

STORMWATER REPORT

for

PARKING LOT IMPROVEMENTS

423 Main Street
Sturbridge, MA

Prepared for:

(Owner/Applicant)

NBM Realty, LLC
PO Box 638,
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Date:

January 4, 2021

Prepared By:



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NARRATIVE

Project Description

Site Location: Parking Lot Improvements
423 Main Street, Sturbridge, MA

Development Type: Multi-Family Dwelling

Project Summary:

The proposed project consists of resurfacing an existing gravel parking area to a paved parking area, and associated stormwater management improvements. The property lies entirely within a Zone II wellhead protection area (a designated Critical Area).

A drainage and stormwater management system will treat and attenuate runoff from the project in full compliance with MassDEP Stormwater Management Standards.

Existing Site Conditions

Location: The project site is located at 423 Main Street.

Ground Cover: The ground cover in the drainage study area is a mix of impervious surfaces (roof and pavement), compacted gravel, brush, lawn and woods.

Slopes: The site generally slopes from north to south towards the southern property line. The slopes are gentle (less than 5%) in the developed area and steep in the wooded area towards a river and wetland system to the south.

Soil Types: Site soil types as mapped by the USDA-NRCS are Merrimac fine sandy loam, Pootatuck fine sandy loam and Udorthents, smoothed (map unit symbols 254B 2A and 651 respectively). These soils are classified as hydrologic soil group (HSG) "A" and HSG "B". It should be noted that the proposed work is entirely located within the Merrimac fine sandy loam, HSG "A". Refer to Appendix D for more detailed USDA-NRCS soil information and to the site plans for onsite soil testing logs.

HYDROLOGY CALCULATIONS

Methodology

Peak rate of runoff flows were calculated using SCS TR-20 and TR-55 methodology as implemented by the HydroCAD Stormwater Modeling System computer program. The 2, 10, 25, and 100-year storm events were analyzed with the HydroCAD program using site-specific NRCC rainfall frequency data as follows:

Rainfall Amounts (inches) by Frequency (NRCC)			
2 Year	10 Year	25 Year	100 Year
3.14	4.65	5.82	8.20

Pre-Development

The total pre-development drainage area studied in this report consists of approximately 0.17 acres. The pre-development hydrology has been modeled as one subcatchment that drains to a single discharge point (design point).

Design Point #1: This design point represents runoff from the site to the southern property line.

Refer to Appendix B for the HydroCAD output sheets for each storm event. A summary of the peak rate of runoff for the design point for each storm is as follows:

Pre-Development Peak Rate of Runoff (cfs)				
	2 Year	10 Year	25 Year	100 Year
Design Point #1 (Southern Property Line)	0.40	0.67	0.87	1.29

Post-Development

The total post-development drainage area is approximately 1.99 acres and is broken into two subcatchments that drain to the same design point.

Refer to Appendix C for the HydroCAD output sheets for each storm event. A summary of the peak rate of runoff for the design point for each storm is as follows:

Post-Development Peak Rate of Runoff (cfs)				
	2 Year	10 Year	25 Year	100 Year
Design Point #1 (Southern Property Line)	0.20	0.61	0.80	1.18

The total net change in peak rate of runoff from pre-development to post-development at the design point for each storm is as follows:

Comparison of Pre- vs. Post-Development Peak Rate of Runoff (cfs)				
	Net Change			
	2 Year	10 Year	25 Year	100 Year
Design Point #1 (Southern Property Line)	-0.2	-0.06	-0.07	-0.11

STORMWATER MANAGEMENT

To demonstrate compliance with MassDEP Stormwater Management, we offer the following in response to each of the 10 Standards.

Drain Outfall Riprap Sizing Calculations (Stormwater Management Standard 1)

There is no drain pipe outfall proposed for this project.

Peak Rate Attenuation (Stormwater Management Standard 2)

Runoff is attenuated for the 2, 10, 25 and 100-year storm events.

Recharge to Groundwater (Stormwater Management Standard 3)

USDA-NRCS soil survey indicates site soils are hydrologic group A soils. The recharge calculations are as follows:

Required recharge volume

Required Recharge Volume (R_v) = $F \times$ Impervious Area where, F = Target Depth Factor (in.)
 $F = 0.6"$ for 'A' Soils

Pre-development Impervious Area = 1,036 ft²

Post-development Impervious Area = 5,695 ft²

Net increase in site impervious area (pre to post conditions) = 4,659 ft²

$$R_v = (0.6"/12") \times 4,659 \text{ ft}^2 = 232.95 \text{ ft}^3$$

The proposed bioretention area has a total volume of 416 ft³ below the lowest outlet, thus Standard 3 is satisfied. See attached HydroCAD Stage-Area-Storage worksheet demonstrating the volume of the system.

Based upon an exfiltration rate of 2.41 in./hr. (Rawls rate for loamy sand), the drawdown time is calculated as follows:

$\text{Time}_{\text{drawdown}} = R_v / (K \times \text{Bottom Area})$ where, R_v = recharge BMP storage volume
 K = Saturated Hydraulic Conductivity (Rawls) Rate

Infiltration Basin

$$\text{Time}_{\text{drawdown}} = 416 \text{ ft}^3 / (2.41 \text{ in./hr.}/12" \times 77.21 \text{ ft}^2) = 26.83 \text{ hours} < 72 \text{ hours.}$$

Water Quality Calculations (Stormwater Management Standard 4)

The site is in a Zone II wellhead protection area thus, the required Water Quality Volume shall be calculated using 1.0 inches of runoff times the impervious area. Refer to Appendix G for detailed TSS calculations that demonstrate better than 80% TSS removal rates for the site and that 44% of TSS is removed prior to exfiltration.

Water Quality Volume: $V = 1.0"/12 \times A_{\text{IMP}}$

Parking Lot Improvements
NBM Realty, LLC

$V = 1.0"/12 \times 4,659 \text{ ft}^2 = 388.25 \text{ ft}^3$ required volume
Provided volume = 416 ft³

(see HydroCAD stage-storage-volume sheet following this Narrative)

Forebay Sizing:

$V = 0.1"/12 \times A_{IMP}$
 $V = 0.1"/12 \times 4,659 = 38.83 \text{ ft}^3$

Forebay #1
Provided volume = 64 ft³

(see HydroCAD stage-storage-volume sheet following this Narrative)

Additionally, a Long-Term Pollution Prevention Plan has been developed for the site (refer to Appendix F).

Higher Potential Pollutant Loads (Stormwater Management Standard 5)

The site's proposed use (Multi-Family Dwelling) does not constitute a land use with a higher potential pollutant load (LUHPPL).

Protection of Critical Areas (Stormwater Management Standard 6)

The site is within a Critical Area (Zone II) and has been designed accordingly.

Redevelopment Projects (Stormwater Management Standard 7)

The site does not meet the criteria of a redevelopment project, as the net impervious area will increase.

Erosion/Sediment Control (Stormwater Management Standard 8)

Site development plans provide details for erosion and sediment control during construction.

Operation/Maintenance Plan (Stormwater Management Standard 9)

Refer to Appendix E for the site Long-Term Drainage System Operation & Maintenance Plan.

Illicit Discharge Compliance Statement (Stormwater Management Standard 10)

There are no existing illicit discharges to GEI or the owner's knowledge and there are no proposed illicit discharges. There are no cross-connections between the stormwater system and the wastewater system and discharges to each will remain separate; these systems are shown on the project drawings.

NBM-423MAIN_POST-DEVELOPMENT

Type III 24-hr 2-Year Rainfall=3.14"

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Printed 12/21/2020

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Stage-Area-Storage for Pond 1P: Rain Garden

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
585.00	77	0	586.04	250	169
585.02	80	2	586.06	254	174
585.04	84	3	586.08	258	179
585.06	87	5	586.10	262	185
585.08	90	7	586.12	266	190
585.10	94	9	586.14	269	195
585.12	97	10	586.16	273	201
585.14	100	12	586.18	277	206
585.16	103	14	586.20	281	212
585.18	107	17	586.22	285	217
585.20	110	19	586.24	289	223
585.22	113	21	586.26	293	229
585.24	117	23	586.28	297	235
585.26	120	26	586.30	301	241
585.28	123	28	586.32	305	247
585.30	126	31	586.34	309	253
585.32	130	33	586.36	313	259
585.34	133	36	586.38	316	266
585.36	136	38	586.40	320	272
585.38	140	41	586.42	324	278
585.40	143	44	586.44	328	285
585.42	146	47	586.46	332	292
585.44	150	50	586.48	336	298
585.46	153	53	586.50	340	305
585.48	156	56	586.52	344	312
585.50	160	59	586.54	348	319
585.52	163	62	586.56	352	326
585.54	166	66	586.58	356	333
585.56	169	69	586.60	360	340
585.58	173	72	586.62	364	347
585.60	176	76	586.64	367	355
585.62	179	79	586.66	371	362
585.64	183	83	586.68	375	369
585.66	186	87	586.70	379	377
585.68	189	91	586.72	383	385
585.70	193	94	586.74	387	392
585.72	196	98	586.76	391	400
585.74	199	102	586.78	395	408
585.76	202	106	586.80	399	416
585.78	206	110	586.82	403	424
585.80	209	114	586.84	407	432
585.82	212	119	586.86	411	440
585.84	216	123	586.88	414	448
585.86	219	127	586.90	418	457
585.88	222	132	586.92	422	465
585.90	225	136	586.94	426	474
585.92	229	141	586.96	430	482
585.94	232	145	586.98	434	491
585.96	235	150	587.00	438	500
585.98	239	155			
586.00	242	160			
586.02	246	164			

LOWEST ORIFICE

NBM-423MAIN_POST-DEVELOPMENT

Type III 24-hr 2-Year Rainfall=3.14"

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Stage-Area-Storage for Pond 2P: Sediment Forebay

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
585.00	10	0	586.04	30	21
585.02	10	0	586.06	31	21
585.04	11	0	586.08	31	22
585.06	11	1	586.10	32	23
585.08	12	1	586.12	33	23
585.10	12	1	586.14	33	24
585.12	12	1	586.16	34	25
585.14	13	2	586.18	34	25
585.16	13	2	586.20	35	26
585.18	13	2	586.22	36	27
585.20	14	2	586.24	36	27
585.22	14	3	586.26	37	28
585.24	15	3	586.28	37	29
585.26	15	3	586.30	38	30
585.28	15	4	586.32	39	30
585.30	16	4	586.34	39	31
585.32	16	4	586.36	40	32
585.34	16	4	586.38	40	33
585.36	17	5	586.40	41	33
585.38	17	5	586.42	42	34
585.40	18	6	586.44	42	35
585.42	18	6	586.46	43	36
585.44	18	6	586.48	43	37
585.46	19	7	586.50	44	38
585.48	19	7	586.52	45	39
585.50	20	7	586.54	45	40
585.52	20	8	586.56	46	40
585.54	20	8	586.58	46	41
585.56	21	9	586.60	47	42
585.58	21	9	586.62	48	43
585.60	21	9	586.64	48	44
585.62	22	10	586.66	49	45
585.64	22	10	586.68	49	46
585.66	23	11	586.70	50	47
585.68	23	11	586.72	51	48
585.70	23	12	586.74	51	49
585.72	24	12	586.76	52	50
585.74	24	13	586.78	52	51
585.76	24	13	586.80	53	52
585.78	25	14	586.82	54	53
585.80	25	14	586.84	54	54
585.82	26	15	586.86	55	56
585.84	26	15	586.88	55	57
585.86	26	16	586.90	56	58
585.88	27	16	586.92	57	59
585.90	27	17	586.94	57	60
585.92	27	17	586.96	58	61
585.94	28	18	586.98	58	62
585.96	28	18	587.00	59	64
585.98	29	19			
586.00	29	20			
586.02	30	20			

FOREBAY VOLUME

Extreme Precipitation Tables

Northeast Regional Climate Center

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

Smoothing	Yes
State	Massachusetts
Location	
Longitude	72.099 degrees West
Latitude	42.113 degrees North
Elevation	0 feet
Date/Time	Mon, 21 Dec 2020 17:01:33 -0500

423 MAIN ST.
STURBRIDGE

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.29	0.45	0.56	0.73	0.91	1.14	1yr	0.79	1.06	1.32	1.65	2.07	2.59	2.89	1yr	2.30	2.78	3.20	3.88	4.50	1yr
2yr	0.35	0.53	0.66	0.87	1.10	1.38	2yr	0.95	1.27	1.60	2.00	2.51	3.14	3.50	2yr	2.78	3.36	3.87	4.60	5.24	2yr
5yr	0.41	0.64	0.80	1.08	1.38	1.75	5yr	1.19	1.58	2.02	2.53	3.15	3.92	4.44	5yr	3.47	4.27	4.89	5.76	6.50	5yr
10yr	0.46	0.73	0.92	1.25	1.63	2.09	10yr	1.41	1.86	2.42	3.03	3.77	4.65	5.32	10yr	4.11	5.12	5.84	6.84	7.65	10yr
25yr	0.55	0.88	1.12	1.54	2.04	2.63	25yr	1.76	2.32	3.07	3.83	4.75	5.82	6.77	25yr	5.15	6.51	7.39	8.58	9.51	25yr
50yr	0.62	1.00	1.28	1.80	2.43	3.16	50yr	2.10	2.74	3.69	4.61	5.67	6.91	8.13	50yr	6.11	7.81	8.84	10.18	11.20	50yr
100yr	0.72	1.17	1.50	2.12	2.89	3.77	100yr	2.49	3.24	4.41	5.50	6.76	8.20	9.76	100yr	7.26	9.39	10.57	12.10	13.21	100yr
200yr	0.82	1.34	1.74	2.49	3.44	4.51	200yr	2.97	3.83	5.28	6.59	8.06	9.75	11.74	200yr	8.63	11.29	12.66	14.39	15.58	200yr
500yr	1.00	1.64	2.14	3.10	4.33	5.72	500yr	3.74	4.79	6.70	8.35	10.19	12.25	15.00	500yr	10.84	14.42	16.06	18.09	19.39	500yr

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.24	0.37	0.45	0.60	0.74	0.97	1yr	0.64	0.94	1.16	1.51	1.94	2.26	2.51	1yr	2.00	2.41	2.95	3.11	4.15	1yr
2yr	0.34	0.52	0.64	0.86	1.06	1.27	2yr	0.92	1.24	1.43	1.89	2.43	3.06	3.40	2yr	2.71	3.27	3.74	4.44	5.07	2yr
5yr	0.38	0.59	0.74	1.01	1.28	1.52	5yr	1.11	1.49	1.75	2.25	2.82	3.67	4.14	5yr	3.25	3.98	4.51	5.30	6.00	5yr
10yr	0.43	0.66	0.82	1.14	1.48	1.75	10yr	1.27	1.71	2.00	2.56	3.13	4.22	4.82	10yr	3.74	4.64	5.20	6.05	6.73	10yr
25yr	0.50	0.76	0.95	1.35	1.78	2.09	25yr	1.53	2.05	2.38	3.03	3.60	5.12	5.91	25yr	4.53	5.68	6.30	7.23	7.81	25yr
50yr	0.56	0.85	1.06	1.52	2.04	2.41	50yr	1.76	2.36	2.74	3.48	4.01	5.93	6.91	50yr	5.25	6.64	7.28	8.30	8.72	50yr
100yr	0.63	0.96	1.20	1.73	2.37	2.79	100yr	2.05	2.73	3.14	3.99	4.46	6.90	8.11	100yr	6.10	7.80	8.43	9.54	9.74	100yr
200yr	0.71	1.07	1.36	1.96	2.74	3.24	200yr	2.36	3.17	3.63	4.61	4.98	8.02	9.55	200yr	7.10	9.18	9.80	10.97	10.91	200yr
500yr	0.85	1.26	1.63	2.36	3.36	3.95	500yr	2.90	3.86	4.41	5.60	5.78	9.84	11.87	500yr	8.71	11.42	11.99	13.25	12.73	500yr

Upper Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.32	0.49	0.59	0.80	0.98	1.18	1yr	0.85	1.15	1.36	1.73	2.33	2.79	3.20	1yr	2.47	3.08	3.50	4.20	4.84	1yr
2yr	0.36	0.55	0.68	0.92	1.13	1.33	2yr	0.98	1.30	1.55	2.00	2.59	3.26	3.63	2yr	2.88	3.49	4.02	4.78	5.51	2yr
5yr	0.44	0.67	0.84	1.15	1.46	1.70	5yr	1.26	1.66	1.95	2.52	3.18	4.19	4.77	5yr	3.71	4.59	5.30	6.25	6.97	5yr
10yr	0.51	0.79	0.98	1.37	1.77	2.05	10yr	1.52	2.00	2.38	3.03	3.75	5.08	5.88	10yr	4.50	5.65	6.54	7.64	8.45	10yr
25yr	0.64	0.97	1.21	1.73	2.27	2.61	25yr	1.96	2.56	3.09	3.85	4.68	6.57	7.72	25yr	5.81	7.42	8.63	9.98	10.90	25yr
50yr	0.75	1.15	1.43	2.05	2.76	3.15	50yr	2.38	3.08	3.76	4.61	5.54	7.96	9.50	50yr	7.04	9.13	10.64	12.22	13.21	50yr
100yr	0.90	1.36	1.70	2.45	3.36	3.79	100yr	2.90	3.70	4.57	5.52	6.52	9.63	11.68	100yr	8.52	11.23	13.11	14.92	16.01	100yr
200yr	1.06	1.59	2.02	2.93	4.08	4.55	200yr	3.52	4.45	5.55	6.61	7.71	11.62	14.35	200yr	10.28	13.80	16.16	18.22	19.41	200yr
500yr	1.35	2.01	2.58	3.75	5.33	5.81	500yr	4.60	5.68	7.16	8.40	9.61	14.93	18.84	500yr	13.22	18.11	21.28	23.66	25.04	500yr



APPENDIX A

MASSDEP STORMWATER REPORT CHECKLIST



Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.¹ This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8²
- Operation and Maintenance Plan required by Standard 9

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

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

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

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

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



Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

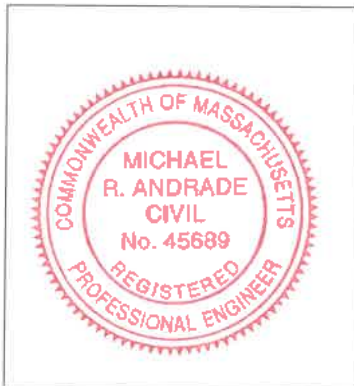
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



 1-4-21
Signature and Date

Checklist

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

- New development
- Redevelopment
- Mix of New Development and Redevelopment



Checklist for Stormwater Report

Checklist (continued)

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

- No disturbance to any Wetland Resource Areas
- Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- Reduced Impervious Area (Redevelopment Only)
- Minimizing disturbance to existing trees and shrubs
- LID Site Design Credit Requested:
 - Credit 1
 - Credit 2
 - Credit 3
- Use of "country drainage" versus curb and gutter conveyance and pipe
- Bioretention Cells (includes Rain Gardens)
- Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- Treebox Filter
- Water Quality Swale
- Grass Channel
- Green Roof
- Other (describe): _____

Standard 1: No New Untreated Discharges

- No new untreated discharges
- Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.



Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

- Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.
- Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.
- Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

- Soil Analysis provided.
- Required Recharge Volume calculation provided.
- Required Recharge volume reduced through use of the LID site Design Credits.
- Sizing the infiltration, BMPs is based on the following method: Check the method used.
 - Static
 - Simple Dynamic
 - Dynamic Field¹
- Runoff from all impervious areas at the site discharging to the infiltration BMP.
- Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.
- Recharge BMPs have been sized to infiltrate the Required Recharge Volume.
- Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:
 - Site is comprised solely of C and D soils and/or bedrock at the land surface
 - M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
 - Solid Waste Landfill pursuant to 310 CMR 19.000
 - Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.
- Calculations showing that the infiltration BMPs will drain in 72 hours are provided.
- Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

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



Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

- The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.
- Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

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

- Good housekeeping practices;
 - Provisions for storing materials and waste products inside or under cover;
 - Vehicle washing controls;
 - Requirements for routine inspections and maintenance of stormwater BMPs;
 - Spill prevention and response plans;
 - Provisions for maintenance of lawns, gardens, and other landscaped areas;
 - Requirements for storage and use of fertilizers, herbicides, and pesticides;
 - Pet waste management provisions;
 - Provisions for operation and management of septic systems;
 - Provisions for solid waste management;
 - Snow disposal and plowing plans relative to Wetland Resource Areas;
 - Winter Road Salt and/or Sand Use and Storage restrictions;
 - Street sweeping schedules;
 - Provisions for prevention of illicit discharges to the stormwater management system;
 - Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
 - Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
 - List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.
- A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.
 - Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:
 - is within the Zone II or Interim Wellhead Protection Area
 - is near or to other critical areas
 - is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
 - involves runoff from land uses with higher potential pollutant loads.
 - The Required Water Quality Volume is reduced through use of the LID site Design Credits.
 - Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.



Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

- The BMP is sized (and calculations provided) based on:
 - The ½" or 1" Water Quality Volume or
 - The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.
- The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.
- A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

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

- The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.
- The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted *prior* to the discharge of stormwater to the post-construction stormwater BMPs.
- The NPDES Multi-Sector General Permit does *not* cover the land use.
- LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.
- All exposure has been eliminated.
- All exposure has *not* been eliminated and all BMPs selected are on MassDEP LUHPPL list.
- The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

- The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.
- Critical areas and BMPs are identified in the Stormwater Report.



Checklist for Stormwater Report

Checklist (continued)

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

- The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:
- Limited Project
 - Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
 - Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
 - Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
 - Bike Path and/or Foot Path
 - Redevelopment Project
 - Redevelopment portion of mix of new and redevelopment.
- Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.
- The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

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

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

- Narrative;
 - Construction Period Operation and Maintenance Plan;
 - Names of Persons or Entity Responsible for Plan Compliance;
 - Construction Period Pollution Prevention Measures;
 - Erosion and Sedimentation Control Plan Drawings;
 - Detail drawings and specifications for erosion control BMPs, including sizing calculations;
 - Vegetation Planning;
 - Site Development Plan;
 - Construction Sequencing Plan;
 - Sequencing of Erosion and Sedimentation Controls;
 - Operation and Maintenance of Erosion and Sedimentation Controls;
 - Inspection Schedule;
 - Maintenance Schedule;
 - Inspection and Maintenance Log Form.
- A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.



Checklist for Stormwater Report

Checklist (continued)

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

- The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has **not** been included in the Stormwater Report but will be submitted **before** land disturbance begins.
- The project is **not** covered by a NPDES Construction General Permit.
- The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.
- The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted **BEFORE** land disturbance begins.

Standard 9: Operation and Maintenance Plan

- The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:
 - Name of the stormwater management system owners;
 - Party responsible for operation and maintenance;
 - Schedule for implementation of routine and non-routine maintenance tasks;
 - Plan showing the location of all stormwater BMPs maintenance access areas;
 - Description and delineation of public safety features;
 - Estimated operation and maintenance budget; and
 - Operation and Maintenance Log Form.
- The responsible party is **not** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:
 - A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
 - A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

- The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;
- An Illicit Discharge Compliance Statement is attached;
- NO** Illicit Discharge Compliance Statement is attached but will be submitted **prior to** the discharge of any stormwater to post-construction BMPs.

APPENDIX B

HYDROCAD REPORTS PRE-DEVELOPMENT



PRE-DEVELOPMENT



Design Point #1
(Southern Property
Line)



NBM-423MAIN_PRE-DEVELOPMENT

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Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
1,055	48	Brush, Poor, HSG A (1S)
5,313	96	Gravel surface, HSG A (1S)
1,034	98	Roofs (1S)
7,402	89	TOTAL AREA

NBM-423MAIN_PRE-DEVELOPMENT

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Page 3

Soil Listing (selected nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
6,368	HSG A	1S
0	HSG B	
0	HSG C	
0	HSG D	
1,034	Other	1S
7,402		TOTAL AREA

NBM-423MAIN_PRE-DEVELOPMENT

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Ground Covers (selected nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchm Numbers
1,055	0	0	0	0	1,055	Brush, Poor	
5,313	0	0	0	0	5,313	Gravel surface	
0	0	0	0	1,034	1,034	Roofs	
6,368	0	0	0	1,034	7,402	TOTAL AREA	

NBM-423MAIN_PRE-DEVELOPMENT

Type III 24-hr 2-Year Rainfall=3.14"

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Page 1

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

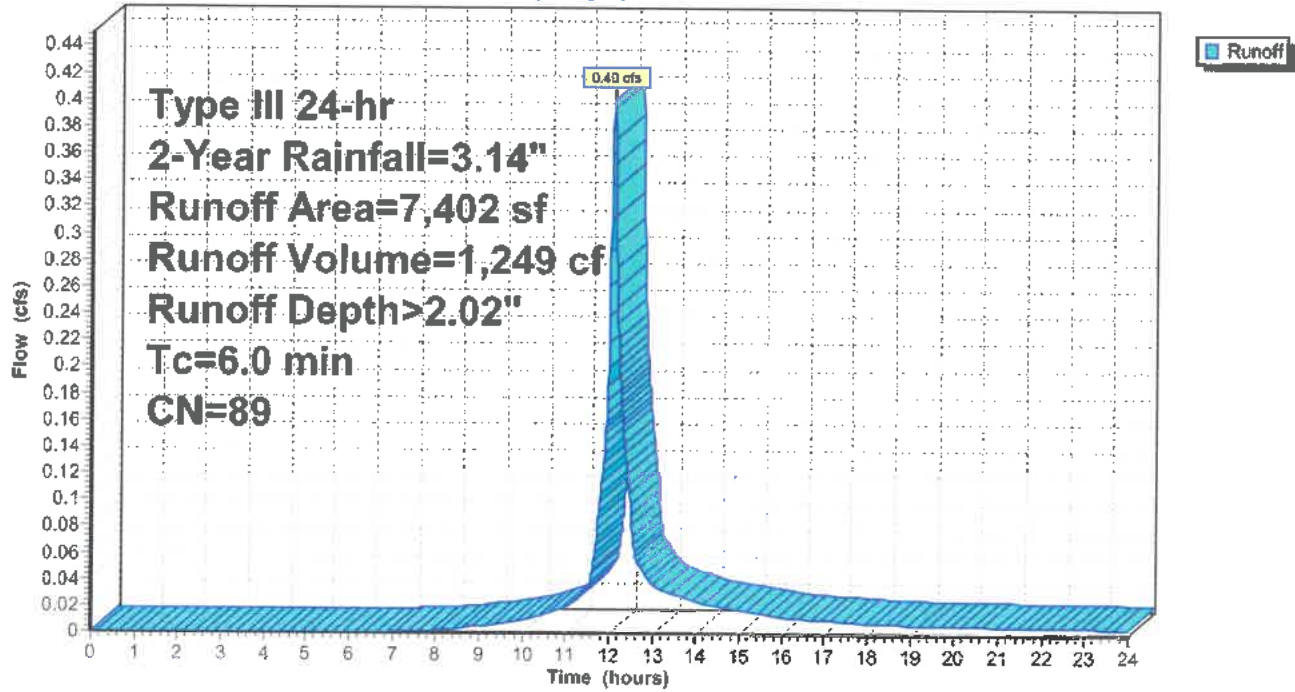
Subcatchment 1S: PRE-DEVELOPMENT Runoff Area=7,402 sf 13.97% Impervious Runoff Depth>2.02"
Tc=6.0 min CN=89 Runoff=0.40 cfs 1,249 cf

Link 1L: Design Point #1 (Southern Property Line) Inflow=0.40 cfs 1,249 cf
Primary=0.40 cfs 1,249 cf

Total Runoff Area = 7,402 sf Runoff Volume = 1,249 cf Average Runoff Depth = 2.02"
86.03% Pervious = 6,368 sf 13.97% Impervious = 1,034 sf

Subcatchment 1S: PRE-DEVELOPMENT

Hydrograph



NBM-423MAIN_PRE-DEVELOPMENT

Type III 24-hr 10-Year Rainfall=4.65"

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

Subcatchment 1S: PRE-DEVELOPMENT Runoff Area=7,402 sf 13.97% Impervious Runoff Depth=3.43"
Tc=6.0 min CN=89 Runoff=0.67 cfs 2,118 cf

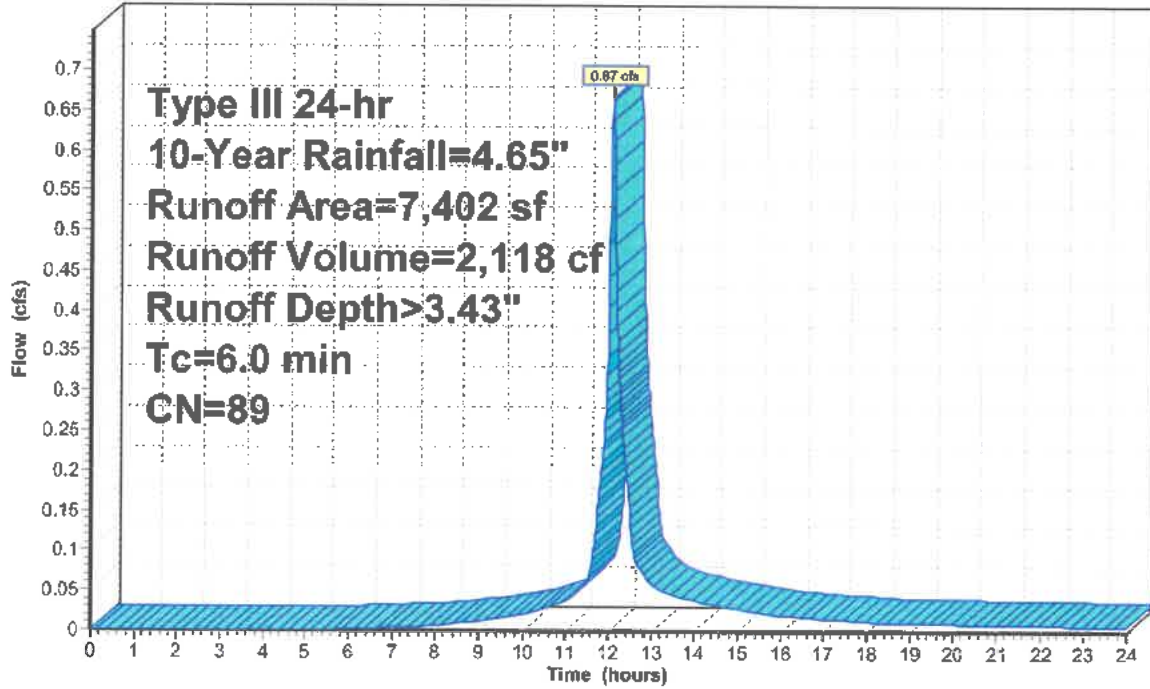
Link 1L: Design Point #1 (Southern Property Line)

Inflow=0.67 cfs 2,118 cf
Primary=0.67 cfs 2,118 cf

Total Runoff Area = 7,402 sf Runoff Volume = 2,118 cf Average Runoff Depth = 3.43"
86.03% Pervious = 6,368 sf 13.97% Impervious = 1,034 sf

Subcatchment 1S: PRE-DEVELOPMENT

Hydrograph



NBM-423MAIN_PRE-DEVELOPMENT

Type III 24-hr 25-Year Rainfall=5.82"

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

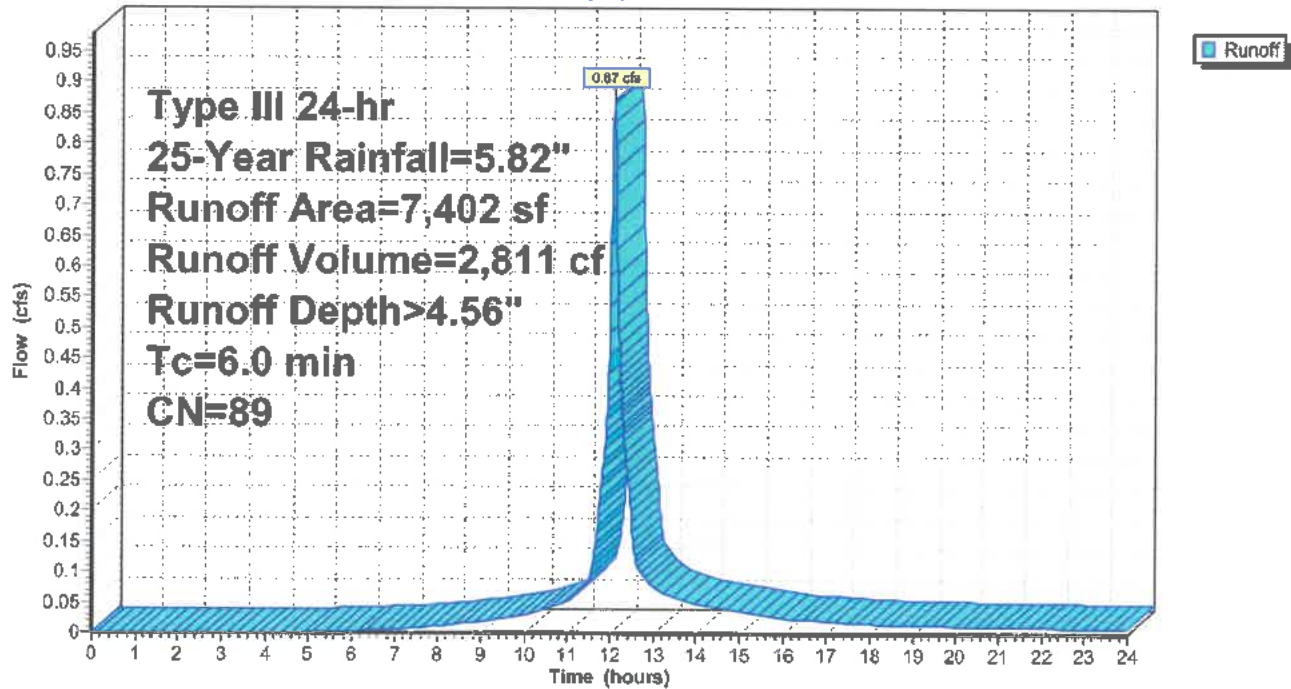
Subcatchment 1S: PRE-DEVELOPMENT Runoff Area=7,402 sf 13.97% Impervious Runoff Depth>4.56"
Tc=6.0 min CN=89 Runoff=0.87 cfs 2,811 cf

Link 1L: Design Point #1 (Southern Property Line) Inflow=0.87 cfs 2,811 cf
Primary=0.87 cfs 2,811 cf

Total Runoff Area = 7,402 sf Runoff Volume = 2,811 cf Average Runoff Depth = 4.56"
86.03% Pervious = 6,368 sf 13.97% Impervious = 1,034 sf

Subcatchment 1S: PRE-DEVELOPMENT

Hydrograph



NBM-423MAIN_PRE-DEVELOPMENT

Type III 24-hr 100-Year Rainfall=8.20"

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

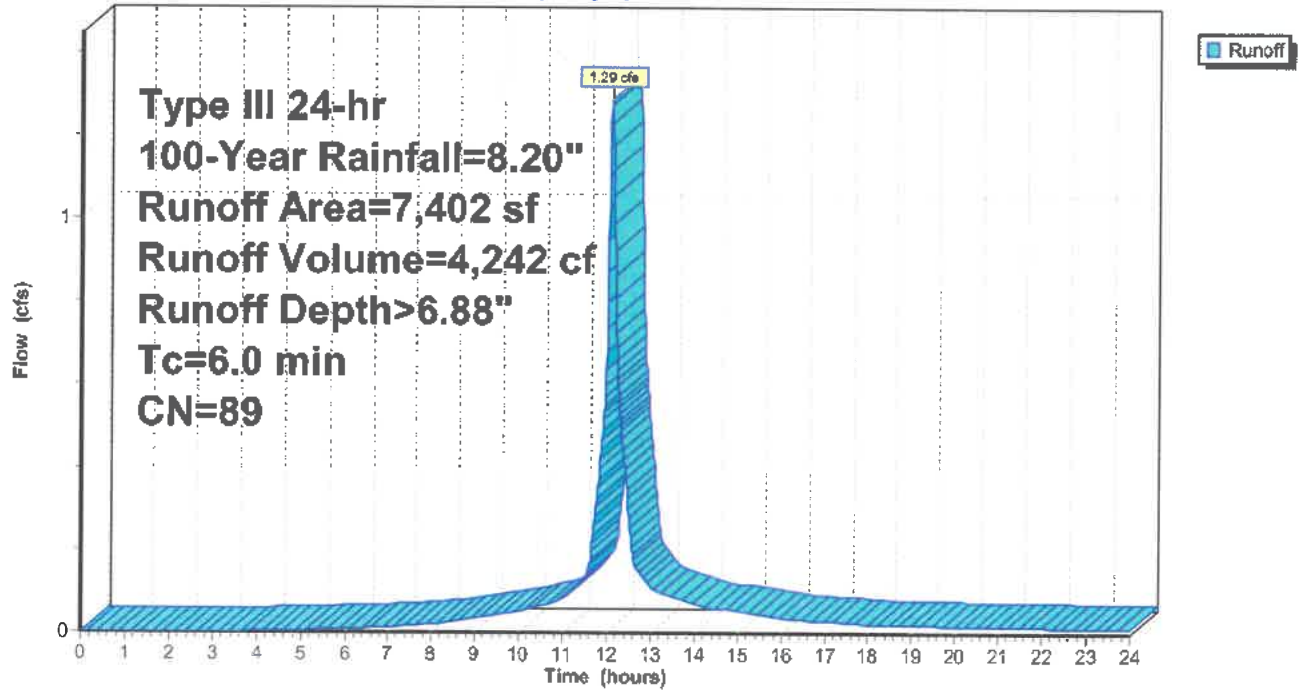
Subcatchment 1S: PRE-DEVELOPMENT Runoff Area=7,402 sf 13.97% Impervious Runoff Depth>6.88"
Tc=6.0 min CN=89 Runoff=1.29 cfs 4,242 cf

Link 1L: Design Point #1 (Southern Property Line) Inflow=1.29 cfs 4,242 cf
Primary=1.29 cfs 4,242 cf

Total Runoff Area = 7,402 sf Runoff Volume = 4,242 cf Average Runoff Depth = 6.88"
86.03% Pervious = 6,368 sf 13.97% Impervious = 1,034 sf

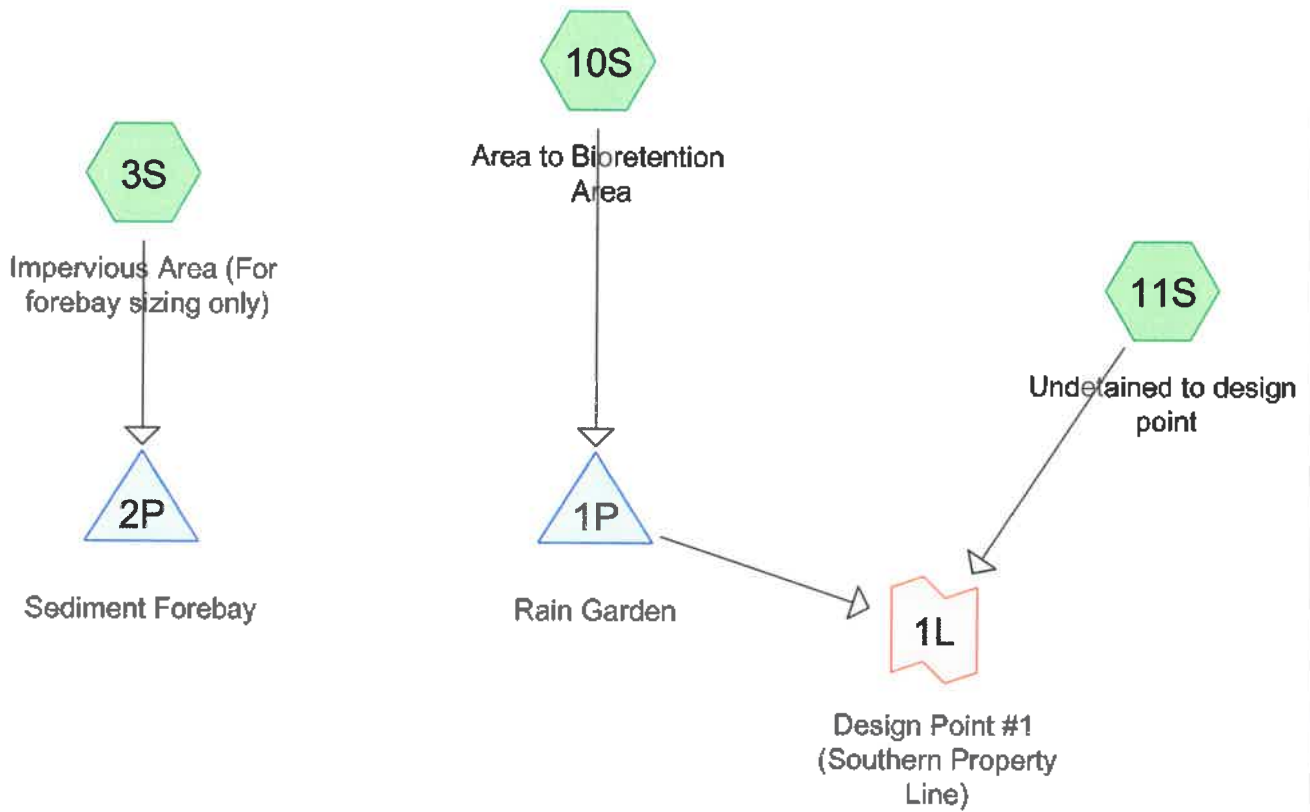
Subcatchment 1S: PRE-DEVELOPMENT

Hydrograph



APPENDIX C

HYDROCAD REPORTS POST-DEVELOPMENT



Routing Diagram for NBM-423MAIN_POST-DEVELOPMENT
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NBM-423MAIN_POST-DEVELOPMENT

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Page 2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
787	39	>75% Grass cover, Good, HSG A (10S)
550	30	Brush, Good, HSG A (11S)
9,756	98	Paved parking (3S, 10S)
2,068	98	Roofs (3S, 10S)
157	98	Unconnected pavement (Stone Trench & Concrete Pad) (10S)
157	98	Unconnected pavement, (Stone Trench, Concrete Pads) (3S)
13,475	92	TOTAL AREA

NBM-423MAIN_POST-DEVELOPMENT

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Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
1,337	HSG A	10S, 11S
0	HSG B	
0	HSG C	
0	HSG D	
12,138	Other	3S, 10S
13,475		TOTAL AREA

NBM-423MAIN_POST-DEVELOPMENT

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Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
787	0	0	0	0	787	>75% Grass cover, Good
550	0	0	0	0	550	Brush, Good
0	0	0	0	9,756	9,756	Paved parking
0	0	0	0	2,068	2,068	Roofs
0	0	0	0	157	157	Unconnected pavement (Stone Trench & Concrete Pad)
0	0	0	0	157	157	Unconnected pavement, (Stone Trench, Concrete Pads)
1,337	0	0	0	12,138	13,475	TOTAL AREA

NBM-423MAIN_POST-DEVELOPMENT

Type III 24-hr 2-Year Rainfall=3.14"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 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 3S: Impervious Area	Runoff Area=6,069 sf	100.00% Impervious	Runoff Depth=2.91"
	Tc=0.0 min	CN=98	Runoff=0.52 cfs 1,471 cf
Subcatchment 10S: Post-Development to	Runoff Area=6,856 sf	88.52% Impervious	Runoff Depth=2.20"
	Tc=6.0 min	CN=91	Runoff=0.40 cfs 1,258 cf
Subcatchment 11S: Post-Development	Runoff Area=550 sf	0.00% Impervious	Runoff Depth=0.00"
	Tc=6.0 min	CN=30	Runoff=0.00 cfs 0 cf
Pond 1P: Rain Garden	Peak Elev=586.86'	Storage=438 cf	Inflow=0.40 cfs 1,258 cf
	Discarded=0.02 cfs 1,005 cf	Primary=0.20 cfs 253 cf	Outflow=0.22 cfs 1,258 cf
Pond 2P: Sediment Forebay	Peak Elev=586.59'	Storage=42 cf	Inflow=0.52 cfs 1,471 cf
			Outflow=0.52 cfs 1,433 cf
Link 1L: Design Point #1 (Southern Property Line)			Inflow=0.20 cfs 253 cf
			Primary=0.20 cfs 253 cf

Total Runoff Area = 13,475 sf Runoff Volume = 2,729 cf Average Runoff Depth = 2.43"
9.92% Pervious = 1,337 sf 90.08% Impervious = 12,138 sf

Summary for Subcatchment 3S: Impervious Area (For forebay sizing only)

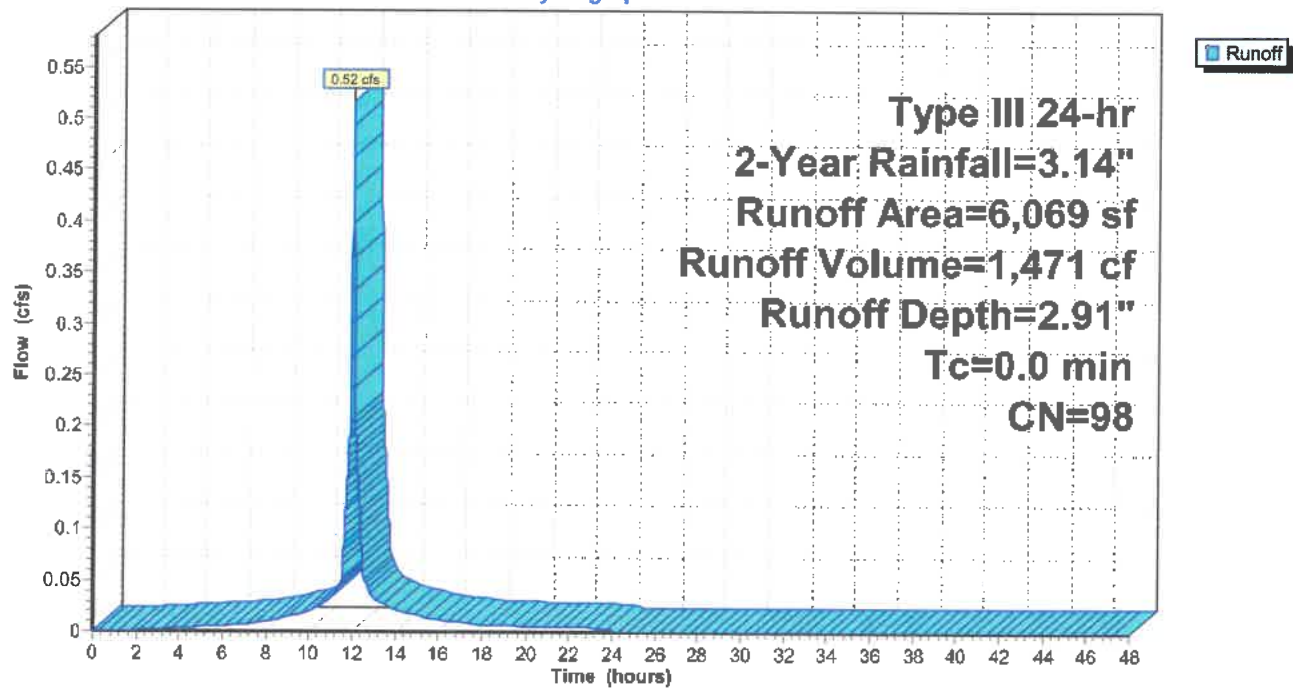
Runoff = 0.52 cfs @ 12.00 hrs, Volume= 1,471 cf, Depth= 2.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2-Year Rainfall=3.14"

	Area (sf)	CN	Description
*	4,878	98	Paved parking
*	157	98	Unconnected pavement, (Stone Trench, Concrete Pads)
*	1,034	98	Roofs
<hr/>			
	6,069	98	Weighted Average
	6,069		100.00% Impervious Area
	157		2.59% Unconnected

Subcatchment 3S: Impervious Area (For forebay sizing only)

Hydrograph



Summary for Subcatchment 10S: Area to Bioretention Area

Runoff = 0.40 cfs @ 12.09 hrs, Volume= 1,258 cf, Depth= 2.20"

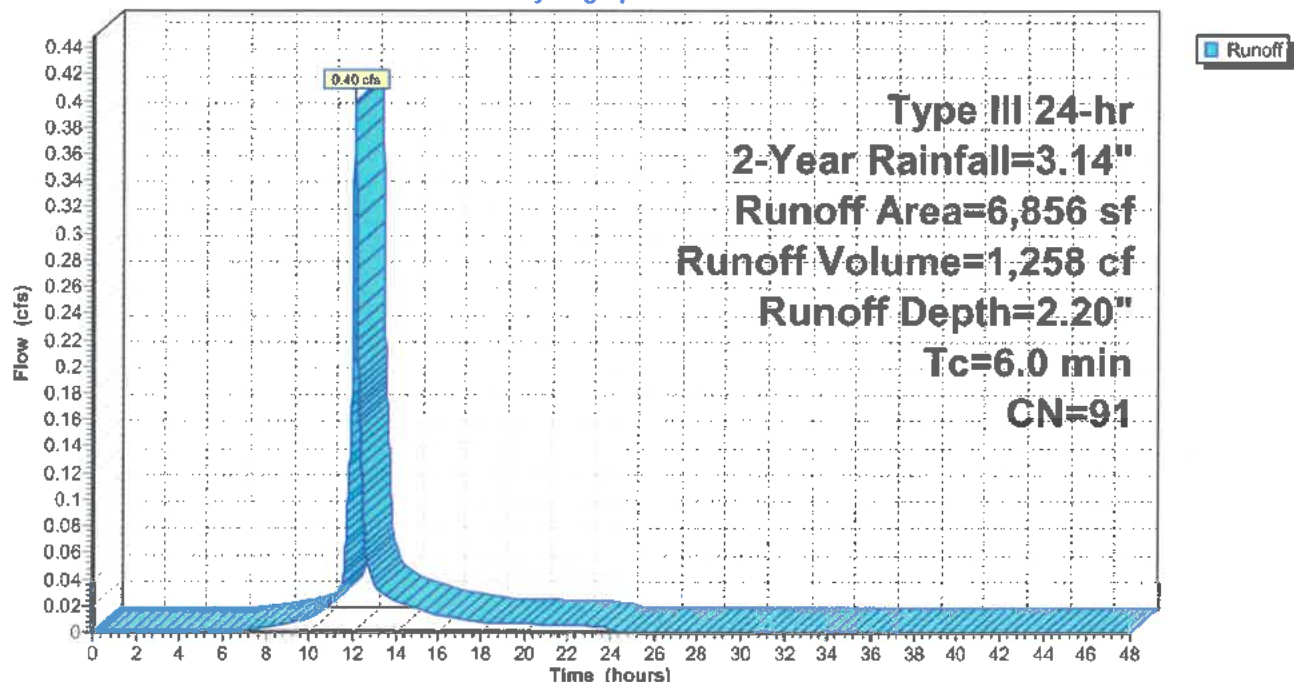
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2-Year Rainfall=3.14"

	Area (sf)	CN	Description
*	4,878	98	Paved parking
*	157	98	Unconnected pavement (Stone Trench & Concrete Pad)
*	1,034	98	Roofs
	787	39	>75% Grass cover, Good, HSG A
	6,856	91	Weighted Average
	787		11.48% Pervious Area
	6,069		88.52% Impervious Area
	157		2.59% Unconnected

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

Subcatchment 10S: Area to Bioretention Area

Hydrograph



Summary for Subcatchment 11S: Undetained to design point

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"

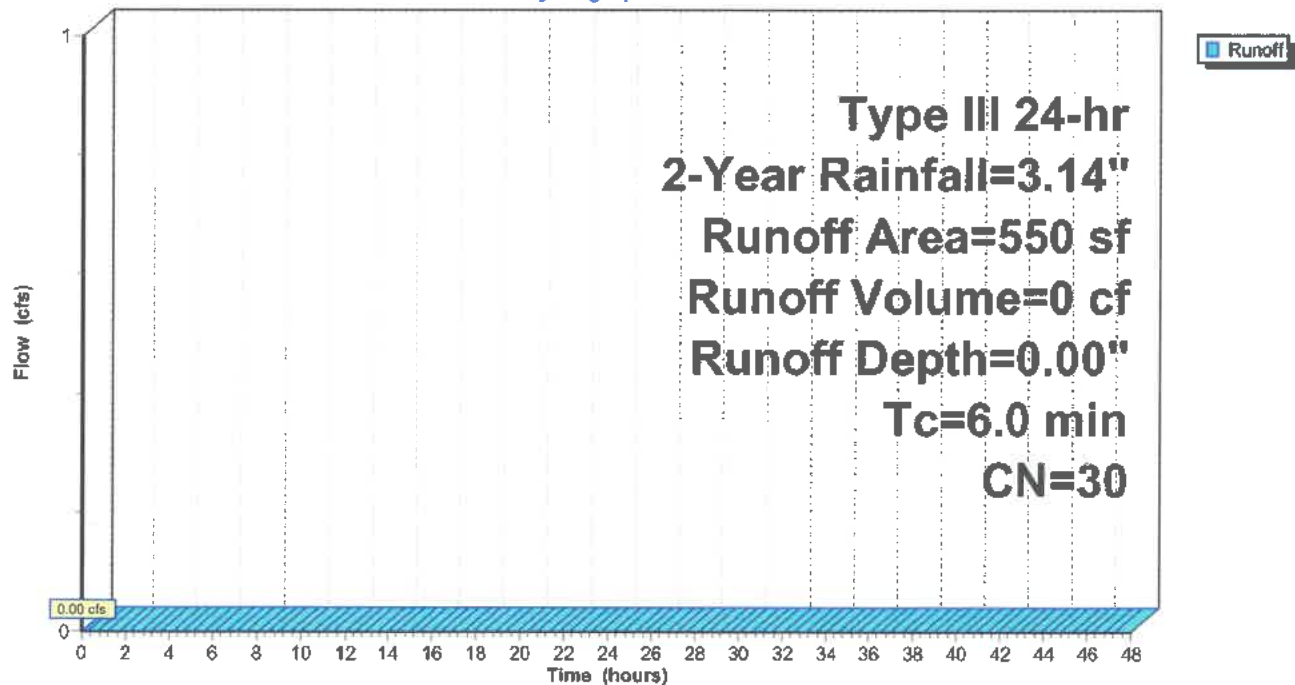
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2-Year Rainfall=3.14"

Area (sf)	CN	Description
550	30	Brush, Good, HSG A
550		100.00% Pervious Area

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

Subcatchment 11S: Undetained to design point

Hydrograph



Summary for Pond 1P: Rain Garden

Inflow Area = 6,856 sf, 88.52% Impervious, Inflow Depth = 2.20" for 2-Year event
 Inflow = 0.40 cfs @ 12.09 hrs, Volume= 1,258 cf
 Outflow = 0.22 cfs @ 12.21 hrs, Volume= 1,258 cf, Atten= 45%, Lag= 7.6 min
 Discarded = 0.02 cfs @ 12.21 hrs, Volume= 1,005 cf
 Primary = 0.20 cfs @ 12.21 hrs, Volume= 253 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 586.86' @ 12.21 hrs Surf.Area= 410 sf Storage= 438 cf

Plug-Flow detention time= 183.5 min calculated for 1,258 cf (100% of inflow)
 Center-of-Mass det. time= 183.5 min (986.7 - 803.2)

Volume	Invert	Avail.Storage	Storage Description
#1	585.00'	500 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
585.00	77	0	0
586.00	242	160	160
587.00	438	340	500

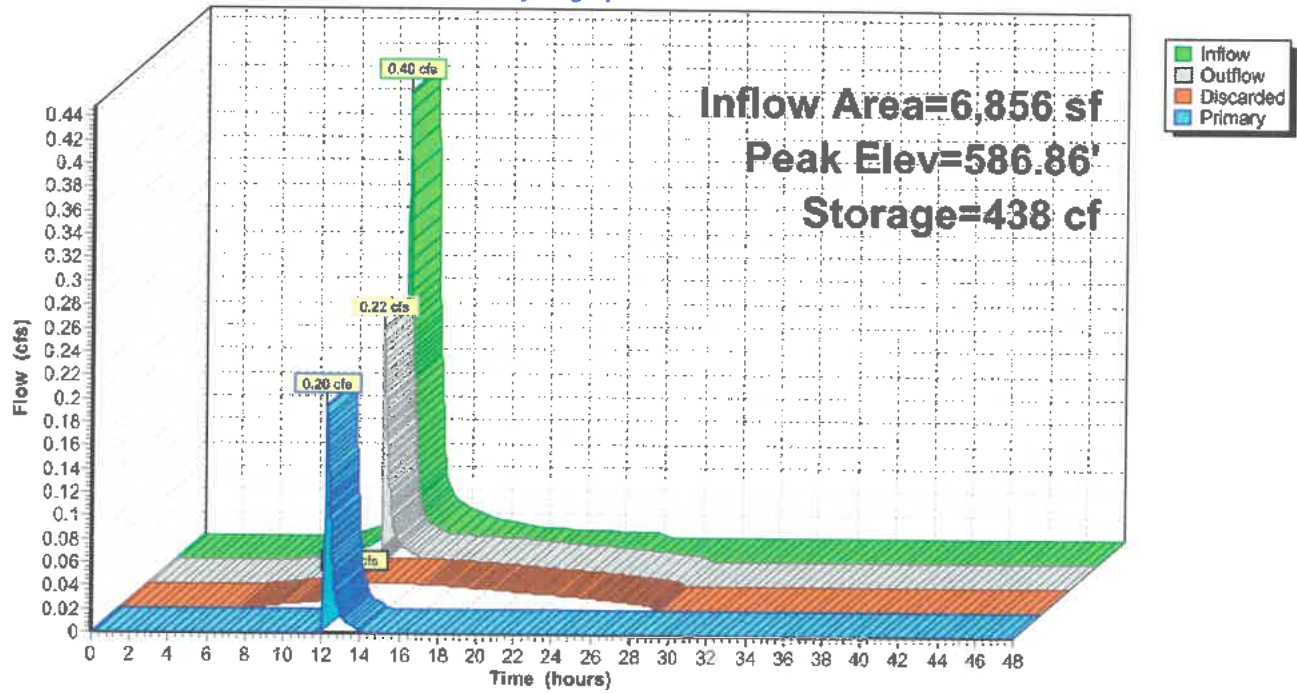
Device	Routing	Invert	Outlet Devices
#1	Primary	586.80'	6.0' long x 3.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32
#2	Discarded	585.00'	2.410 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.02 cfs @ 12.21 hrs HW=586.86' (Free Discharge)
 ↳2=Exfiltration (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.19 cfs @ 12.21 hrs HW=586.86' (Free Discharge)
 ↳1=Broad-Crested Rectangular Weir (Weir Controls 0.19 cfs @ 0.58 fps)

Pond 1P: Rain Garden

Hydrograph



Stage-Area-Storage for Pond 1P: Rain Garden

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
585.00	77	0	586.04	250	169
585.02	80	2	586.06	254	174
585.04	84	3	586.08	258	179
585.06	87	5	586.10	262	185
585.08	90	7	586.12	266	190
585.10	94	9	586.14	269	195
585.12	97	10	586.16	273	201
585.14	100	12	586.18	277	206
585.16	103	14	586.20	281	212
585.18	107	17	586.22	285	217
585.20	110	19	586.24	289	223
585.22	113	21	586.26	293	229
585.24	117	23	586.28	297	235
585.26	120	26	586.30	301	241
585.28	123	28	586.32	305	247
585.30	126	31	586.34	309	253
585.32	130	33	586.36	313	259
585.34	133	36	586.38	316	266
585.36	136	38	586.40	320	272
585.38	140	41	586.42	324	278
585.40	143	44	586.44	328	285
585.42	146	47	586.46	332	292
585.44	150	50	586.48	336	298
585.46	153	53	586.50	340	305
585.48	156	56	586.52	344	312
585.50	160	59	586.54	348	319
585.52	163	62	586.56	352	326
585.54	166	66	586.58	356	333
585.56	169	69	586.60	360	340
585.58	173	72	586.62	364	347
585.60	176	76	586.64	367	355
585.62	179	79	586.66	371	362
585.64	183	83	586.68	375	369
585.66	186	87	586.70	379	377
585.68	189	91	586.72	383	385
585.70	193	94	586.74	387	392
585.72	196	98	586.76	391	400
585.74	199	102	586.78	395	408
585.76	202	106	586.80	399	416
585.78	206	110	586.82	403	424
585.80	209	114	586.84	407	432
585.82	212	119	586.86	411	440
585.84	216	123	586.88	414	448
585.86	219	127	586.90	418	457
585.88	222	132	586.92	422	465
585.90	225	136	586.94	426	474
585.92	229	141	586.96	430	482
585.94	232	145	586.98	434	491
585.96	235	150	587.00	438	500
585.98	239	155			
586.00	242	160			
586.02	246	164			

Summary for Pond 2P: Sediment Forebay

Inflow Area = 6,069 sf, 100.00% Impervious, Inflow Depth = 2.91" for 2-Year event
 Inflow = 0.52 cfs @ 12.00 hrs, Volume= 1,471 cf
 Outflow = 0.52 cfs @ 12.00 hrs, Volume= 1,433 cf, Atten= 1%, Lag= 0.1 min
 Primary = 0.52 cfs @ 12.00 hrs, Volume= 1,433 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 586.59' @ 12.00 hrs Surf.Area= 47 sf Storage= 42 cf

Plug-Flow detention time= 29.6 min calculated for 1,433 cf (97% of inflow)
 Center-of-Mass det. time= 13.5 min (764.7 - 751.2)

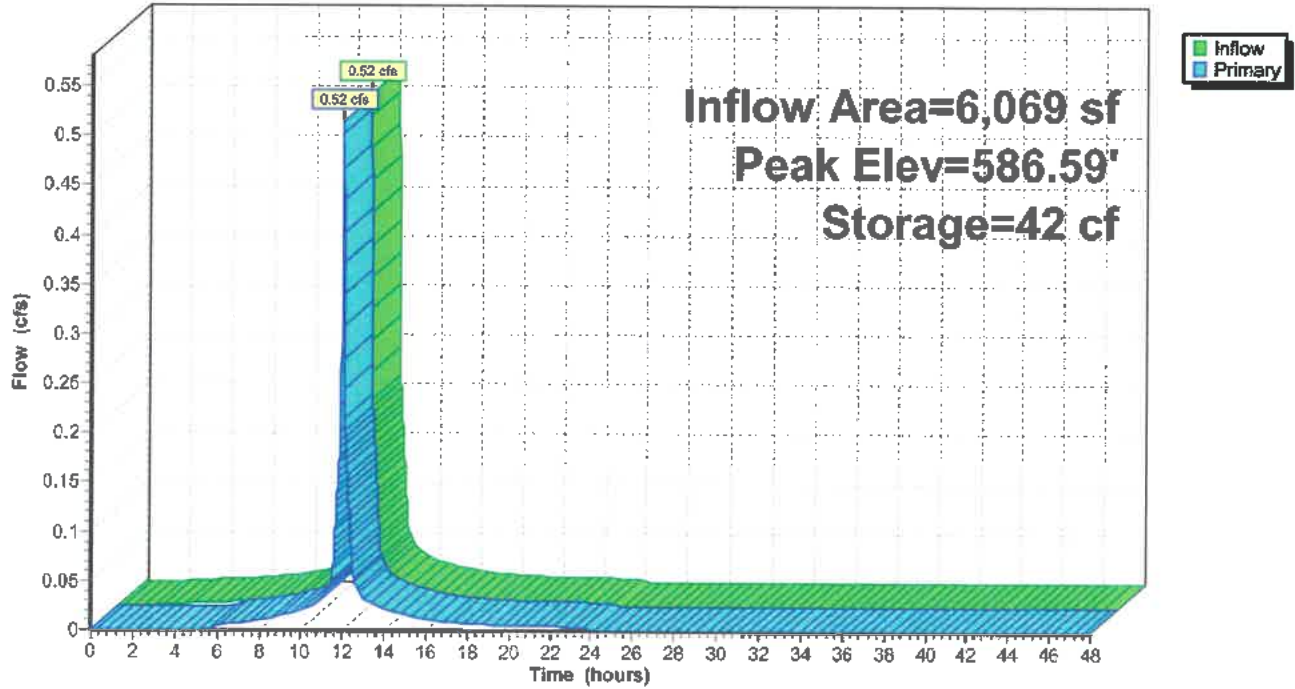
Volume	Invert	Avall.Storage	Storage Description
#1	585.00'	64 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
585.00	10	0	0
586.00	29	20	20
587.00	59	44	64

Device	Routing	Invert	Outlet Devices
#1	Primary	586.50'	6.5' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=0.51 cfs @ 12.00 hrs HW=586.59' (Free Discharge)
 ↳ **1=Broad-Crested Rectangular Weir** (Weir Controls 0.51 cfs @ 0.85 fps)

Pond 2P: Sediment Forebay

Hydrograph



Stage-Area-Storage for Pond 2P: Sediment Forebay

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
585.00	10	0	586.04	30	21
585.02	10	0	586.06	31	21
585.04	11	0	586.08	31	22
585.06	11	1	586.10	32	23
585.08	12	1	586.12	33	23
585.10	12	1	586.14	33	24
585.12	12	1	586.16	34	25
585.14	13	2	586.18	34	25
585.16	13	2	586.20	35	26
585.18	13	2	586.22	36	27
585.20	14	2	586.24	36	27
585.22	14	3	586.26	37	28
585.24	15	3	586.28	37	29
585.26	15	3	586.30	38	30
585.28	15	4	586.32	39	30
585.30	16	4	586.34	39	31
585.32	16	4	586.36	40	32
585.34	16	4	586.38	40	33
585.36	17	5	586.40	41	33
585.38	17	5	586.42	42	34
585.40	18	6	586.44	42	35
585.42	18	6	586.46	43	36
585.44	18	6	586.48	43	37
585.46	19	7	586.50	44	38
585.48	19	7	586.52	45	39
585.50	20	7	586.54	45	40
585.52	20	8	586.56	46	40
585.54	20	8	586.58	46	41
585.56	21	9	586.60	47	42
585.58	21	9	586.62	48	43
585.60	21	9	586.64	48	44
585.62	22	10	586.66	49	45
585.64	22	10	586.68	49	46
585.66	23	11	586.70	50	47
585.68	23	11	586.72	51	48
585.70	23	12	586.74	51	49
585.72	24	12	586.76	52	50
585.74	24	13	586.78	52	51
585.76	24	13	586.80	53	52
585.78	25	14	586.82	54	53
585.80	25	14	586.84	54	54
585.82	26	15	586.86	55	56
585.84	26	15	586.88	55	57
585.86	26	16	586.90	56	58
585.88	27	16	586.92	57	59
585.90	27	17	586.94	57	60
585.92	27	17	586.96	58	61
585.94	28	18	586.98	58	62
585.96	28	18	587.00	59	64
585.98	29	19			
586.00	29	20			
586.02	30	20			

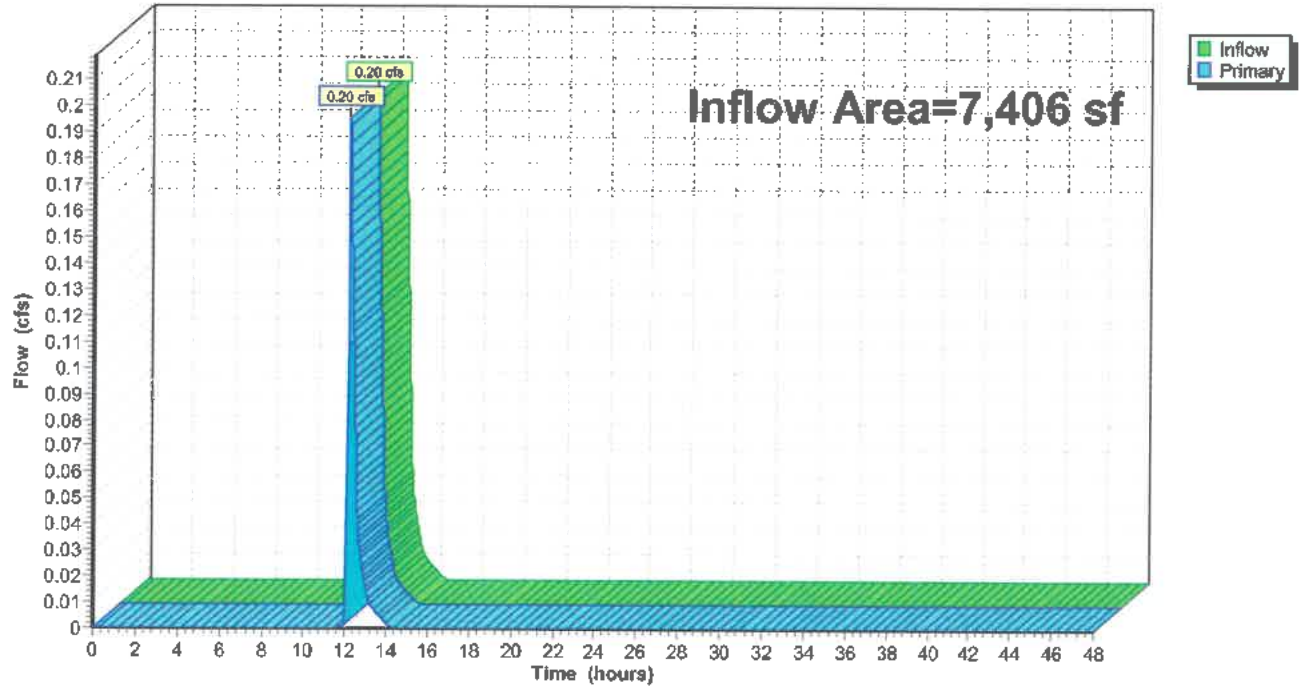
Summary for Link 1L: Design Point #1 (Southern Property Line)

Inflow Area = 7,406 sf, 81.95% Impervious, Inflow Depth = 0.41" for 2-Year event
Inflow = 0.20 cfs @ 12.21 hrs, Volume= 253 cf
Primary = 0.20 cfs @ 12.21 hrs, Volume= 253 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 1L: Design Point #1 (Southern Property Line)

Hydrograph



NBM-423MAIN_POST-DEVELOPMENT

Type III 24-hr 10-Year Rainfall=4.65"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 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 3S: Impervious Area Runoff Area=6,069 sf 100.00% Impervious Runoff Depth=4.41"
Tc=0.0 min CN=98 Runoff=0.77 cfs 2,232 cf

Subcatchment 10S: Post-Development to Runoff Area=6,856 sf 88.52% Impervious Runoff Depth=3.64"
Tc=6.0 min CN=91 Runoff=0.65 cfs 2,081 cf

Subcatchment 11S: Post-Development Runoff Area=550 sf 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=30 Runoff=0.00 cfs 0 cf

Pond 1P: Rain Garden Peak Elev=586.92' Storage=465 cf Inflow=0.65 cfs 2,081 cf
Discarded=0.02 cfs 1,218 cf Primary=0.61 cfs 863 cf Outflow=0.63 cfs 2,081 cf

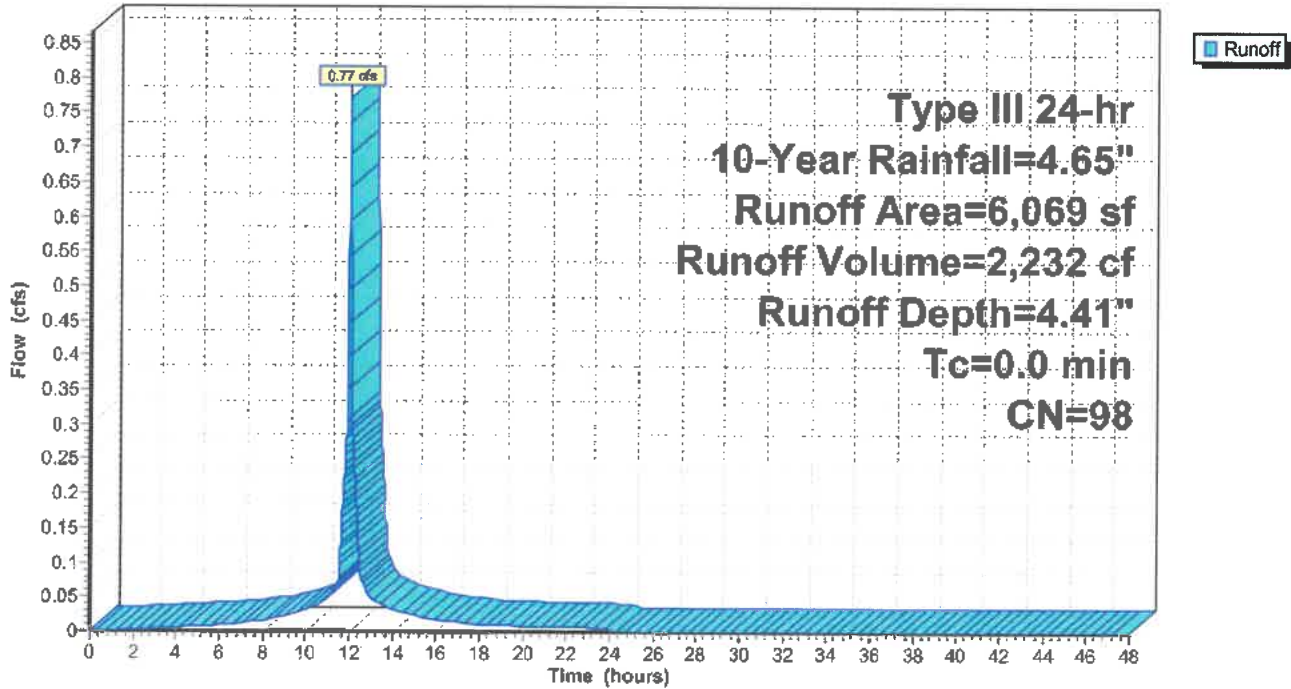
Pond 2P: Sediment Forebay Peak Elev=586.62' Storage=43 cf Inflow=0.77 cfs 2,232 cf
Outflow=0.77 cfs 2,195 cf

Link 1L: Design Point #1 (Southern Property Line) Inflow=0.61 cfs 863 cf
Primary=0.61 cfs 863 cf

Total Runoff Area = 13,475 sf Runoff Volume = 4,314 cf Average Runoff Depth = 3.84"
9.92% Pervious = 1,337 sf 90.08% Impervious = 12,138 sf

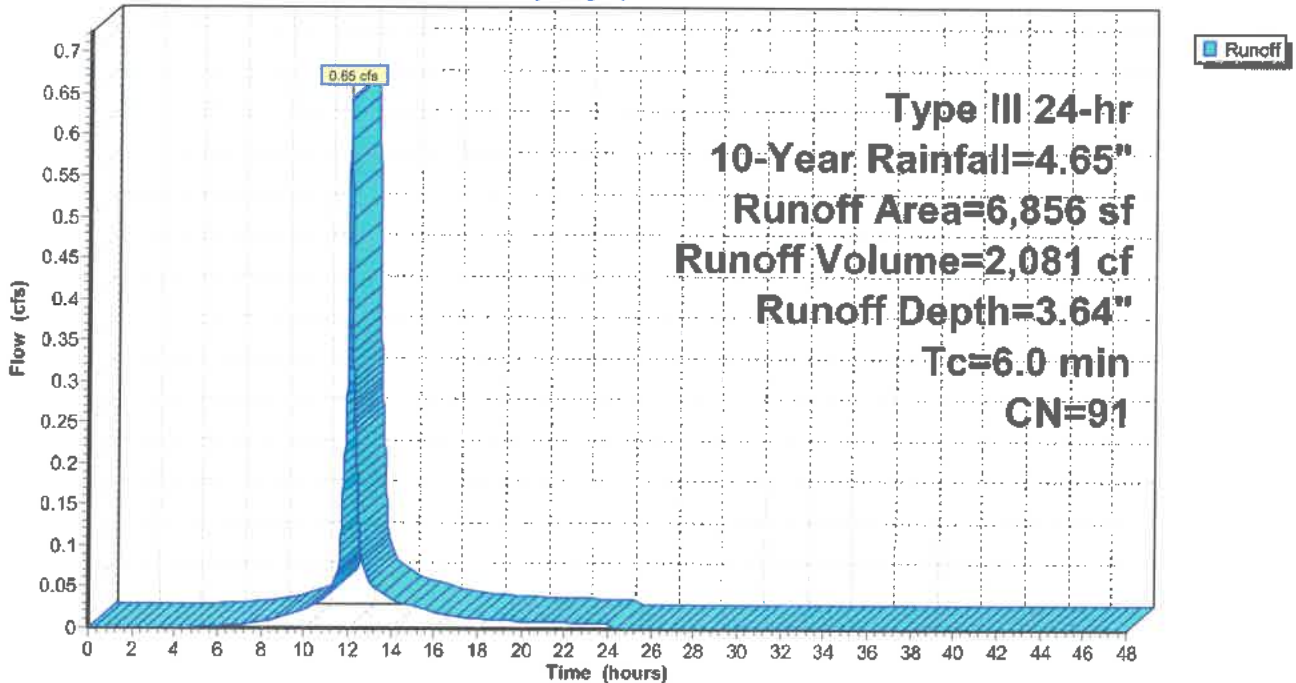
Subcatchment 3S: Impervious Area (For forebay sizing only)

Hydrograph



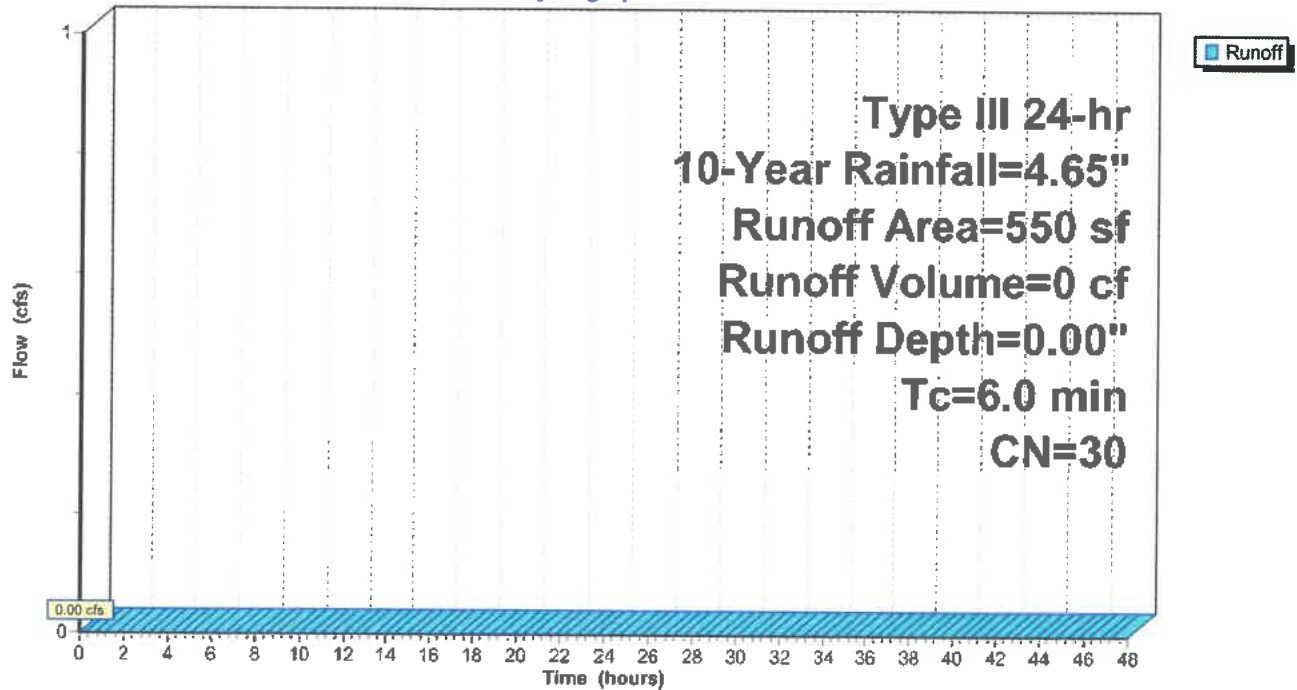
Subcatchment 10S: Area to Bioretention Area

Hydrograph



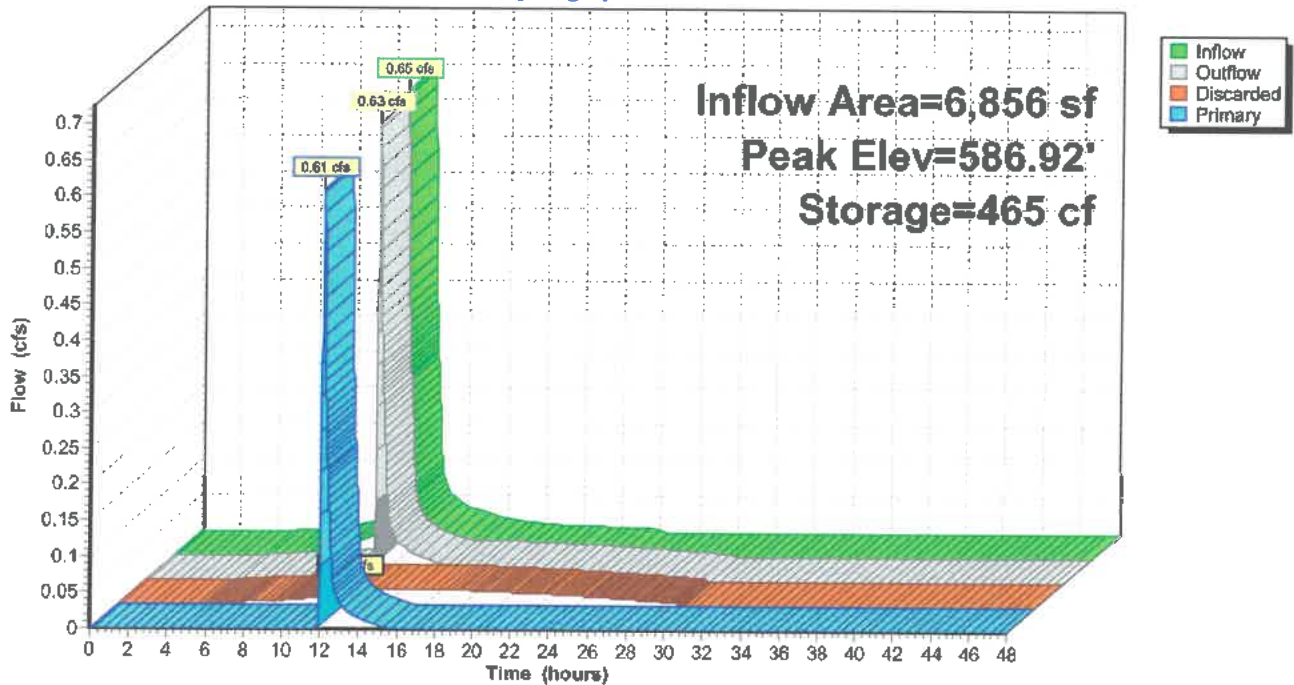
Subcatchment 11S: Undetained to design point

Hydrograph



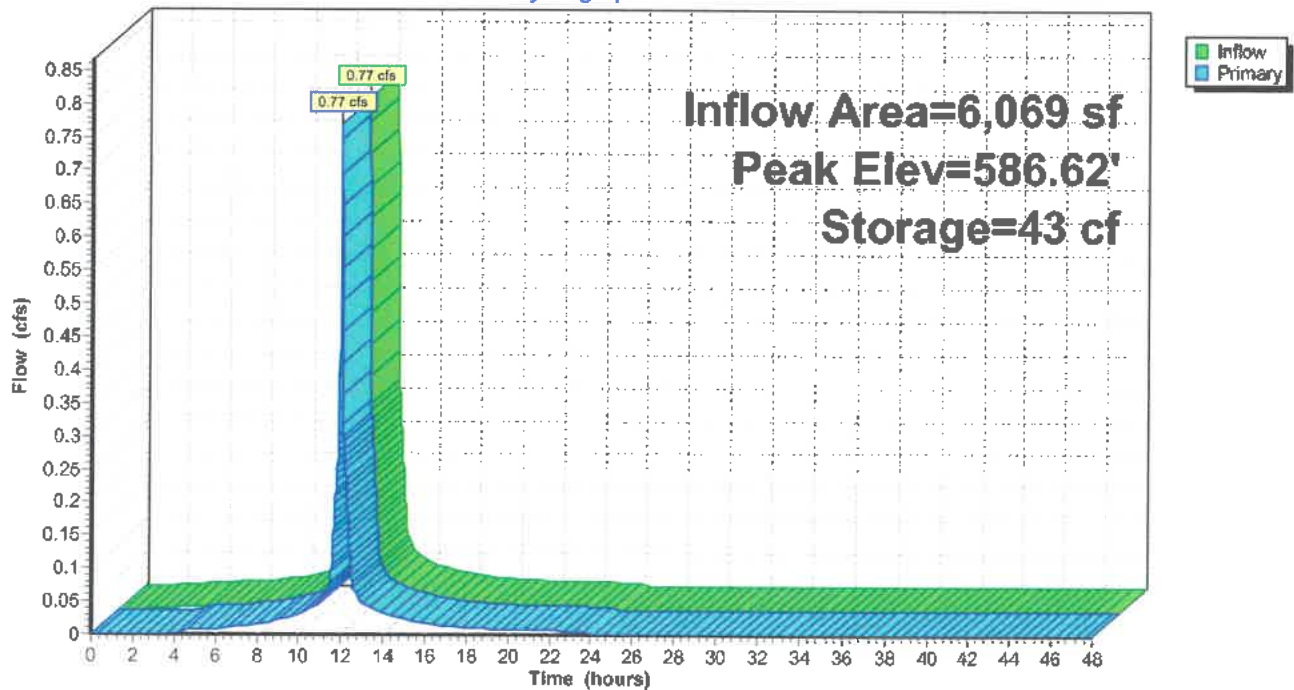
Pond 1P: Rain Garden

Hydrograph



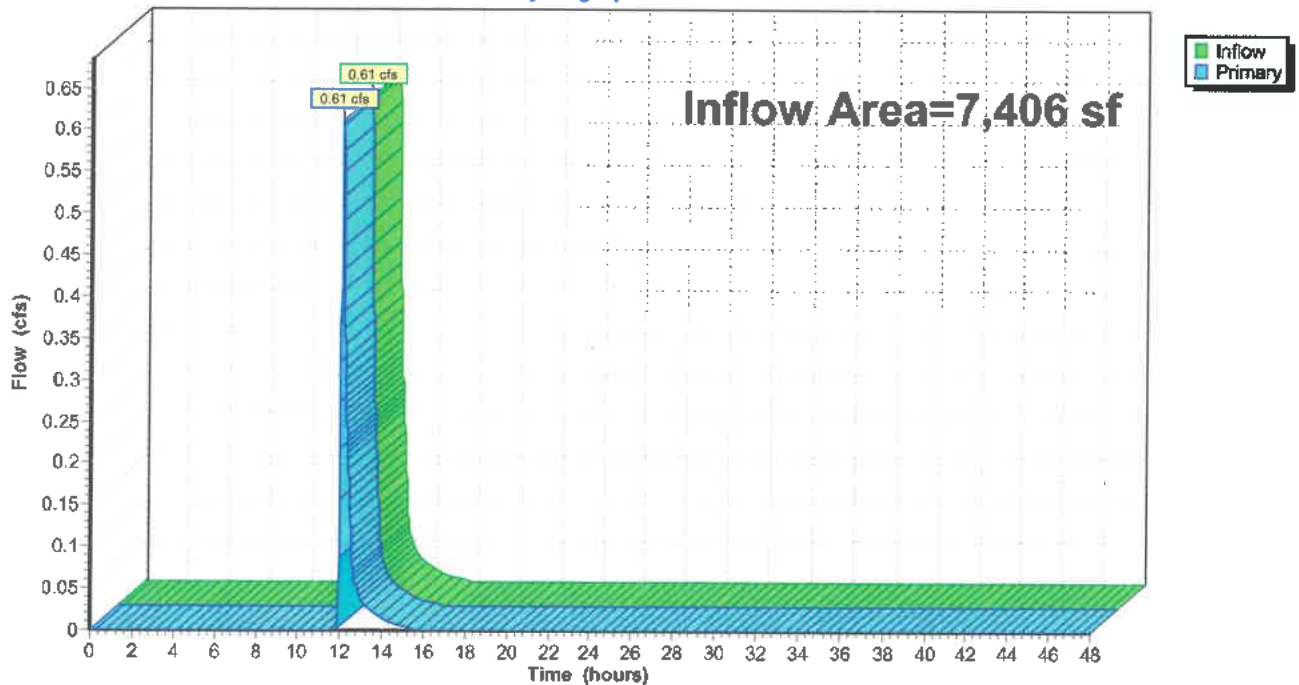
Pond 2P: Sediment Forebay

Hydrograph



Link 1L: Design Point #1 (Southern Property Line)

Hydrograph



NBM-423MAIN_POST-DEVELOPMENT

Type III 24-hr 25-Year Rainfall=5.82"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 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 3S: Impervious Area Runoff Area=6,069 sf 100.00% Impervious Runoff Depth=5.58"
Tc=0.0 min CN=98 Runoff=0.97 cfs 2,823 cf

Subcatchment 10S: Post-Development to Runoff Area=6,856 sf 88.52% Impervious Runoff Depth=4.78"
Tc=6.0 min CN=91 Runoff=0.84 cfs 2,732 cf

Subcatchment 11S: Post-Development Runoff Area=550 sf 0.00% Impervious Runoff Depth=0.05"
Tc=6.0 min CN=30 Runoff=0.00 cfs 2 cf

Pond 1P: Rain Garden Peak Elev=586.94' Storage=475 cf Inflow=0.84 cfs 2,732 cf
Discarded=0.02 cfs 1,356 cf Primary=0.80 cfs 1,376 cf Outflow=0.82 cfs 2,732 cf

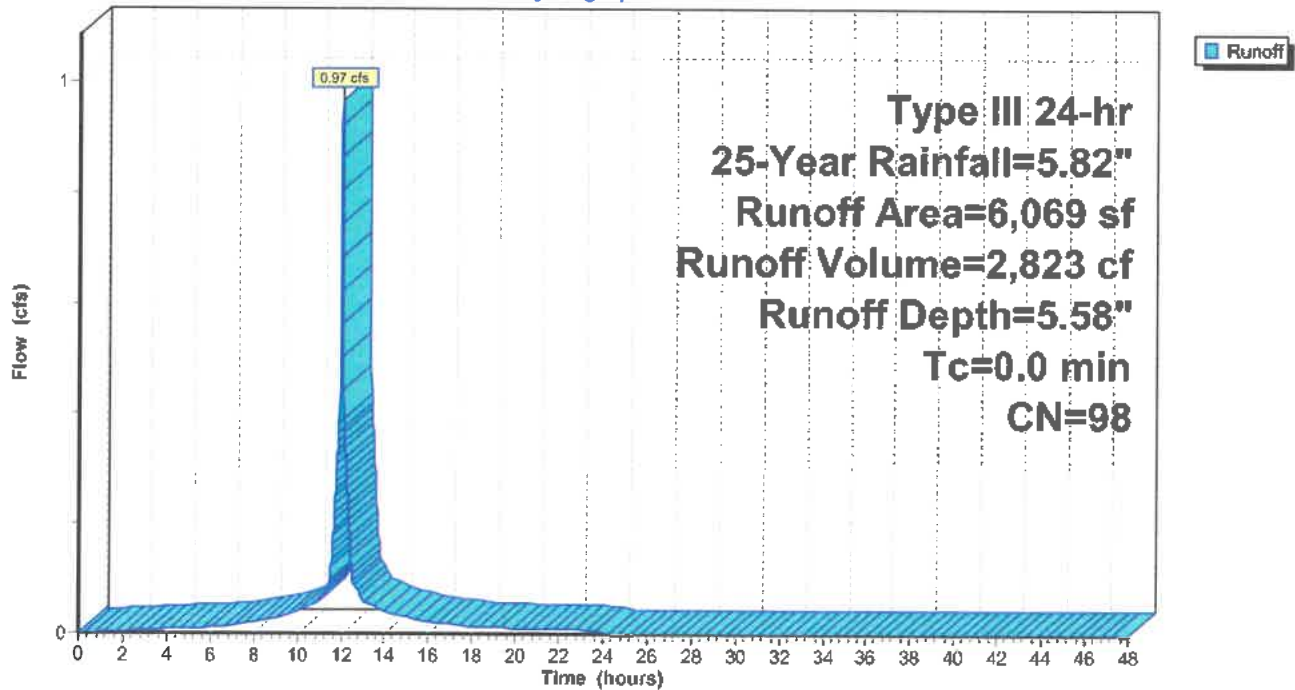
Pond 2P: Sediment Forebay Peak Elev=586.64' Storage=44 cf Inflow=0.97 cfs 2,823 cf
Outflow=0.97 cfs 2,785 cf

Link 1L: Design Point #1 (Southern Property Line) Inflow=0.80 cfs 1,378 cf
Primary=0.80 cfs 1,378 cf

Total Runoff Area = 13,475 sf Runoff Volume = 5,557 cf Average Runoff Depth = 4.95"
9.92% Pervious = 1,337 sf 90.08% Impervious = 12,138 sf

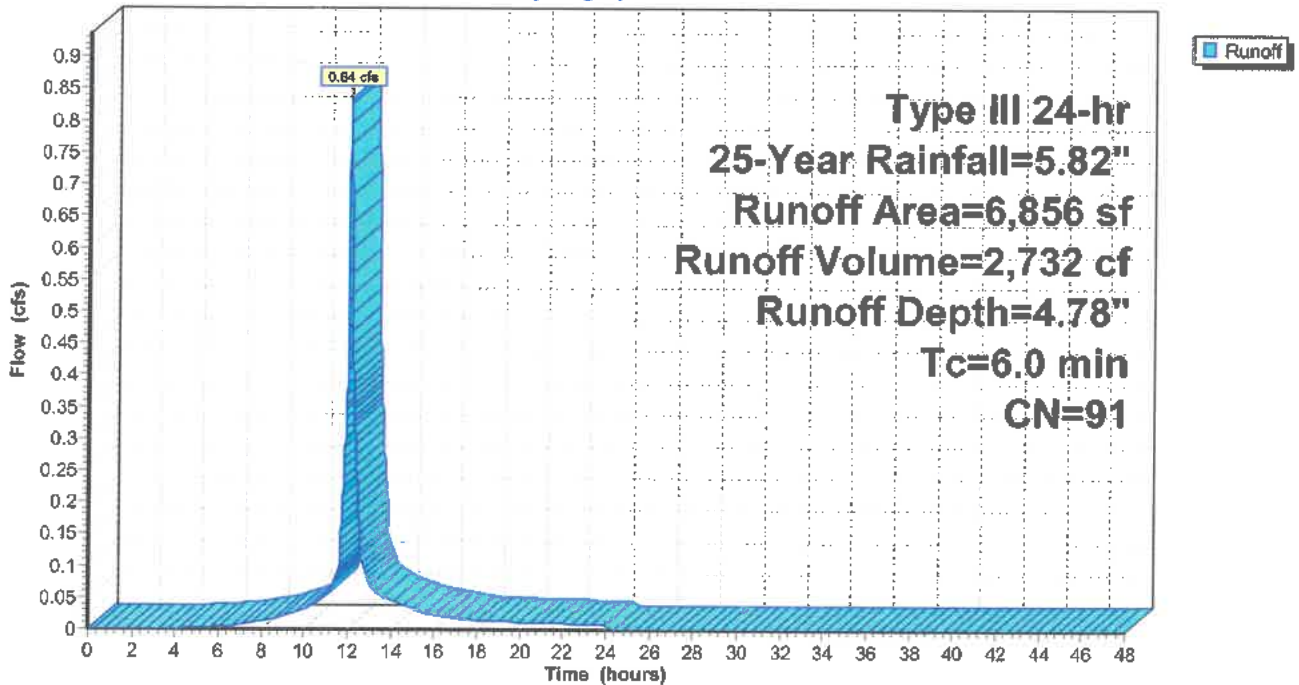
Subcatchment 3S: Impervious Area (For forebay sizing only)

Hydrograph



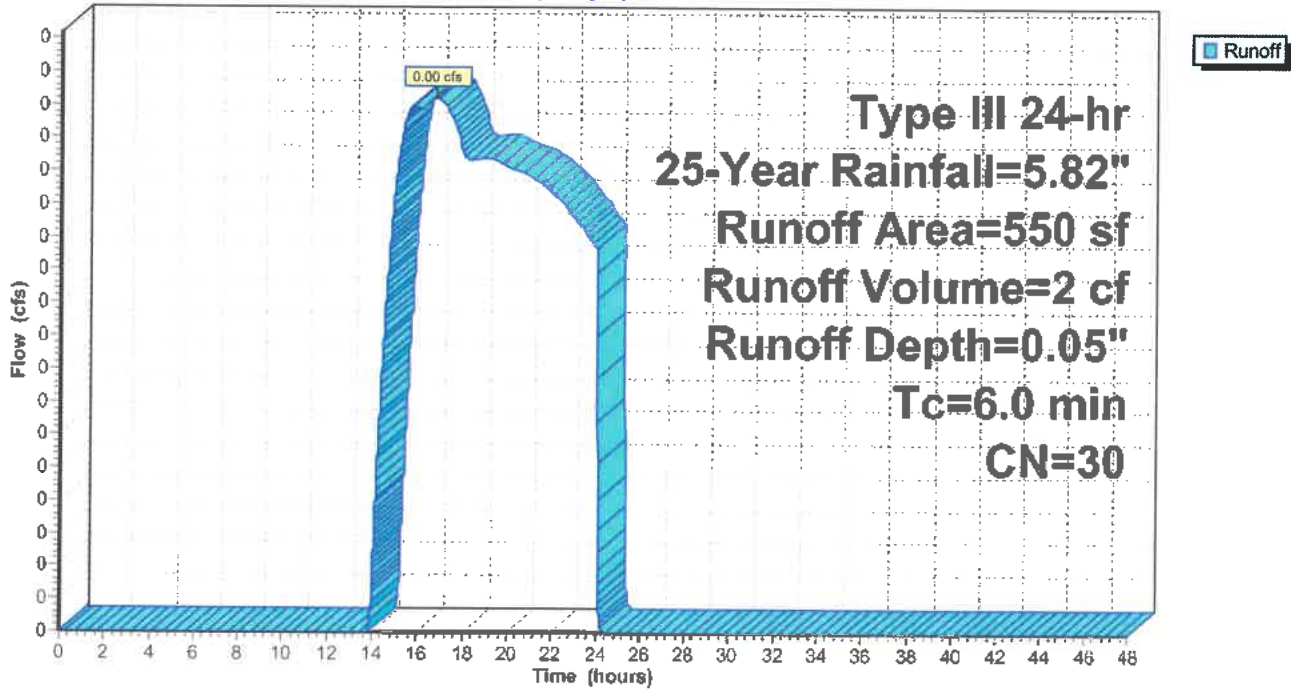
Subcatchment 10S: Area to Bioretention Area

Hydrograph



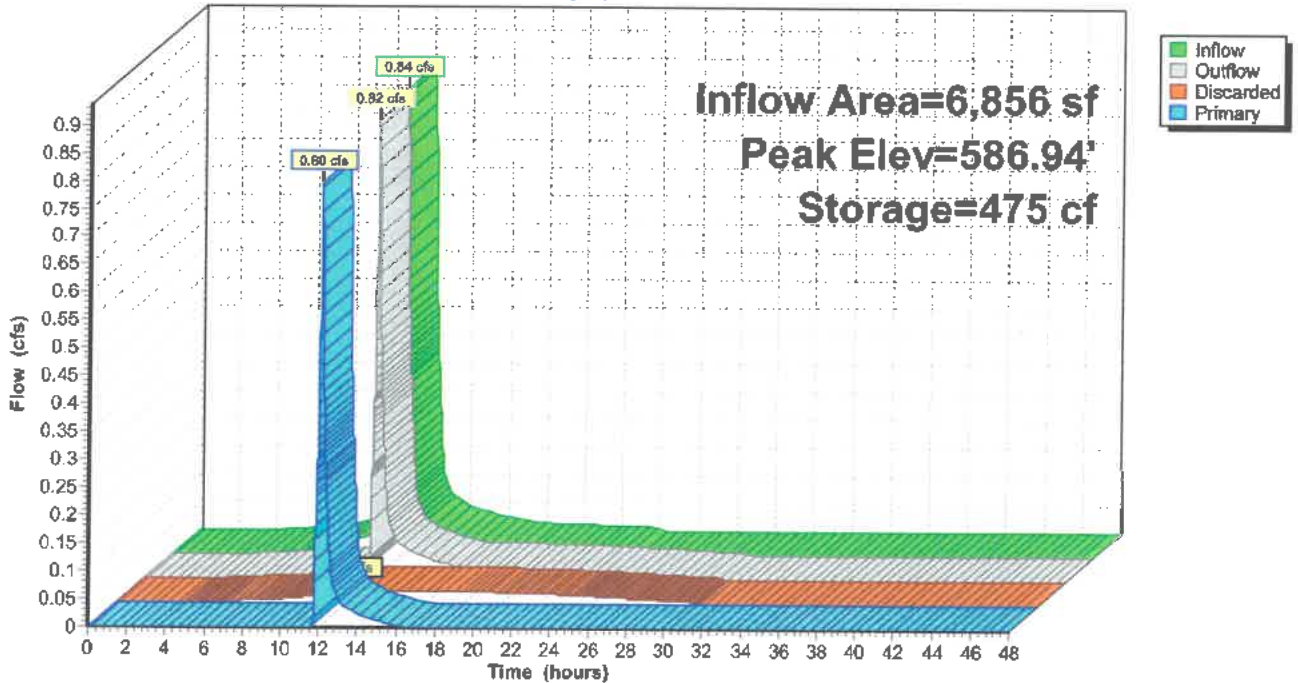
Subcatchment 11S: Undetained to design point

Hydrograph



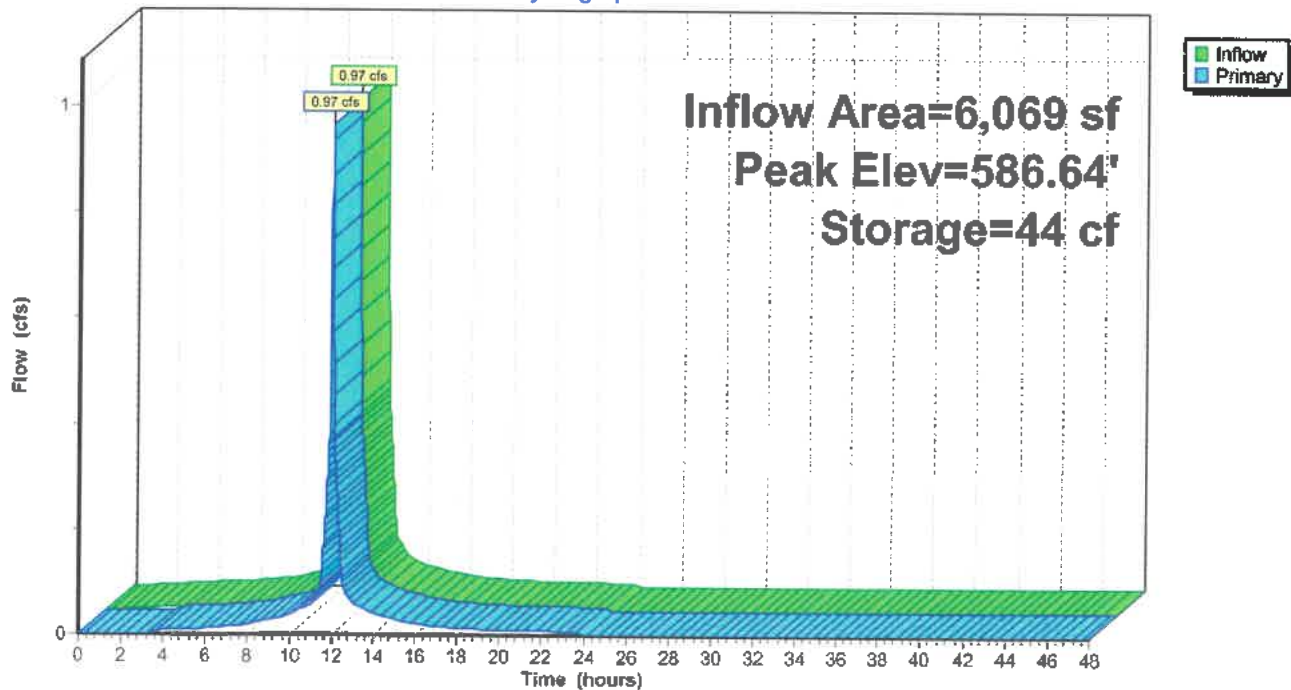
Pond 1P: Rain Garden

Hydrograph



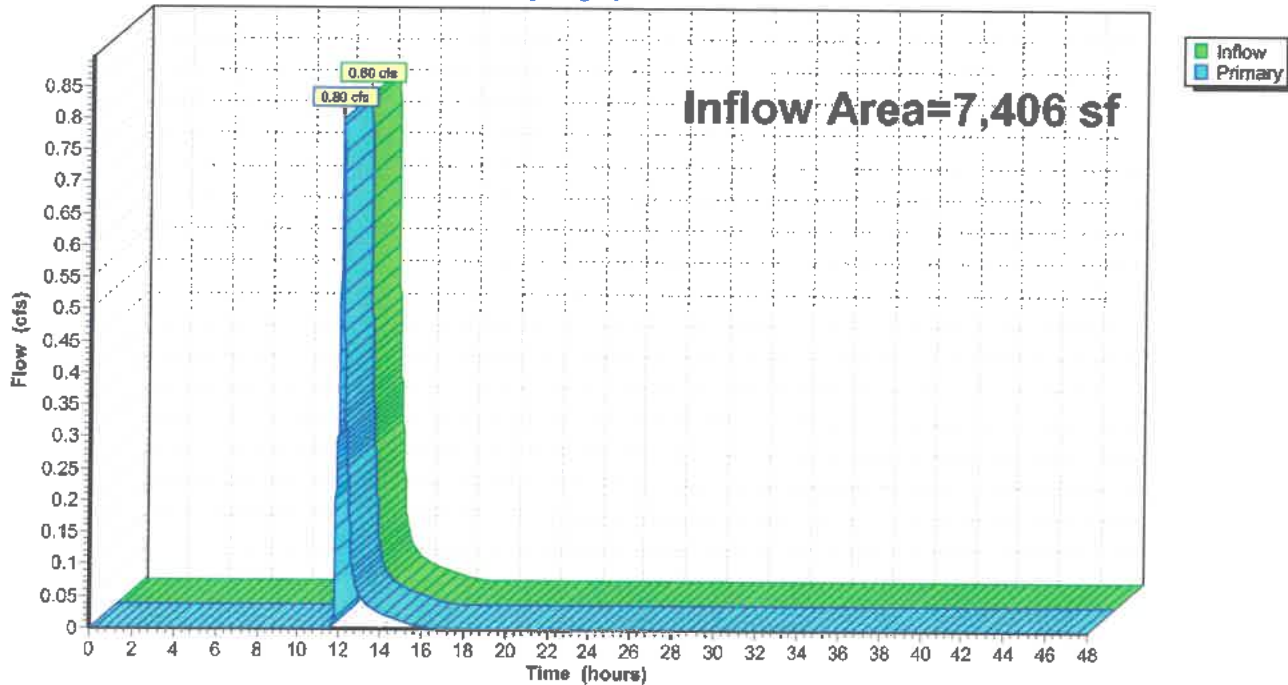
Pond 2P: Sediment Forebay

Hydrograph



Link 1L: Design Point #1 (Southern Property Line)

Hydrograph



NBM-423MAIN_POST-DEVELOPMENT

Type III 24-hr 100-Year Rainfall=8.20"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 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 3S: Impervious Area Runoff Area=6,069 sf 100.00% Impervious Runoff Depth=7.96"
Tc=0.0 min CN=98 Runoff=1.37 cfs 4,026 cf

Subcatchment 10S: Post-Development to Runoff Area=6,856 sf 88.52% Impervious Runoff Depth=7.12"
Tc=6.0 min CN=91 Runoff=1.22 cfs 4,069 cf

Subcatchment 11S: Post-Development Runoff Area=550 sf 0.00% Impervious Runoff Depth=0.46"
Tc=6.0 min CN=30 Runoff=0.00 cfs 21 cf

Pond 1P: Rain Garden Peak Elev=586.99' Storage=494 cf Inflow=1.22 cfs 4,069 cf
Discarded=0.02 cfs 1,583 cf Primary=1.18 cfs 2,486 cf Outflow=1.20 cfs 4,069 cf

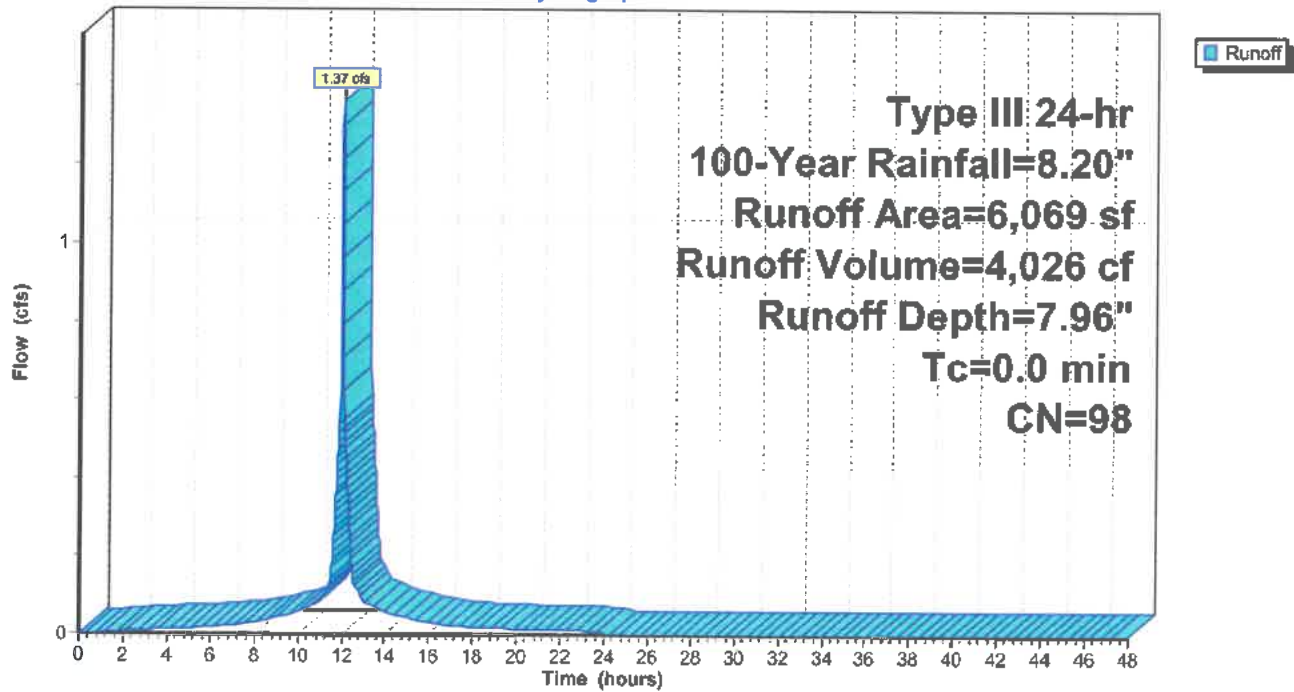
Pond 2P: Sediment Forebay Peak Elev=586.68' Storage=46 cf Inflow=1.37 cfs 4,026 cf
Outflow=1.36 cfs 3,988 cf

Link 1L: Design Point #1 (Southern Property Line) Inflow=1.18 cfs 2,507 cf
Primary=1.18 cfs 2,507 cf

Total Runoff Area = 13,475 sf Runoff Volume = 8,116 cf Average Runoff Depth = 7.23"
9.92% Pervious = 1,337 sf 90.08% Impervious = 12,138 sf

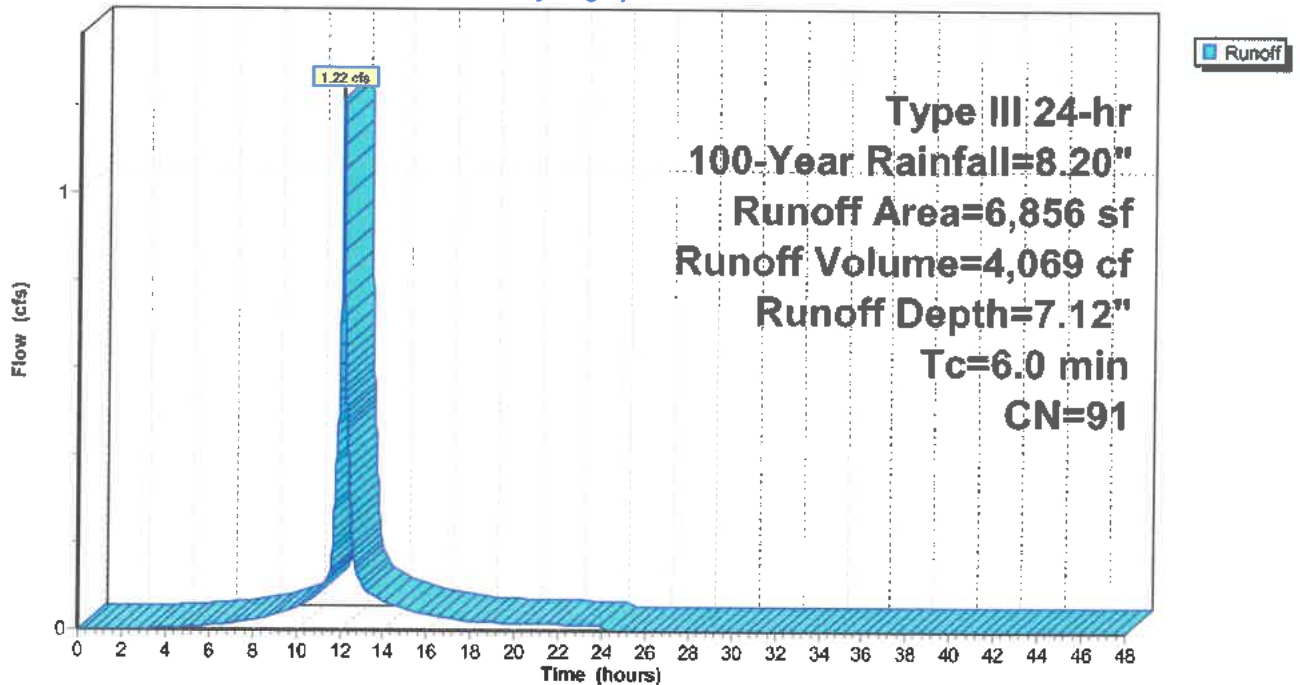
Subcatchment 3S: Impervious Area (For forebay sizing only)

Hydrograph



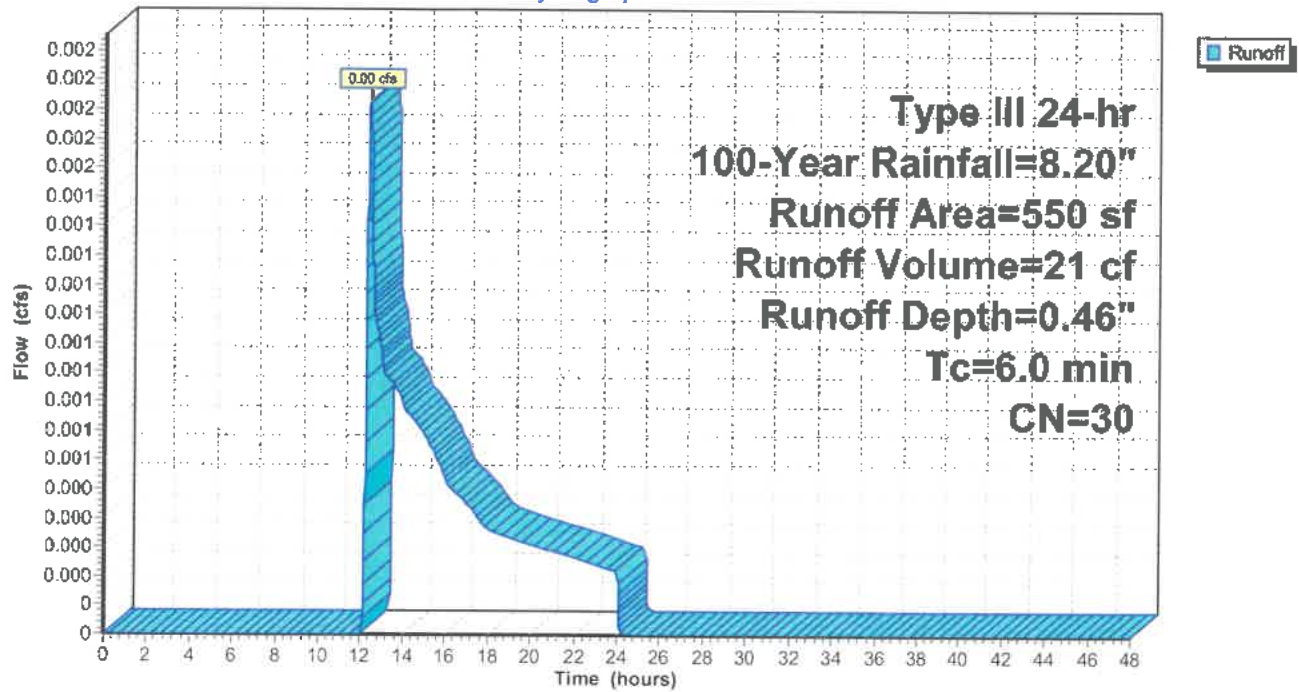
Subcatchment 10S: Area to Bioretention Area

Hydrograph



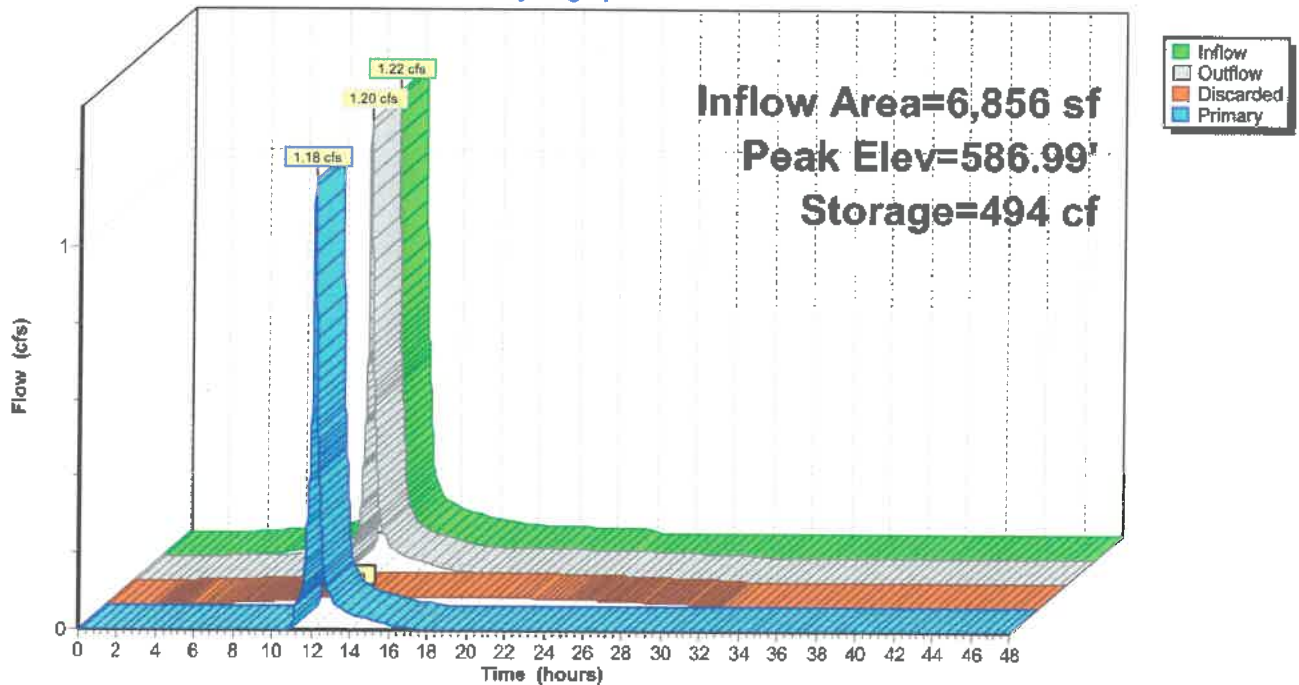
Subcatchment 11S: Undetained to design point

Hydrograph



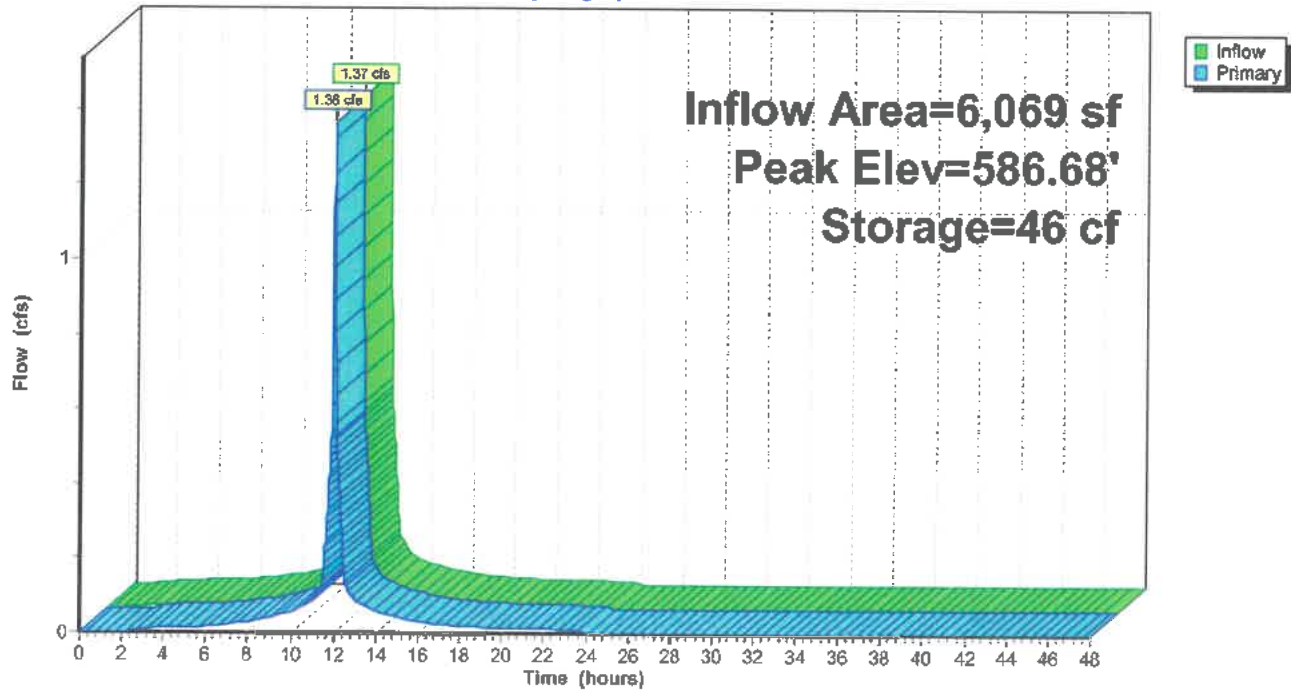
Pond 1P: Rain Garden

Hydrograph



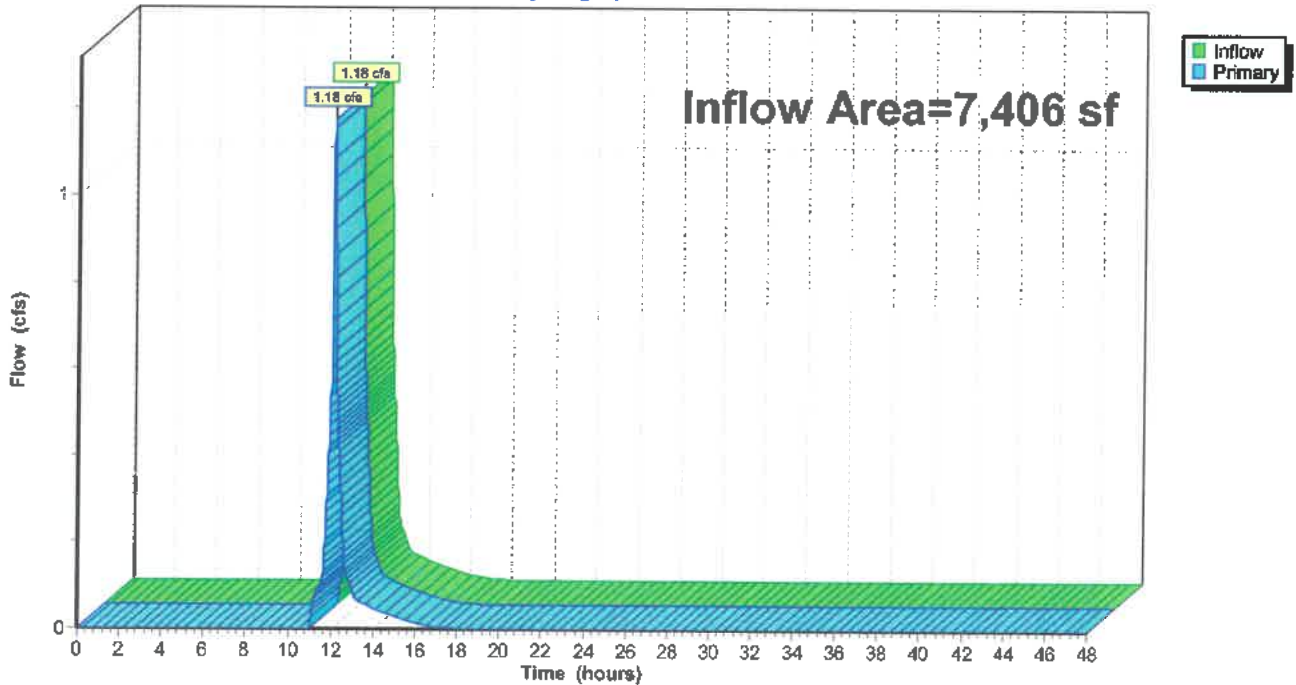
Pond 2P: Sediment Forebay

Hydrograph



Link 1L: Design Point #1 (Southern Property Line)

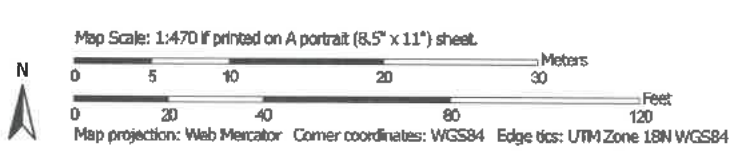
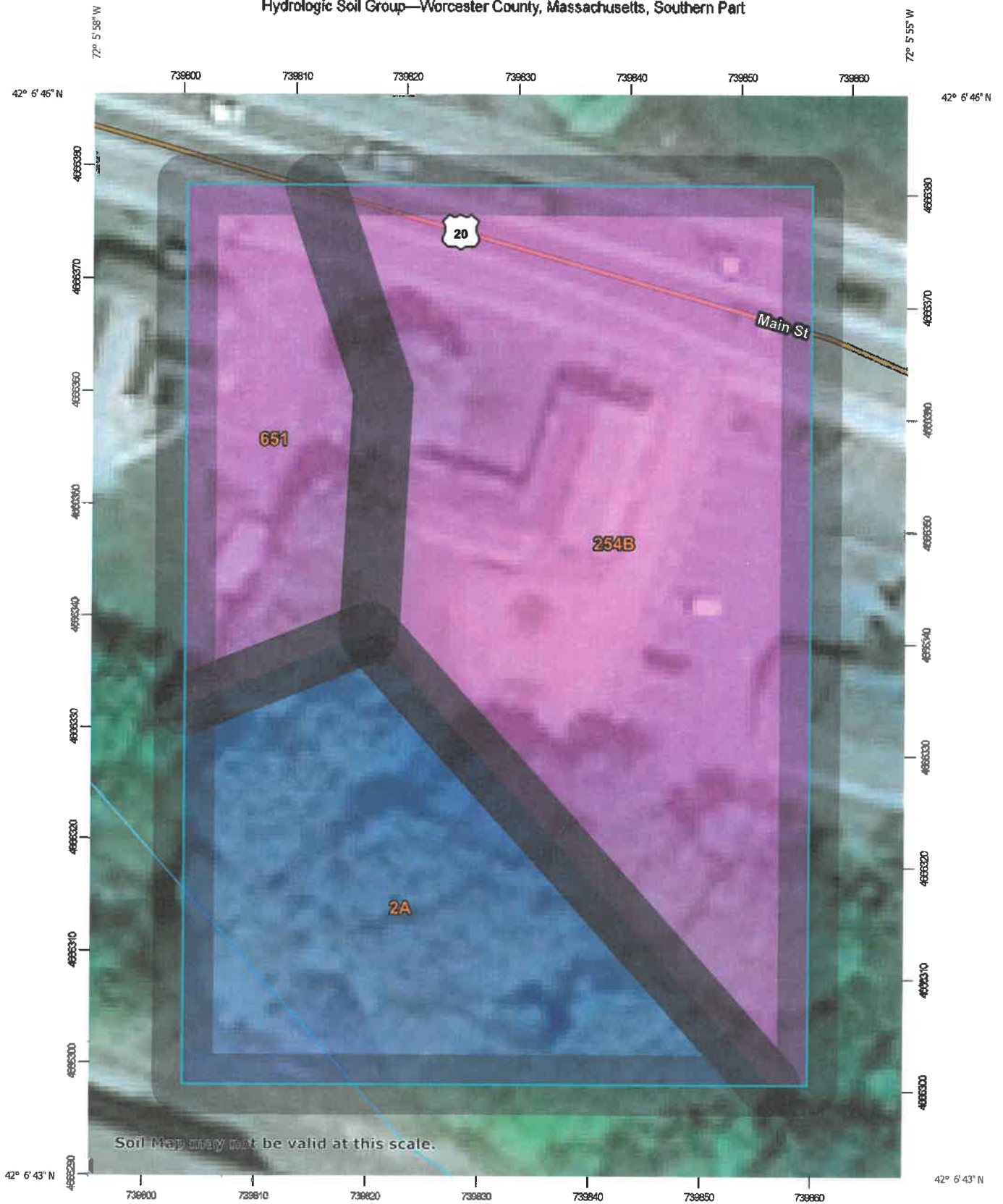
Hydrograph



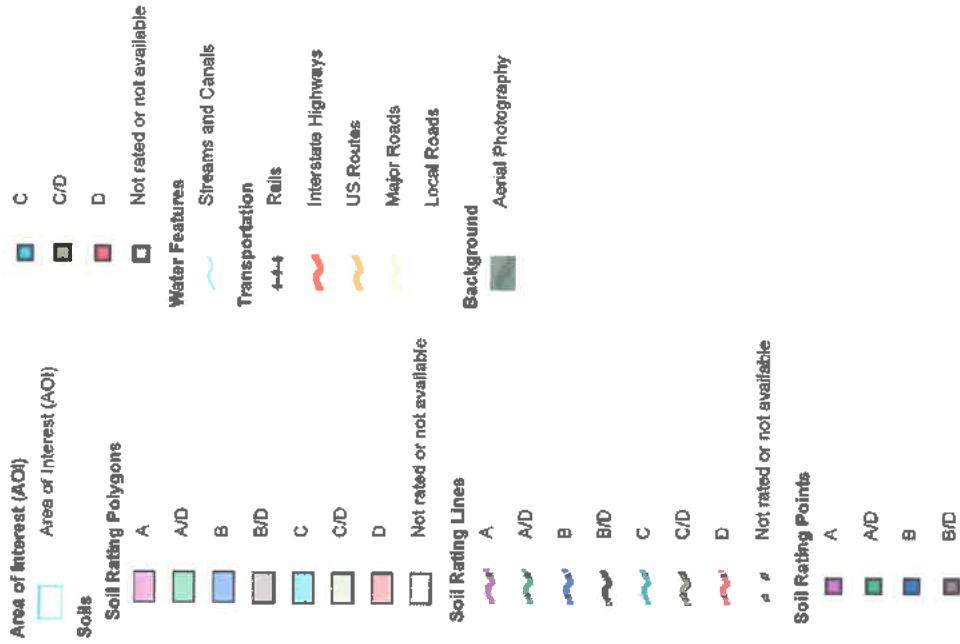
APPENDIX D

USDA-NRCS SITE SOILS MAP

Hydrologic Soil Group—Worcester County, Massachusetts, Southern Part



MAP LEGEND



MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Worcester County, Massachusetts, Southern Part
 Survey Area Data: Version 13, Jun 11, 2020

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

Date(s) aerial images were photographed: May 18, 2019—Jul 9, 2019

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
2A	Pootatuck fine sandy loam, 0 to 3 percent slopes	B	0.3	29.9%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	A	0.6	54.9%
651	Udorthents, smoothed	A	0.2	15.2%
Totals for Area of Interest			1.1	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX E

LONG-TERM DRAINAGE SYSTEM OPERATION & MAINTENANCE PLAN

LONG-TERM DRAINAGE SYSTEM OPERATION & MAINTENANCE PLAN

System

The drainage system associated with the site at 423 Main Street is an open drainage system consisting of a crushed stone filter strip, a sediment forebay and a bioretention area (also known as a rain garden).

Responsible Parties

The drainage system located on site property will be operated and maintained by the owner, NBM Realty, LLC post-construction. Drainage system maintenance tasks shall include routine cleaning of the overall drainage network and specific duties as listed below.

The responsible party must designate a "qualified personnel" to perform the inspections associated with this plan. This means a person knowledgeable of the layout and overall function of the stormwater system. As necessary, this "qualified personnel" shall employ the services of a registered professional engineer when inspections reveal a failing stormwater system component or when similar attention is needed beyond the knowledge or experience of the inspector.

Operation and Maintenance Duties

The following duties shall be considered the minimum required and may be supplemented by additional measures as necessary to maintain the function of the drainage system. This operation and maintenance plan shall serve as a supplement to any and all existing drainage system duties.

Sweeping:

Sweeping of the impervious areas, parking lots and driveways should be done at least 2 times annually, namely in the spring and fall. It is imperative that sweeping take place immediately following final winter snowmelt to remove winter sand. All sediments containing hydrocarbons shall be handled properly and disposed of in accordance with local, state and federal guidelines and regulations.

Sediment Forebay:

The sediment forebay shall be inspected every month. If necessary, remove any accumulated sediment and replace or repair dislodged riprap.

Bioretention Area:

Bioretention area maintenance begins with education of the function and purpose of the structure; namely that of stormwater management and treatment. It is imperative that sand used in winter conditions not be allowed to enter the bioretention area as it will clog the soil media. Reduced sanding should be employed in the area draining to the bioretention area and any accumulated sand should be removed immediately. Snow must not be stored in the bioretention area. Deicing chemicals should not be used in the area draining to the bioretention area.

Inspections should be performed monthly and/or after every rain event of more than 2 inches of rainfall in 24 hours; there should be no ponding water within the bioretention area after 72 hours following a rainstorm. Inspect the bioretention area for signs of erosion and repair immediately if found. Re-mulch void areas as needed (use only shredded hardwood mulch, 3" depth). Monthly inspections must also include the following:

- Remove litter and debris.

Parking Lot Improvements
NBM Realty, LLC

- Treat diseased plantings as needed; prune and replace dead vegetation with like material.
- Remove invasive vegetation and weeds.
- Fertilize and apply pesticides if needed.

Annual Budget

An annual budget for the operation and maintenance tasks describe above is estimated at \$1,000.

APPENDIX F

LONG-TERM POLLUTION PREVENTION PLAN

LONG-TERM POLLUTION PREVENTION PLAN

Pollution Prevention and Source Control Plan

The site owner, NBM Realty, LLC, shall designate a pollution prevention team whose responsibilities are the following:

- Good housekeeping: General trash and litter cleanup of the site, inspect all vehicles on a regular basis for detection of leaking oil, gas and other fluids, provide routine visual inspections of potential pollution sources, maintain an inventory of potential pollution sources stored on site (i.e. paints, solvents, etc.). Initiate and maintain record keeping of activity with regard to the contents of this plan.
- Storing materials and waste products inside or under cover: All materials and waste products shall be stored within the building or within the covered dumpster.
- Vehicle washing: Vehicle washing is to be performed offsite.
- Routine inspections and maintenance of stormwater BMP's: Follow the requirements of the site *Long-Term Drainage System Operation & Maintenance Plan*. Be aware of site drainage components and Best Management Practices (BMP's) and their locations including the sediment forebay, bioretention area and riverfront restoration area.
- Spill prevention and response: In the event of a spill outside of the building, immediately initiate containment and cleanup procedures appropriate for the material including but not limited to sorbent media, towels and barriers, catch basin inlet seals, etc. as well as notifying the proper authorities. All attempts must be made to prevent spilled material from entering the drainage system or infiltrating into the ground.
- Maintenance of lawns and landscaped areas: Regularly mow lawn areas and weed landscaped areas.
- Storage and use of fertilizers, herbicides, and pesticides: All such materials shall be stored inside the proposed building(s). It is recommended not to store such materials in large quantities.

NBM Realty, LLC shall be responsible for training designated staff in the procedures described herein. Note that this Plan does not indemnify NBM Realty, LLC from the requirements of any local, state, or federal requirements of regulations regarding the storage or release of potentially hazardous materials.

Snow Management Plan

The goal of this plan is to employ proper management of snow and snow melt, in terms of snow removal and storage, use of de-icing compounds, and other practices that can prevent or minimize runoff pollutant loading impacts. The following measures shall be taken:

- Use of de-icing compounds:
 - Use alternative de-icing compounds such as calcium chloride (CaCl₂) and calcium magnesium acetate (CMA),
 - Reduce the use of de-icing compounds through better training and careful application.
- Storage of de-icing compounds:
 - Store compounds on sheltered (protected from precipitation and wind) impervious pads or in original shipment containers if possible.

Parking Lot Improvements
NBM Realty, LLC

- *Snow removal and storage:*
 - Place snow in designated area where it can slowly infiltrate however it should not be placed over any component of the site's stormwater management system nor the riverfront restoration area.

APPENDIX G

TSS REMOVAL CALCULATION WORKSHEET

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: **To Design Point #1 (SW) thru Bioretention Pond**

BMP ¹	C TSS Removal Rate ¹	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Sediment Forebay	0.25	1.00	0.25	0.75
Bioretention Area	0.90	0.75	0.68	0.08
	0.00	0.08	0.00	0.08
	0.00	0.08	0.00	0.08
	0.00	0.08	0.00	0.08

Total TSS Removal = 93%

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

Project: **423 Main Street**
 Prepared By: **D. Sheehan**
 Date: **1/4/2021**

*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

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.

Version 1, Automated: Mar. 4, 2008

Location:

B	C	D	E	F
BMP ¹	TSS Removal Rate ¹	Starting TSS Load*	Removed (C*D)	Remaining Load (D-E)
Sediment Forebay	0.25	1.00	0.25	0.75
Sediment Forebay	0.25	0.75	0.19	0.56
	0.00	0.56	0.00	0.56
	0.00	0.56	0.00	0.56
	0.00	0.56	0.00	0.56

Total TSS Removal =

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

Project:
 Prepared By:
 Date:

*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

KEY

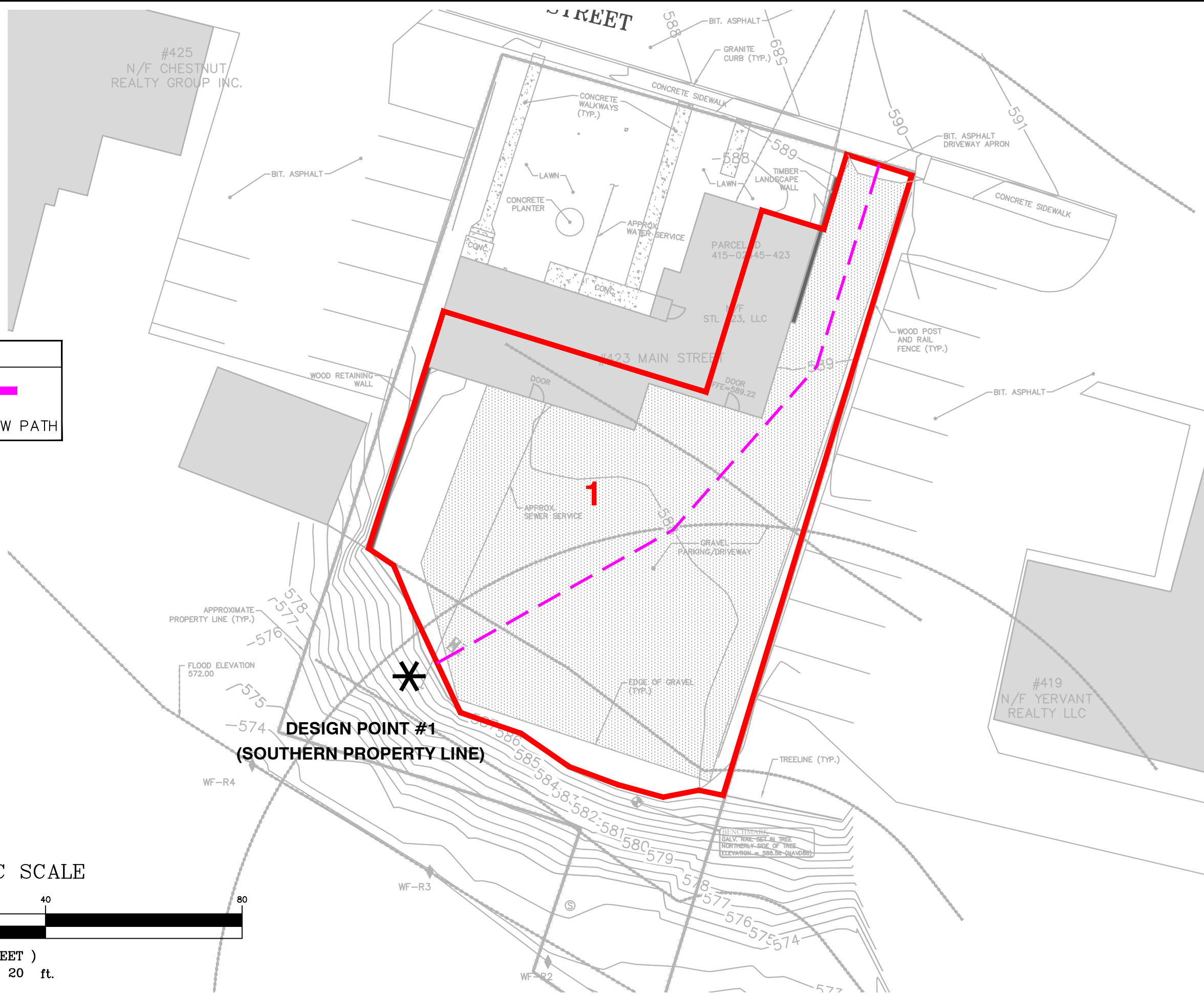
TIME OF CONCENTRATION FLOW PATH



GRAPHIC SCALE



(IN FEET)
1 inch = 20 ft.



GRAVES
ENGINEERING, INC.

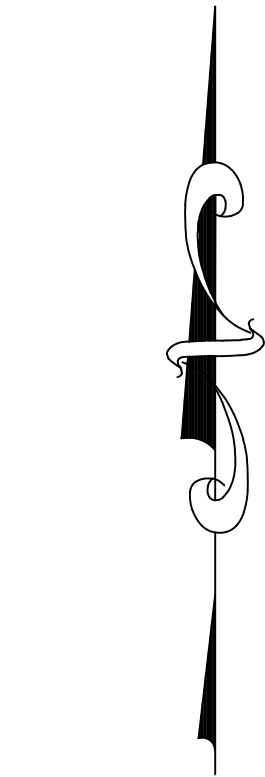
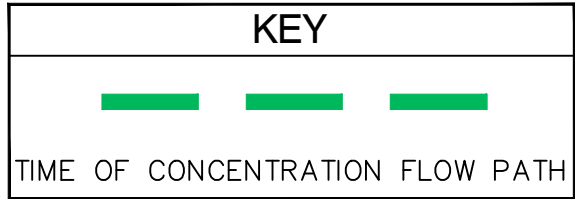
100 GROVE STREET | WORCESTER, MA 01605
T: 508-856-0321 | F: 508-856-0357
gravesengineering.com

NO.	DATE	BY	DESCRIPTION

PRE-DEVELOPMENT DRAINAGE AREAS
PARKING LOT IMPROVEMENTS
423 MAIN STREET, STURBRIDGE, MA 01566

CLIENT: NEM REALTY, LLC
PO BOX 638, STURBRIDGE, MA 01566

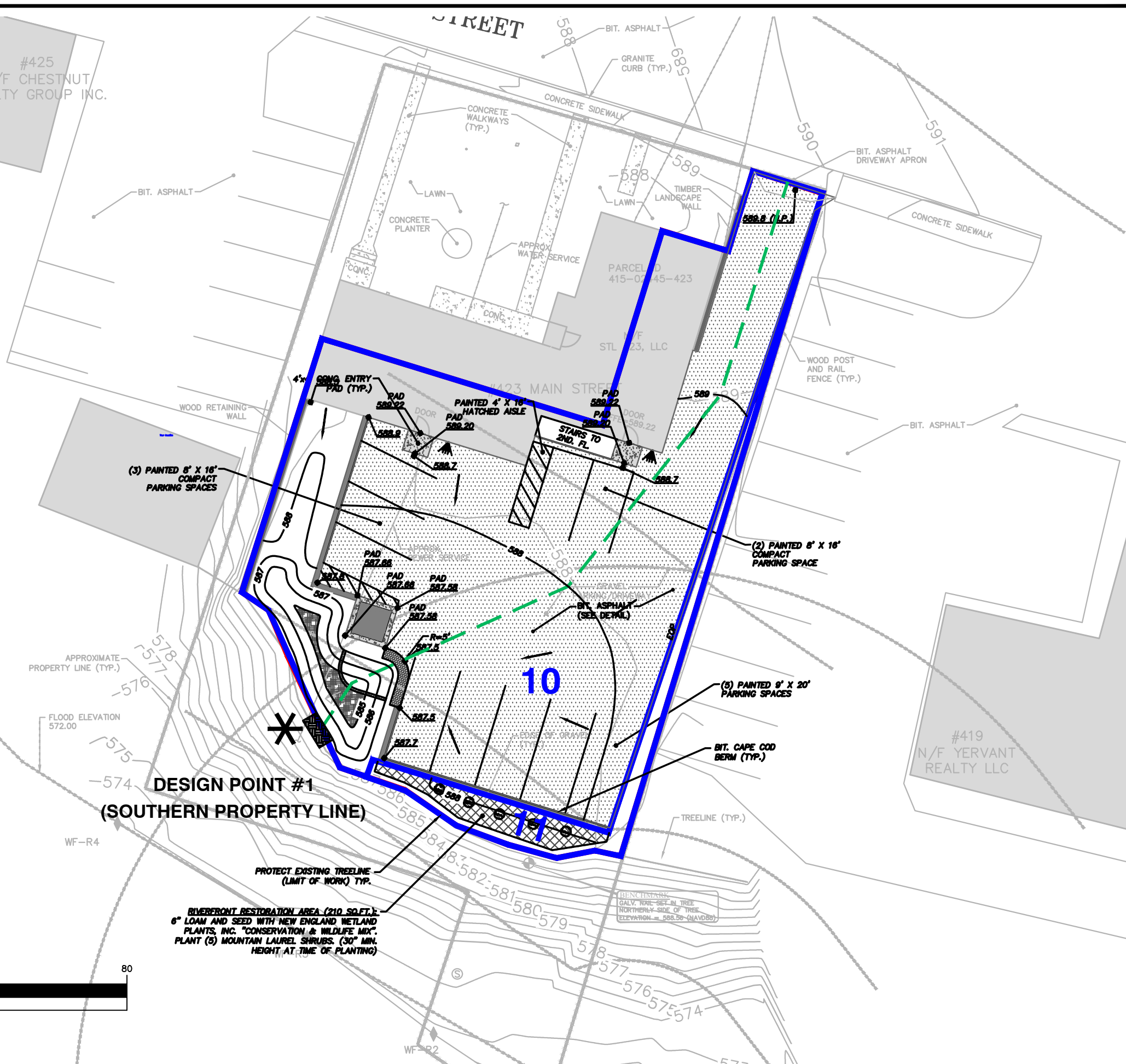
DATE: 01/04/21 SCALE: 1"=20'
DES. BY: DFS
DRW. BY: DFS
CHK. BY: MRA
PRJ. NO.: 20134



GRAPHIC SCALE



(IN FEET)
1 inch = 20 ft.



100 GROVE STREET | WORCESTER, MA 01605
T: 508-856-0321 | F: 508-856-0357
gravesengineering.com

NO.	DATE	BY	REVISIONS

**POST-DEVELOPMENT DRAINAGE AREAS
PARKING LOT IMPROVEMENTS**
423 MAIN STREET, STURBRIDGE, MA 01566

CLIENT: NEM REALTY, LLC
PO BOX 688, STURBRIDGE, MA 01566

DATE: 01/04/21 SCALE: 1"=20'
DES. BY: DFS
CHK. BY: MRA
PRJ. NO.: 20134