs
Average Depth at Peak Storage= 0.26' , Surface Width= 1.13'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 11.68 cfs

18.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 133.0'   Slope= 0.0105 '/'
Inlet Invert= 330.15', Outlet Invert= 328.75'
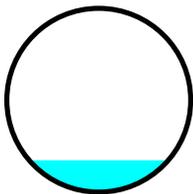
24.0168 PRE HydroCAD
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 25-Year Rainfall=6.37"
Printed 9/18/2025
Page 19

Summary for Reach 2R: 12" Pipe

Inflow Area =   52,630 sf, 33.97% Impervious, Inflow Depth =   4.44"   for 25-Year event
Inflow   =   2.46 cfs @   12.04 hrs, Volume=   19,456 cf
Outflow   =   2.43 cfs @   12.05 hrs, Volume=   19,489 cf, Atten= 1%, Lag= 0.4 min
    Routed to Link 1L : Spruce Pond

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Max. Velocity= 5.28 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.34 fps, Avg. Travel Time= 0.7 min

Peak Storage= 43 cf @ 12.06 hrs
Average Depth at Peak Storage= 0.57' , Surface Width= 0.99'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.94 cfs

12.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 92.0'   Slope= 0.0104 '/'
Inlet Invert= 330.10', Outlet Invert= 329.14'
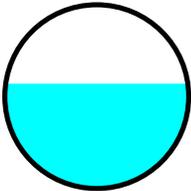
Summary for Link 1L: Spruce Pond

Inflow Area =   66,646 sf, 41.43% Impervious, Inflow Depth =   4.63"   for 25-Year event
Inflow   =   3.18 cfs @   12.04 hrs, Volume=   25,714 cf
Primary   =   3.18 cfs @   12.04 hrs, Volume=   25,714 cf, Atten= 0%, Lag= 0.0 min
    Routed to nonexistent node 3L

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs

Summary for Link 2L: King St System

Inflow Area =   536 sf, 76.61% Impervious, Inflow Depth =   5.43"   for 25-Year event
Inflow   =   0.03 cfs @   12.02 hrs, Volume=   243 cf
Primary   =   0.03 cfs @   12.02 hrs, Volume=   243 cf, Atten= 0%, Lag= 0.0 min
    Routed to nonexistent node 3L

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs

24.0168 PRE HydroCAD
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 100-Year Rainfall=8.16"
Printed 9/18/2025
Page 20

Time span=0.00-48.00 hrs, dt=1.00 hrs, 49 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EDA-1: Subcat EDA-1
Runoff Area=52,630 sf   33.97% Impervious   Runoff Depth=6.13"
Flow Length=204'   Tc=7.1 min   CN=83   Runoff=3.37 cfs 26,887 cf

Subcatchment EDA-2: Subcat EDA-2
Runoff Area=14,015 sf   69.46% Impervious   Runoff Depth=7.08"
Tc=6.0 min   CN=91   Runoff=1.00 cfs 8,272 cf

Subcatchment EDA-3: Subcat EDA-3
Runoff Area=536 sf   76.61% Impervious   Runoff Depth=7.20"
Tc=6.0 min   CN=92   Runoff=0.04 cfs 322 cf

Reach 1R: 18" Pipe
Avg. Flow Depth=0.30'   Max Vel=4.03 fps   Inflow=1.00 cfs 8,272 cf
18.0" Round Pipe   n=0.012   L=133.0'   S=0.0105 '/'   Capacity=11.68 cfs   Outflow=0.99 cfs 8,287 cf

Reach 2R: 12" Pipe
Avg. Flow Depth=0.71'   Max Vel=5.63 fps   Inflow=3.37 cfs 26,887 cf
12.0" Round Pipe   n=0.012   L=92.0'   S=0.0104 '/'   Capacity=3.94 cfs   Outflow=3.34 cfs 26,932 cf

Link 1L: Spruce Pond
Inflow=4.32 cfs 35,219 cf
Primary=4.32 cfs 35,219 cf

Link 2L: King St System
Inflow=0.04 cfs 322 cf
Primary=0.04 cfs 322 cf

Total Runoff Area = 67,182 sf   Runoff Volume = 35,480 cf   Average Runoff Depth = 6.34"
58.29% Pervious = 39,157 sf   41.71% Impervious = 28,024 sf

24.0168 PRE HydroCAD
Type III 24-hr 100-Year Rainfall=8.16"
Prepared by Narragansett Engineering Inc
Printed 9/18/2025
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC
Page 21

Summary for Subcatchment EDA-1: Subcat EDA-1

Runoff   =   3.37 cfs @ 12.03 hrs, Volume=   26,887 cf, Depth= 6.13"
    Routed to Reach 2R : 12" Pipe

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
17,879	98	Paved parking, HSG C
25,644	70	Woods, Good, HSG C
9,107	89	Gravel roads, HSG C
52,630	83	Weighted Average
34,751	75	66.03% Pervious Area
17,879	98	33.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	7	0.0083	0.58		**Sheet Flow, Sheet Flow - Paved**
					Smooth surfaces n= 0.011 P2= 3.36"
5.6	47	0.1191	0.14		**Sheet Flow, Sheet Flow - Woods**
					Woods: Light underbrush n= 0.400 P2= 3.36"
0.5	46	0.0459	1.68		**Sheet Flow, Sheet Flow - Gravel**
					Smooth surfaces n= 0.011 P2= 3.36"
0.3	52	0.0418	3.29		**Shallow Concentrated Flow, Shallow Concentrated - Gravel**
					Unpaved Kv= 16.1 fps
0.5	52	0.0252	1.59		**Shallow Concentrated Flow, Shallow Concentrated - Woods**
					Nearly Bare & Untilled Kv= 10.0 fps
7.1	204	Total			

Summary for Subcatchment EDA-2: Subcat EDA-2

Runoff   =   1.00 cfs @ 12.02 hrs, Volume=   8,272 cf, Depth= 7.08"
    Routed to Reach 1R : 18" Pipe

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
9,735	98	Paved parking, HSG C
1,629	70	Woods, Good, HSG C
2,194	74	>75% Grass cover, Good, HSG C
457	89	Gravel roads, HSG C
14,015	91	Weighted Average
4,280	74	30.54% Pervious Area
9,735	98	69.46% Impervious Area

24.0168 PRE HydroCAD
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 100-Year Rainfall=8.16"
Printed 9/18/2025
Page 22

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins)**

Summary for Subcatchment EDA-3: Subcat EDA-3

Runoff   =   0.04 cfs @ 12.02 hrs, Volume=   322 cf, Depth= 7.20"
    Routed to Link 2L : King St System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
411	98	Paved parking, HSG C
125	74	>75% Grass cover, Good, HSG C
536	92	Weighted Average
125	74	23.39% Pervious Area
411	98	76.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins)**

Summary for Reach 1R: 18" Pipe

Inflow Area =   14,015 sf, 69.46% Impervious, Inflow Depth = 7.08"   for 100-Year event
Inflow   =   1.00 cfs @ 12.02 hrs, Volume=   8,272 cf
Outflow   =   0.99 cfs @ 12.03 hrs, Volume=   8,287 cf, Atten= 2%, Lag= 0.7 min
    Routed to Link 1L : Spruce Pond

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Max. Velocity= 4.03 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 1.66 fps, Avg. Travel Time= 1.3 min

Peak Storage= 33 cf @ 12.04 hrs
Average Depth at Peak Storage= 0.30' , Surface Width= 1.19'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 11.68 cfs

18.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 133.0'   Slope= 0.0105 '/'
Inlet Invert= 330.15', Outlet Invert= 328.75'
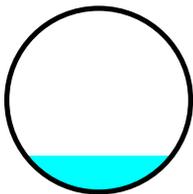
24.0168 PRE HydroCAD
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 100-Year Rainfall=8.16"
Printed 9/18/2025
Page 23

Summary for Reach 2R: 12" Pipe

Inflow Area =   52,630 sf, 33.97% Impervious, Inflow Depth =   6.13"   for 100-Year event
Inflow   =   3.37 cfs @   12.03 hrs, Volume=   26,887 cf
Outflow   =   3.34 cfs @   12.04 hrs, Volume=   26,932 cf, Atten= 1%, Lag= 0.4 min
     Routed to Link 1L : Spruce Pond

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Max. Velocity= 5.63 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.53 fps, Avg. Travel Time= 0.6 min

Peak Storage= 55 cf @ 12.05 hrs
Average Depth at Peak Storage= 0.71' , Surface Width= 0.91'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.94 cfs

12.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 92.0'   Slope= 0.0104 '/'
Inlet Invert= 330.10', Outlet Invert= 329.14'
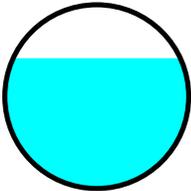
Summary for Link 1L: Spruce Pond

Inflow Area =   66,646 sf, 41.43% Impervious, Inflow Depth =   6.34"   for 100-Year event
Inflow   =   4.32 cfs @   12.04 hrs, Volume=   35,219 cf
Primary   =   4.32 cfs @   12.04 hrs, Volume=   35,219 cf, Atten= 0%, Lag= 0.0 min
     Routed to nonexistent node 3L

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs

Summary for Link 2L: King St System

Inflow Area =   536 sf, 76.61% Impervious, Inflow Depth =   7.20"   for 100-Year event
Inflow   =   0.04 cfs @   12.02 hrs, Volume=   322 cf
Primary   =   0.04 cfs @   12.02 hrs, Volume=   322 cf, Atten= 0%, Lag= 0.0 min
     Routed to nonexistent node 3L

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs

PDA-1

Subcat PDA-1

PDA-4

Subcat PDA-4

PDA-2

Subcat PDA-2

1P

BMP 1

2P

BMP 2

3P

BMP 3

PDA-5

Subcat PDA-5

1R

12" Pipe to Spruce Pond

2R

18" Pipe to Spruce Pond

PDA-6

Subcat PDA-6

PDA-3

Subcat PDA-3

1L

Spruce Pond

2L

King Street

Subcat   Reach   Pond   Link

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	WQv	Type III 24-hr		Default	24.00	1	1.20	2
2	2-Year	Type III 24-hr		Default	24.00	1	3.36	2
3	10-Year	Type III 24-hr		Default	24.00	1	5.22	2
4	25-Year	Type III 24-hr		Default	24.00	1	6.37	2
5	100-Year	Type III 24-hr		Default	24.00	1	8.16	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
13,576	74	>75% Grass cover, Good, HSG C (PDA-1, PDA-2, PDA-3, PDA-4, PDA-5, PDA-6)
41,565	98	Paved parking, HSG C (PDA-1, PDA-2, PDA-3, PDA-4, PDA-5, PDA-6)
12,147	98	Roofs, HSG C (PDA-1, PDA-2, PDA-4)
67,288	**93**	**TOTAL AREA**

24.0168 POST HydroCAD - Joe
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr WQv Rainfall=1.20"
Printed 9/18/2025
Page 4

Time span=0.00-48.00 hrs, dt=1.00 hrs, 49 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PDA-1: Subcat PDA-1 Runoff Area=15,193 sf 90.52% Impervious Runoff Depth=0.81"
Tc=6.0 min CN=96 Runoff=0.13 cfs 1,030 cf

Subcatchment PDA-2: Subcat PDA-2 Runoff Area=13,823 sf 88.47% Impervious Runoff Depth=0.74"
Tc=6.0 min CN=95 Runoff=0.11 cfs 852 cf

Subcatchment PDA-3: Subcat PDA-3 Runoff Area=260 sf 99.73% Impervious Runoff Depth=0.99"
Tc=6.0 min CN=98 Runoff=0.00 cfs 21 cf

Subcatchment PDA-4: Subcat PDA-4 Runoff Area=30,982 sf 77.65% Impervious Runoff Depth=0.61"
Flow Length=135' Tc=8.4 min CN=93 Runoff=0.20 cfs 1,578 cf

Subcatchment PDA-5: Subcat PDA-5 Runoff Area=3,691 sf 25.83% Impervious Runoff Depth=0.15"
Flow Length=126' Tc=6.9 min CN=80 Runoff=0.00 cfs 47 cf

Subcatchment PDA-6: Subcat PDA-6 Runoff Area=3,339 sf 73.65% Impervious Runoff Depth=0.56"
Tc=6.0 min CN=92 Runoff=0.02 cfs 155 cf

Reach 1R: 12" Pipe to Spruce Pond Avg. Flow Depth=0.02' Max Vel=0.84 fps Inflow=0.00 cfs 47 cf
12.0" Round Pipe n=0.010 L=92.3' S=0.0105 '/' Capacity=4.75 cfs Outflow=0.00 cfs 47 cf

Reach 2R: 18" Pipe to Spruce Pond Avg. Flow Depth=0.04' Max Vel=1.39 fps Inflow=0.02 cfs 155 cf
18.0" Round Pipe n=0.010 L=133.0' S=0.0105 '/' Capacity=14.01 cfs Outflow=0.02 cfs 155 cf

Pond 1P: BMP 1 Peak Elev=332.52' Storage=385 cf Inflow=0.13 cfs 1,030 cf
Discarded=0.03 cfs 1,047 cf Primary=0.00 cfs 0 cf Outflow=0.03 cfs 1,047 cf

Pond 2P: BMP 2 Peak Elev=336.80' Storage=700 cf Inflow=0.20 cfs 1,578 cf
Discarded=0.03 cfs 1,592 cf Primary=0.00 cfs 0 cf Outflow=0.03 cfs 1,592 cf

Pond 3P: BMP 3 Peak Elev=336.82' Storage=241 cf Inflow=0.11 cfs 852 cf
Discarded=0.04 cfs 869 cf Primary=0.00 cfs 0 cf Outflow=0.04 cfs 869 cf

Link 1L: Spruce Pond Inflow=0.02 cfs 202 cf
Primary=0.02 cfs 202 cf

Link 2L: King Street Inflow=0.00 cfs 21 cf
Primary=0.00 cfs 21 cf

Total Runoff Area = 67,288 sf Runoff Volume = 3,682 cf Average Runoff Depth = 0.66"
20.18% Pervious = 13,576 sf   79.82% Impervious = 53,712 sf

24.0168 POST HydroCAD - Joe
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr WQv Rainfall=1.20"
Printed 9/18/2025
Page 5

Summary for Subcatchment PDA-1: Subcat PDA-1

Runoff   =   0.13 cfs @ 12.04 hrs, Volume=   1,030 cf, Depth= 0.81"
     Routed to Pond 1P : BMP 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr WQv Rainfall=1.20"

Area (sf)	CN	Description
1,440	74	>75% Grass cover, Good, HSG C
13,639	98	Paved parking, HSG C
114	98	Roofs, HSG C
15,193	96	Weighted Average
1,440	74	9.48% Pervious Area
13,753	98	90.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins.)**

Summary for Subcatchment PDA-2: Subcat PDA-2

Runoff   =   0.11 cfs @ 12.05 hrs, Volume=   852 cf, Depth= 0.74"
     Routed to Pond 3P : BMP 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr WQv Rainfall=1.20"

Area (sf)	CN	Description
1,594	74	>75% Grass cover, Good, HSG C
12,208	98	Paved parking, HSG C
21	98	Roofs, HSG C
13,823	95	Weighted Average
1,594	74	11.53% Pervious Area
12,229	98	88.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins.)**

Summary for Subcatchment PDA-3: Subcat PDA-3

Runoff   =   0.00 cfs @ 12.02 hrs, Volume=   21 cf, Depth= 0.99"
     Routed to Link 2L : King Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr WQv Rainfall=1.20"

24.0168 POST HydroCAD - Joe
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr WQv Rainfall=1.20"
Printed 9/18/2025
Page 6

Area (sf)	CN	Description
1	74	>75% Grass cover, Good, HSG C
259	98	Paved parking, HSG C
260	98	Weighted Average
1	74	0.27% Pervious Area
259	98	99.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins.)**

Summary for Subcatchment PDA-4: Subcat PDA-4

Runoff   =   0.20 cfs @ 12.07 hrs, Volume=   1,578 cf, Depth= 0.61"
   Routed to Pond 2P : BMP 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr WQv Rainfall=1.20"

Area (sf)	CN	Description
12,046	98	Paved parking, HSG C
6,924	74	>75% Grass cover, Good, HSG C
12,012	98	Roofs, HSG C
30,982	93	Weighted Average
6,924	74	22.35% Pervious Area
24,058	98	77.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	100	0.0370	0.22		**Sheet Flow, Sheet Flow - Grass** Grass: Short n= 0.150 P2= 3.36"
0.9	35	0.0086	0.65		**Shallow Concentrated Flow, Shallow Concentrated - Grass** Short Grass Pasture Kv= 7.0 fps
8.4	135	Total			

Summary for Subcatchment PDA-5: Subcat PDA-5

Runoff   =   0.00 cfs @ 12.30 hrs, Volume=   47 cf, Depth= 0.15"
   Routed to Reach 1R : 12" Pipe to Spruce Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr WQv Rainfall=1.20"

Area (sf)	CN	Description
953	98	Paved parking, HSG C
2,738	74	>75% Grass cover, Good, HSG C
3,691	80	Weighted Average
2,738	74	74.17% Pervious Area
953	98	25.83% Impervious Area

24.0168 POST HydroCAD - Joe
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr WQv Rainfall=1.20"
Printed 9/18/2025
Page 7

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	100	0.0500	0.25		**Sheet Flow, Sheet Flow - Grass**
					Grass: Short n= 0.150 P2= 3.36"
0.3	26	0.0385	1.37		**Shallow Concentrated Flow, Shallow Concentrated - Grass**
					Short Grass Pasture Kv= 7.0 fps
6.9	126	Total			

Summary for Subcatchment PDA-6: Subcat PDA-6

Runoff   =   0.02 cfs @ 12.07 hrs, Volume=   155 cf, Depth= 0.56"
    Routed to Reach 2R : 18" Pipe to Spruce Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr WQv Rainfall=1.20"

Area (sf)	CN	Description
2,459	98	Paved parking, HSG C
880	74	>75% Grass cover, Good, HSG C
3,339	92	Weighted Average
880	74	26.35% Pervious Area
2,459	98	73.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins)**

Summary for Reach 1R: 12" Pipe to Spruce Pond

Inflow Area =   49,866 sf, 77.74% Impervious, Inflow Depth = 0.01"   for WQv event
Inflow   =   0.00 cfs @ 12.30 hrs, Volume=   47 cf
Outflow   =   0.00 cfs @ 12.41 hrs, Volume=   47 cf, Atten= 6%, Lag= 6.4 min
    Routed to Link 1L : Spruce Pond

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Max. Velocity= 0.84 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 0.61 fps, Avg. Travel Time= 2.5 min

Peak Storage= 0 cf @ 12.40 hrs
Average Depth at Peak Storage= 0.02' , Surface Width= 0.29'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 4.75 cfs

12.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 92.3'   Slope= 0.0105 '/'
Inlet Invert= 330.11', Outlet Invert= 329.14'

24.0168 POST HydroCAD - Joe
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr WQv Rainfall=1.20"
Printed 9/18/2025
Page 8
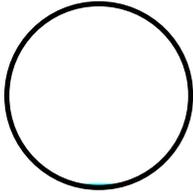
Summary for Reach 2R: 18" Pipe to Spruce Pond

Inflow Area =   17,162 sf, 85.59% Impervious, Inflow Depth =   0.11"   for WQv event
Inflow   =   0.02 cfs @ 12.07 hrs, Volume=   155 cf
Outflow   =   0.02 cfs @ 12.11 hrs, Volume=   155 cf, Atten= 6%, Lag= 2.4 min
   Routed to Link 1L : Spruce Pond

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Max. Velocity= 1.39 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 0.79 fps, Avg. Travel Time= 2.8 min

Peak Storage= 2 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.04' , Surface Width= 0.49'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 14.01 cfs

18.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 133.0'   Slope= 0.0105 '/'
Inlet Invert= 330.15', Outlet Invert= 328.75'
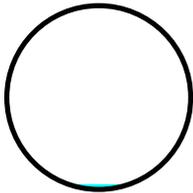
Summary for Pond 1P: BMP 1

Inflow Area =   15,193 sf, 90.52% Impervious, Inflow Depth =   0.81"   for WQv event
Inflow   =   0.13 cfs @ 12.04 hrs, Volume=   1,030 cf
Outflow   =   0.03 cfs @ 12.00 hrs, Volume=   1,047 cf, Atten= 74%, Lag= 0.0 min
Discarded   =   0.03 cfs @ 12.00 hrs, Volume=   1,047 cf
Primary   =   0.00 cfs @   0.00 hrs, Volume=   0 cf
   Routed to Reach 1R : 12" Pipe to Spruce Pond

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Peak Elev= 332.52' @ 13.42 hrs   Surf.Area= 1,421 sf   Storage= 385 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 92.4 min (897.6 - 805.3)

24.0168 POST HydroCAD - Joe
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr WQv Rainfall=1.20"
Printed 9/18/2025
Page 9

Volume	Invert	Avail.Storage	Storage Description
#1A	331.90'	538 cf	**29.00'W x 49.00'L x 2.50'H Field A** 3,553 cf Overall - 2,016 cf Embedded = 1,536 cf x 35.0% Voids
#2A	332.40'	1,351 cf	**Shea Leaching Chamber 4x8x1.5** x 42 Inside #1 Inside= 42.0"W x 15.0"H => 4.29 sf x 7.50'L = 32.2 cf Outside= 48.0"W x 18.0"H => 6.00 sf x 8.00'L = 48.0 cf 42 Chambers in 7 Rows
		1,889 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	331.90'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	333.30'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	333.80'	**0.5' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Primary	334.10'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.03 cfs @ 12.00 hrs HW=332.27' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=331.90' (Free Discharge)
├─**2=Orifice/Grate** (Controls 0.00 cfs)
├─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
└─**4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 2P: BMP 2

Inflow Area =		30,982 sf, 77.65% Impervious,	Inflow Depth = 0.61"	for WQv event
Inflow =	0.20 cfs @ 12.07 hrs,	Volume=	1,578 cf	
Outflow =	0.03 cfs @ 12.00 hrs,	Volume=	1,592 cf,	Atten= 83%, Lag= 0.0 min
Discarded =	0.03 cfs @ 12.00 hrs,	Volume=	1,592 cf	
Primary =	0.00 cfs @ 0.00 hrs,	Volume=	0 cf	

   Routed to Reach 1R : 12" Pipe to Spruce Pond

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Peak Elev= 336.80' @ 14.34 hrs Surf.Area= 1,421 sf Storage= 700 cf

Plug-Flow detention time= 206.3 min calculated for 1,559 cf (99% of inflow)
Center-of-Mass det. time= 207.9 min (1,039.9 - 832.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	335.90'	538 cf	**29.00'W x 49.00'L x 2.50'H Field A** 3,553 cf Overall - 2,016 cf Embedded = 1,536 cf x 35.0% Voids
#2A	336.40'	1,351 cf	**Shea Leaching Chamber 4x8x1.5** x 42 Inside #1 Inside= 42.0"W x 15.0"H => 4.29 sf x 7.50'L = 32.2 cf Outside= 48.0"W x 18.0"H => 6.00 sf x 8.00'L = 48.0 cf 42 Chambers in 7 Rows
		1,889 cf	Total Available Storage

Storage Group A created with Chamber Wizard

24.0168 POST HydroCAD - Joe
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr WQv Rainfall=1.20"
Printed 9/18/2025
Page 10

Device	Routing	Invert	Outlet Devices
#1	Discarded	335.90'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	337.45'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	338.00'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.03 cfs @ 12.00 hrs HW=336.45'   (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=335.90'   (Free Discharge)
├─**2=Orifice/Grate** (Controls 0.00 cfs)
└─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 3P: BMP 3

Inflow Area =		13,823 sf,	88.47% Impervious,	Inflow Depth = 0.74"	for WQv event
Inflow	=	0.11 cfs @ 12.05 hrs,	Volume=	852 cf	
Outflow	=	0.04 cfs @ 12.00 hrs,	Volume=	869 cf,	Atten= 64%, Lag= 0.0 min
Discarded	=	0.04 cfs @ 12.00 hrs,	Volume=	869 cf	
Primary	=	0.00 cfs @ 0.00 hrs,	Volume=	0 cf	

Routed to Reach 2R : 18" Pipe to Spruce Pond

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Peak Elev= 336.82' @ 13.16 hrs   Surf.Area= 1,653 sf   Storage= 241 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 50.3 min (864.8 - 814.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	336.40'	628 cf	**29.00'W x 57.00'L x 2.08'H Field A**
			3,438 cf Overall - 1,643 cf Embedded = 1,796 cf x 35.0% Voids
#2A	336.90'	1,016 cf	**Shea Leaching Chamber 4x8x1** x 49 Inside #1
			Inside= 42.0"W x 10.0"H => 2.76 sf x 7.50'L = 20.7 cf
			Outside= 48.0"W x 13.0"H => 4.19 sf x 8.00'L = 33.5 cf
			49 Chambers in 7 Rows
		1,644 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	336.40'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	337.50'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	338.10'	**1.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
			338.6' Crest Height

Discarded OutFlow Max=0.04 cfs @ 12.00 hrs HW=336.63'   (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=336.40'   (Free Discharge)
├─**2=Orifice/Grate** (Controls 0.00 cfs)
└─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link 1L: Spruce Pond

Inflow Area =   67,028 sf, 79.75% Impervious, Inflow Depth =   0.04"   for WQv event
Inflow   =   0.02 cfs @   12.14 hrs, Volume=   202 cf
Primary   =   0.02 cfs @   12.14 hrs, Volume=   202 cf, Atten= 0%, Lag= 0.0 min
      Routed to nonexistent node 3L

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs

Summary for Link 2L: King Street

Inflow Area =   260 sf, 99.73% Impervious, Inflow Depth =   0.99"   for WQv event
Inflow   =   0.00 cfs @   12.02 hrs, Volume=   21 cf
Primary   =   0.00 cfs @   12.02 hrs, Volume=   21 cf, Atten= 0%, Lag= 0.0 min
      Routed to nonexistent node 3L

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs

24.0168 POST HydroCAD - Joe
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 2-Year Rainfall=3.36"
Printed 9/18/2025
Page 12

Time span=0.00-48.00 hrs, dt=1.00 hrs, 49 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PDA-1: Subcat PDA-1
Runoff Area=15,193 sf 90.52% Impervious Runoff Depth=2.91"
Tc=6.0 min CN=96 Runoff=0.45 cfs 3,680 cf

Subcatchment PDA-2: Subcat PDA-2
Runoff Area=13,823 sf 88.47% Impervious Runoff Depth=2.80"
Tc=6.0 min CN=95 Runoff=0.40 cfs 3,227 cf

Subcatchment PDA-3: Subcat PDA-3
Runoff Area=260 sf 99.73% Impervious Runoff Depth=3.13"
Tc=6.0 min CN=98 Runoff=0.01 cfs 68 cf

Subcatchment PDA-4: Subcat PDA-4
Runoff Area=30,982 sf 77.65% Impervious Runoff Depth=2.60"
Flow Length=135' Tc=8.4 min CN=93 Runoff=0.83 cfs 6,712 cf

Subcatchment PDA-5: Subcat PDA-5
Runoff Area=3,691 sf 25.83% Impervious Runoff Depth=1.53"
Flow Length=126' Tc=6.9 min CN=80 Runoff=0.06 cfs 469 cf

Subcatchment PDA-6: Subcat PDA-6
Runoff Area=3,339 sf 73.65% Impervious Runoff Depth=2.50"
Tc=6.0 min CN=92 Runoff=0.09 cfs 696 cf

Reach 1R: 12" Pipe to Spruce Pond
Avg. Flow Depth=0.29' Max Vel=4.63 fps Inflow=0.89 cfs 4,634 cf
12.0" Round Pipe n=0.010 L=92.3' S=0.0105 '/' Capacity=4.75 cfs Outflow=0.88 cfs 4,645 cf

Reach 2R: 18" Pipe to Spruce Pond
Avg. Flow Depth=0.10' Max Vel=2.44 fps Inflow=0.12 cfs 1,234 cf
18.0" Round Pipe n=0.010 L=133.0' S=0.0105 '/' Capacity=14.01 cfs Outflow=0.12 cfs 1,234 cf

Pond 1P: BMP 1
Peak Elev=333.70' Storage=1,635 cf Inflow=0.45 cfs 3,680 cf
Discarded=0.03 cfs 2,927 cf Primary=0.12 cfs 792 cf Outflow=0.15 cfs 3,719 cf

Pond 2P: BMP 2
Peak Elev=338.11' Storage=1,745 cf Inflow=0.83 cfs 6,712 cf
Discarded=0.03 cfs 3,359 cf Primary=0.76 cfs 3,373 cf Outflow=0.79 cfs 6,731 cf

Pond 3P: BMP 3
Peak Elev=337.75' Storage=1,344 cf Inflow=0.40 cfs 3,227 cf
Discarded=0.04 cfs 2,746 cf Primary=0.10 cfs 537 cf Outflow=0.14 cfs 3,283 cf

Link 1L: Spruce Pond
Inflow=1.00 cfs 5,879 cf
Primary=1.00 cfs 5,879 cf

Link 2L: King Street
Inflow=0.01 cfs 68 cf
Primary=0.01 cfs 68 cf

Total Runoff Area = 67,288 sf   Runoff Volume = 14,853 cf   Average Runoff Depth = 2.65"
20.18% Pervious = 13,576 sf   79.82% Impervious = 53,712 sf

24.0168 POST HydroCAD - Joe
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 2-Year Rainfall=3.36"
Printed 9/18/2025
Page 13

Summary for Subcatchment PDA-1: Subcat PDA-1

Runoff   =   0.45 cfs @   12.02 hrs, Volume=   3,680 cf, Depth= 2.91"
    Routed to Pond 1P : BMP 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (sf)	CN	Description
1,440	74	>75% Grass cover, Good, HSG C
13,639	98	Paved parking, HSG C
114	98	Roofs, HSG C
15,193	96	Weighted Average
1,440	74	9.48% Pervious Area
13,753	98	90.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins.)**

Summary for Subcatchment PDA-2: Subcat PDA-2

Runoff   =   0.40 cfs @   12.02 hrs, Volume=   3,227 cf, Depth= 2.80"
    Routed to Pond 3P : BMP 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (sf)	CN	Description
1,594	74	>75% Grass cover, Good, HSG C
12,208	98	Paved parking, HSG C
21	98	Roofs, HSG C
13,823	95	Weighted Average
1,594	74	11.53% Pervious Area
12,229	98	88.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins.)**

Summary for Subcatchment PDA-3: Subcat PDA-3

Runoff   =   0.01 cfs @   12.01 hrs, Volume=   68 cf, Depth= 3.13"
    Routed to Link 2L : King Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 2-Year Rainfall=3.36"

24.0168 POST HydroCAD - Joe
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 2-Year Rainfall=3.36"
Printed 9/18/2025
Page 14

Area (sf)	CN	Description
1	74	>75% Grass cover, Good, HSG C
259	98	Paved parking, HSG C
260	98	Weighted Average
1	74	0.27% Pervious Area
259	98	99.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins.)**

Summary for Subcatchment PDA-4: Subcat PDA-4

Runoff   =   0.83 cfs @ 12.04 hrs, Volume=   6,712 cf, Depth= 2.60"
    Routed to Pond 2P : BMP 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (sf)	CN	Description
12,046	98	Paved parking, HSG C
6,924	74	>75% Grass cover, Good, HSG C
12,012	98	Roofs, HSG C
30,982	93	Weighted Average
6,924	74	22.35% Pervious Area
24,058	98	77.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	100	0.0370	0.22		**Sheet Flow, Sheet Flow - Grass**
					Grass: Short n= 0.150 P2= 3.36"
0.9	35	0.0086	0.65		**Shallow Concentrated Flow, Shallow Concentrated - Grass**
					Short Grass Pasture Kv= 7.0 fps
8.4	135	Total			

Summary for Subcatchment PDA-5: Subcat PDA-5

Runoff   =   0.06 cfs @ 12.07 hrs, Volume=   469 cf, Depth= 1.53"
    Routed to Reach 1R : 12" Pipe to Spruce Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (sf)	CN	Description
953	98	Paved parking, HSG C
2,738	74	>75% Grass cover, Good, HSG C
3,691	80	Weighted Average
2,738	74	74.17% Pervious Area
953	98	25.83% Impervious Area

24.0168 POST HydroCAD - Joe
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 2-Year Rainfall=3.36"
Printed 9/18/2025
Page 15

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	100	0.0500	0.25		**Sheet Flow, Sheet Flow - Grass**
					Grass: Short n= 0.150 P2= 3.36"
0.3	26	0.0385	1.37		**Shallow Concentrated Flow, Shallow Concentrated - Grass**
					Short Grass Pasture Kv= 7.0 fps
6.9	126	Total			

Summary for Subcatchment PDA-6: Subcat PDA-6

Runoff   =   0.09 cfs @ 12.03 hrs, Volume=   696 cf, Depth= 2.50"
    Routed to Reach 2R : 18" Pipe to Spruce Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (sf)	CN	Description
2,459	98	Paved parking, HSG C
880	74	>75% Grass cover, Good, HSG C
3,339	92	Weighted Average
880	74	26.35% Pervious Area
2,459	98	73.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins)**

Summary for Reach 1R: 12" Pipe to Spruce Pond

Inflow Area =   49,866 sf, 77.74% Impervious, Inflow Depth = 1.12"   for 2-Year event
Inflow   =   0.89 cfs @ 12.94 hrs, Volume=   4,634 cf
Outflow   =   0.88 cfs @ 12.95 hrs, Volume=   4,645 cf, Atten= 1%, Lag= 0.4 min
    Routed to Link 1L : Spruce Pond

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Max. Velocity= 4.63 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.64 fps, Avg. Travel Time= 0.9 min

Peak Storage= 18 cf @ 12.93 hrs
Average Depth at Peak Storage= 0.29' , Surface Width= 0.91'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 4.75 cfs

12.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 92.3'   Slope= 0.0105 '/'
Inlet Invert= 330.11', Outlet Invert= 329.14'

24.0168 POST HydroCAD - Joe
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 2-Year Rainfall=3.36"
Printed 9/18/2025
Page 16
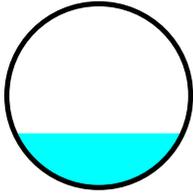
Summary for Reach 2R: 18" Pipe to Spruce Pond

Inflow Area =   17,162 sf, 85.59% Impervious, Inflow Depth = 0.86"   for 2-Year event
Inflow   =   0.12 cfs @ 12.80 hrs, Volume=   1,234 cf
Outflow   =   0.12 cfs @ 12.83 hrs, Volume=   1,234 cf, Atten= 0%, Lag= 1.6 min
      Routed to Link 1L : Spruce Pond

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Max. Velocity= 2.44 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 1.10 fps, Avg. Travel Time= 2.0 min

Peak Storage= 7 cf @ 12.81 hrs
Average Depth at Peak Storage= 0.10' , Surface Width= 0.75'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 14.01 cfs

18.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 133.0'   Slope= 0.0105 '/'
Inlet Invert= 330.15', Outlet Invert= 328.75'
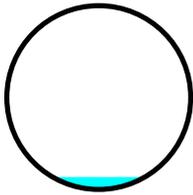
Summary for Pond 1P: BMP 1

Inflow Area =   15,193 sf, 90.52% Impervious, Inflow Depth = 2.91"   for 2-Year event
Inflow   =   0.45 cfs @ 12.02 hrs, Volume=   3,680 cf
Outflow   =   0.15 cfs @ 13.19 hrs, Volume=   3,719 cf, Atten= 66%, Lag= 70.1 min
Discarded   =   0.03 cfs @ 10.00 hrs, Volume=   2,927 cf
Primary   =   0.12 cfs @ 13.19 hrs, Volume=   792 cf
      Routed to Reach 1R : 12" Pipe to Spruce Pond

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Peak Elev= 333.70' @ 13.29 hrs   Surf.Area= 1,421 sf   Storage= 1,635 cf

Plug-Flow detention time= 297.2 min calculated for 3,643 cf (99% of inflow)
Center-of-Mass det. time= 307.2 min (1,078.5 - 771.3)

24.0168 POST HydroCAD - Joe
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 2-Year Rainfall=3.36"
Printed 9/18/2025
Page 17

Volume	Invert	Avail.Storage	Storage Description
#1A	331.90'	538 cf	**29.00'W x 49.00'L x 2.50'H Field A**
			3,553 cf Overall - 2,016 cf Embedded = 1,536 cf x 35.0% Voids
#2A	332.40'	1,351 cf	**Shea Leaching Chamber 4x8x1.5** x 42 Inside #1
			Inside= 42.0"W x 15.0"H => 4.29 sf x 7.50'L = 32.2 cf
			Outside= 48.0"W x 18.0"H => 6.00 sf x 8.00'L = 48.0 cf
			42 Chambers in 7 Rows
		1,889 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	331.90'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	333.30'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	333.80'	**0.5' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Primary	334.10'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.03 cfs @ 10.00 hrs HW=331.98'   (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.11 cfs @ 13.19 hrs HW=333.64'   (Free Discharge)
├─**2=Orifice/Grate** (Orifice Controls 0.11 cfs @ 2.22 fps)
├─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
└─**4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 2P: BMP 2

Inflow Area =		30,982 sf, 77.65% Impervious,	Inflow Depth = 2.60"	for 2-Year event
Inflow	=	0.83 cfs @ 12.04 hrs, Volume=	6,712 cf	
Outflow	=	0.79 cfs @ 12.93 hrs, Volume=	6,731 cf, Atten= 5%, Lag= 53.7 min	
Discarded	=	0.03 cfs @ 9.00 hrs, Volume=	3,359 cf	
Primary	=	0.76 cfs @ 12.93 hrs, Volume=	3,373 cf	

Routed to Reach 1R : 12" Pipe to Spruce Pond

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Peak Elev= 338.11' @ 12.74 hrs Surf.Area= 1,421 sf Storage= 1,745 cf

Plug-Flow detention time= 210.4 min calculated for 6,594 cf (98% of inflow)
Center-of-Mass det. time= 221.4 min (1,012.7 - 791.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	335.90'	538 cf	**29.00'W x 49.00'L x 2.50'H Field A**
			3,553 cf Overall - 2,016 cf Embedded = 1,536 cf x 35.0% Voids
#2A	336.40'	1,351 cf	**Shea Leaching Chamber 4x8x1.5** x 42 Inside #1
			Inside= 42.0"W x 15.0"H => 4.29 sf x 7.50'L = 32.2 cf
			Outside= 48.0"W x 18.0"H => 6.00 sf x 8.00'L = 48.0 cf
			42 Chambers in 7 Rows
		1,889 cf	Total Available Storage

Storage Group A created with Chamber Wizard

24.0168 POST HydroCAD - Joe
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 2-Year Rainfall=3.36"
Printed 9/18/2025
Page 18

Device	Routing	Invert	Outlet Devices
#1	Discarded	335.90'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	337.45'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	338.00'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.03 cfs @ 9.00 hrs HW=335.96' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.63 cfs @ 12.93 hrs HW=338.03' (Free Discharge)
├─**2=Orifice/Grate** (Orifice Controls 0.55 cfs @ 2.78 fps)
└─**3=Sharp-Crested Rectangular Weir** (Weir Controls 0.08 cfs @ 0.61 fps)

Summary for Pond 3P: BMP 3

Inflow Area =		13,823 sf, 88.47% Impervious,	Inflow Depth =	2.80" for 2-Year event

Inflow   =   0.40 cfs @ 12.02 hrs, Volume=   3,227 cf
Outflow   =   0.14 cfs @ 13.11 hrs, Volume=   3,283 cf, Atten= 65%, Lag= 65.2 min
Discarded =   0.04 cfs @ 11.00 hrs, Volume=   2,746 cf
Primary   =   0.10 cfs @ 13.11 hrs, Volume=   537 cf
   Routed to Reach 2R : 18" Pipe to Spruce Pond

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Peak Elev= 337.75' @ 13.32 hrs   Surf.Area= 1,653 sf   Storage= 1,344 cf

Plug-Flow detention time= 229.1 min calculated for 3,216 cf (100% of inflow)
Center-of-Mass det. time= 240.0 min (1,018.0 - 778.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	336.40'	628 cf	**29.00'W x 57.00'L x 2.08'H Field A** 3,438 cf Overall - 1,643 cf Embedded = 1,796 cf x 35.0% Voids
#2A	336.90'	1,016 cf	**Shea Leaching Chamber 4x8x1** x 49 Inside #1 Inside= 42.0"W x 10.0"H => 2.76 sf x 7.50'L = 20.7 cf Outside= 48.0"W x 13.0"H => 4.19 sf x 8.00'L = 33.5 cf 49 Chambers in 7 Rows
		1,644 cf	Total Available Storage

   Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	336.40'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	337.50'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	338.10'	**1.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 338.6' Crest Height

Discarded OutFlow Max=0.04 cfs @ 11.00 hrs HW=336.51' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.09 cfs @ 13.11 hrs HW=337.71' (Free Discharge)
├─**2=Orifice/Grate** (Orifice Controls 0.09 cfs @ 1.56 fps)
└─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link 1L: Spruce Pond

Inflow Area =   67,028 sf, 79.75% Impervious, Inflow Depth =   1.05"   for 2-Year event
Inflow   =   1.00 cfs @   12.94 hrs, Volume=   5,879 cf
Primary   =   1.00 cfs @   12.94 hrs, Volume=   5,879 cf, Atten= 0%, Lag= 0.0 min
    Routed to nonexistent node 3L

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs

Summary for Link 2L: King Street

Inflow Area =   260 sf, 99.73% Impervious, Inflow Depth =   3.13"   for 2-Year event
Inflow   =   0.01 cfs @   12.01 hrs, Volume=   68 cf
Primary   =   0.01 cfs @   12.01 hrs, Volume=   68 cf, Atten= 0%, Lag= 0.0 min
    Routed to nonexistent node 3L

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs

24.0168 POST HydroCAD - Joe
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 10-Year Rainfall=5.22"
Printed 9/18/2025
Page 20

Time span=0.00-48.00 hrs, dt=1.00 hrs, 49 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PDA-1: Subcat PDA-1 Runoff Area=15,193 sf 90.52% Impervious Runoff Depth=4.75"
Tc=6.0 min CN=96 Runoff=0.71 cfs 6,015 cf

Subcatchment PDA-2: Subcat PDA-2 Runoff Area=13,823 sf 88.47% Impervious Runoff Depth=4.64"
Tc=6.0 min CN=95 Runoff=0.64 cfs 5,342 cf

Subcatchment PDA-3: Subcat PDA-3 Runoff Area=260 sf 99.73% Impervious Runoff Depth=4.98"
Tc=6.0 min CN=98 Runoff=0.01 cfs 108 cf

Subcatchment PDA-4: Subcat PDA-4 Runoff Area=30,982 sf 77.65% Impervious Runoff Depth=4.41"
Flow Length=135' Tc=8.4 min CN=93 Runoff=1.38 cfs 11,396 cf

Subcatchment PDA-5: Subcat PDA-5 Runoff Area=3,691 sf 25.83% Impervious Runoff Depth=3.09"
Flow Length=126' Tc=6.9 min CN=80 Runoff=0.12 cfs 949 cf

Subcatchment PDA-6: Subcat PDA-6 Runoff Area=3,339 sf 73.65% Impervious Runoff Depth=4.30"
Tc=6.0 min CN=92 Runoff=0.15 cfs 1,198 cf

Reach 1R: 12" Pipe to Spruce Pond Avg. Flow Depth=0.40' Max Vel=5.26 fps Inflow=1.52 cfs 11,284 cf
12.0" Round Pipe n=0.010 L=92.3' S=0.0105 '/' Capacity=4.75 cfs Outflow=1.50 cfs 11,286 cf

Reach 2R: 18" Pipe to Spruce Pond Avg. Flow Depth=0.21' Max Vel=3.85 fps Inflow=0.56 cfs 3,416 cf
18.0" Round Pipe n=0.010 L=133.0' S=0.0105 '/' Capacity=14.01 cfs Outflow=0.55 cfs 3,421 cf

Pond 1P: BMP 1 Peak Elev=334.18' Storage=1,779 cf Inflow=0.71 cfs 6,015 cf
Discarded=0.03 cfs 3,338 cf Primary=0.62 cfs 2,696 cf Outflow=0.65 cfs 6,034 cf

Pond 2P: BMP 2 Peak Elev=338.21' Storage=1,794 cf Inflow=1.38 cfs 11,396 cf
Discarded=0.03 cfs 3,783 cf Primary=1.18 cfs 7,638 cf Outflow=1.22 cfs 11,422 cf

Pond 3P: BMP 3 Peak Elev=338.27' Storage=1,521 cf Inflow=0.64 cfs 5,342 cf
Discarded=0.04 cfs 3,124 cf Primary=0.52 cfs 2,219 cf Outflow=0.56 cfs 5,343 cf

Link 1L: Spruce Pond Inflow=1.92 cfs 14,707 cf
Primary=1.92 cfs 14,707 cf

Link 2L: King Street Inflow=0.01 cfs 108 cf
Primary=0.01 cfs 108 cf

Total Runoff Area = 67,288 sf   Runoff Volume = 25,009 cf   Average Runoff Depth = 4.46"
20.18% Pervious = 13,576 sf   79.82% Impervious = 53,712 sf

24.0168 POST HydroCAD - Joe
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 10-Year Rainfall=5.22"
Printed 9/18/2025
Page 21

Summary for Subcatchment PDA-1: Subcat PDA-1

Runoff   =   0.71 cfs @ 12.02 hrs, Volume=   6,015 cf, Depth= 4.75"
    Routed to Pond 1P : BMP 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 10-Year Rainfall=5.22"

Area (sf)	CN	Description
1,440	74	>75% Grass cover, Good, HSG C
13,639	98	Paved parking, HSG C
114	98	Roofs, HSG C
15,193	96	Weighted Average
1,440	74	9.48% Pervious Area
13,753	98	90.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins.)**

Summary for Subcatchment PDA-2: Subcat PDA-2

Runoff   =   0.64 cfs @ 12.02 hrs, Volume=   5,342 cf, Depth= 4.64"
    Routed to Pond 3P : BMP 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 10-Year Rainfall=5.22"

Area (sf)	CN	Description
1,594	74	>75% Grass cover, Good, HSG C
12,208	98	Paved parking, HSG C
21	98	Roofs, HSG C
13,823	95	Weighted Average
1,594	74	11.53% Pervious Area
12,229	98	88.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins.)**

Summary for Subcatchment PDA-3: Subcat PDA-3

Runoff   =   0.01 cfs @ 12.01 hrs, Volume=   108 cf, Depth= 4.98"
    Routed to Link 2L : King Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 10-Year Rainfall=5.22"

24.0168 POST HydroCAD - Joe
Type III 24-hr 10-Year Rainfall=5.22"
Prepared by Narragansett Engineering Inc
Printed 9/18/2025
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC
Page 22

Area (sf)	CN	Description
1	74	>75% Grass cover, Good, HSG C
259	98	Paved parking, HSG C
260	98	Weighted Average
1	74	0.27% Pervious Area
259	98	99.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins.)**

Summary for Subcatchment PDA-4: Subcat PDA-4

Runoff = 1.38 cfs @ 12.03 hrs, Volume= 11,396 cf, Depth= 4.41"
 Routed to Pond 2P : BMP 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 10-Year Rainfall=5.22"

Area (sf)	CN	Description
12,046	98	Paved parking, HSG C
6,924	74	>75% Grass cover, Good, HSG C
12,012	98	Roofs, HSG C
30,982	93	Weighted Average
6,924	74	22.35% Pervious Area
24,058	98	77.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	100	0.0370	0.22		**Sheet Flow, Sheet Flow - Grass** Grass: Short n= 0.150 P2= 3.36"
0.9	35	0.0086	0.65		**Shallow Concentrated Flow, Shallow Concentrated - Grass** Short Grass Pasture Kv= 7.0 fps
8.4	135	Total			

Summary for Subcatchment PDA-5: Subcat PDA-5

Runoff = 0.12 cfs @ 12.05 hrs, Volume= 949 cf, Depth= 3.09"
 Routed to Reach 1R : 12" Pipe to Spruce Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 10-Year Rainfall=5.22"

Area (sf)	CN	Description
953	98	Paved parking, HSG C
2,738	74	>75% Grass cover, Good, HSG C
3,691	80	Weighted Average
2,738	74	74.17% Pervious Area
953	98	25.83% Impervious Area

24.0168 POST HydroCAD - Joe
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 10-Year Rainfall=5.22"
Printed 9/18/2025
Page 23

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	100	0.0500	0.25		**Sheet Flow, Sheet Flow - Grass**
					Grass: Short n= 0.150 P2= 3.36"
0.3	26	0.0385	1.37		**Shallow Concentrated Flow, Shallow Concentrated - Grass**
					Short Grass Pasture Kv= 7.0 fps
6.9	126	Total			

Summary for Subcatchment PDA-6: Subcat PDA-6

Runoff   =   0.15 cfs @   12.02 hrs, Volume=   1,198 cf, Depth= 4.30"
   Routed to Reach 2R : 18" Pipe to Spruce Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 10-Year Rainfall=5.22"

Area (sf)	CN	Description
2,459	98	Paved parking, HSG C
880	74	>75% Grass cover, Good, HSG C
3,339	92	Weighted Average
880	74	26.35% Pervious Area
2,459	98	73.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins)**

Summary for Reach 1R: 12" Pipe to Spruce Pond

Inflow Area =   49,866 sf, 77.74% Impervious, Inflow Depth = 2.72"   for 10-Year event
Inflow   =   1.52 cfs @   12.36 hrs, Volume=   11,284 cf
Outflow   =   1.50 cfs @   12.38 hrs, Volume=   11,286 cf, Atten= 1%, Lag= 1.1 min
   Routed to Link 1L : Spruce Pond

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Max. Velocity= 5.26 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.96 fps, Avg. Travel Time= 0.8 min

Peak Storage= 27 cf @ 12.40 hrs
Average Depth at Peak Storage= 0.40' , Surface Width= 0.98'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 4.75 cfs

12.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 92.3'   Slope= 0.0105 '/'
Inlet Invert= 330.11', Outlet Invert= 329.14'

24.0168 POST HydroCAD - Joe
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 10-Year Rainfall=5.22"
Printed 9/18/2025
Page 24
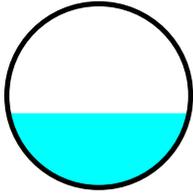
Summary for Reach 2R: 18" Pipe to Spruce Pond

Inflow Area =   17,162 sf, 85.59% Impervious, Inflow Depth = 2.39"   for 10-Year event
Inflow   =   0.56 cfs @ 12.86 hrs, Volume=   3,416 cf
Outflow   =   0.55 cfs @ 12.87 hrs, Volume=   3,421 cf, Atten= 1%, Lag= 0.6 min
    Routed to Link 1L : Spruce Pond

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Max. Velocity= 3.85 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 1.24 fps, Avg. Travel Time= 1.8 min

Peak Storage= 19 cf @ 12.83 hrs
Average Depth at Peak Storage= 0.21' , Surface Width= 1.04'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 14.01 cfs

18.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 133.0'   Slope= 0.0105 '/'
Inlet Invert= 330.15', Outlet Invert= 328.75'
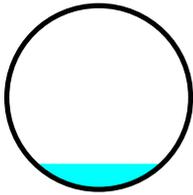
Summary for Pond 1P: BMP 1

Inflow Area =   15,193 sf, 90.52% Impervious, Inflow Depth = 4.75"   for 10-Year event
Inflow   =   0.71 cfs @ 12.02 hrs, Volume=   6,015 cf
Outflow   =   0.65 cfs @ 12.94 hrs, Volume=   6,034 cf, Atten= 9%, Lag= 55.7 min
Discarded =   0.03 cfs @   8.00 hrs, Volume=   3,338 cf
Primary   =   0.62 cfs @ 12.94 hrs, Volume=   2,696 cf
    Routed to Reach 1R : 12" Pipe to Spruce Pond

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Peak Elev= 334.18' @ 12.79 hrs   Surf.Area= 1,421 sf   Storage= 1,779 cf

Plug-Flow detention time= 207.3 min calculated for 5,911 cf (98% of inflow)
Center-of-Mass det. time= 216.4 min (976.5 - 760.1)

24.0168 POST HydroCAD - Joe
Type III 24-hr 10-Year Rainfall=5.22"
Prepared by Narragansett Engineering Inc
Printed 9/18/2025
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC
Page 25

Volume	Invert	Avail.Storage	Storage Description
#1A	331.90'	538 cf	**29.00'W x 49.00'L x 2.50'H Field A**
			3,553 cf Overall - 2,016 cf Embedded = 1,536 cf x 35.0% Voids
#2A	332.40'	1,351 cf	**Shea Leaching Chamber 4x8x1.5** x 42 Inside #1
			Inside= 42.0"W x 15.0"H => 4.29 sf x 7.50'L = 32.2 cf
			Outside= 48.0"W x 18.0"H => 6.00 sf x 8.00'L = 48.0 cf
			42 Chambers in 7 Rows
		1,889 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	331.90'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	333.30'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	333.80'	**0.5' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Primary	334.10'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.03 cfs @ 8.00 hrs HW=331.94' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.50 cfs @ 12.94 hrs HW=334.12' (Free Discharge)
├─**2=Orifice/Grate** (Orifice Controls 0.20 cfs @ 4.02 fps)
├─**3=Sharp-Crested Rectangular Weir** (Weir Controls 0.26 cfs @ 1.85 fps)
└─**4=Sharp-Crested Rectangular Weir** (Weir Controls 0.04 cfs @ 0.48 fps)

Summary for Pond 2P: BMP 2

Inflow Area =		30,982 sf, 77.65% Impervious,	Inflow Depth =	4.41"	for 10-Year event	
Inflow	=	1.38 cfs @ 12.03 hrs, Volume=		11,396 cf		
Outflow	=	1.22 cfs @ 12.15 hrs, Volume=		11,422 cf,	Atten= 12%, Lag= 7.2 min	
Discarded	=	0.03 cfs @ 7.00 hrs, Volume=		3,783 cf		
Primary	=	1.18 cfs @ 12.15 hrs, Volume=		7,638 cf		

Routed to Reach 1R : 12" Pipe to Spruce Pond

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Peak Elev= 338.21' @ 12.40 hrs Surf.Area= 1,421 sf Storage= 1,794 cf

Plug-Flow detention time= 150.4 min calculated for 11,189 cf (98% of inflow)
Center-of-Mass det. time= 163.7 min (941.1 - 777.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	335.90'	538 cf	**29.00'W x 49.00'L x 2.50'H Field A**
			3,553 cf Overall - 2,016 cf Embedded = 1,536 cf x 35.0% Voids
#2A	336.40'	1,351 cf	**Shea Leaching Chamber 4x8x1.5** x 42 Inside #1
			Inside= 42.0"W x 15.0"H => 4.29 sf x 7.50'L = 32.2 cf
			Outside= 48.0"W x 18.0"H => 6.00 sf x 8.00'L = 48.0 cf
			42 Chambers in 7 Rows
		1,889 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	335.90'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	337.45'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	338.00'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.03 cfs @ 7.00 hrs HW=335.94' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=1.04 cfs @ 12.15 hrs HW=338.10' (Free Discharge)
├─**2=Orifice/Grate** (Orifice Controls 0.60 cfs @ 3.06 fps)
└─**3=Sharp-Crested Rectangular Weir** (Weir Controls 0.44 cfs @ 1.06 fps)

Summary for Pond 3P: BMP 3

Inflow Area =	13,823 sf, 88.47% Impervious,	Inflow Depth = 4.64" for 10-Year event	
Inflow =	0.64 cfs @ 12.02 hrs, Volume=	5,342 cf	
Outflow =	0.56 cfs @ 12.95 hrs, Volume=	5,343 cf, Atten= 13%, Lag= 55.7 min	
Discarded =	0.04 cfs @ 9.00 hrs, Volume=	3,124 cf	
Primary =	0.52 cfs @ 12.95 hrs, Volume=	2,219 cf	

Routed to Reach 2R : 18" Pipe to Spruce Pond

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Peak Elev= 338.27' @ 12.87 hrs Surf.Area= 1,653 sf Storage= 1,521 cf

Plug-Flow detention time= 158.3 min calculated for 5,234 cf (98% of inflow)
Center-of-Mass det. time= 161.3 min (927.1 - 765.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	336.40'	628 cf	**29.00'W x 57.00'L x 2.08'H Field A** 3,438 cf Overall - 1,643 cf Embedded = 1,796 cf x 35.0% Voids
#2A	336.90'	1,016 cf	**Shea Leaching Chamber 4x8x1** x 49 Inside #1 Inside= 42.0"W x 10.0"H => 2.76 sf x 7.50'L = 20.7 cf Outside= 48.0"W x 13.0"H => 4.19 sf x 8.00'L = 33.5 cf 49 Chambers in 7 Rows
		1,644 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	336.40'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	337.50'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	338.10'	**1.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 338.6' Crest Height

Discarded OutFlow Max=0.04 cfs @ 9.00 hrs HW=336.45' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.46 cfs @ 12.95 hrs HW=338.23' (Free Discharge)
├─**2=Orifice/Grate** (Orifice Controls 0.31 cfs @ 3.60 fps)
└─**3=Sharp-Crested Rectangular Weir** (Weir Controls 0.14 cfs @ 1.16 fps)

24.0168 POST HydroCAD - Joe
Type III 24-hr 10-Year Rainfall=5.22"
Prepared by Narragansett Engineering Inc
Printed 9/18/2025
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC
Page 27

Summary for Link 1L: Spruce Pond

Inflow Area =   67,028 sf, 79.75% Impervious, Inflow Depth = 2.63"   for 10-Year event
Inflow   =   1.92 cfs @ 12.57 hrs, Volume=   14,707 cf
Primary   =   1.92 cfs @ 12.57 hrs, Volume=   14,707 cf, Atten= 0%, Lag= 0.0 min
     Routed to nonexistent node 3L

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs

Summary for Link 2L: King Street

Inflow Area =   260 sf, 99.73% Impervious, Inflow Depth = 4.98"   for 10-Year event
Inflow   =   0.01 cfs @ 12.01 hrs, Volume=   108 cf
Primary   =   0.01 cfs @ 12.01 hrs, Volume=   108 cf, Atten= 0%, Lag= 0.0 min
     Routed to nonexistent node 3L

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs

24.0168 POST HydroCAD - Joe
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 25-Year Rainfall=6.37"
Printed 9/18/2025
Page 28

Time span=0.00-48.00 hrs, dt=1.00 hrs, 49 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PDA-1: Subcat PDA-1   Runoff Area=15,193 sf 90.52% Impervious   Runoff Depth=5.90"
Tc=6.0 min   CN=96   Runoff=0.88 cfs 7,465 cf

Subcatchment PDA-2: Subcat PDA-2   Runoff Area=13,823 sf 88.47% Impervious   Runoff Depth=5.78"
Tc=6.0 min   CN=95   Runoff=0.79 cfs 6,657 cf

Subcatchment PDA-3: Subcat PDA-3   Runoff Area=260 sf 99.73% Impervious   Runoff Depth=6.13"
Tc=6.0 min   CN=98   Runoff=0.02 cfs 133 cf

Subcatchment PDA-4: Subcat PDA-4   Runoff Area=30,982 sf 77.65% Impervious   Runoff Depth=5.55"
Flow Length=135' Tc=8.4 min   CN=93   Runoff=1.71 cfs 14,324 cf

Subcatchment PDA-5: Subcat PDA-5   Runoff Area=3,691 sf 25.83% Impervious   Runoff Depth=4.12"
Flow Length=126' Tc=6.9 min   CN=80   Runoff=0.16 cfs 1,266 cf

Subcatchment PDA-6: Subcat PDA-6   Runoff Area=3,339 sf 73.65% Impervious   Runoff Depth=5.43"
Tc=6.0 min   CN=92   Runoff=0.18 cfs 1,512 cf

Reach 1R: 12" Pipe to Spruce Pond   Avg. Flow Depth=0.51' Max Vel=6.01 fps Inflow=2.37 cfs 15,624 cf
12.0" Round Pipe   n=0.010   L=92.3'   S=0.0105 '/' Capacity=4.75 cfs   Outflow=2.35 cfs 15,648 cf

Reach 2R: 18" Pipe to Spruce Pond   Avg. Flow Depth=0.22' Max Vel=3.93 fps Inflow=0.63 cfs 4,741 cf
18.0" Round Pipe   n=0.010   L=133.0'   S=0.0105 '/' Capacity=14.01 cfs   Outflow=0.63 cfs 4,743 cf

Pond 1P: BMP 1   Peak Elev=334.24' Storage=1,808 cf Inflow=0.88 cfs 7,465 cf
Discarded=0.03 cfs 3,552 cf Primary=0.62 cfs 3,927 cf Outflow=0.65 cfs 7,478 cf

Pond 2P: BMP 2   Peak Elev=338.21' Storage=1,794 cf Inflow=1.71 cfs 14,324 cf
Discarded=0.03 cfs 3,894 cf Primary=1.78 cfs 10,431 cf Outflow=1.82 cfs 14,326 cf

Pond 3P: BMP 3   Peak Elev=338.34' Storage=1,561 cf Inflow=0.79 cfs 6,657 cf
Discarded=0.04 cfs 3,458 cf Primary=0.56 cfs 3,229 cf Outflow=0.60 cfs 6,688 cf

Link 1L: Spruce Pond   Inflow=2.88 cfs 20,391 cf
Primary=2.88 cfs 20,391 cf

Link 2L: King Street   Inflow=0.02 cfs 133 cf
Primary=0.02 cfs 133 cf

Total Runoff Area = 67,288 sf   Runoff Volume = 31,357 cf   Average Runoff Depth = 5.59"
20.18% Pervious = 13,576 sf   79.82% Impervious = 53,712 sf

24.0168 POST HydroCAD - Joe
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 25-Year Rainfall=6.37"
Printed 9/18/2025
Page 29

Summary for Subcatchment PDA-1: Subcat PDA-1

Runoff   =   0.88 cfs @ 12.01 hrs, Volume=   7,465 cf, Depth= 5.90"
   Routed to Pond 1P : BMP 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 25-Year Rainfall=6.37"

Area (sf)	CN	Description
1,440	74	>75% Grass cover, Good, HSG C
13,639	98	Paved parking, HSG C
114	98	Roofs, HSG C
15,193	96	Weighted Average
1,440	74	9.48% Pervious Area
13,753	98	90.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins.)**

Summary for Subcatchment PDA-2: Subcat PDA-2

Runoff   =   0.79 cfs @ 12.02 hrs, Volume=   6,657 cf, Depth= 5.78"
   Routed to Pond 3P : BMP 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 25-Year Rainfall=6.37"

Area (sf)	CN	Description
1,594	74	>75% Grass cover, Good, HSG C
12,208	98	Paved parking, HSG C
21	98	Roofs, HSG C
13,823	95	Weighted Average
1,594	74	11.53% Pervious Area
12,229	98	88.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins.)**

Summary for Subcatchment PDA-3: Subcat PDA-3

Runoff   =   0.02 cfs @ 12.01 hrs, Volume=   133 cf, Depth= 6.13"
   Routed to Link 2L : King Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 25-Year Rainfall=6.37"

24.0168 POST HydroCAD - Joe
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 25-Year Rainfall=6.37"
Printed 9/18/2025
Page 30

Area (sf)	CN	Description
1	74	>75% Grass cover, Good, HSG C
259	98	Paved parking, HSG C
260	98	Weighted Average
1	74	0.27% Pervious Area
259	98	99.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins.)**

Summary for Subcatchment PDA-4: Subcat PDA-4

Runoff   =   1.71 cfs @ 12.03 hrs, Volume=   14,324 cf, Depth= 5.55"
    Routed to Pond 2P : BMP 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 25-Year Rainfall=6.37"

Area (sf)	CN	Description
12,046	98	Paved parking, HSG C
6,924	74	>75% Grass cover, Good, HSG C
12,012	98	Roofs, HSG C
30,982	93	Weighted Average
6,924	74	22.35% Pervious Area
24,058	98	77.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	100	0.0370	0.22		**Sheet Flow, Sheet Flow - Grass** Grass: Short n= 0.150 P2= 3.36"
0.9	35	0.0086	0.65		**Shallow Concentrated Flow, Shallow Concentrated - Grass** Short Grass Pasture Kv= 7.0 fps
8.4	135	Total			

Summary for Subcatchment PDA-5: Subcat PDA-5

Runoff   =   0.16 cfs @ 12.04 hrs, Volume=   1,266 cf, Depth= 4.12"
    Routed to Reach 1R : 12" Pipe to Spruce Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 25-Year Rainfall=6.37"

Area (sf)	CN	Description
953	98	Paved parking, HSG C
2,738	74	>75% Grass cover, Good, HSG C
3,691	80	Weighted Average
2,738	74	74.17% Pervious Area
953	98	25.83% Impervious Area

24.0168 POST HydroCAD - Joe
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 25-Year Rainfall=6.37"
Printed 9/18/2025
Page 31

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	100	0.0500	0.25		**Sheet Flow, Sheet Flow - Grass**
					Grass: Short n= 0.150 P2= 3.36"
0.3	26	0.0385	1.37		**Shallow Concentrated Flow, Shallow Concentrated - Grass**
					Short Grass Pasture Kv= 7.0 fps
6.9	126	Total			

Summary for Subcatchment PDA-6: Subcat PDA-6

Runoff   =   0.18 cfs @ 12.02 hrs, Volume=   1,512 cf, Depth= 5.43"
    Routed to Reach 2R : 18" Pipe to Spruce Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 25-Year Rainfall=6.37"

Area (sf)	CN	Description
2,459	98	Paved parking, HSG C
880	74	>75% Grass cover, Good, HSG C
3,339	92	Weighted Average
880	74	26.35% Pervious Area
2,459	98	73.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins)**

Summary for Reach 1R: 12" Pipe to Spruce Pond

Inflow Area =   49,866 sf, 77.74% Impervious, Inflow Depth = 3.76"   for 25-Year event
Inflow   =   2.37 cfs @ 12.14 hrs, Volume=   15,624 cf
Outflow   =   2.35 cfs @ 12.14 hrs, Volume=   15,648 cf, Atten= 1%, Lag= 0.5 min
    Routed to Link 1L : Spruce Pond

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Max. Velocity= 6.01 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.18 fps, Avg. Travel Time= 0.7 min

Peak Storage= 36 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.51' , Surface Width= 1.00'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 4.75 cfs

12.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 92.3'   Slope= 0.0105 '/'
Inlet Invert= 330.11', Outlet Invert= 329.14'

24.0168 POST HydroCAD - Joe
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 25-Year Rainfall=6.37"
Printed 9/18/2025
Page 32
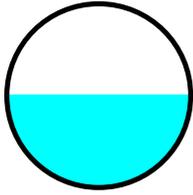
Summary for Reach 2R: 18" Pipe to Spruce Pond

Inflow Area = 17,162 sf, 85.59% Impervious, Inflow Depth = 3.32"   for 25-Year event
Inflow   =   0.63 cfs @ 12.63 hrs, Volume=   4,741 cf
Outflow   =   0.63 cfs @ 12.65 hrs, Volume=   4,743 cf, Atten= 0%, Lag= 1.5 min
    Routed to Link 1L : Spruce Pond

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Max. Velocity= 3.93 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 1.37 fps, Avg. Travel Time= 1.6 min

Peak Storage= 21 cf @ 12.62 hrs
Average Depth at Peak Storage= 0.22' , Surface Width= 1.07'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 14.01 cfs

18.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 133.0'   Slope= 0.0105 '/'
Inlet Invert= 330.15', Outlet Invert= 328.75'
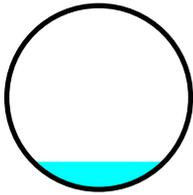
Summary for Pond 1P: BMP 1

Inflow Area = 15,193 sf, 90.52% Impervious, Inflow Depth = 5.90"   for 25-Year event
Inflow   =   0.88 cfs @ 12.01 hrs, Volume=   7,465 cf
Outflow   =   0.65 cfs @ 12.75 hrs, Volume=   7,478 cf, Atten= 25%, Lag= 44.0 min
Discarded =   0.03 cfs @   7.00 hrs, Volume=   3,552 cf
Primary   =   0.62 cfs @ 12.75 hrs, Volume=   3,927 cf
    Routed to Reach 1R : 12" Pipe to Spruce Pond

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Peak Elev= 334.24' @ 12.57 hrs   Surf.Area= 1,421 sf   Storage= 1,808 cf

Plug-Flow detention time= 185.3 min calculated for 7,326 cf (98% of inflow)
Center-of-Mass det. time= 195.0 min (950.7 - 755.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	331.90'	538 cf	**29.00'W x 49.00'L x 2.50'H Field A** 3,553 cf Overall - 2,016 cf Embedded = 1,536 cf x 35.0% Voids
#2A	332.40'	1,351 cf	**Shea Leaching Chamber 4x8x1.5** x 42 Inside #1 Inside= 42.0"W x 15.0"H => 4.29 sf x 7.50'L = 32.2 cf Outside= 48.0"W x 18.0"H => 6.00 sf x 8.00'L = 48.0 cf 42 Chambers in 7 Rows
		1,889 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	331.90'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	333.30'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	333.80'	**0.5' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Primary	334.10'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.03 cfs @ 7.00 hrs HW=331.93'   (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.51 cfs @ 12.75 hrs HW=334.12'   (Free Discharge)
├─**2=Orifice/Grate** (Orifice Controls 0.20 cfs @ 4.03 fps)
├─**3=Sharp-Crested Rectangular Weir** (Weir Controls 0.26 cfs @ 1.86 fps)
└─**4=Sharp-Crested Rectangular Weir** (Weir Controls 0.05 cfs @ 0.51 fps)

Summary for Pond 2P: BMP 2

Inflow Area =		30,982 sf, 77.65% Impervious,	Inflow Depth = 5.55"	for 25-Year event
Inflow	=	1.71 cfs @ 12.03 hrs, Volume=	14,324 cf	
Outflow	=	1.82 cfs @ 12.06 hrs, Volume=	14,326 cf, Atten= 0%, Lag= 1.9 min	
Discarded	=	0.03 cfs @ 6.00 hrs, Volume=	3,894 cf	
Primary	=	1.78 cfs @ 12.06 hrs, Volume=	10,431 cf	

   Routed to Reach 1R : 12" Pipe to Spruce Pond

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Peak Elev= 338.21' @ 12.17 hrs Surf.Area= 1,421 sf   Storage= 1,794 cf

Plug-Flow detention time= 123.2 min calculated for 14,033 cf (98% of inflow)
Center-of-Mass det. time= 135.8 min (907.6 - 771.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	335.90'	538 cf	**29.00'W x 49.00'L x 2.50'H Field A** 3,553 cf Overall - 2,016 cf Embedded = 1,536 cf x 35.0% Voids
#2A	336.40'	1,351 cf	**Shea Leaching Chamber 4x8x1.5** x 42 Inside #1 Inside= 42.0"W x 15.0"H => 4.29 sf x 7.50'L = 32.2 cf Outside= 48.0"W x 18.0"H => 6.00 sf x 8.00'L = 48.0 cf 42 Chambers in 7 Rows
		1,889 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	335.90'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	337.45'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	338.00'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.03 cfs @ 6.00 hrs HW=335.93'   (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=1.61 cfs @ 12.06 hrs HW=338.18'   (Free Discharge)
├─**2=Orifice/Grate** (Orifice Controls 0.65 cfs @ 3.32 fps)
└─**3=Sharp-Crested Rectangular Weir** (Weir Controls 0.96 cfs @ 1.37 fps)

Summary for Pond 3P: BMP 3

Inflow Area =		13,823 sf,	88.47% Impervious,	Inflow Depth =	5.78"	for 25-Year event

Inflow	=	0.79 cfs @ 12.02 hrs,	Volume=	6,657 cf	
Outflow	=	0.60 cfs @ 12.79 hrs,	Volume=	6,688 cf,	Atten= 25%, Lag= 46.5 min
Discarded	=	0.04 cfs @ 8.00 hrs,	Volume=	3,458 cf	
Primary	=	0.56 cfs @ 12.79 hrs,	Volume=	3,229 cf	

   Routed to Reach 2R : 18" Pipe to Spruce Pond

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Peak Elev= 338.34' @ 12.62 hrs Surf.Area= 1,653 sf   Storage= 1,561 cf

Plug-Flow detention time= 149.8 min calculated for 6,551 cf (98% of inflow)
Center-of-Mass det. time= 157.6 min (918.4 - 760.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	336.40'	628 cf	**29.00'W x 57.00'L x 2.08'H Field A** 3,438 cf Overall - 1,643 cf Embedded = 1,796 cf x 35.0% Voids
#2A	336.90'	1,016 cf	**Shea Leaching Chamber 4x8x1** x 49 Inside #1 Inside= 42.0"W x 10.0"H => 2.76 sf x 7.50'L = 20.7 cf Outside= 48.0"W x 13.0"H => 4.19 sf x 8.00'L = 33.5 cf 49 Chambers in 7 Rows
		1,644 cf	Total Available Storage

   Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	336.40'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	337.50'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	338.10'	**1.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 338.6' Crest Height

Discarded OutFlow Max=0.04 cfs @ 8.00 hrs HW=336.43'   (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.49 cfs @ 12.79 hrs HW=338.24'   (Free Discharge)
├─**2=Orifice/Grate** (Orifice Controls 0.32 cfs @ 3.65 fps)
└─**3=Sharp-Crested Rectangular Weir** (Weir Controls 0.17 cfs @ 1.22 fps)

Summary for Link 1L: Spruce Pond

Inflow Area =   67,028 sf, 79.75% Impervious, Inflow Depth = 3.65"   for 25-Year event
Inflow   =   2.88 cfs @ 12.20 hrs, Volume=   20,391 cf
Primary   =   2.88 cfs @ 12.20 hrs, Volume=   20,391 cf, Atten= 0%, Lag= 0.0 min
    Routed to nonexistent node 3L

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs

Summary for Link 2L: King Street

Inflow Area =   260 sf, 99.73% Impervious, Inflow Depth = 6.13"   for 25-Year event
Inflow   =   0.02 cfs @ 12.01 hrs, Volume=   133 cf
Primary   =   0.02 cfs @ 12.01 hrs, Volume=   133 cf, Atten= 0%, Lag= 0.0 min
    Routed to nonexistent node 3L

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs

Time span=0.00-48.00 hrs, dt=1.00 hrs, 49 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PDA-1: Subcat PDA-1   Runoff Area=15,193 sf 90.52% Impervious Runoff Depth=7.68"
Tc=6.0 min CN=96 Runoff=1.13 cfs 9,724 cf

Subcatchment PDA-2: Subcat PDA-2   Runoff Area=13,823 sf 88.47% Impervious Runoff Depth=7.56"
Tc=6.0 min CN=95 Runoff=1.02 cfs 8,710 cf

Subcatchment PDA-3: Subcat PDA-3   Runoff Area=260 sf 99.73% Impervious Runoff Depth=7.92"
Tc=6.0 min CN=98 Runoff=0.02 cfs 172 cf

Subcatchment PDA-4: Subcat PDA-4   Runoff Area=30,982 sf 77.65% Impervious Runoff Depth=7.32"
Flow Length=135' Tc=8.4 min CN=93 Runoff=2.23 cfs 18,903 cf

Subcatchment PDA-5: Subcat PDA-5   Runoff Area=3,691 sf 25.83% Impervious Runoff Depth=5.78"
Flow Length=126' Tc=6.9 min CN=80 Runoff=0.22 cfs 1,776 cf

Subcatchment PDA-6: Subcat PDA-6   Runoff Area=3,339 sf 73.65% Impervious Runoff Depth=7.20"
Tc=6.0 min CN=92 Runoff=0.24 cfs 2,004 cf

Reach 1R: 12" Pipe to Spruce Pond   Avg. Flow Depth=0.60' Max Vel=6.46 fps Inflow=3.17 cfs 22,610 cf
12.0" Round Pipe n=0.010 L=92.3' S=0.0105 '/' Capacity=4.75 cfs Outflow=3.14 cfs 22,616 cf

Reach 2R: 18" Pipe to Spruce Pond   Avg. Flow Depth=0.27' Max Vel=4.52 fps Inflow=0.98 cfs 6,991 cf
18.0" Round Pipe n=0.010 L=133.0' S=0.0105 '/' Capacity=14.01 cfs Outflow=0.97 cfs 6,995 cf

Pond 1P: BMP 1   Peak Elev=334.29' Storage=1,835 cf Inflow=1.13 cfs 9,724 cf
Discarded=0.03 cfs 3,766 cf Primary=0.92 cfs 5,961 cf Outflow=0.95 cfs 9,728 cf

Pond 2P: BMP 2   Peak Elev=338.22' Storage=1,802 cf Inflow=2.23 cfs 18,903 cf
Discarded=0.03 cfs 4,048 cf Primary=2.03 cfs 14,872 cf Outflow=2.06 cfs 18,920 cf

Pond 3P: BMP 3   Peak Elev=338.44' Storage=1,621 cf Inflow=1.02 cfs 8,710 cf
Discarded=0.04 cfs 3,756 cf Primary=0.75 cfs 4,987 cf Outflow=0.79 cfs 8,743 cf

Link 1L: Spruce Pond   Inflow=4.10 cfs 29,611 cf
Primary=4.10 cfs 29,611 cf

Link 2L: King Street   Inflow=0.02 cfs 172 cf
Primary=0.02 cfs 172 cf

Total Runoff Area = 67,288 sf Runoff Volume = 41,288 cf Average Runoff Depth = 7.36"
20.18% Pervious = 13,576 sf 79.82% Impervious = 53,712 sf

Summary for Subcatchment PDA-1: Subcat PDA-1

Runoff   =   1.13 cfs @ 12.01 hrs, Volume=   9,724 cf, Depth= 7.68"
   Routed to Pond 1P : BMP 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
1,440	74	>75% Grass cover, Good, HSG C
13,639	98	Paved parking, HSG C
114	98	Roofs, HSG C
15,193	96	Weighted Average
1,440	74	9.48% Pervious Area
13,753	98	90.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins.)**

Summary for Subcatchment PDA-2: Subcat PDA-2

Runoff   =   1.02 cfs @ 12.01 hrs, Volume=   8,710 cf, Depth= 7.56"
   Routed to Pond 3P : BMP 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
1,594	74	>75% Grass cover, Good, HSG C
12,208	98	Paved parking, HSG C
21	98	Roofs, HSG C
13,823	95	Weighted Average
1,594	74	11.53% Pervious Area
12,229	98	88.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins.)**

Summary for Subcatchment PDA-3: Subcat PDA-3

Runoff   =   0.02 cfs @ 12.01 hrs, Volume=   172 cf, Depth= 7.92"
   Routed to Link 2L : King Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 100-Year Rainfall=8.16"

24.0168 POST HydroCAD - Joe
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 100-Year Rainfall=8.16"
Printed 9/18/2025
Page 38

Area (sf)	CN	Description
1	74	>75% Grass cover, Good, HSG C
259	98	Paved parking, HSG C
260	98	Weighted Average
1	74	0.27% Pervious Area
259	98	99.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins.)**

Summary for Subcatchment PDA-4: Subcat PDA-4

Runoff   =   2.23 cfs @ 12.02 hrs, Volume=   18,903 cf, Depth= 7.32"
     Routed to Pond 2P : BMP 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
12,046	98	Paved parking, HSG C
6,924	74	>75% Grass cover, Good, HSG C
12,012	98	Roofs, HSG C
30,982	93	Weighted Average
6,924	74	22.35% Pervious Area
24,058	98	77.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	100	0.0370	0.22		**Sheet Flow, Sheet Flow - Grass**
					Grass: Short n= 0.150 P2= 3.36"
0.9	35	0.0086	0.65		**Shallow Concentrated Flow, Shallow Concentrated - Grass**
					Short Grass Pasture Kv= 7.0 fps
8.4	135	Total			

Summary for Subcatchment PDA-5: Subcat PDA-5

Runoff   =   0.22 cfs @ 12.04 hrs, Volume=   1,776 cf, Depth= 5.78"
     Routed to Reach 1R : 12" Pipe to Spruce Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
953	98	Paved parking, HSG C
2,738	74	>75% Grass cover, Good, HSG C
3,691	80	Weighted Average
2,738	74	74.17% Pervious Area
953	98	25.83% Impervious Area

24.0168 POST HydroCAD - Joe
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 100-Year Rainfall=8.16"
Printed 9/18/2025
Page 39

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	100	0.0500	0.25		**Sheet Flow, Sheet Flow - Grass**
					Grass: Short n= 0.150 P2= 3.36"
0.3	26	0.0385	1.37		**Shallow Concentrated Flow, Shallow Concentrated - Grass**
					Short Grass Pasture Kv= 7.0 fps
6.9	126	Total			

Summary for Subcatchment PDA-6: Subcat PDA-6

Runoff   =   0.24 cfs @ 12.02 hrs, Volume=   2,004 cf, Depth= 7.20"
    Routed to Reach 2R : 18" Pipe to Spruce Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
2,459	98	Paved parking, HSG C
880	74	>75% Grass cover, Good, HSG C
3,339	92	Weighted Average
880	74	26.35% Pervious Area
2,459	98	73.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (Less than 6 Mins)**

Summary for Reach 1R: 12" Pipe to Spruce Pond

Inflow Area =   49,866 sf, 77.74% Impervious, Inflow Depth = 5.44"   for 100-Year event
Inflow   =   3.17 cfs @ 12.08 hrs, Volume=   22,610 cf
Outflow   =   3.14 cfs @ 12.09 hrs, Volume=   22,616 cf, Atten= 1%, Lag= 0.3 min
    Routed to Link 1L : Spruce Pond

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Max. Velocity= 6.46 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.36 fps, Avg. Travel Time= 0.7 min

Peak Storage= 45 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.60' , Surface Width= 0.98'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 4.75 cfs

12.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 92.3'   Slope= 0.0105 '/'
Inlet Invert= 330.11', Outlet Invert= 329.14'

24.0168 POST HydroCAD - Joe
Prepared by Narragansett Engineering Inc
HydroCAD® 10.20-5c s/n 13427 © 2023 HydroCAD Software Solutions LLC

Type III 24-hr 100-Year Rainfall=8.16"
Printed 9/18/2025
Page 40
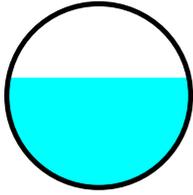
Summary for Reach 2R: 18" Pipe to Spruce Pond

Inflow Area =   17,162 sf, 85.59% Impervious, Inflow Depth =   4.89"   for 100-Year event
Inflow   =   0.98 cfs @   12.19 hrs, Volume=   6,991 cf
Outflow   =   0.97 cfs @   12.21 hrs, Volume=   6,995 cf, Atten= 2%, Lag= 1.1 min
    Routed to Link 1L : Spruce Pond

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Max. Velocity= 4.52 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.52 fps, Avg. Travel Time= 1.5 min

Peak Storage= 29 cf @ 12.25 hrs
Average Depth at Peak Storage= 0.27' , Surface Width= 1.16'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 14.01 cfs

18.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 133.0'   Slope= 0.0105 '/'
Inlet Invert= 330.15', Outlet Invert= 328.75'
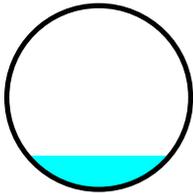
Summary for Pond 1P: BMP 1

Inflow Area =   15,193 sf, 90.52% Impervious, Inflow Depth =   7.68"   for 100-Year event
Inflow   =   1.13 cfs @   12.01 hrs, Volume=   9,724 cf
Outflow   =   0.95 cfs @   12.17 hrs, Volume=   9,728 cf, Atten= 16%, Lag= 9.1 min
Discarded =   0.03 cfs @   6.00 hrs, Volume=   3,766 cf
Primary   =   0.92 cfs @   12.17 hrs, Volume=   5,961 cf
    Routed to Reach 1R : 12" Pipe to Spruce Pond

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Peak Elev= 334.29' @ 12.42 hrs   Surf.Area= 1,421 sf   Storage= 1,835 cf

Plug-Flow detention time= 157.0 min calculated for 9,529 cf (98% of inflow)
Center-of-Mass det. time= 166.9 min (917.6 - 750.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	331.90'	538 cf	**29.00'W x 49.00'L x 2.50'H Field A** 3,553 cf Overall - 2,016 cf Embedded = 1,536 cf x 35.0% Voids
#2A	332.40'	1,351 cf	**Shea Leaching Chamber 4x8x1.5** x 42 Inside #1 Inside= 42.0"W x 15.0"H => 4.29 sf x 7.50'L = 32.2 cf Outside= 48.0"W x 18.0"H => 6.00 sf x 8.00'L = 48.0 cf 42 Chambers in 7 Rows
		1,889 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	331.90'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	333.30'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	333.80'	**0.5' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Primary	334.10'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.03 cfs @ 6.00 hrs HW=331.93' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.80 cfs @ 12.17 hrs HW=334.18' (Free Discharge)
├─**2=Orifice/Grate** (Orifice Controls 0.20 cfs @ 4.17 fps)
├─**3=Sharp-Crested Rectangular Weir** (Weir Controls 0.32 cfs @ 2.01 fps)
└─**4=Sharp-Crested Rectangular Weir** (Weir Controls 0.28 cfs @ 0.90 fps)

Summary for Pond 2P: BMP 2

Inflow Area =   30,982 sf, 77.65% Impervious, Inflow Depth = 7.32" for 100-Year event
Inflow   =   2.23 cfs @ 12.02 hrs, Volume=   18,903 cf
Outflow   =   2.06 cfs @ 12.05 hrs, Volume=   18,920 cf, Atten= 8%, Lag= 1.6 min
Discarded   =   0.03 cfs @ 5.00 hrs, Volume=   4,048 cf
Primary   =   2.03 cfs @ 12.05 hrs, Volume=   14,872 cf
    Routed to Reach 1R : 12" Pipe to Spruce Pond

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Peak Elev= 338.22' @ 12.13 hrs Surf.Area= 1,421 sf Storage= 1,802 cf

Plug-Flow detention time= 97.5 min calculated for 18,534 cf (98% of inflow)
Center-of-Mass det. time= 110.7 min (876.1 - 765.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	335.90'	538 cf	**29.00'W x 49.00'L x 2.50'H Field A** 3,553 cf Overall - 2,016 cf Embedded = 1,536 cf x 35.0% Voids
#2A	336.40'	1,351 cf	**Shea Leaching Chamber 4x8x1.5** x 42 Inside #1 Inside= 42.0"W x 15.0"H => 4.29 sf x 7.50'L = 32.2 cf Outside= 48.0"W x 18.0"H => 6.00 sf x 8.00'L = 48.0 cf 42 Chambers in 7 Rows
		1,889 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	335.90'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	337.45'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	338.00'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.03 cfs @ 5.00 hrs HW=335.95' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=1.94 cfs @ 12.05 hrs HW=338.21' (Free Discharge)
├─**2=Orifice/Grate** (Orifice Controls 0.68 cfs @ 3.45 fps)
└─**3=Sharp-Crested Rectangular Weir** (Weir Controls 1.27 cfs @ 1.51 fps)

Summary for Pond 3P: BMP 3

Inflow Area =	13,823 sf, 88.47% Impervious, Inflow Depth = 7.56" for 100-Year event			
Inflow =	1.02 cfs @ 12.01 hrs, Volume=	8,710 cf		
Outflow =	0.79 cfs @ 12.26 hrs, Volume=	8,743 cf, Atten= 23%, Lag= 15.0 min		
Discarded =	0.04 cfs @ 7.00 hrs, Volume=	3,756 cf		
Primary =	0.75 cfs @ 12.26 hrs, Volume=	4,987 cf		

Routed to Reach 2R : 18" Pipe to Spruce Pond

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs
Peak Elev= 338.44' @ 12.41 hrs Surf.Area= 1,653 sf Storage= 1,621 cf

Plug-Flow detention time= 131.0 min calculated for 8,564 cf (98% of inflow)
Center-of-Mass det. time= 139.7 min (895.1 - 755.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	336.40'	628 cf	**29.00'W x 57.00'L x 2.08'H Field A**
			3,438 cf Overall - 1,643 cf Embedded = 1,796 cf x 35.0% Voids
#2A	336.90'	1,016 cf	**Shea Leaching Chamber 4x8x1** x 49 Inside #1
			Inside= 42.0"W x 10.0"H => 2.76 sf x 7.50'L = 20.7 cf
			Outside= 48.0"W x 13.0"H => 4.19 sf x 8.00'L = 33.5 cf
			49 Chambers in 7 Rows
		1,644 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	336.40'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	337.50'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	338.10'	**1.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
			338.6' Crest Height

Discarded OutFlow Max=0.04 cfs @ 7.00 hrs HW=336.43' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.66 cfs @ 12.26 hrs HW=338.32' (Free Discharge)
├─**2=Orifice/Grate** (Orifice Controls 0.34 cfs @ 3.88 fps)
└─**3=Sharp-Crested Rectangular Weir** (Weir Controls 0.32 cfs @ 1.52 fps)

Summary for Link 1L: Spruce Pond

Inflow Area =   67,028 sf, 79.75% Impervious, Inflow Depth = 5.30"   for 100-Year event
Inflow   =   4.10 cfs @ 12.12 hrs, Volume=   29,611 cf
Primary   =   4.10 cfs @ 12.12 hrs, Volume=   29,611 cf, Atten= 0%, Lag= 0.0 min
    Routed to nonexistent node 3L

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs

Summary for Link 2L: King Street

Inflow Area =   260 sf, 99.73% Impervious, Inflow Depth = 7.92"   for 100-Year event
Inflow   =   0.02 cfs @ 12.01 hrs, Volume=   172 cf
Primary   =   0.02 cfs @ 12.01 hrs, Volume=   172 cf, Atten= 0%, Lag= 0.0 min
    Routed to nonexistent node 3L

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 1.00 hrs

APPENDIX D

STORMWATER POLLUTION AND PREVENTION PLAN

Proposed Development Project
Franklin Crossing

380 King Street
Franklin MA 02038

Assessors Plat 303, Lot 042
Zoned CII
Issued 5/12/25
Rev. 1: 9/18/25

Property Owner:
Margaret Marguerite Trust
PO Box 211
Franklin MA 02038

Applicant/Operator:
Patrick Marguerite
PO Box 211
Franklin MA 02038
E: patmkw@gmail.com

Prepared by Joe Malo, PE

NEI Job Number: 24.0168

Prepared by: Narragansett Engineering, Inc. 3102 East Main St, Portsmouth, RI 02871

STORM WATER POLLUTION PREVENTION PLAN
TABLE OF CONTENTS

1. INTRODUCTION

This Storm Water Pollution Prevention Plan (SWPPP) addresses the development at 380 King Street, Franklin MA, consisting of a 30 – unit residential housing complex with associated pedestrian access routes and parking. The project will include construction of the residential development along with associated site, utility, and drainage improvements.

This Plan has been prepared in accordance with the provisions of the National Pollutant Discharge Elimination System (NPDES) Construction General Permit for the Discharge of Storm Water Associated with Construction Activity. The basic guidelines utilized in this Plan include the Massachusetts Stormwater Handbook (MADEP 2010) and has been prepared in conformance with Stormwater Standards 4 and 8.

2. SITE DESCRIPTION AND PROPOSED CONSTRUCTION ACTIVITIES

2.1 Site Description

The development site is located on a north-south sloping site and is currently developed with a gravel base parking lot, paved accessways and other associated improvements. Undeveloped areas of the site are vegetated with varying sized trees, shrubs and open lawn. Site elevations range from approximately 346 to the west to approximately 334 to the east. The limit of disturbance totals approximately 1.26 acres.

The development is shown on the project plans entitled "380 King Street - Condominiums", prepared by Narragansett Engineering dated May 2025 (the "Plans").

2.2 Pollution Prevention Team

The pollution prevention team post construction for the long-term implementation of this SWPPP is the current owner and facility staff within the Franklin Crossing facility. The pollution prevention

team is responsible for the compliance set forth in this SWPPP. Currently, these entities/personnel are as follows:

Owner:

Margaret Marguerite Trust

PO Box 211

Franklin MA 02038

Facility Manager:

Tim Jones

T: 774-571-1972

E: gracewooddevelopment@gmail.com

The current owner retains the right to assign pollution prevention team members as well as a designee for the owner's responsibility of pollution prevention team responsibilities.

2.3   Timetable

Construction of the project is expected to commence Spring 2026. The entire project is scheduled to be completed by Spring 2027.

2.4   Sequence of Construction

Land disturbing activities will be undertaken as a single phase. A generalized sequence of the site work for the facility is provided below:

1. Contractor mobilization.
2. Install perimeter sedimentation controls and construction fencing.
3. Mark trees to remain and install tree protection.
4. Clear and grub where required.
5. Remove existing site features and utilities.
6. Rough grade site.

7. Install foundations and construct buildings.

8. Install drainage system.

9. Install underground utilities on the site.

10. Site grading. Place bulk fill.

11. Fine grade vehicular areas.

12. Install asphalt paving.

13. Install landscaping plantings.

14. Bring stormwater systems online

15. Complete punch list items.

2.5   Ultimate Intended Use

The ultimate intended use for this site is to provide residential housing for residents of Franklin MA.

2.6   Disturbed Area

The construction limits for the project encompass approximately 1.26 acres.

2.7   Pre and Post-Development Runoff

Pre-and post-development drainage patterns are depicted on the subwatershed maps included in the Stormwater Report. Storm water runoff falling on the site under the existing condition drains via overland flow toward the north to Spruce Pond.

Infiltration and low impact development techniques were incorporated into the proposed stormwater management system wherever possible. The use of curbs, gutters, and closed drainage systems was required to collect and direct much of the runoff to the proposed best management practices. Underground infiltration systems, and isolator pretreatment rows have been proposed throughout the site.

The stormwater management systems will provide total suspended solid removal and infiltration to treat and mitigate peak flows to reduce the proposed flow for all storm events.

Proposed condition stormwater runoff drains to one of three underground infiltration systems via site grading to drainage collection structures. The stormwater entering the systems is collected and sent to a diversion manhole sending the "first flush" of runoff to isolator rows to perform pretreatment operations. Larger storms are diverted directly to the Best Management Practice (BMP). The systems are designed to collect and allow for infiltration of the runoff storms and overflow to the existing drainage system within the Franklin Crossing facility ultimately discharging to Spruce Pond by existing conveyances.

Hydrologic calculations for both existing and proposed conditions were performed using HydroCAD version 10.20 software, which utilizes TR-55 and TR-20 methodology. The hydraulic design calculations were completed using this software.

2.7.1 Receiving Waters

The final point of discharge for stormwater from this site is Spruce Pond, which has not been identified as impaired. The good housekeeping practices, preventative maintenance and Best Management Practices implemented at the facility are appropriate and adequate controls to prevent potential impairments to the receiving waters of the site.

2.7.2 Potential Sources of Pollution

Potential sources of pollution during construction include sediment carried by stormwater runoff and dewatering operations, as well as the limited potential for accidental spillage of construction equipment fuel. To minimize potential pollution, erosion and sedimentation controls will be installed prior to site disturbance. All disturbed areas will be vegetated as soon as possible, but no later than 14 days after final grades are established. Temporary vegetation and/or mulching will be used for any unfinished areas that will be exposed for more than fourteen days (14) unless the activity is to resume within twenty-one (21) days. Fuel spills will be avoided as described in Section 3.5.3.

2.7.3 Non-Stormwater Discharges

Allowable non-stormwater discharges may include the following:

- Discharges resulting from the washdown of vehicles where no detergents are used;
- External building washdown where no detergents are used;
- The use of water to control dust
- Fire fighting activities
- Fire hydrant flushings
- Air conditioning condensation
- Uncontaminated groundwater
- Lawn watering
- Potable water sources including waterline flushing
- Irrigation drainage
- Pavement wash waters where spills or leaks of toxic or hazardous materials have not occurred (unless all spilled materials have been removed) and where detergents have not been used

It has been determined that the above non-stormwater discharges at Franklin Crossing do not represent a significant contribution of pollution to the waters of the United States.

2.7.4 Illicit Discharges

Illicit discharges are not permitted per MADEP Stormwater Standard No. 10. Prevention of illicit discharges to the stormwater management system of Franklin Crossing is the responsibility of the owner and staff within the Franklin Crossing facility. Identification of potential illicit discharges and preventative maintenance of onsite facilities prove effective in the prevention of illicit discharges. There are no existing or proposed illicit discharges on the project site.

3.0 CONTROLS

A number of erosion and sedimentation control BMP's will be utilized site-wide throughout construction. These will include vegetative and temporary mulching practices, construction entrances, sediment barriers (staked haybales and siltation fence), catch basin inlet protection, stockpile management procedures, and permanent vegetation. As indicated in the Sequence of Construction (2.4), perimeter sedimentation controls will be in place prior to land disturbance.

3.1 Vegetative and Temporary Mulching Practices

Grass seeding and landscaping plantings will be the main vegetative control used on the site. Upon the completion of grading activities, any disturbed or otherwise unstabilized soil will be promptly protected by the application of a plantable soil, where necessary, and an appropriate permanent grass seed mixture.

Mulching is to be used as necessary to protect against erosion until a good stand of permanent vegetation is established. Mulches will consist of organic material such as hay and straw, wood chips, or bark mulch. Wood chips or bark mulch must be at least 50% decomposed for use as mulch.

These vegetative practices shall be initiated not more than fourteen (14) days after the construction activity has temporarily or permanently ceased, unless the activity is to resume within twenty-one (21) days.

3.2   Non-Structural Practices

3.2.1   Construction Entrances

Construction entrances shall be placed at points of ingress and egress prior to commencing work on the site. When sediment fills the voids of the stone, the construction entrance must be removed and replaced with new stone. Site conditions may require that washing be performed to remove sediment from heavy vehicles to prevent tracking of sediment off-site. Provisions to wash construction vehicles should be provided at this point. The Contractor must sweep and clean sediment tracked off the site onto adjacent roadways immediately prior to the close of the workday.

3.2.2   Perimeter Sediment Barrier

Prior to construction, a continuous line of staked compost filter sock and silt fence shall be installed as shown on the plans. The barriers shall be maintained throughout the construction period. Inspection should be made after each storm event and repair and or replacement should be made as promptly as needed. Cleanout of accumulated sediment behind the sock is necessary if ½ of the original height of the sock becomes filled with sediment.

The silt fence will consist of pervious fabric supported by posts or stakes driven along the contour. The fabric will be securely fastened to the stakes and the bottom will be secured within the soil. Silt fences will be placed so that water cannot bypass the ends. Silt fences will be installed in accordance with the manufacturer's specifications. The fence must be inspected often and the sediment must be cleared periodically to prevent buildup or damages.

3.2.3   Inlet Protection

During construction, compost filter sock shall be installed around existing and newly installed catch basins to prevent sediment accumulation in the system. In addition, filter fabric or a sediment bag shall be installed below the grates until the contributing area is stabilized. Sediment

shall be removed and the trap restored to its original dimensions when the sediment has accumulated to half (½) of the design depth of the trap. The sediment that is removed should be disposed in an area in which erosion will not take place.

3.2.4 Stockpile Management

Erodible material stockpiles shall be encircled with compost filter sock, silt fence, or other barrier to prevent sediment transport out of the stockpile area. If expected to remain for more than 21 days, stockpiles shall be seeded with temporary grass seed mix and mulched.

3.3 Structural BMP Practices

No structural BMP practices are proposed at this time.

3.4 Post-Construction Storm Water Management

The following stormwater BMPs are proposed:

3.4.1 Closed Drainage System

The Franklin Crossing site is designed to collect surface runoff by site grading directed to catch basin structures that convey runoff via pipe and drainage manholes to the underground infiltration systems described in Section 3.4.2. These devices will provide conveyance patterns and collection for stormwater drainage pathways for the site. Catch basins will provide removal of sediment and separation of oil and other floatable debris.

3.4.2 Underground Infiltration System

The proposed storm water management system has been designed to remove a net annual 85% total suspended solids from the runoff collected from new impervious areas. The underground

infiltration systems receive runoff via surface sheet flow collected by catch basins conveyed through drainage manholes. These subsurface infiltration chambers utilize isolator rows for pretreatment that collects the "first flush" of rainfall storms. The isolator rows are designed to provide adequate pretreatment for the BMP's they are serving. The remainder of the system promotes steady infiltration through a crushed stone bed surrounding the entirely of each system which provides ground water recharge. In largest storm events where all runoff is not directed to infiltration, an overflow is directed to existing drainage structures that divert runoff to Spruce Pond.

3.4.3 Outlet Protection

Existing riprap aprons downstream of point storm water discharges will be inspected prior to bringing post construction stormwater BMP's online to ensure sheet flow and control potential for erosion downstream is promoted within the existing outlets. Existing riprap pads will be cleaned of sediment following the construction period.

3.5 Other Controls

3.5.1 Off-site Tracking of Vehicle Sediments

Stabilized construction site entrances will be provided as set forth in Section 3.2.1. Refer to the Drawings for locations.

3.5.2 Waste Disposal

3.5.2.1 During Construction

Any materials generated during demolition that can be recycled or reused on the site shall be so handled. Excess demolition and construction wastes shall be disposed consistent with the appropriate State and Federal regulations. It is anticipated that the contractor and/or subcontractors will secure commercial dumpsters for this purpose. In no case shall un-controlled trash or litter be permitted to leave the construction area.

3.5.2.2 Post Construction

Waste management is to occur onsite within properly maintained facilities within the Franklin Crossing building proper. This waste is to ultimately be collected and stored within the provided waste management dumpsters located in the back of the facility. Scheduled waste removal from these receptacles shall be determined by the current property owner. Where waste is not properly disposed of in assigned containers due diligence of Franklin Crossing staff is expected to properly dispose of solid waste in a timely and effective manner.

3.5.3 Spill Prevention and Response Procedure

Spills related to construction vehicles and materials will be prevented by the following procedures:

1) No vehicles will be left unattended in project areas, which, in the event of a hazardous material spill, would flow into any portion of the drainage system.
2) Vehicles will be fueled in areas and using procedures that will not lead to a discharge of fuel into Waters of the State.
3) In the event of a release of hazardous material, the equipment operator will take all measures to stop and/or contain the leak and without exacerbating the release, and attempt to remove equipment from areas likely to cause a discharge of hazardous materials into Water of the State. Further, site supervisors shall be contacted and, should it be determined that the spill is of a reportable quantity, the MADEP shall be notified. A licensed hazardous waste remediation contractor shall be engaged to remediate any such spills in accordance with MADEP Regulations and procedures.

Any hazardous materials used for construction will be stored away from the drainage system components and protected from precipitation. In the event of a release beyond the ability of construction staff to contain, emergency services of the Town of Franklin, Massachusetts and a licensed hazardous waste remediation contractor will be contacted for assistance.

To prevent pollution of surface waters, the following construction procedures shall be prohibited:

1) Dumping of or discharging of spoil material or excessively turbid water into any stream corridor, any wetland, or any surface waters.

2) Indiscriminate operation of equipment in any stream corridors, any wetlands, or any surface waters.

3) Pumping of silt-laden water from trenches or other excavations into the drainage system.

4) Open burning of project debris.

5) Location of storage stockpiles in environmentally sensitive areas.

Long Term Prevention:

Franklin Crossing does not plan to store hazardous materials other than those noted previously during the long-term use of the facility, and no obsolete vehicles or other potential sources of pollutants are kept at any structure at Franklin Crossing. Preventative Maintenance can minimize the occurrence of stormwater pollution including spill prevention by addressing issues before they materialize. Vehicles and equipment should be regularly inspected to prevent leaks of fuel, oil, and other liquids. Structural stormwater controls should be regularly maintained to prevent inadequate performance during storm events.

The following is a list of preventative maintenance procedures practiced at the facility

- All staff members are aware of spill prevention and response procedures.
- All staff members have received formal spill prevention and response procedure training.
- Material storage tanks and containers are regularly inspected for leaks.
- All material and bulk deliveries are monitored by facility employees.

3.5.4 Control of Allowable Non-Stormwater Discharges

Allowable non-stormwater discharges shall be monitored for erosion and sedimentation impacts and appropriate BMPs provided as necessary. Records of such BMP's shall be made and retained.

3.5.5 Good Housekeeping

Good housekeeping practices are activities, often conducted daily, that help maintain a clean facility and prevent stormwater pollution problems. The following is a list of good housekeeping measures that are practiced at the facility:

- During construction activities, all construction debris shall be properly disposed of and/or covered at the end of each working day to avoid contact with precipitation.
- All fluid products and wastes are kept indoors.
- Materials are stored indoors or in covered areas to minimize exposure to stormwater.
- Tools and materials are returned to designated storage areas after use.
- Waste materials are properly collected and disposed of.
- Different types of wastes are separated as appropriate.
- Regular waste disposal is arranged.
- Work areas are clean and organized.
- Work areas are regularly swept or vacuumed to collect metal, wood, and other particulates and materials.
- Materials are recycled when possible.
- Staff is familiar with manufacturer directions for proper use of materials and associated Safety Data Sheets (SDSs).
- Staff is familiar with proper use of equipment.

3.5.7 Material Storage

Storage of road salt/sand and additive measures for landscaped areas including but not limited to fertilizers, herbicides and pesticides shall be stored per the manufactured recommendations within the maintenance storage areas allowed onsite. Containers and storage locations shall be periodically inspected for container leakage, spills, and proper storage procedures.

3.5.8 Pet Waste Management

Pet waste management onsite shall be the responsibly of the pet owner to properly dispose of pet waste that occurs on the Franklin Crossing property. In the event pet waste management is not performed by pet owners, it will be the sole responsibility of the Franklin Crossing employee staff to collect and dispose of pet waste in a timely and proper manner.

3.5.9 Snow Storage

Snow storage sites, at a minimum, should include the following parameters:

- Located on a pervious surface and upland from water resources and wellheads
- A capacity to accept the anticipated snowfall totals for the season.

For the Franklin Crossing site, the recommended snow dump location is within the landscaped areas of the southern portions of the site. At time of writing and implementation of this SWPPP, this is the desired location for the snow dump site. As site conditions change, this location may not prove as optimal as other locations on site.

Proper preparation and maintenance of snow disposal sites will also prevent stormwater pollution. Before winter begins, a silt fence or sediment barrier should be placed on the down-gradient side of the snow dump to collect any sediment in snow meltwater. If the site is located near a body of water, a 50-foot vegetated buffer strip (at minimum) should be maintained during the growth season to filter pollutants out of meltwater. Prior to using the site for snow disposal, all debris should be cleared.

Debris and litter left after the snow has melted should be cleared and disposed of at the end of the snow season, no later than May 15 of each year.

Except under the most extraordinary of circumstances, when all land-based snow disposal options have been exhausted, snow should not be dumped into any body of water. When this option is necessary, requirements of "Snow Disposal Guidance" (BRPG01-01) issued by MassDEP on March 8, 2001, shall be followed.

3.5.10 Maintenance

Maintenance of the drainage structures and underground infiltration structures, including sediment removal, is completed by maintenance team members of the facility. The requirements for inspection and maintenance of the stormwater structures and other features of Franklin Crossing are provided within the Operation and Maintenance Manual.

4.0 PLAN IMPLIMENTATION

4.1   Employee Training

Regular employee training is required for employees who work in areas where materials or activities are exposed to stormwater, or who are responsible for implementing activities identified in the SWPPP, including all members of the Pollution Prevention Team.

Franklin Crossing staff is responsible for stormwater management training for Franklin Crossing employees. This position coordinates training related to stormwater management on at least an annual basis to review specific responsibilities for implementing this SWPPP, what and how to accomplish those responsibilities, including BMP implementation.

Additionally, general awareness training is provided regularly (preferably annually) to all employees whose actives may impact stormwater discharges. The purpose of this training is to

educate workers on activities that can impact stormwater discharges and to help implement BMPs.

All employees responsible for the fueling or lubrication of vehicles or equipment stored at the facility will be trained regularly (preferably annually). The topics below will be covered at employee training sessions.

1. Spill prevention and response.
2. Good housekeeping.
3. Materials management practices.

Pollution Prevention Team members will meet at least twice a year to discuss the effectiveness of and improvement to the SWPPP.

4.2   Site Inspection Requirements

It is required that the entire Franklin Crossing be inspected at least once each calendar quarter when the facility is in operation (at least one inspection must be conducted during a period when stormwater discharge is occurring). The project owner or designee is responsible for completing this inspection.

The inspection must check for evidence of pollution, evaluate non-structural controls in place at the site, and inspect equipment. The site inspection report must include:

- The inspection date and time
- The name of the inspector
- Weather information and a description of any discharge occurring at the time of the inspection
- Identification of any previously unidentified discharges from the site
- Any control measures needing maintenance or repair
- Any failed control measures that need replacement

- Any SWPPP changes required as a result of the inspection
- Signed certification statement.

Corrective actions may be required based on evidence of past stormwater pollution or the high potential for future stormwater pollution to occur. Information about any issues and the respective corrective actions must be included in a Compliance Evaluation report. The permittee must repair or replace control measures in need of repair or replacement before the next anticipated storm event if possible, or as soon as practicable. In the interim, the permittee shall have back-up measures in place. The Compliance Evaluation report must be kept with the SWPPP and must state the problem, the solution, and when the solution was implemented.

4.3   Recordkeeping and Reporting

The permittee must keep a written record (hardcopy or electronic) of all activities required by the SWPPP including but not limited to maintenance, inspections, and training for a period of at least five years.

This SWPPP shall be kept at the Franklin Crossing facility and shall be updated if any of the conditions in Section 4.4 occur. The SWPPP and records shall be made available to state or federal inspectors and the general public upon request.

Inspections of Franklin Crossing should be performed at least quarterly (at least one during stormwater discharge) and described in the Annual Report.

4.4   Triggers for SWPPP Revisions

Margaret Marguerite Trust shall review this SWPPP regularly to determine if any update or revision is required. Changes that may trigger revision include:

- An increase in the quantity of any potential pollutant stored at the facility;

- The addition of any new potential pollutant (not already addressed in this SWPPP) to the list of materials stored or used at the facility;
- Physical changes to the facility that expose any potential pollutant (not presently exposed) to stormwater;
- Presence of a new authorized non-stormwater discharge at the facility; or
- Addition of an activity that introduces a new potential pollutant.

Changes in activity may include an expansion of operations, or changes in any significant material handling or storage practices which could impact stormwater.

The amended SWPPP will describe the new activities that could contribute to increased pollution, as well as control measures that have been implemented to minimize the potential for pollution.

This SWPPP will be amended if a state or federal inspector determines that it is not effective in controlling stormwater pollutants discharged to waterways.

STORMWATER O&M Plan

NEI
Narragansett
Engineering Inc.
Civil · Survey · Structural · Environmental · Design
3102 East Main Road, Portsmouth RI 02871
Tel. 401.683.6630   www.nei-cds.com

Proposed Development Project
Franklin Crossing

380 King Street
Franklin MA 02038

Assessors Plat 303, Lot 042
Zoned CII
Issued 5/1/25

Property Owner:
Margaret Marguerite Trust
PO Box 211
Franklin MA 02038

Applicant/Operator:
Patrick Marguerite
PO Box 211
Franklin MA 02038
E: patmkw@gmail.com

Prepared by Joe Malo, PE

NEI Job Number: 24.0168

Prepared by: Narragansett Engineering, Inc. 3102 East Main St, Portsmouth, RI 02871

EXISTING SITE CONDITIONS

Under existing conditions, the Area of Concern (AOC) includes a number of stormwater best management practices (BMPs) to control stormwater quality and quantity for the development. BMPs proposed for the project include multiple underground infiltration facilities. The AOC includes a proposed 30-unit residential complex with associated onsite parking and landscape features.

<u>Short-term Requirements</u>

Once construction has been completed, more frequent inspections and required maintenance shall be performed during the first growing season. These inspections shall be performed weekly during the first month after construction is completed and monthly for the remainder of the first growing season. The goal of these inspections is to ensure that no erosion of the partially stabilized soils is occurring. Any erosion that is observed shall be remedied quickly by repairing and reseeding as necessary

OPERATION AND MAINTENANCE PLAN

The stormwater management system, including all structural stormwater controls and conveyances, must have an operation and management plan to ensure that it continues to function as designed. The plan shall identify measures for implementing maintenance activities in a manner that minimizes stormwater runoff impacts. The owners of the lot will be responsible for the operation and maintenance of the site, the estimated budget, and the funding for the activities and equipment required. A legally binding and enforceable maintenance agreement shall be executed between the facility owner and the responsible authority to ensure the following:

<u>REQUIRED ELEMENTS</u>

Landscaping Maintenance:

The trees and bushed shall be trimmed to maintain a 20-foot wide by 14-foot tall clearance to allow for emergency vehicles along all access drives and parking areas.

Catch Basin Maintenance:

The deep sump catch basins (4ft) will also need inspection and cleaning as sediment reaches a depth of 2 feet.

Underground Infiltration System:

The frequency of inspection and maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices. At a minimum, Shea recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row was designed to reduce the cost of periodic maintenance. By "isolating" sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is

required, please follow local and OSHA rules for a confined space entries. Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" are best. Shea recommends a maximum nozzle pressure of 2000 psi be utilized during cleaning. JetVac reels can vary in Examples of culvert cleaning nozzles appropriate for Isolator Row maintenance. Please see the Shea Product catalog for more information.

DESIGN GUIDANCE

Long-Term Maintenance of Non-Stormwater Related Activities
Solid Waste Containment: Solid waste shall be collected by a licensed waste disposal firm on a regular basis and disposed of off-site in conformance with all applicable regulatory standards.

Snow Disposal: Snow shall be removed from all drives, parking areas, fire access drive, and sidewalks whenever an accumulation of snow occurs by the owner/operator or a private licensed subcontractor. No snow shall be plowed in or adjacent to catch basins or stormwater areas.

Lawn and Landscape Management: The Owner shall mow to a height of no less than two inches during the growing season, apply minimum to the extent practicable of fertilizers, pesticides, and irrigation. All landscaping and landscaping maintenance shall be performed by a licensed subcontractor or property owner and all materials removed from the premises shall be in conformance with all applicable regulatory standards.

OWNER INFORMATION
Margaret Marguerite Trust
PO Box 211
Franklin MA 02038

OPERATOR
Tim Jones
Street Address
Town, State, Zip
T: 774-571-1972
E: gracewooddevelopment@gmail.com

Comments:

_____

_____

_____

_____

Actions to be Taken:

_____

_____

_____

_____

Open Channel Operation, Maintenance, and Management
Inspection Checklist

CB or DMH#   _____ (Enter #)
Each structure must be inspected and a separate inspection sheet for each structure generated

Project:

Location:

Site Status:

Date:

Time:

Inspector:

MAINTENANCE ITEM	SATISFACTORY/ UNSATISFACTORY	COMMENTS
1. Debris Cleanout (Annual, After Major Storms)		
Contributing areas clean of debris		
2. Vegetation (Annual, After Major Storms)		
Check Condition in contributing area		
No evidence of surface erosion		

MAINTENANCE ITEM	SATISFACTORY/ UNSATISFACTORY	COMMENTS
3. Dewatering (Annual, After Major Storms)		
Dewaters between storms		
4. Sediment deposition (Annual, After Major Storms)		
Clean surface of any sediment		
5. Outlet/Overflow Spillway (Annual, After Major Storms)		
Check sump sediment level Sediment to be 2' below Pipe invert. If less, clean entire sump.		
Good condition, no evidence of clogging		
Closed drainage outlet/piping, inspect for debris or clogging		
Good condition, no need for repairs		
No evidence of erosion at discharge		

Underground Infiltration System

Project:

Location:

Site Status:

Date:

Time:

Inspector:

	Frequency	Action
Inlets and Outlets		• .
	Spring and Fall	• Check inlet and outlets for clogging and remove any debris as required. •
Sand Filter Chamber	2 years after commissioning	• Inspect the interior of the infiltration structure closely looking for settling, stained sand surface, and lack of draining. • Clean out sediment and debris if practice is not draining with 48 hours of a major storm event
	Spring and Fall	• Clean stormwater management forebay and all CB's
Surrounding Site	Monthly in 1st year	• Check for depressions in impervious areas over and surrounding the CB's and Collection system.
	Spring and Fall	• Check for depressions in areas over and surrounding the infiltration practice.
	Yearly	• Confirm that no unauthorized modifications have been performed to the site.

5.1 Minor Maintenance Log

Frequency		Action
Monthly in first year		Check inlets and outlets for clogging and remove any debris, as required.
		Notes
□ Month 1	Date:	
□ Month 2	Date:	
□ Month 3	Date:	
□ Month 4	Date	
□ Month 5	Date:	
□ Month 6	Date:	
□ Month 7	Date:	
□ Month 8	Date:	
□ Month 9	Date:	
□ Month 10	Date:	
□ Month 11	Date:	
□ Month 12	Date:	
Spring and Fall		Check inlets and outlets for clogging and remove any debris, as required.
		Notes
□ Spring	Date:	
□ Fall	Date:	
□ Spring	Date:	
□ Fall	Date:	
□ Spring	Date:	
□ Fall	Date:	
□ Spring	Date:	
□ Fall	Date:	
□ Spring	Date:	
□ Fall	Date:	
□ Spring	Date:	
One year after commissioning		Check inlets and outlets for clogging and remove any debris, as required.
		Notes
□ Year 1	Date:	
□ Year 4	Date:	
□ Year 7	Date:	
□ Year 10	Date:	
□ Year 13	Date:	
□ Year 16	Date:	
□ Year 19	Date:	
□ Year 22	Date:	

Frequency		Action
Monthly in 1ˢᵗ year		□ Check for depressions in areas over and surrounding the stormwater management system.
		Notes
□ Month 1	Date:	
□ Month 2	Date:	
□ Month 3	Date:	
□ Month 4	Date:	
□ Month 5	Date:	
□ Month 6	Date:	
□ Month 7	Date:	
□ Month 8	Date:	
□ Month 9	Date:	
□ Month 10	Date:	
□ Month 11	Date:	
□ Month 12	Date:	
Spring and Fall		□ Check for depressions in areas over and surrounding the stormwater management system.
		Notes
□ Spring	Date:	
□ Fall	Date:	
□ Spring	Date:	
□ Fall	Date:	
□ Spring	Date:	
□ Fall	Date:	
□ Spring	Date:	
□ Fall	Date:	
□ Spring	Date:	
□ Fall	Date:	
□ Spring	Date:	
□ Fall	Date:	
Yearly		□ Confirm that no unauthorized modifications have been performed to the site.
		Notes
□ Year 1	Date:	
□ Year 2	Date:	
□ Year 3	Date:	
□ Year 4	Date:	
□ Year 5	Date:	
□ Year 6	Date:	
□ Year 7	Date:	

Surrounding Site

The projected O&M budget for the attached project includes

21.0149 Estimate of Yearly O&M Costs				
Item	Description	Yearly Frequency	Estimated Cost	Yearly Cost
1	Street Sweeping	2	500	$ 1,000.00
2	Erosion Repairs	0.5	500	$ 250.00
3	Mowing	3	100	$ 300.00
5	Outlet Maint	0.25	600	$ 150.00
6	CB Sump Cleaning	0.33	1000	$ 330.00
			Expected Yearly Budget	$ 2,030.00

Stormwater Facility Maintenance Agreement

THIS AGREEMENT, made and entered into this____ day of_____, 20__, by and between_____hereinafter called the "Landowner", and the Town of Franklin, hereinafter called the "Town". WITNESSETH, that WHEREAS, the Landowner is the owner of certain real property described as_____, as recorded by deed in the land records of_____, Deed Book_____, Page_____hereinafter called the "Property".

WHEREAS, the Landowner is proceeding to build on and develop the property; and

WHEREAS, the Site Plan/Subdivision Plan known as _____, hereinafter called the "Plan", which is expressly made a part hereof, as approved or to be approved by the Town, provides for detention of stormwater within the confines of the property; and

WHEREAS, the Town and the Landowner, its successors and assigns, agree that the health, safety, and welfare of the residents of the Town require that on-site stormwater management facilities be constructed and maintained on the Property; and

WHEREAS, the Town requires that on-site stormwater management facilities as shown on the Plan be constructed and adequately maintained by the Landowner, its successors and assigns.

NOW, THEREFORE, in consideration of the foregoing premises, the mutual covenants contained herein, and the following terms and conditions, the parties hereto agree as follows:

1. The on-site stormwater management facilities shall be constructed by the Landowner, its successors and assigns, in accordance with the plans and specifications identified in the Plan.
2. The Landowner, its successors and assigns, shall adequately maintain the stormwater management facilities in accordance with the required Operation and Maintenance Plan. This includes all pipes, channels or other conveyances built to convey stormwater to the facility, as well as all structures, improvements, and vegetation provided to control the quantity and quality of the stormwater. Adequate maintenance is herein defined as good working condition so that these facilities are performing their design functions. The Stormwater Best Management Practices Operation, Maintenance and Management Checklists are to be used to establish what good working condition is acceptable to the Town.

3. The Landowner, its successors and assigns, shall inspect the stormwater management facility as required in the Operation and Maintenance Plan. The purpose of the inspection is to assure safe and proper functioning of the facilities. The inspection shall cover the entire facilities, berms, outlet structures, basin areas, access roads, etc. Deficiencies shall be noted in an inspection report.

4. The Landowner, its successors and assigns, hereby grant permission to the Town, its authorized agents and employees, to enter upon the Property and to inspect the stormwater management facilities whenever the Town deems necessary upon 48-hours's notice by the Town. The purpose of inspection is to follow-up on reported deficiencies and/or to respond to citizen complaints. The Town shall provide the Landowner, its successors and assigns, copies of the inspection findings and a directive to commence with the repairs if necessary.

5. In the event the Landowner, its successors and assigns, fails to maintain the stormwater management facilities in good working condition acceptable to the Town, upon 72 hours' notice the Town may enter upon the Property and take whatever steps necessary to correct deficiencies identified in the inspection report and to charge the costs of such repairs to the Landowner, its successors and assigns. This provision shall not be construed to allow the Town to erect any structure of permanent nature on the land of the Landowner outside of the easement for the stormwater management facilities. It is expressly understood and agreed that the Town is under no obligation to routinely maintain or repair said facilities, and in no event shall this Agreement be construed to impose any such obligation on the Town.

6. The Landowner, its successors and assigns, will perform the work necessary to keep these facilities in good working order as appropriate. In the event a maintenance schedule for the stormwater management facilities (including sediment removal) is outlined on the approved plans, the schedule will be followed.

7. In the event the Town pursuant to this Agreement, performs work of any nature, or expends any funds in performance of said work for labor, use of equipment, supplies, materials, and the like, the Landowner, its successors and assigns, shall reimburse the Town upon demand, within thirty (30) days of receipt thereof for all actual costs incurred by the Town hereunder.

8. This Agreement imposes no liability of any kind whatsoever on the Town and the Landowner agrees to hold the Town harmless from any liability in the event the stormwater management facilities fail to operate properly.

9. This Agreement shall be recorded among the land records of the Town and shall constitute a covenant running with the land, and shall be binding on the Landowner, its administrators, executors, assigns, heirs and any other successors in interests.

WITNESS the following signatures and seals:

_____

Company/Corporation/Partnership Name (Seal)

By:_____

_____

(Type Name and Title)

The foregoing Agreement was acknowledged before me this_____day of
_____, 20____, by

_____

_____

NOTARY PUBLIC
My Commission Expires:_____ By: _____

_____

(Type Name and Title)

The foregoing Agreement was acknowledged before me this_____day of
_____, 20____, by

_____

_____

NOTARY PUBLIC
My Commission Expires: _____

Approved as to Form:

_____ _____

[Town/City] Attorney   Date

APPENDIX E