STORMWATER REPORT

for

MULTI-FAMILY RESIDENTIAL PROJECT

505 Main Street
Sturbridge, MA 01518

Prepared for:

STL Group, LLC
P.O. Box 638
Sturbridge, MA 01566

Date:

December 22, 2022

Prepared By:

GRAVES ENGINEERING, Inc.
100 Grove Street
Worcester, MA 01605
T 508-856-0321
F 508-856-0357
gravesengineering.com

TABLE OF CONTENTS

NARRATIVE

Project Description

Site Location: Multi-Family Residential Project
505 Main Street, Sturbridge, MA 01518

Development Type: Residential

Project Summary:

The proposed project consists of the construction of a free-standing two-story 2,632 square foot multi-family residential building and associated paved parking area. The subject property is currently developed with one building and paved parking areas previously utilized for commercial purposes. The existing two-story building and paved parking areas will be demolished to accommodate the new building and new paved parking area. A bioretention area will be constructed to treat and attenuate runoff from the new building's roof and the new parking area. The proposed drainage and stormwater management system for the project is in full compliance with MassDEP Stormwater Management Standards. The project results in a net increase of impervious surface areas.

Existing Site Conditions

Location: The project site is located at 505 Main Street in Sturbridge, MA.

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

Slopes: The project area generally slopes from north to south towards an existing wetland located south of the property.

Soil Types: Site soil types as mapped by the USDA-NRCS are primarily Pootatuck fine sandy loam and Canton fine sandy loam (map unit symbols 2A and 420B respectively). These soils are classified as hydrologic soil group (HSG) "B". 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**
3.13	4.64	5.81	8.18

Pre-Development

The total pre-development drainage area studied in this report consists of approximately 0.40 acres. The pre-development hydrology has been modeled as two subcatchment areas that ultimately drain to two separate discharge points (design points).

Design Point #1 - Wetland: This design point represents runoff from the site flowing towards the existing wetland located south of the property.

Design Point #2 - Main Street: This design point represents runoff from a northeasterly portion of the site flowing in a northerly direction towards the existing municipal drainage system in Main Street.

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

Pre-Development Peak Rate of Runoff (cfs)				
	2 Year	**10 Year**	**25 Year**	**100 Year**
Design Point #1 – Wetland	0.54	1.04	1.44	2.26
Design Point #2 – Main Street	0.04	0.08	0.10	0.15

Post-Development

The total post-development drainage area is the same as the pre-development area in size and is modeled as three subcatchment areas.

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

Post-Development Peak Rate of Runoff (cfs)				
	2 Year	**10 Year**	**25 Year**	**100 Year**
Design Point #1 – Wetland	0.52	0.97	1.31	1.99
Design Point #2 – Main Street	0.02	0.04	0.06	0.11

The total net change in peak rate of runoff from pre-development to post-development at the design points 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 – Wetland	-0.02	-0.07	-0.13	-0.27
Design Point #2 – Main Street	-0.02	-0.04	-0.04	-0.04

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 one drain outfall proposed for this project. The drain outfall is for the 12" diameter outlet of the bioretention area.

$La = 1.8Q/(Do^{1.5}) + 7Do$

$W = 3Do + La$

$D_{50} = (0.02 \times Q^{1.3})/(TW \times Do)$

Bioretention Area

$La = (1.8 \times 1.82)/(1^{1.5}) + 7(1) = 10.3$ ft. (10 ft. proposed)

$W = 3(1) + 10.3 = 14.3$ ft. (13 ft. proposed)

$D_{50} = (0.02 \times 1.82^{1.3})/(0.5 \times 1) = 0.087$ ft. (6" diameter proposed)

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 in the project area are hydrologic group B soils. The recharge calculations are as follows:

Required Recharge Volume for Bioretention Area

Required Recharge Volume (R_v) = F x Impervious Area where, F = Target Depth Factor (in.)
F = 0.35" for 'B' Soils

Net increase in site impervious area (pre to post conditions) = 1,164 ft²

$R_v = (0.35"/12") \times 1{,}164$ ft² = 33.95 ft³

The proposed bioretention area has a total volume of 111 ft³ below the 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 sandy loam as witnessed during soil testing; conservatively using 2.41 in./hr. rate in light of presence of sand and gravel witnessed during soil testing; logs provided on the plans), the drawdown time is calculated as follows:

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

Bioretention Area
$Time_{drawdown}$ = 111 ft³ / (2.41 in./hr./12" x 227 ft²) = 2.4 hours < 72 hours

Water Quality Calculations (Stormwater Management Standard 4)

The underlying soils for portions of the site are classified by NRCS as Hydrologic Soil Group "B" soils, and the presence of sand and gravel in the native "C" soil horizon was observed during soil testing. Based upon this information, the area is within soils with a rapid infiltration rate and requires pretreatment of 44% TSS removal prior to infiltration. The proposed runoff flow path to the bioretention area entails runoff directed to a sediment forebay and then into the bioretention area. The proposed treatment train of a sediment forebay and the bioretention area is anticipated to have a TSS removal rate of 90%. By the time stormwater passes through the bioretention area soil media, it will have been treated to remove 90% of TSS, thereby much greater than 44% prior to infiltration (which occurs at the bottom of the soil media). Refer to Appendix G for detailed TSS calculations that demonstrate the TSS removal rates for the site.

The site is within a Zone II Wellhead Protection Area per the Massachusetts Department of Environmental Protection, which is classified as a Critical Area, thus the required Water Quality Volume shall be calculated using 1.0 inch of runoff times the impervious area. Additionally, the Town of Sturbridge requires the use of a minimum of 0.8 inch for calculations.

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

Bioretention Area
$V = 1.0"/12 \times 1{,}164\ ft^2 =$ 97 ft^3 required volume per MassDEP
Provided volume = 111 ft^3 (below outlet in bioretention area)

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

Forebay Sizing:

$V = 0.1"/12 \times A_{IMP}$

Forebay (Bioretention Area)
$V = 0.1"/12 \times 10{,}678\ ft^2 = 89\ ft^3$
Provided volume = 192 ft^3

(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 existing and proposed use 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 the Zone II Wellhead Protection Area per MassDEP, which is classified as a Critical Area. A Long-Term Pollution Prevention Plan has been developed for the site.

Redevelopment Projects (Stormwater Management Standard 7)

The project does not qualify as a redevelopment project.

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's 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.

Phosphorus Removal (Sturbridge Stormwater Management Regulations)

Per the Stormwater Management Regulations for the town of Sturbridge, stormwater management systems shall be designed to meet specific average annual pollutant removal rates. For a redevelopment project, the removal requirement is 50% for total phosphorus. Utilizing the method to calculate phosphorus reduction for the proposed treatment train per Attachment 3 to Appendix F of the 2016 Massachusetts MS4 General Permit, the proposed phosphorus load reduction is 51% (the supporting calculations, such as the BATT worksheet, are included in Appendix H).

BMP Load = (IA x PLER) + (PA x PLER)
= (0.245 acre x 1.96) + (0.129 acre x 0.12) = 0.496 lbs/yr

BMP Volume (IA-in) = (111 ft^3/0.245 acre) x (12 in/ft x 1 acre/43,560 ft^2) = 0.12 inch

BMP Volume (PA- ft^3) = (0.129 acre x 0.00 inch) x 3,630 ft^3/acre-inch = 0.0 ft^3

BMP Volume (IA- ft^3) = 111 ft^3 - 0 ft^3 = 111 ft^3 (No change)

BMP Volume (IA-in)2 = (111 ft^3/0.245 acre) x (12 in/ft x 1 acre/43,560 ft^2) = 0.12 inch (No Change)

% Difference = ((0.12 – 0.12)/0.12) x 100 = 0.0% (No Change)

Per Table 3-14 and Figure 3-11 (Infiltration rate = 2.41 inch/hour), phosphorus reduction = 51%

BMP Reduction = 0.496 x 0.51 = 0.25 lbs/yr

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	72.109 degrees West
Latitude	42.115 degrees North
Elevation	0 feet
Date/Time	Wed, 07 Dec 2022 09:23:15 -0500

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	2.06	2.59	2.89	**1yr**	2.29	2.78	3.19	3.88	4.50	**1yr**
2yr	0.35	0.53	0.66	0.88	1.10	1.39	**2yr**	0.95	1.27	1.60	2.00	2.50	3.13	3.49	**2yr**	2.77	3.36	3.86	4.59	5.24	**2yr**
5yr	0.41	0.64	0.80	1.08	1.38	1.75	**5yr**	1.19	1.58	2.03	2.53	3.15	3.91	4.43	**5yr**	3.46	4.26	4.88	5.75	6.50	**5yr**
10yr	0.47	0.73	0.92	1.26	1.64	2.09	**10yr**	1.41	1.87	2.43	3.04	3.76	4.64	5.31	**10yr**	4.10	5.11	5.83	6.83	7.65	**10yr**
25yr	0.56	0.88	1.12	1.55	2.05	2.64	**25yr**	1.77	2.33	3.07	3.84	4.74	5.81	6.76	**25yr**	5.14	6.50	7.38	8.56	9.51	**25yr**
50yr	0.63	1.01	1.29	1.81	2.44	3.17	**50yr**	2.11	2.75	3.70	4.61	5.67	6.89	8.11	**50yr**	6.10	7.80	8.83	10.17	11.21	**50yr**
100yr	0.72	1.16	1.50	2.13	2.91	3.80	**100yr**	2.51	3.26	4.43	5.53	6.76	8.18	9.74	**100yr**	7.24	9.37	10.56	12.09	13.22	**100yr**
200yr	0.83	1.35	1.75	2.51	3.46	4.54	**200yr**	2.99	3.86	5.31	6.61	8.07	9.72	11.71	**200yr**	8.60	11.26	12.64	14.37	15.60	**200yr**
500yr	1.01	1.65	2.15	3.12	4.37	5.76	**500yr**	3.77	4.83	6.74	8.37	10.19	12.21	14.96	**500yr**	10.81	14.38	16.04	18.07	19.42	**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	0.61	0.75	0.96	**1yr**	0.64	0.94	1.17	1.51	1.95	2.28	2.52	**1yr**	2.02	2.42	2.95	3.09	4.14	**1yr**
2yr	0.34	0.52	0.64	0.86	1.07	1.27	**2yr**	0.92	1.24	1.43	1.89	2.43	3.05	3.40	**2yr**	2.70	3.27	3.73	4.43	5.07	**2yr**
5yr	0.39	0.59	0.74	1.01	1.29	1.53	**5yr**	1.11	1.49	1.76	2.25	2.83	3.66	4.14	**5yr**	3.24	3.98	4.50	5.30	5.99	**5yr**
10yr	0.43	0.66	0.82	1.15	1.48	1.76	**10yr**	1.28	1.72	2.01	2.57	3.14	4.21	4.82	**10yr**	3.72	4.63	5.20	6.04	6.73	**10yr**
25yr	0.50	0.77	0.95	1.36	1.79	2.11	**25yr**	1.55	2.06	2.40	3.05	3.61	5.10	5.91	**25yr**	4.52	5.68	6.29	7.22	7.80	**25yr**
50yr	0.56	0.86	1.07	1.54	2.07	2.44	**50yr**	1.79	2.39	2.76	3.53	4.03	5.91	6.91	**50yr**	5.23	6.64	7.28	8.28	8.70	**50yr**
100yr	0.64	0.97	1.22	1.76	2.41	2.83	**100yr**	2.08	2.77	3.18	4.05	4.48	6.87	8.11	**100yr**	6.08	7.80	8.44	9.52	9.71	**100yr**
200yr	0.73	1.09	1.39	2.01	2.80	3.30	**200yr**	2.42	3.22	3.68	4.70	5.00	7.98	9.54	**200yr**	7.07	9.18	9.80	10.94	10.88	**200yr**
500yr	0.87	1.29	1.66	2.42	3.44	4.03	**500yr**	2.97	3.94	4.48	5.73	5.83	9.79	11.86	**500yr**	8.66	11.40	12.02	13.22	12.68	**500yr**

Upper Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.31	0.49	0.59	0.80	0.98	1.18	**1yr**	0.85	1.15	1.36	1.72	2.31	2.78	3.20	**1yr**	2.46	3.07	3.50	4.20	4.84	**1yr**
2yr	0.35	0.55	0.67	0.91	1.13	1.33	**2yr**	0.97	1.30	1.56	2.00	2.59	3.25	3.63	**2yr**	2.88	3.49	4.01	4.77	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	4.18	4.77	**5yr**	3.70	4.58	5.30	6.24	6.97	**5yr**
10yr	0.52	0.79	0.98	1.37	1.77	2.05	**10yr**	1.53	2.00	2.38	3.03	3.75	5.08	5.87	**10yr**	4.49	5.65	6.54	7.63	8.44	**10yr**
25yr	0.64	0.98	1.22	1.74	2.28	2.62	**25yr**	1.97	2.56	3.10	3.84	4.67	6.56	7.72	**25yr**	5.81	7.42	8.64	9.95	10.88	**25yr**
50yr	0.76	1.15	1.43	2.06	2.78	3.16	**50yr**	2.40	3.09	3.78	4.61	5.53	7.95	9.50	**50yr**	7.04	9.13	10.67	12.19	13.19	**50yr**
100yr	0.90	1.36	1.71	2.47	3.38	3.80	**100yr**	2.92	3.72	4.60	5.52	6.50	9.61	11.69	**100yr**	8.51	11.24	13.15	14.88	15.97	**100yr**
200yr	1.07	1.60	2.03	2.94	4.10	4.57	**200yr**	3.54	4.47	5.58	6.61	7.68	11.61	14.36	**200yr**	10.27	13.81	16.23	18.17	19.36	**200yr**
500yr	1.35	2.01	2.58	3.75	5.33	5.84	**500yr**	4.60	5.71	7.22	8.40	9.56	14.92	18.85	**500yr**	13.20	18.13	21.38	23.59	24.97	**500yr**

Powered by ACIS
Northeast Regional Climate Center

Stage-Area-Storage for Pond 1P: Bioretention Area

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
585.00	227	0
585.02	232	5
585.04	236	9
585.06	241	14
585.08	246	19
585.10	251	24
585.12	256	29
585.14	261	34
585.16	266	39
585.18	271	45
585.20	276	50
585.22	281	56
585.24	286	61
585.26	292	67
585.28	297	73
585.30	302	79
585.32	308	85
585.34	313	91
585.36	319	98
585.38	324	104
585.40	330	111
585.42	335	117
585.44	341	124
585.46	347	131
585.48	353	138
585.50	359	145
585.52	364	152
585.54	370	160
585.56	376	167
585.58	382	175
585.60	388	182
585.62	395	190
585.64	401	198
585.66	407	206
585.68	413	215
585.70	420	223
585.72	426	231
585.74	432	240
585.76	439	249
585.78	445	257
585.80	452	266
585.82	458	276
585.84	465	285
585.86	472	294
585.88	479	304
585.90	485	313
585.92	492	323
585.94	499	333
585.96	506	343
585.98	513	353
586.00	520	364
586.02	526	374
586.04	532	385
586.06	538	395
586.08	545	406
586.10	551	417
586.12	557	428
586.14	563	439
586.16	570	451
586.18	576	462
586.20	583	474
586.22	589	485
586.24	596	497
586.26	602	509
586.28	609	521
586.30	615	534
586.32	622	546
586.34	629	559
586.36	635	571
586.38	642	584
586.40	649	597
586.42	656	610
586.44	663	623
586.46	669	636
586.48	676	650
586.50	683	663
586.52	690	677
586.54	697	691
586.56	704	705
586.58	712	719
586.60	719	734
586.62	726	748
586.64	733	763
586.66	740	777
586.68	748	792
586.70	755	807
586.72	762	822
586.74	770	838
586.76	777	853
586.78	785	869
586.80	792	885
586.82	800	900
586.84	807	917
586.86	815	933
586.88	822	949
586.90	830	966
586.92	838	982
586.94	846	999
586.96	853	1,016
586.98	861	1,033
587.00	**869**	**1,051**

Volume Below Invert

Summary for Pond FB: Forebay

[43] Hint: Has no inflow (Outflow=Zero)

Volume	Invert	Avail.Storage	Storage Description
#1	585.00'	192 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
585.00	29	21.0	0	0	29
586.00	92	37.0	58	58	108
587.00	182	52.0	134	192	224

Impervious area = 10,678 square feet

Volume Criteria
0.1 inch per impervious acre

.1"/12" x 10,678 square feet = 89 cubic feet (min.)

APPENDIX A

MASSDEP STORMWATER REPORT CHECKLIST

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

Checklist for Stormwater Report

A. Introduction

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

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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

Electronically stamped by Michael Andrade, PE: 12/22/22

Signature and Date

Checklist

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

☐ New development

☐ Redevelopment

☒ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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

APPENDIX B

HYDROCAD REPORTS
PRE-DEVELOPMENT

KEY

A — B

TIME OF CONCENTRATION SEGMENT

DESIGN POINT #2
(MAIN STREET)

DESIGN POINT #1
(WETLAND)

MAIN STREET
(PUBLIC - 1927 STATE HIGHWAY LAYOUT)
(AKA US ROUTE 20)

20

10

HSG B

HSG B

MAP 2432
LOT 507
N/F LANDS OF
ADVANT & BAPTISTE SOCIETY
(DEED NOT FOUND)

MAP 2432
LOT 501
N/F LANDS OF
TOWN OF STURBRIDGE
BK. 62224, PG. 137

MAP 2432
LOT 505
N/F LANDS OF
JENNY BOUNPHASAYSONH
BK. 47562, PG. 345

#505
2 STORY WOOD FRAME BUILDING
(2,099 SF)

ZONING SETBACK LINE (TYP.)

GRAPHIC SCALE
10 0 5 10 20 40
(IN FEET)
1 inch = 10 ft.

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

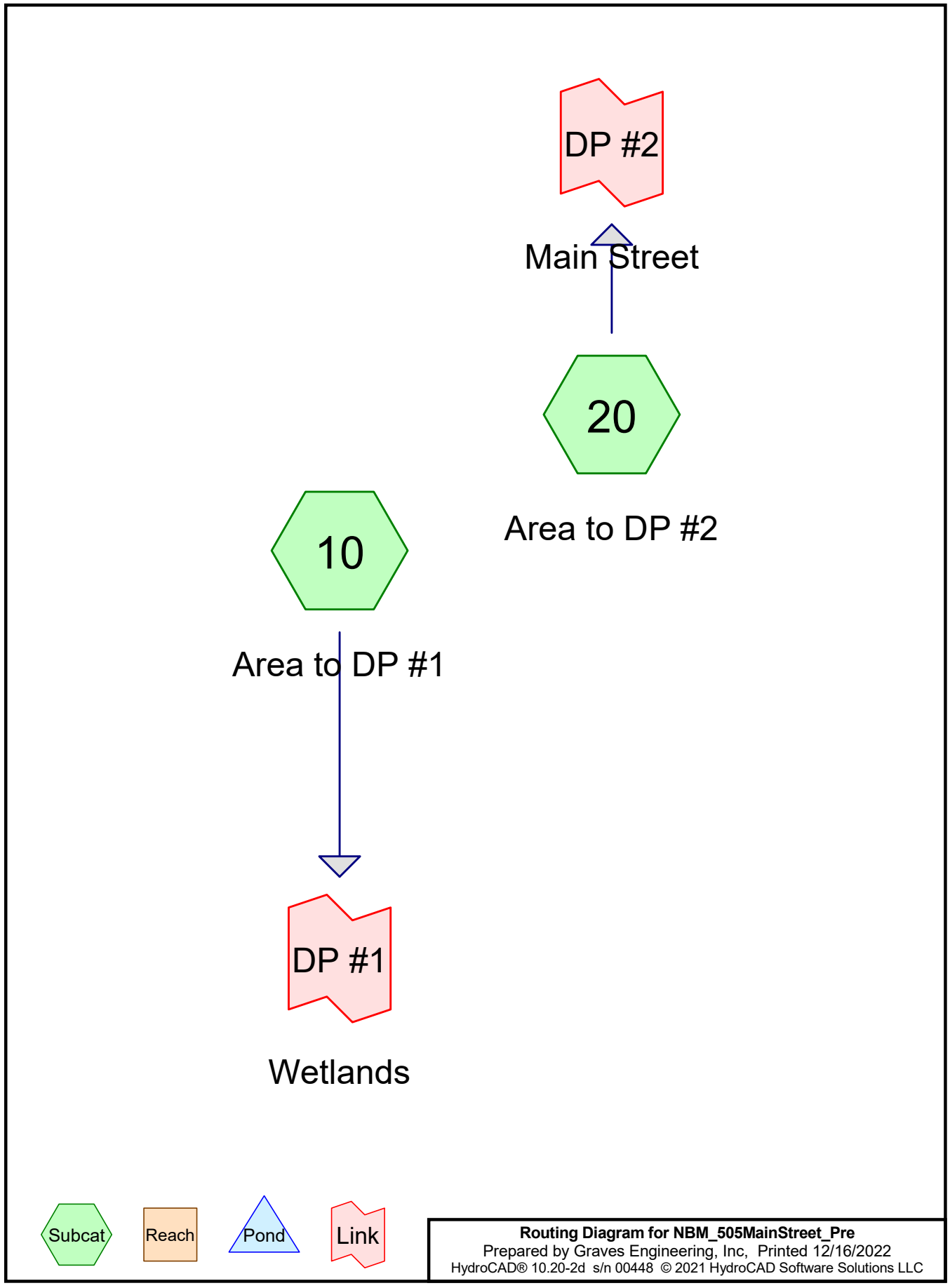
NO.	DATE	BY	REVISIONS DESCRIPTION

PRE-DEVELOPMENT DRAINAGE AREA
MULTI-FAMILY RESIDENTIAL PROJECT
505 MAIN STREET, STURBRIDGE, MA 01518

PREPARED FOR:
STL GROUP, LLC
PO BOX 638, STURBRIDGE, MA 01566

DATE: 12/15/22 | SCALE: 1"=10' | DES. BY: ROM | DRW. BY: ROM | CHK. BY: MRA | PRJ. NO.: 22152

PRE


DP #2
Main Street
20
Area to DP #2
10
Area to DP #1
DP #1
Wetlands
Subcat
Reach
Pond
Link
Routing Diagram for NBM_505MainStreet_Pre
Prepared by Graves Engineering, Inc, Printed 12/16/2022
HydroCAD® 10.20-2d s/n 00448 © 2021 HydroCAD Software Solutions LLC

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 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 10: Area to DP #1 Runoff Area=16,264 sf 56.03% Impervious Runoff Depth>1.35"
Flow Length=175' Tc=6.0 min CN=80 Runoff=0.54 cfs 0.042 af

Subcatchment 20: Area to DP #2 Runoff Area=950 sf 73.26% Impervious Runoff Depth>1.93"
Flow Length=53' Tc=6.0 min CN=88 Runoff=0.04 cfs 0.004 af

Link DP #1: Wetlands Inflow=0.54 cfs 0.042 af
Primary=0.54 cfs 0.042 af

Link DP #2: Main Street Inflow=0.04 cfs 0.004 af
Primary=0.04 cfs 0.004 af

Total Runoff Area = 0.395 ac Runoff Volume = 0.045 af Average Runoff Depth = 1.38"
43.02% Pervious = 0.170 ac 56.98% Impervious = 0.225 ac

Summary for Subcatchment 10: Area to DP #1

Runoff = 0.54 cfs @ 12.13 hrs, Volume= 0.042 af, Depth> 1.35"
Routed to Link DP #1 : Wetlands

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2 year Rainfall=3.13"

Area (sf)	CN	Description
7,013	98	Paved parking, HSG B
2,100	98	Unconnected roofs, HSG B
5,256	61	>75% Grass cover, Good, HSG B
1,895	48	Brush, Good, HSG B
16,264	80	Weighted Average
7,151		43.97% Pervious Area
9,113		56.03% Impervious Area
2,100		23.04% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	175		0.49		**Direct Entry, TC**

Summary for Subcatchment 20: Area to DP #2

Runoff = 0.04 cfs @ 12.13 hrs, Volume= 0.004 af, Depth> 1.93"
Routed to Link DP #2 : Main Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2 year Rainfall=3.13"

Area (sf)	CN	Description
696	98	Paved parking, HSG B
254	61	>75% Grass cover, Good, HSG B
950	88	Weighted Average
254		26.74% Pervious Area
696		73.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	53		0.15		**Direct Entry, TC**

Summary for Link DP #1: Wetlands

Inflow Area = 0.373 ac, 56.03% Impervious, Inflow Depth > 1.35" for 2 year event
Inflow = 0.54 cfs @ 12.13 hrs, Volume= 0.042 af
Primary = 0.54 cfs @ 12.13 hrs, Volume= 0.042 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Summary for Link DP #2: Main Street

Inflow Area = 0.022 ac, 73.26% Impervious, Inflow Depth > 1.93" for 2 year event
Inflow = 0.04 cfs @ 12.13 hrs, Volume= 0.004 af
Primary = 0.04 cfs @ 12.13 hrs, Volume= 0.004 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 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 10: Area to DP #1 Runoff Area=16,264 sf 56.03% Impervious Runoff Depth>2.58"
Flow Length=175' Tc=6.0 min CN=80 Runoff=1.04 cfs 0.080 af

Subcatchment 20: Area to DP #2 Runoff Area=950 sf 73.26% Impervious Runoff Depth>3.32"
Flow Length=53' Tc=6.0 min CN=88 Runoff=0.08 cfs 0.006 af

Link DP #1: Wetlands Inflow=1.04 cfs 0.080 af
Primary=1.04 cfs 0.080 af

Link DP #2: Main Street Inflow=0.08 cfs 0.006 af
Primary=0.08 cfs 0.006 af

Total Runoff Area = 0.395 ac Runoff Volume = 0.086 af Average Runoff Depth = 2.62"
43.02% Pervious = 0.170 ac 56.98% Impervious = 0.225 ac

Summary for Subcatchment 10: Area to DP #1

Runoff = 1.04 cfs @ 12.13 hrs, Volume= 0.080 af, Depth> 2.58"
Routed to Link DP #1 : Wetlands

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10 year Rainfall=4.64"

Area (sf)	CN	Description
7,013	98	Paved parking, HSG B
2,100	98	Unconnected roofs, HSG B
5,256	61	>75% Grass cover, Good, HSG B
1,895	48	Brush, Good, HSG B
16,264	80	Weighted Average
7,151		43.97% Pervious Area
9,113		56.03% Impervious Area
2,100		23.04% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	175		0.49		**Direct Entry, TC**

Summary for Subcatchment 20: Area to DP #2

Runoff = 0.08 cfs @ 12.13 hrs, Volume= 0.006 af, Depth> 3.32"
Routed to Link DP #2 : Main Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10 year Rainfall=4.64"

Area (sf)	CN	Description
696	98	Paved parking, HSG B
254	61	>75% Grass cover, Good, HSG B
950	88	Weighted Average
254		26.74% Pervious Area
696		73.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	53		0.15		**Direct Entry, TC**

Summary for Link DP #1: Wetlands

Inflow Area = 0.373 ac, 56.03% Impervious, Inflow Depth > 2.58" for 10 year event
Inflow = 1.04 cfs @ 12.13 hrs, Volume= 0.080 af
Primary = 1.04 cfs @ 12.13 hrs, Volume= 0.080 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Summary for Link DP #2: Main Street

Inflow Area = 0.022 ac, 73.26% Impervious, Inflow Depth > 3.32" for 10 year event
Inflow = 0.08 cfs @ 12.13 hrs, Volume= 0.006 af
Primary = 0.08 cfs @ 12.13 hrs, Volume= 0.006 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 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 10: Area to DP #1 Runoff Area=16,264 sf 56.03% Impervious Runoff Depth>3.61"
Flow Length=175' Tc=6.0 min CN=80 Runoff=1.44 cfs 0.112 af

Subcatchment 20: Area to DP #2 Runoff Area=950 sf 73.26% Impervious Runoff Depth>4.44"
Flow Length=53' Tc=6.0 min CN=88 Runoff=0.10 cfs 0.008 af

Link DP #1: Wetlands Inflow=1.44 cfs 0.112 af
Primary=1.44 cfs 0.112 af

Link DP #2: Main Street Inflow=0.10 cfs 0.008 af
Primary=0.10 cfs 0.008 af

Total Runoff Area = 0.395 ac Runoff Volume = 0.120 af Average Runoff Depth = 3.65"
43.02% Pervious = 0.170 ac 56.98% Impervious = 0.225 ac

Summary for Subcatchment 10: Area to DP #1

Runoff = 1.44 cfs @ 12.13 hrs, Volume= 0.112 af, Depth> 3.61"
Routed to Link DP #1 : Wetlands

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 25 year Rainfall=5.81"

Area (sf)	CN	Description
7,013	98	Paved parking, HSG B
2,100	98	Unconnected roofs, HSG B
5,256	61	>75% Grass cover, Good, HSG B
1,895	48	Brush, Good, HSG B
16,264	80	Weighted Average
7,151		43.97% Pervious Area
9,113		56.03% Impervious Area
2,100		23.04% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	175		0.49		**Direct Entry, TC**

Summary for Subcatchment 20: Area to DP #2

Runoff = 0.10 cfs @ 12.13 hrs, Volume= 0.008 af, Depth> 4.44"
Routed to Link DP #2 : Main Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 25 year Rainfall=5.81"

Area (sf)	CN	Description
696	98	Paved parking, HSG B
254	61	>75% Grass cover, Good, HSG B
950	88	Weighted Average
254		26.74% Pervious Area
696		73.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	53		0.15		**Direct Entry, TC**

Summary for Link DP #1: Wetlands

Inflow Area = 0.373 ac, 56.03% Impervious, Inflow Depth > 3.61" for 25 year event
Inflow = 1.44 cfs @ 12.13 hrs, Volume= 0.112 af
Primary = 1.44 cfs @ 12.13 hrs, Volume= 0.112 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Summary for Link DP #2: Main Street

Inflow Area = 0.022 ac, 73.26% Impervious, Inflow Depth > 4.44" for 25 year event
Inflow = 0.10 cfs @ 12.13 hrs, Volume= 0.008 af
Primary = 0.10 cfs @ 12.13 hrs, Volume= 0.008 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 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 10: Area to DP #1 Runoff Area=16,264 sf 56.03% Impervious Runoff Depth>5.79"
Flow Length=175' Tc=6.0 min CN=80 Runoff=2.26 cfs 0.180 af

Subcatchment 20: Area to DP #2 Runoff Area=950 sf 73.26% Impervious Runoff Depth>6.74"
Flow Length=53' Tc=6.0 min CN=88 Runoff=0.15 cfs 0.012 af

Link DP #1: Wetlands Inflow=2.26 cfs 0.180 af
Primary=2.26 cfs 0.180 af

Link DP #2: Main Street Inflow=0.15 cfs 0.012 af
Primary=0.15 cfs 0.012 af

Total Runoff Area = 0.395 ac Runoff Volume = 0.192 af Average Runoff Depth = 5.84"
43.02% Pervious = 0.170 ac 56.98% Impervious = 0.225 ac

Summary for Subcatchment 10: Area to DP #1

Runoff = 2.26 cfs @ 12.13 hrs, Volume= 0.180 af, Depth> 5.79"
Routed to Link DP #1 : Wetlands

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100 year Rainfall=8.18"

Area (sf)	CN	Description
7,013	98	Paved parking, HSG B
2,100	98	Unconnected roofs, HSG B
5,256	61	>75% Grass cover, Good, HSG B
1,895	48	Brush, Good, HSG B
16,264	80	Weighted Average
7,151		43.97% Pervious Area
9,113		56.03% Impervious Area
2,100		23.04% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	175		0.49		**Direct Entry, TC**

Summary for Subcatchment 20: Area to DP #2

Runoff = 0.15 cfs @ 12.13 hrs, Volume= 0.012 af, Depth> 6.74"
Routed to Link DP #2 : Main Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100 year Rainfall=8.18"

Area (sf)	CN	Description
696	98	Paved parking, HSG B
254	61	>75% Grass cover, Good, HSG B
950	88	Weighted Average
254		26.74% Pervious Area
696		73.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	53		0.15		**Direct Entry, TC**

Summary for Link DP #1: Wetlands

Inflow Area = 0.373 ac, 56.03% Impervious, Inflow Depth > 5.79" for 100 year event
Inflow = 2.26 cfs @ 12.13 hrs, Volume= 0.180 af
Primary = 2.26 cfs @ 12.13 hrs, Volume= 0.180 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Summary for Link DP #2: Main Street

Inflow Area = 0.022 ac, 73.26% Impervious, Inflow Depth > 6.74" for 100 year event
Inflow = 0.15 cfs @ 12.13 hrs, Volume= 0.012 af
Primary = 0.15 cfs @ 12.13 hrs, Volume= 0.012 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

APPENDIX C

HYDROCAD REPORTS
POST-DEVELOPMENT

KEY

A — B

TIME OF CONCENTRATION SEGMENT

DESIGN POINT #2
(MAIN STREET)

DESIGN POINT #1
(WETLAND)

MAIN STREET
(PUBLIC - 100' STATE HIGHWAY LAYOUT)
(AKA US ROUTE 20)

BULLNOSE CURB CUT (SEE DETAIL)

RECONSTRUCTED CONCRETE SIDEWALK

GRANITE CURB

CONC. WALK

CONC. APRON

HYDRANT

WHITE CROSSHATCH

4' WIDE CONCRETE WALKWAY

ZONING SETBACK LINE (TYP.)

W.L. (TYP.)

ASPHALT PAVEMENT

BITUMINOUS ASPHALT (TYP.)

CAPE COD BERM (TYP.)

LANDSCAPED AREA (TYP.)

CONC. WALL

GRASS AREA

CONCRETE CURB (TYP.)

TP-1

6' WIDE CONCRETE WALKWAY AT GRADE (BELOW 2ND FLOOR OVERHANG)

FOREBAY STONE BERM (TYP.) (CONSTRUCT PER BIORETENTION AREA DETAIL)

SEDIMENT FOREBAY

CONCRETE MODULAR BLOCK RETAINING WALL OF VARYING HEIGHT (DESIGN BY OTHERS)

WOOD GUARDRAIL (SET FACE OF RAIL 1' OFF BACK OF CAPE COD BERM)

STORMWATER BIORETENTION AREA

8' WIDE VEGETATED SPILLWAY CREST ELEV. = 586.50

12" HDPE WITH FLARED END SECTION, 20' LONG, S=7% INV. IN=585.40 INV. OUT=584.00, 10'X10' RIPRAP APPARON

LIMIT OF CLEARING (R&D BRUSH)

WETLAND

WOODED AREA

IRON PIPE FOUND

IRON ROD FOUND N:1.5'

100

200

101

HSG B

MAP 2432
LOT 501
N/F LANDS OF
TOWN OF STURBRIDGE
BK. 62224, PG. 137

MAP 2432
LOT 507
N/F LANDS OF
ADVANT & BAPTISTE SOCIETY
(DEED NOT FOUND)

GRAPHIC SCALE

10 0 5 10 20 40

(IN FEET)
1 inch = 10 ft.

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

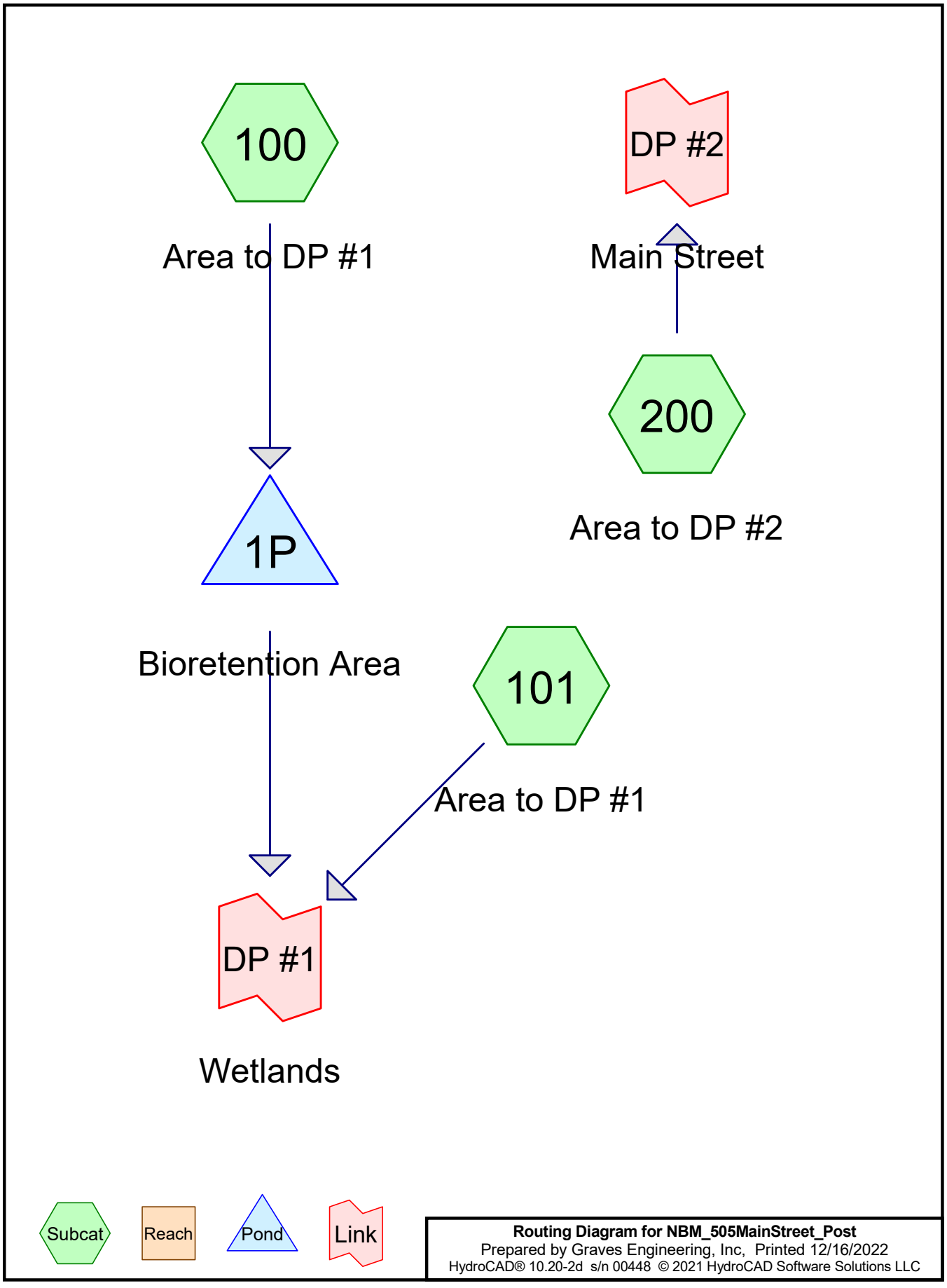
NO.	DATE	BY	DESCRIPTION
			REVISIONS

POST-DEVELOPMENT DRAINAGE AREA
MULTI-FAMILY RESIDENTIAL PROJECT
505 MAIN STREET, STURBRIDGE, MA 01518

PREPARED FOR:
STL GROUP, LLC
PO BOX 638, STURBRIDGE, MA 01566

DATE: 12/15/22 | SCALE: 1"=10' | DES. BY: ROM | DRW. BY: ROM | CHK. BY: MRA | PRJ. NO.: 22152

POST



Routing Diagram for NBM_505MainStreet_Post
Prepared by Graves Engineering, Inc, Printed 12/16/2022

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 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 100: Area to DP #1 Runoff Area=14,234 sf 75.02% Impervious Runoff Depth>2.01"
Flow Length=175' Tc=6.0 min CN=89 Runoff=0.70 cfs 0.055 af

Subcatchment 101: Area to DP #1 Runoff Area=2,085 sf 0.00% Impervious Runoff Depth>0.29"
Flow Length=16' Tc=6.0 min CN=57 Runoff=0.01 cfs 0.001 af

Subcatchment 200: Area to DP #2 Runoff Area=895 sf 32.96% Impervious Runoff Depth>0.94"
Flow Length=53' Tc=6.0 min CN=73 Runoff=0.02 cfs 0.002 af

Pond 1P: Bioretention Area Peak Elev=585.81' Storage=269 cf Inflow=0.70 cfs 0.055 af
Discarded=0.09 cfs 0.041 af Primary=0.51 cfs 0.014 af Outflow=0.60 cfs 0.055 af

Link DP #1: Wetlands Inflow=0.52 cfs 0.015 af
Primary=0.52 cfs 0.015 af

Link DP #2: Main Street Inflow=0.02 cfs 0.002 af
Primary=0.02 cfs 0.002 af

Total Runoff Area = 0.395 ac Runoff Volume = 0.058 af Average Runoff Depth = 1.75"
36.26% Pervious = 0.143 ac 63.74% Impervious = 0.252 ac

Summary for Subcatchment 100: Area to DP #1

Runoff = 0.70 cfs @ 12.13 hrs, Volume= 0.055 af, Depth> 2.01"
Routed to Pond 1P : Bioretention Area

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2 year Rainfall=3.13"

Area (sf)	CN	Description
8,046	98	Paved parking, HSG B
2,632	98	Unconnected roofs, HSG B
3,556	61	>75% Grass cover, Good, HSG B
14,234	89	Weighted Average
3,556		24.98% Pervious Area
10,678		75.02% Impervious Area
2,632		24.65% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	175		0.49		**Direct Entry, TC**

Summary for Subcatchment 101: Area to DP #1

Runoff = 0.01 cfs @ 12.17 hrs, Volume= 0.001 af, Depth> 0.29"
Routed to Link DP #1 : Wetlands

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2 year Rainfall=3.13"

Area (sf)	CN	Description
1,445	61	>75% Grass cover, Good, HSG B
640	48	Brush, Good, HSG B
2,085	57	Weighted Average
2,085		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	16		0.04		**Direct Entry, TC**

Summary for Subcatchment 200: Area to DP #2

Runoff = 0.02 cfs @ 12.14 hrs, Volume= 0.002 af, Depth> 0.94"
Routed to Link DP #2 : Main Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2 year Rainfall=3.13"

Area (sf)	CN	Description
295	98	Unconnected pavement, HSG B
600	61	>75% Grass cover, Good, HSG B
895	73	Weighted Average
600		67.04% Pervious Area
295		32.96% Impervious Area
295		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	53		0.15		**Direct Entry, TC**

Summary for Pond 1P: Bioretention Area

Inflow Area = 0.327 ac, 75.02% Impervious, Inflow Depth > 2.01" for 2 year event
Inflow = 0.70 cfs @ 12.13 hrs, Volume= 0.055 af
Outflow = 0.60 cfs @ 12.17 hrs, Volume= 0.055 af, Atten= 14%, Lag= 2.5 min
Discarded = 0.09 cfs @ 12.17 hrs, Volume= 0.041 af
Primary = 0.51 cfs @ 12.17 hrs, Volume= 0.014 af
Routed to Link DP #1 : Wetlands

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 585.81' @ 12.17 hrs Surf.Area= 454 sf Storage= 269 cf
Flood Elev= 587.00' Surf.Area= 869 sf Storage= 1,051 cf

Plug-Flow detention time= 10.9 min calculated for 0.055 af (100% of inflow)
Center-of-Mass det. time= 10.6 min (840.6 - 830.0)

Volume	Invert	Avail.Storage	Storage Description
#1	585.00'	1,051 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
585.00	227	86.0	0	0	227
586.00	520	106.0	364	364	547
587.00	869	125.0	687	1,051	915

Device	Routing	Invert	Outlet Devices
#1	Discarded	585.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	586.50'	**8.0' long x 5.0' breadth Emergency Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#3	Primary	585.40'	**12.0" Round Outlet Pipe** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 585.40' / 584.00' S= 0.0700 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Discarded OutFlow Max=0.09 cfs @ 12.17 hrs HW=585.80' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Primary OutFlow Max=0.49 cfs @ 12.17 hrs HW=585.80' (Free Discharge)
├**2=Emergency Spillway** (Controls 0.00 cfs)
└**3=Outlet Pipe** (Inlet Controls 0.49 cfs @ 1.70 fps)

Summary for Link DP #1: Wetlands

Inflow Area = 0.375 ac, 65.43% Impervious, Inflow Depth > 0.49" for 2 year event
Inflow = 0.52 cfs @ 12.17 hrs, Volume= 0.015 af
Primary = 0.52 cfs @ 12.17 hrs, Volume= 0.015 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Summary for Link DP #2: Main Street

Inflow Area = 0.021 ac, 32.96% Impervious, Inflow Depth > 0.94" for 2 year event
Inflow = 0.02 cfs @ 12.14 hrs, Volume= 0.002 af
Primary = 0.02 cfs @ 12.14 hrs, Volume= 0.002 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 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 100: Area to DP #1 Runoff Area=14,234 sf 75.02% Impervious Runoff Depth>3.42"
Flow Length=175' Tc=6.0 min CN=89 Runoff=1.16 cfs 0.093 af

Subcatchment 101: Area to DP #1 Runoff Area=2,085 sf 0.00% Impervious Runoff Depth>0.92"
Flow Length=16' Tc=6.0 min CN=57 Runoff=0.04 cfs 0.004 af

Subcatchment 200: Area to DP #2 Runoff Area=895 sf 32.96% Impervious Runoff Depth>2.00"
Flow Length=53' Tc=6.0 min CN=73 Runoff=0.04 cfs 0.003 af

Pond 1P: Bioretention Area Peak Elev=585.97' Storage=346 cf Inflow=1.16 cfs 0.093 af
Discarded=0.10 cfs 0.059 af Primary=0.93 cfs 0.034 af Outflow=1.03 cfs 0.093 af

Link DP #1: Wetlands Inflow=0.97 cfs 0.038 af
Primary=0.97 cfs 0.038 af

Link DP #2: Main Street Inflow=0.04 cfs 0.003 af
Primary=0.04 cfs 0.003 af

Total Runoff Area = 0.395 ac Runoff Volume = 0.100 af Average Runoff Depth = 3.05"
36.26% Pervious = 0.143 ac 63.74% Impervious = 0.252 ac

Summary for Subcatchment 100: Area to DP #1

Runoff = 1.16 cfs @ 12.13 hrs, Volume= 0.093 af, Depth> 3.42"
Routed to Pond 1P : Bioretention Area

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10 year Rainfall=4.64"

Area (sf)	CN	Description
8,046	98	Paved parking, HSG B
2,632	98	Unconnected roofs, HSG B
3,556	61	>75% Grass cover, Good, HSG B
14,234	89	Weighted Average
3,556		24.98% Pervious Area
10,678		75.02% Impervious Area
2,632		24.65% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	175		0.49		**Direct Entry, TC**

Summary for Subcatchment 101: Area to DP #1

Runoff = 0.04 cfs @ 12.14 hrs, Volume= 0.004 af, Depth> 0.92"
Routed to Link DP #1 : Wetlands

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10 year Rainfall=4.64"

Area (sf)	CN	Description
1,445	61	>75% Grass cover, Good, HSG B
640	48	Brush, Good, HSG B
2,085	57	Weighted Average
2,085		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	16		0.04		**Direct Entry, TC**

Summary for Subcatchment 200: Area to DP #2

Runoff = 0.04 cfs @ 12.13 hrs, Volume= 0.003 af, Depth> 2.00"
Routed to Link DP #2 : Main Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10 year Rainfall=4.64"

Area (sf)	CN	Description
295	98	Unconnected pavement, HSG B
600	61	>75% Grass cover, Good, HSG B
895	73	Weighted Average
600		67.04% Pervious Area
295		32.96% Impervious Area
295		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	53		0.15		**Direct Entry, TC**

Summary for Pond 1P: Bioretention Area

Inflow Area = 0.327 ac, 75.02% Impervious, Inflow Depth > 3.42" for 10 year event
Inflow = 1.16 cfs @ 12.13 hrs, Volume= 0.093 af
Outflow = 1.03 cfs @ 12.16 hrs, Volume= 0.093 af, Atten= 11%, Lag= 2.1 min
Discarded = 0.10 cfs @ 12.16 hrs, Volume= 0.059 af
Primary = 0.93 cfs @ 12.16 hrs, Volume= 0.034 af
Routed to Link DP #1 : Wetlands

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 585.97' @ 12.16 hrs Surf.Area= 508 sf Storage= 346 cf
Flood Elev= 587.00' Surf.Area= 869 sf Storage= 1,051 cf

Plug-Flow detention time= 11.4 min calculated for 0.093 af (100% of inflow)
Center-of-Mass det. time= 11.0 min (821.7 - 810.7)

Volume	Invert	Avail.Storage	Storage Description
#1	585.00'	1,051 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
585.00	227	86.0	0	0	227
586.00	520	106.0	364	364	547
587.00	869	125.0	687	1,051	915

Device	Routing	Invert	Outlet Devices
#1	Discarded	585.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	586.50'	**8.0' long x 5.0' breadth Emergency Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#3	Primary	585.40'	**12.0" Round Outlet Pipe** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 585.40' / 584.00' S= 0.0700 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Discarded OutFlow Max=0.10 cfs @ 12.16 hrs HW=585.96' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.10 cfs)

Primary OutFlow Max=0.90 cfs @ 12.16 hrs HW=585.96' (Free Discharge)
├**2=Emergency Spillway** (Controls 0.00 cfs)
└**3=Outlet Pipe** (Inlet Controls 0.90 cfs @ 2.01 fps)

Summary for Link DP #1: Wetlands

Inflow Area = 0.375 ac, 65.43% Impervious, Inflow Depth > 1.20" for 10 year event
Inflow = 0.97 cfs @ 12.16 hrs, Volume= 0.038 af
Primary = 0.97 cfs @ 12.16 hrs, Volume= 0.038 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Summary for Link DP #2: Main Street

Inflow Area = 0.021 ac, 32.96% Impervious, Inflow Depth > 2.00" for 10 year event
Inflow = 0.04 cfs @ 12.13 hrs, Volume= 0.003 af
Primary = 0.04 cfs @ 12.13 hrs, Volume= 0.003 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 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 100: Area to DP #1 Runoff Area=14,234 sf 75.02% Impervious Runoff Depth>4.55"
Flow Length=175' Tc=6.0 min CN=89 Runoff=1.51 cfs 0.124 af

Subcatchment 101: Area to DP #1 Runoff Area=2,085 sf 0.00% Impervious Runoff Depth>1.56"
Flow Length=16' Tc=6.0 min CN=57 Runoff=0.08 cfs 0.006 af

Subcatchment 200: Area to DP #2 Runoff Area=895 sf 32.96% Impervious Runoff Depth>2.93"
Flow Length=53' Tc=6.0 min CN=73 Runoff=0.06 cfs 0.005 af

Pond 1P: Bioretention Area Peak Elev=586.07' Storage=402 cf Inflow=1.51 cfs 0.124 af
Discarded=0.10 cfs 0.072 af Primary=1.24 cfs 0.052 af Outflow=1.34 cfs 0.124 af

Link DP #1: Wetlands Inflow=1.31 cfs 0.058 af
Primary=1.31 cfs 0.058 af

Link DP #2: Main Street Inflow=0.06 cfs 0.005 af
Primary=0.06 cfs 0.005 af

Total Runoff Area = 0.395 ac Runoff Volume = 0.135 af Average Runoff Depth = 4.10"
36.26% Pervious = 0.143 ac 63.74% Impervious = 0.252 ac

Summary for Subcatchment 100: Area to DP #1

Runoff = 1.51 cfs @ 12.13 hrs, Volume= 0.124 af, Depth> 4.55"
Routed to Pond 1P : Bioretention Area

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 25 year Rainfall=5.81"

Area (sf)	CN	Description
8,046	98	Paved parking, HSG B
2,632	98	Unconnected roofs, HSG B
3,556	61	>75% Grass cover, Good, HSG B
14,234	89	Weighted Average
3,556		24.98% Pervious Area
10,678		75.02% Impervious Area
2,632		24.65% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	175		0.49		**Direct Entry, TC**

Summary for Subcatchment 101: Area to DP #1

Runoff = 0.08 cfs @ 12.14 hrs, Volume= 0.006 af, Depth> 1.56"
Routed to Link DP #1 : Wetlands

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 25 year Rainfall=5.81"

Area (sf)	CN	Description
1,445	61	>75% Grass cover, Good, HSG B
640	48	Brush, Good, HSG B
2,085	57	Weighted Average
2,085		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	16		0.04		**Direct Entry, TC**

Summary for Subcatchment 200: Area to DP #2

Runoff = 0.06 cfs @ 12.13 hrs, Volume= 0.005 af, Depth> 2.93"
Routed to Link DP #2 : Main Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 25 year Rainfall=5.81"

Area (sf)	CN	Description
295	98	Unconnected pavement, HSG B
600	61	>75% Grass cover, Good, HSG B
895	73	Weighted Average
600		67.04% Pervious Area
295		32.96% Impervious Area
295		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	53		0.15		**Direct Entry, TC**

Summary for Pond 1P: Bioretention Area

Inflow Area = 0.327 ac, 75.02% Impervious, Inflow Depth > 4.55" for 25 year event
Inflow = 1.51 cfs @ 12.13 hrs, Volume= 0.124 af
Outflow = 1.34 cfs @ 12.16 hrs, Volume= 0.124 af, Atten= 11%, Lag= 2.1 min
Discarded = 0.10 cfs @ 12.16 hrs, Volume= 0.072 af
Primary = 1.24 cfs @ 12.16 hrs, Volume= 0.052 af
Routed to Link DP #1 : Wetlands

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 586.07' @ 12.16 hrs Surf.Area= 542 sf Storage= 402 cf
Flood Elev= 587.00' Surf.Area= 869 sf Storage= 1,051 cf

Plug-Flow detention time= 11.8 min calculated for 0.123 af (100% of inflow)
Center-of-Mass det. time= 11.5 min (812.1 - 800.6)

Volume	Invert	Avail.Storage	Storage Description
#1	585.00'	1,051 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
585.00	227	86.0	0	0	227
586.00	520	106.0	364	364	547
587.00	869	125.0	687	1,051	915

Device	Routing	Invert	Outlet Devices
#1	Discarded	585.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	586.50'	**8.0' long x 5.0' breadth Emergency Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#3	Primary	585.40'	**12.0" Round Outlet Pipe** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 585.40' / 584.00' S= 0.0700 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Discarded OutFlow Max=0.10 cfs @ 12.16 hrs HW=586.06' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.10 cfs)

Primary OutFlow Max=1.21 cfs @ 12.16 hrs HW=586.06' (Free Discharge)
├**2=Emergency Spillway** (Controls 0.00 cfs)
└**3=Outlet Pipe** (Inlet Controls 1.21 cfs @ 2.19 fps)

Summary for Link DP #1: Wetlands

Inflow Area = 0.375 ac, 65.43% Impervious, Inflow Depth > 1.86" for 25 year event
Inflow = 1.31 cfs @ 12.16 hrs, Volume= 0.058 af
Primary = 1.31 cfs @ 12.16 hrs, Volume= 0.058 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Summary for Link DP #2: Main Street

Inflow Area = 0.021 ac, 32.96% Impervious, Inflow Depth > 2.93" for 25 year event
Inflow = 0.06 cfs @ 12.13 hrs, Volume= 0.005 af
Primary = 0.06 cfs @ 12.13 hrs, Volume= 0.005 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 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 100: Area to DP #1 Runoff Area=14,234 sf 75.02% Impervious Runoff Depth>6.86"
Flow Length=175' Tc=6.0 min CN=89 Runoff=2.22 cfs 0.187 af

Subcatchment 101: Area to DP #1 Runoff Area=2,085 sf 0.00% Impervious Runoff Depth>3.13"
Flow Length=16' Tc=6.0 min CN=57 Runoff=0.16 cfs 0.012 af

Subcatchment 200: Area to DP #2 Runoff Area=895 sf 32.96% Impervious Runoff Depth>4.96"
Flow Length=53' Tc=6.0 min CN=73 Runoff=0.11 cfs 0.008 af

Pond 1P: Bioretention Area Peak Elev=586.28' Storage=519 cf Inflow=2.22 cfs 0.187 af
Discarded=0.12 cfs 0.093 af Primary=1.84 cfs 0.094 af Outflow=1.95 cfs 0.187 af

Link DP #1: Wetlands Inflow=1.99 cfs 0.106 af
Primary=1.99 cfs 0.106 af

Link DP #2: Main Street Inflow=0.11 cfs 0.008 af
Primary=0.11 cfs 0.008 af

Total Runoff Area = 0.395 ac Runoff Volume = 0.208 af Average Runoff Depth = 6.31"
36.26% Pervious = 0.143 ac 63.74% Impervious = 0.252 ac

Summary for Subcatchment 100: Area to DP #1

Runoff = 2.22 cfs @ 12.13 hrs, Volume= 0.187 af, Depth> 6.86"
Routed to Pond 1P : Bioretention Area

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100 year Rainfall=8.18"

Area (sf)	CN	Description
8,046	98	Paved parking, HSG B
2,632	98	Unconnected roofs, HSG B
3,556	61	>75% Grass cover, Good, HSG B
14,234	89	Weighted Average
3,556		24.98% Pervious Area
10,678		75.02% Impervious Area
2,632		24.65% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	175		0.49		**Direct Entry, TC**

Summary for Subcatchment 101: Area to DP #1

Runoff = 0.16 cfs @ 12.13 hrs, Volume= 0.012 af, Depth> 3.13"
Routed to Link DP #1 : Wetlands

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100 year Rainfall=8.18"

Area (sf)	CN	Description
1,445	61	>75% Grass cover, Good, HSG B
640	48	Brush, Good, HSG B
2,085	57	Weighted Average
2,085		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	16		0.04		**Direct Entry, TC**

Summary for Subcatchment 200: Area to DP #2

Runoff = 0.11 cfs @ 12.13 hrs, Volume= 0.008 af, Depth> 4.96"
Routed to Link DP #2 : Main Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100 year Rainfall=8.18"

Area (sf)	CN	Description
295	98	Unconnected pavement, HSG B
600	61	>75% Grass cover, Good, HSG B
895	73	Weighted Average
600		67.04% Pervious Area
295		32.96% Impervious Area
295		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	53		0.15		**Direct Entry, TC**

Summary for Pond 1P: Bioretention Area

Inflow Area = 0.327 ac, 75.02% Impervious, Inflow Depth > 6.86" for 100 year event
Inflow = 2.22 cfs @ 12.13 hrs, Volume= 0.187 af
Outflow = 1.95 cfs @ 12.16 hrs, Volume= 0.187 af, Atten= 12%, Lag= 2.2 min
Discarded = 0.12 cfs @ 12.16 hrs, Volume= 0.093 af
Primary = 1.84 cfs @ 12.16 hrs, Volume= 0.094 af
Routed to Link DP #1 : Wetlands

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 586.28' @ 12.16 hrs Surf.Area= 607 sf Storage= 519 cf
Flood Elev= 587.00' Surf.Area= 869 sf Storage= 1,051 cf

Plug-Flow detention time= 12.8 min calculated for 0.186 af (100% of inflow)
Center-of-Mass det. time= 12.5 min (799.3 - 786.8)

Volume	Invert	Avail.Storage	Storage Description
#1	585.00'	1,051 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
585.00	227	86.0	0	0	227
586.00	520	106.0	364	364	547
587.00	869	125.0	687	1,051	915

Device	Routing	Invert	Outlet Devices
#1	Discarded	585.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	586.50'	**8.0' long x 5.0' breadth Emergency Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#3	Primary	585.40'	**12.0" Round Outlet Pipe** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 585.40' / 584.00' S= 0.0700 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Discarded OutFlow Max=0.12 cfs @ 12.16 hrs HW=586.26' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=1.80 cfs @ 12.16 hrs HW=586.26' (Free Discharge)
├**2=Emergency Spillway** (Controls 0.00 cfs)
└**3=Outlet Pipe** (Inlet Controls 1.80 cfs @ 2.50 fps)

Summary for Link DP #1: Wetlands

Inflow Area = 0.375 ac, 65.43% Impervious, Inflow Depth > 3.40" for 100 year event
Inflow = 1.99 cfs @ 12.16 hrs, Volume= 0.106 af
Primary = 1.99 cfs @ 12.16 hrs, Volume= 0.106 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

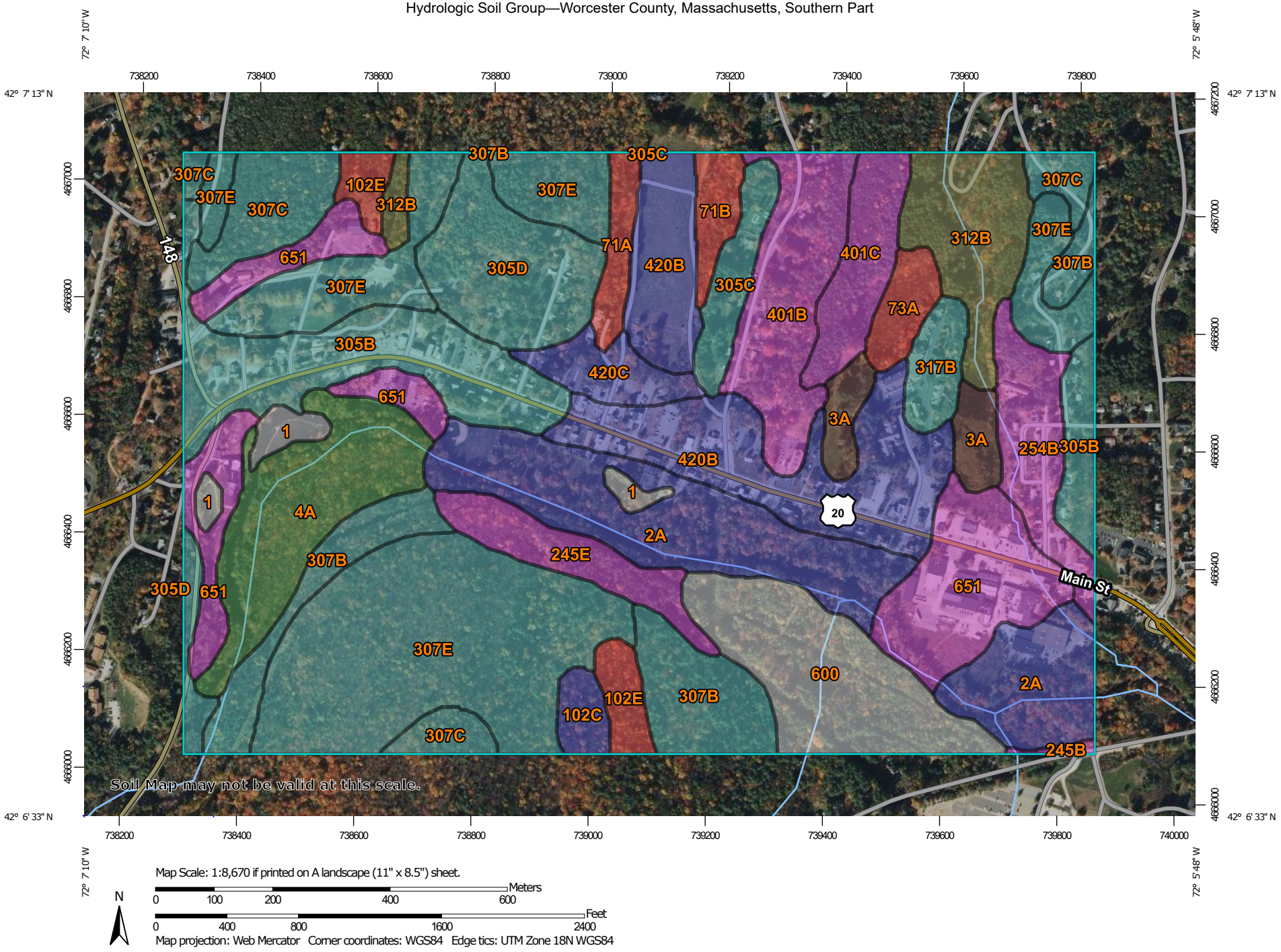
Summary for Link DP #2: Main Street

Inflow Area = 0.021 ac, 32.96% Impervious, Inflow Depth > 4.96" for 100 year event
Inflow = 0.11 cfs @ 12.13 hrs, Volume= 0.008 af
Primary = 0.11 cfs @ 12.13 hrs, Volume= 0.008 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

APPENDIX D

USDA-NRCS SITE SOILS MAP



Map Scale: 1:8,670 if printed on A landscape (11" x 8.5") sheet.

N

0 100 200 400 600 Meters

0 400 800 1600 2400 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Lines

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Points

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Water Features

Streams and Canals

Transportation

Rails
Interstate Highways
US Routes
Major Roads
Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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 15, Sep 9, 2022

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

Date(s) aerial images were photographed: Oct 15, 2020—Oct 31, 2020

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Water		3.8	1.0%
2A	Pootatuck fine sandy loam, 0 to 3 percent slopes, occasionally flooded	B	37.3	9.5%
3A	Scarboro and Walpole soils, 0 to 3 percent slopes	B/D	6.2	1.6%
4A	Rippowam fine sandy loam, 0 to 3 percent slopes, frequently flooded	A/D	20.2	5.1%
71A	Ridgebury fine sandy loam, 0 to 3 percent slopes, extremely stony	D	3.9	1.0%
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	D	3.7	0.9%
73A	Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony	D	4.1	1.0%
102C	Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes	B	2.8	0.7%
102E	Chatfield-Hollis-Rock outcrop complex, 15 to 35 percent slopes	D	5.6	1.4%
245B	Hinckley loamy sand, 3 to 8 percent slopes	A	0.5	0.1%
245E	Hinckley loamy sand, 15 to 35 percent slopes	A	8.6	2.2%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	A	10.4	2.6%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	C	26.5	6.7%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	C	5.9	1.5%
305D	Paxton fine sandy loam, 15 to 25 percent slopes	C	18.7	4.7%
307B	Paxton fine sandy loam, 0 to 8 percent slopes, extremely stony	C	20.5	5.2%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
307C	Paxton fine sandy loam, 8 to 15 percent slopes, extremely stony	C	14.2	3.6%
307E	Paxton fine sandy loam, 15 to 35 percent slopes, extremely stony	C	65.8	16.7%
312B	Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony	C/D	15.0	3.8%
317B	Scituate fine sandy loam, 3 to 8 percent slopes, extremely stony	C	4.6	1.2%
401B	Brookfield fine sandy loam, 3 to 8 percent slopes, extremely stony	A	17.0	4.3%
401C	Brookfield fine sandy loam, 8 to 15 percent slopes, extremely stony	A	8.9	2.2%
420B	Canton fine sandy loam, 3 to 8 percent slopes	B	34.1	8.6%
420C	Canton fine sandy loam, 8 to 15 percent slopes	B	5.7	1.4%
600	Pits, gravel		21.4	5.4%
651	Udorthents, smoothed	A	29.5	7.5%
Totals for Area of Interest			**394.8**	**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 505 Main Street is an open drainage system consisting of a sediment forebay and a bioretention area (also known as a rain garden).

Responsible Parties

The drainage system located on the site property will be operated and maintained by the applicant, STL Group, 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.

Owner: Jenny Bounphasaysonh
Responsible Party for O&M, Financing, and Records: STL Group, LLC (P.O. Box 638, Sturbridge, MA 01566)
Point of Contact: Nick St. Laurent
(nbmrealty@gmail.com)
(Telephone: 617-300-0245)

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.

Culverts and pipes:
All culverts and pipes shall be inspected four times per year and cleaned when drainage impediments are discovered. Flushing of pipes may be required to remove accumulated sediment.

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). The mulch needs to be replaced every two years, in the early spring. Monthly inspections must also include the following:

- Remove litter and debris.
- Treat diseased plantings as needed; prune and replace dead vegetation with like material.
- Remove invasive vegetation and weeds.
- Maintain all culverts, outlet structures, and piping free of debris and blockages.

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 ($CaCl_2$) 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 in sheltered (protected from precipitation and wind) impervious pads or in original shipment containers if possible.
- *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 in the wetland buffer area.

Annual Budget

An annual budget for the operation and maintenance tasks describe above is estimated at $1,500.

Records

A copy of the O&M Plan will be kept by STL Group, LLC.

MAIN STREET
(PUBLIC - 1923 STATE HIGHWAY LAYOUT)
(AKA US ROUTE 20)

BULLNOSE CURB CUT (SEE DETAIL)
RECONSTRUCTED CONCRETE SIDEWALK
GRANITE CURB
CONC. WALK
CONC. APRON
CONC. WALK
CONC. APRON
CONC. WALK
IRON ROD FOUND N:1.5'
HYDRANT
WHITE CROSSHATCH
GRASS AREA
4' WIDE CONCRETE WALKWAY
ZONING SETBACK LINE (TYP.)
W.L. (TYP.)
ASPHALT PAVEMENT
CONC. WALL
BITUMINOUS ASPHALT (TYP.)
CAPE COD BERM (TYP.)
LANDSCAPED AREA (TYP.)
LANDSCAPED AREA (TYP.)
CONCRETE CURB (TYP.)
TP-1
6' WIDE CONCRETE WALKWAY AT GRADE (BELOW 2ND FLOOR OVERHANG)
FOREBAY STONE BERM (TYP.) (CONSTRUCT PER BIORETENTION AREA DETAIL)
SNOW STORAGE AREA (TYP.)
8'x8' CONCRETE DUMPSTER PAD ENCLOSURE (PITCH 1.0% TOWARDS PAVEMENT) 6' HIGH SOLID WOOD OR VINYL FENCE WITH TWO 4' WIDE SWING GATES AND CENTER DROP PIN. SET POSTS IN 12" DIAM. CONCRETE, 36" DEEP
SEDIMENT FOREBAY
CONCRETE MODULAR BLOCK RETAINING WALL OF VARYING HEIGHT (DESIGN BY OTHERS)
WOOD GUARDRAIL (SET FACE OF RAIL 1' OFF BACK OF CAPE COD BERM)
STORMWATER BIORETENTION AREA
8' WIDE VEGETATED SPILLWAY CREST ELEV.=586.50
12" HDPE WITH FLARED END SECTION, 20' LONG, S=7%, INV. IN=585.40 INV. OUT=584.00, 13'X10' RIPRAP APRON
LIMIT OF CLEARING (R&D BRUSH)
WETLAND
BRUSH
WOODED AREA
IRON PIPE FOUND

MAP 2432
LOT 501
N/F LANDS OF
TOWN OF STURBRIDGE
BK. 62224, PG. 137

MAP 2432
LOT 507
N/F LANDS OF
ADVANT & BAPTISTE SOCIETY
(DEED NOT FOUND)

GRAPHIC SCALE
10 0 5 10 20 40
(IN FEET)
1 inch = 10 ft.

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

NO.	DATE	BY	DESCRIPTION
			REVISIONS

OPERATION & MAINTENANCE PLAN
MULTI-FAMILY RESIDENTIAL PROJECT
505 MAIN STREET, STURBRIDGE, MA 01518

PREPARED FOR:
STL GROUP, LLC
PO BOX 638, STURBRIDGE, MA 01566

DATE: 12/15/22 | SCALE: 1"=10' | DES. BY: ROM | DRW. BY: ROM | CHK. BY: MRA | PRJ. NO.: 22152

O&M

O&M LOG

PROJECT: Multi-Family Residential Project
ADDRESS: 505 Main Street, Sturbridge, MA 01518

					ACTION		
LOG #	BY	DATE	BMP FEATURE	OBSERVATIONS	CORRECTIVE ACTION TAKEN (IF NEEDED)	DATE	NOTES

APPENDIX F

LONG-TERM POLLUTION PREVENTION PLAN

LONG-TERM POLLUTION PREVENTION PLAN

Pollution Prevention and Source Control Plan

STL Group, 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 detention 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 regarding 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 (BMPs) and their locations including the sediment forebay, bioretention area and the wetlands buffer 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 existing building. It is recommended not to store such materials in large quantities.

STL Group, LLC shall be responsible for training designated staff in the procedures described herein. Note that this Plan does not indemnify STL Group, 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 ($CaCl_2$) 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 in sheltered (protected from precipitation and wind) impervious pads or in original shipment containers if possible.

- *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 in the wetland buffer area.

APPENDIX G

TSS REMOVAL CALCULATION WORKSHEET

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

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 Wetland through Bioretention Area (with Sediment Forebay)

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Bioretention Area	**0.90**	**1.00**	**0.90**	**0.10**
	0.00	**0.10**	**0.00**	**0.10**
	0.00	**0.10**	**0.00**	**0.10**
	0.00	**0.10**	**0.00**	**0.10**
	0.00	**0.10**	**0.00**	**0.10**

Total TSS Removal = **90%**

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

Project: **Multi-Family Residential - 505 Main Street, Sturbridge**

Prepared By: **ROM**

Date: **12/15/2022**

*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

APPENDIX H

TOTAL PHOSPHORUS REDUCTION CALCULATIONS

State	MASSACHUSETTS
Municipality	STURBRIDGE
Permit Type	MS4
Permit Number	
Major Watershed	QUINEBAUG
TP Load Reduction Target	50%
TN Load Reduction Target	N/A
TSS Load Reduction Target	N/A

Table 1. Project Summary Credit for STURBRIDGE, MASSACHUSETTS

Project Type	Removed Phosphorus Load (lb/yr)	Removed Nitrogen Load (lb/yr)	Removed Sediment Load (lb/yr)
Structural	0.25	2.47	82.91
Non-Structural	0	0	0
Land Use Conversion	0	0	0
Total	0.25	2.47	82.91

Table 2. Structural Project Summary for STURBRIDGE, MASSACHUSETTS

Project ID	BMP Type	BMP Storage Capacity (ft^3)/ Filter Depth (in.)	Phosphorus BMP Efficiency (%)	Nitrogen BMP Efficiency (%)	Sediment BMP Efficiency (%)	Removed Phosphorus Load (lb/yr)	Removed Nitrogen Load (lb/yr)	Removed Sediment Load (lb/yr)	Impervious Area Treated (ac)	Runoff Depth (in.)
505 Main Street	INFILTRATION BASIN	111	51.21	68.47	74.47	0.25	2.47	82.91	0.245	0.12

Table 3. Non-Structural Project Summary for STURBRIDGE, MASSACHUSETTS

There are no non-structural BMPs.

Table 4. Land Use Conversion Project Summary for STURBRIDGE, MASSACHUSETTS

There are no land use conversion projects.