DRAINAGE ANALYSIS

FOR
Definitive Subdivision
Donovan Estates

LOCATED IN
FRANKLIN, MASSACHUSETTS

PREPARED FOR
Donovan Family Realty Trust
47 Partridge Street
Franklin, MA 02038

PREPARED BY
UNITED CONSULTANTS, INC.
850 FRANKLIN STREET, SUITE 11D
WRENTHAM, MA. 02093

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Table of Contents

APPENDIX A

I. DESCRIPTION

This report is offered in support of the stormwater management system designed for the "Definitive Subdivision – Donovan Estates" in Franklin, Massachusetts. The site currently consists of three lots with a total area of approximately 12 acres. One existing house is located on the site with out buildings and a pool. There are existing houses and vacant land abutting the site. The site has a wetland system which includes bordering vegetated wetlands, a river and a flood plain.
The project included the construction of a roadway with a water main underground utilities and a stormwater system.
The primary goals of the stormwater system are to collect and treat the stormwater runoff generated from the proposed roadway, driveways, and houses. The stormwater will be directed to an infiltration pond. Infiltration Pond 1 is open infiltration area located on Lot P.
Both the pre-development and post-development conditions flowing to the bordering vegetated wetlands are summarized in Appendix B.

II. Purpose

The purpose of this report is to examine the hydrological and hydraulic aspects of the proposed "Definitive Subdivision – Donovan Estates". This report was developed for review by the Town of Franklin Planning Board and Conservation Commission to obtain the necessary permits to allow the project to proceed.

This report considers the overall hydrological impact of proposed additional development upon the local watersheds with specific emphasis directed toward the adjacent and immediate downstream areas. The hydrology and criteria are consistent with the Town of Franklin Planning Board, Franklin Conservation Commission and Mass DEP Storm Water Management Policies.

III. Pre-Development Conditions

The site currently consists of three lots with a total area of approximately 12 acres. One existing house is located on the site with out buildings and a pool. There are existing houses and vacant land abutting the site. The site has a wetland system which includes bordering vegetated wetlands, a river and a flood plain.
The project included the construction of a roadway with a water main underground utilities and a stormwater system.
The upland soils for the site were taken from the soil survey of Norfolk and Suffolk counties. The soils are mapped as -Charlton Hollis Rock-Outcrop Complex (HSG-C) and Woodbridge Fine Sandy Loam (HSG-B) Note: Refer to the subdivision plan for the location and soil types. Soil testing was conducted on the site to determine soil types and permeability rates. See the soil logs and permeability test results located in Appendix F. Permeability test was completed on site and the results can be found in Appendix F.
Utilizing a Hydrocad computer model the pre-development and post development conditions were calculated. This included an analysis of the watershed utilizing a Hydrologic soil group B or C. A comparison of the pre-development vs. post development rate and volume of runoff can be found in Appendix B.

IV. Post Development Conditions

The project included the construction of a roadway with a water main underground utilities and a stormwater system.
The roadway stormwater runoff will be captured in deep sump hooded catch basin and then directed to a sediment forebay and then to an open infiltration pond. The proposed infiltration system will promote groundwater re-charge as required by the Town of Franklin Stormwater Regulations. Municipal utility connections are also proposed for the project. The proposal is to service the houses with town water and sewer. The project includes the construction of a proposed roadway.
TSS removal will be accomplished by a treatment train with deep sump hooded catch basin, sediment forebay and an infiltration pond. Additionally, the entrance portion of the roadway will have a sediment forebay and two water quality swales. Utilizing the same computer model as the existing conditions we have modeled the changes in surfaces and ground cover and have calculated the post development conditions.
All calculations for the above have been included in this report. Pre-development calculations are in Appendix C. Post-development calculations are located in Appendix D.

V. Conclusion

Stormwater from the proposed roadway will be captured by the catch basins type water quality units and a sediment forebay for TSS removal which will then be directed to the underground infiltration pond. Additionally, the entrance portion of the roadway will have a sediment forebay and two water quality swales.
The comparison in Appendix B summarizes the rate and volumes of runoff at the bordering vegetated wetland boundary in both the pre-development and post-development conditions.

VI. Stormwater Management Standards

Refer to Checklist for Stormwater Report in Appendix H

Town of Franklin Stormwater Management Bylaw – Chapter 153 – Bylaw Amendment 21-867

Impervious Coverage Entire Site site =

1" x 61,111 sq. ft. impervious = 5,093 cubic feet (Required)

Storage in Pond 1 below the outlet invert (171.0) = 14,338 cubic feet (Provided) See Stage-Area-Storage for Pond 1 this Appendix.

LID Measures

- Existing Vegetation Removal within the buffer zone has been reduced to the extent practicable and mitigation plantings have been proposed.

Standard 1: No New Untreated Discharges
No new untreated discharges are proposed.
A stormwater system has been provided or is proposed which will provide the required TSS removal which includes the installation of deep sump hooded catch basins, sediment forebay and an infiltration basin as well as a sediment forebay and water quality swales.

Standard 2: Peak Rate Attenuation
The drainage system has been designed to match or reduce the rate of storm-water runoff from the site when comparing the pre-development conditions to the post development conditions. See Appendix B of this report for a summary of the design storms.

Standard 3: Recharge

- Soil testing has been completed. See Appendix F of this report for permeability test results and soil testing information. Additionally, soil testing results can be found on the plan sheets.

- Drawdown within 72 hours
  Pond 1 - Storage Volume below outlet = 14,338 cubic feet
  Time = (14,338) / (0.39"/hr x 1'/12" x 8,348 sf. = 52.85 hours < 72 hours
  See Stage-Area-Storage table for Pond 1this Appendix.

Standard 4: Water Quality

- The owner will be responsible for compliance with standard four requirements.
- Refer to the Operation and Maintenance Plan and the Storm-water Facilities Plan for the Inspection and Maintenance Schedule and the Operation and Maintenance Schedule.
- See Appendix E for the Manufactures TSS removal rate. The site is not located within a zone II. The Infiltration Pond has been designed with an infiltration rate of 0.39 inches per hour. This led to a Water Quality volume of 1/2" WQV.

The proposed project will include a stormwater system which includes the installation of deep sump hooded catch basins, sediment forebay and an infiltration basin as well as a sediment forebay and water quality swales.

Water Quality Volumes for Pond 1 Note: Due to Town of Franklin Stormwater Management Bylaw a WQV of 1" is being used.

Storage in Pond 1 below the outlet invert (171.0) = 14,338 cubic feet (Provided)

Standard 5: Land uses with higher potential pollutant loads
None proposed.

Standard 6: Critical Areas
N/A

Standard 7: Re-developments and Other Projects
N/A

Standard 8: Construction Period Pollution Prevention and Erosion Sedimentation Control

- Refer to Site Plans for the Inspection and Maintenance Schedule and the Operation and Maintenance Schedule.
- The project will be covered by an NPDES Construction General Permit.

Standard 9: Operation and Maintenance Plan

- Refer to Site Plans for the Inspection and Maintenance Schedule and the Operation and Maintenance Schedule.

- The owner will be responsible for the storm-water management system, implementation of the operation and maintenance, the maintenance costs, and completion of the maintenance logs.

Standard 10: Prohibition of Illicit Discharges

- Owner to be responsible for compliance with avoiding illicit discharges.
- The site will be connected to the town sewer system.

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

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
169.50	8,348	0	170.02	9,173	4,555
169.51	8,364	84	170.03	9,190	4,647
169.52	8,380	167	170.04	9,206	4,739
169.53	8,396	251	170.05	9,223	4,831
169.54	8,411	335	170.06	9,239	4,923
169.55	8,427	419	170.07	9,256	5,016
169.56	8,443	504	170.08	9,272	5,108
169.57	8,459	588	170.09	9,289	5,201
169.58	8,475	673	170.10	9,305	5,294
169.59	8,491	758	170.11	9,322	5,387
169.60	8,506	843	170.12	9,338	5,481
169.61	8,522	928	170.13	9,355	5,574
169.62	8,538	1,013	170.14	9,371	5,668
169.63	8,554	1,099	170.15	9,388	5,762
169.64	8,570	1,184	170.16	9,404	5,856
169.65	8,586	1,270	170.17	9,421	5,950
169.66	8,601	1,356	170.18	9,437	6,044
169.67	8,617	1,442	170.19	9,454	6,138
169.68	8,633	1,528	170.20	9,470	6,233
169.69	8,649	1,615	170.21	9,487	6,328
169.70	8,665	1,701	170.22	9,503	6,423
169.71	8,681	1,788	170.23	9,520	6,518
169.72	8,696	1,875	170.24	9,536	6,613
169.73	8,712	1,962	170.25	9,553	6,709
169.74	8,728	2,049	170.26	9,569	6,804
169.75	8,744	2,137	170.27	9,586	6,900
169.76	8,760	2,224	170.28	9,602	6,996
169.77	8,776	2,312	170.29	9,619	7,092
169.78	8,792	2,400	170.30	9,635	7,188
169.79	8,807	2,488	170.31	9,652	7,285
169.80	8,823	2,576	170.32	9,668	7,381
169.81	8,839	2,664	170.33	9,685	7,478
169.82	8,855	2,752	170.34	9,701	7,575
169.83	8,871	2,841	170.35	9,718	7,672
169.84	8,887	2,930	170.36	9,734	7,769
169.85	8,902	3,019	170.37	9,751	7,867
169.86	8,918	3,108	170.38	9,767	7,964
169.87	8,934	3,197	170.39	9,784	8,062
169.88	8,950	3,287	170.40	9,800	8,160
169.89	8,966	3,376	170.41	9,817	8,258
169.90	8,982	3,466	170.42	9,833	8,356
169.91	8,997	3,556	170.43	9,850	8,455
169.92	9,013	3,646	170.44	9,866	8,553
169.93	9,029	3,736	170.45	9,883	8,652
169.94	9,045	3,826	170.46	9,899	8,751
169.95	9,061	3,917	170.47	9,916	8,850
169.96	9,077	4,008	170.48	9,932	8,949
169.97	9,092	4,099	170.49	9,949	9,049
169.98	9,108	4,190	170.50	9,966	9,148
169.99	9,124	4,281	170.51	9,982	9,248
170.00	9,140	4,372	170.52	9,999	9,348
170.01	9,157	4,463	170.53	10,015	9,448

Stage-Area-Storage for Pond 1P: POND 1 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
170.54	10,032	9,548
170.55	10,048	9,649
170.56	10,065	9,749
170.57	10,081	9,850
170.58	10,098	9,951
170.59	10,114	10,052
170.60	10,131	10,153
170.61	10,147	10,255
170.62	10,164	10,356
170.63	10,180	10,458
170.64	10,197	10,560
170.65	10,213	10,662
170.66	10,230	10,764
170.67	10,246	10,866
170.68	10,263	10,969
170.69	10,279	11,072
170.70	10,296	11,174
170.71	10,312	11,278
170.72	10,329	11,381
170.73	10,345	11,484
170.74	10,362	11,588
170.75	10,378	11,691
170.76	10,395	11,795
170.77	10,411	11,899
170.78	10,428	12,003
170.79	10,444	12,108
170.80	10,461	12,212
170.81	10,477	12,317
170.82	10,494	12,422
170.83	10,510	12,527
170.84	10,527	12,632
170.85	10,543	12,737
170.86	10,560	12,843
170.87	10,576	12,949
170.88	10,593	13,054
170.89	10,609	13,160
170.90	10,626	13,267
170.91	10,642	13,373
170.92	10,659	13,480
170.93	10,675	13,586
170.94	10,692	13,693
170.95	10,708	13,800
170.96	10,725	13,907
170.97	10,741	14,015
170.98	10,758	14,122
170.99	10,774	14,230
171.00	10,791	14,338
171.01	10,808	14,445
171.02	10,824	14,554
171.03	10,841	14,662
171.04	10,857	14,770
171.05	10,874	14,879
171.06	10,890	14,988
171.07	10,907	15,097
171.08	10,923	15,206
171.09	10,940	15,315
171.10	10,956	15,425
171.11	10,973	15,534
171.12	10,989	15,644
171.13	11,006	15,754
171.14	11,022	15,864
171.15	11,039	15,975
171.16	11,055	16,085
171.17	11,072	16,196
171.18	11,088	16,307
171.19	11,105	16,418
171.20	11,121	16,529
171.21	11,138	16,640
171.22	11,154	16,751
171.23	11,171	16,863
171.24	11,187	16,975
171.25	11,204	17,087
171.26	11,220	17,199
171.27	11,237	17,311
171.28	11,253	17,424
171.29	11,270	17,536
171.30	11,286	17,649
171.31	11,303	17,762
171.32	11,319	17,875
171.33	11,336	17,988
171.34	11,352	18,102
171.35	11,369	18,215
171.36	11,385	18,329
171.37	11,402	18,443
171.38	11,418	18,557
171.39	11,435	18,672
171.40	11,451	18,786
171.41	11,468	18,901
171.42	11,484	19,015
171.43	11,501	19,130
171.44	11,517	19,245
171.45	11,534	19,361
171.46	11,550	19,476
171.47	11,567	19,592
171.48	11,583	19,707
171.49	11,600	19,823
171.50	11,617	19,939
171.51	11,633	20,056
171.52	11,650	20,172
171.53	11,666	20,289
171.54	11,683	20,405
171.55	11,699	20,522
171.56	11,716	20,639
171.57	11,732	20,757

Stage-Area-Storage for Pond 1P: POND 1 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
171.58	11,749	20,874
171.59	11,765	20,992
171.60	11,782	21,109
171.61	11,798	21,227
171.62	11,815	21,345
171.63	11,831	21,463
171.64	11,848	21,582
171.65	11,864	21,700
171.66	11,881	21,819
171.67	11,897	21,938
171.68	11,914	22,057
171.69	11,930	22,176
171.70	11,947	22,296
171.71	11,963	22,415
171.72	11,980	22,535
171.73	11,996	22,655
171.74	12,013	22,775
171.75	12,029	22,895
171.76	12,046	23,015
171.77	12,062	23,136
171.78	12,079	23,257
171.79	12,095	23,378
171.80	12,112	23,499
171.81	12,128	23,620
171.82	12,145	23,741
171.83	12,161	23,863
171.84	12,178	23,984
171.85	12,194	24,106
171.86	12,211	24,228
171.87	12,227	24,350
171.88	12,244	24,473
171.89	12,260	24,595
171.90	12,277	24,718
171.91	12,293	24,841
171.92	12,310	24,964
171.93	12,326	25,087
171.94	12,343	25,210
171.95	12,359	25,334
171.96	12,376	25,458
171.97	12,392	25,581
171.98	12,409	25,705
171.99	12,425	25,830
172.00	12,442	25,954
172.01	12,459	26,079
172.02	12,477	26,203
172.03	12,494	26,328
172.04	12,512	26,453
172.05	12,529	26,578
172.06	12,547	26,704
172.07	12,564	26,829
172.08	12,582	26,955
172.09	12,599	27,081
172.10	12,617	27,207
172.11	12,634	27,333
172.12	12,652	27,460
172.13	12,669	27,586
172.14	12,687	27,713
172.15	12,704	27,840
172.16	12,722	27,967
172.17	12,739	28,094
172.18	12,757	28,222
172.19	12,774	28,350
172.20	12,791	28,477
172.21	12,809	28,605
172.22	12,826	28,734
172.23	12,844	28,862
172.24	12,861	28,990
172.25	12,879	29,119
172.26	12,896	29,248
172.27	12,914	29,377
172.28	12,931	29,506
172.29	12,949	29,636
172.30	12,966	29,765
172.31	12,984	29,895
172.32	13,001	30,025
172.33	13,019	30,155
172.34	13,036	30,285
172.35	13,054	30,416
172.36	13,071	30,546
172.37	13,089	30,677
172.38	13,106	30,808
172.39	13,123	30,939
172.40	13,141	31,071
172.41	13,158	31,202
172.42	13,176	31,334
172.43	13,193	31,466
172.44	13,211	31,598
172.45	13,228	31,730
172.46	13,246	31,862
172.47	13,263	31,995
172.48	13,281	32,127
172.49	13,298	32,260
172.50	13,316	32,393
172.51	13,333	32,527
172.52	13,351	32,660
172.53	13,368	32,794
172.54	13,386	32,927
172.55	13,403	33,061
172.56	13,421	33,196
172.57	13,438	33,330
172.58	13,455	33,464
172.59	13,473	33,599
172.60	13,490	33,734
172.61	13,508	33,869

Stage-Area-Storage for Pond 1P: POND 1 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
172.62	13,525	34,004
172.63	13,543	34,139
172.64	13,560	34,275
172.65	13,578	34,410
172.66	13,595	34,546
172.67	13,613	34,682
172.68	13,630	34,819
172.69	13,648	34,955
172.70	13,665	35,091
172.71	13,683	35,228
172.72	13,700	35,365
172.73	13,718	35,502
172.74	13,735	35,639
172.75	13,753	35,777
172.76	13,770	35,915
172.77	13,787	36,052
172.78	13,805	36,190
172.79	13,822	36,328
172.80	13,840	36,467
172.81	13,857	36,605
172.82	13,875	36,744
172.83	13,892	36,883
172.84	13,910	37,022
172.85	13,927	37,161
172.86	13,945	37,300
172.87	13,962	37,440
172.88	13,980	37,580
172.89	13,997	37,719
172.90	14,015	37,859
172.91	14,032	38,000
172.92	14,050	38,140
172.93	14,067	38,281
172.94	14,084	38,421
172.95	14,102	38,562
172.96	14,119	38,703
172.97	14,137	38,845
172.98	14,154	38,986
172.99	14,172	39,128
173.00	14,189	39,270
173.01	14,207	39,412
173.02	14,224	39,554
173.03	14,242	39,696
173.04	14,259	39,839
173.05	14,277	39,981
173.06	14,294	40,124
173.07	14,312	40,267
173.08	14,329	40,410
173.09	14,347	40,554
173.10	14,364	40,697
173.11	14,382	40,841
173.12	14,399	40,985
173.13	14,416	41,129
173.14	14,434	41,273
173.15	14,451	41,418
173.16	14,469	41,562
173.17	14,486	41,707
173.18	14,504	41,852
173.19	14,521	41,997
173.20	14,539	42,142
173.21	14,556	42,288
173.22	14,574	42,434
173.23	14,591	42,579
173.24	14,609	42,725
173.25	14,626	42,872
173.26	14,644	43,018
173.27	14,661	43,164
173.28	14,679	43,311
173.29	14,696	43,458
173.30	14,714	43,605
173.31	14,731	43,752
173.32	14,748	43,900
173.33	14,766	44,047
173.34	14,783	44,195
173.35	14,801	44,343
173.36	14,818	44,491
173.37	14,836	44,639
173.38	14,853	44,788
173.39	14,871	44,936
173.40	14,888	45,085
173.41	14,906	45,234
173.42	14,923	45,383
173.43	14,941	45,533
173.44	14,958	45,682
173.45	14,976	45,832
173.46	14,993	45,982
173.47	15,011	46,132
173.48	15,028	46,282
173.49	15,046	46,432
173.50	**15,063**	**46,583**

APPENDIX B

Pre-Development vs. Post Development Rate and Volume of Runoff

This analysis was prepared to show the summary of the pre-development and post development rate and volume of runoff as required by the Town of Franklin Storm-water Requirements.

The pre-development watershed area 1S has a discharge to the on-site wetland. Post-development Link 1L was provided to combine the outlet from Pond 1 and the wet swale with the undeveloped area which discharge to the on-site wetland. A comparison of the rate and volume for pre-development area 1S and post-development Link 1L (To Wetlands) is provided below:

2-year storm event (CFS)		
Pre		Post
1S	vs	1L
5.23		4.15

2 year storm event (A.F.)		
Pre		Post
1S	vs	1L
0.729		0.568

10 year storm event (CFS)		
Pre		Post
1S	vs	1L
17.14		12.98

10 year storm event (A.F.)		
Pre		Post
1S	vs	1L
1.995		1.847

100 year storm event (CFS)		
Pre		Post
1S	vs	1L
41.08		33.22

100 year storm event (A.F.)		
Pre		Post
1S	vs	1L
4.544		4.515

The rate of runoff and volume of runoff for the 2 year, 10 year and 100 year storm events have been matched or reduced.

APPENDIX C

1S

Subcat Reach Pond Link

Drainage Diagram for UC1340-PRE
Prepared by United Consultants, Inc.

Area Listing (all nodes)

Area (acres)	CN	Description (subcats)
1.766	55	Woods, Good, HSG B (1S)
8.386	61	>75% Grass cover, Good, HSG B (1S)
0.494	70	Woods, Good, HSG C (1S)
2.412	74	>75% Grass cover, Good, HSG C (1S)
0.609	98	Paved parking & roofs (1S)
13.667		

2 YR PRE-DEVELOPMENT

Subcatchment 1S: 1S

Runoff = 5.23 cfs @ 12.38 hrs, Volume= 0.729 af, Depth= 0.64"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YR-NOAA Rainfall=3.37"

Area (sf)	CN	Description
26,517	98	Paved parking & roofs
365,308	61	>75% Grass cover, Good, HSG B
105,060	74	>75% Grass cover, Good, HSG C
76,931	55	Woods, Good, HSG B
21,529	70	Woods, Good, HSG C
595,345	64	Weighted Average
568,828		Pervious Area
26,517		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.3	42	0.0110	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.37"
2.4	127	0.0310	0.88		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.6	172	0.0650	1.78		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	13	0.0220	3.01		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.8	301	0.0220	1.04		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
22.2	655	Total			

10 YR PRE-DEVELOPMENT

Subcatchment 1S: 1S

Runoff = 17.14 cfs @ 12.33 hrs, Volume= 1.995 af, Depth= 1.75"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YR-NOAA Rainfall=5.26"

Area (sf)	CN	Description
26,517	98	Paved parking & roofs
365,308	61	>75% Grass cover, Good, HSG B
105,060	74	>75% Grass cover, Good, HSG C
76,931	55	Woods, Good, HSG B
21,529	70	Woods, Good, HSG C
595,345	64	Weighted Average
568,828		Pervious Area
26,517		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.3	42	0.0110	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.37"
2.4	127	0.0310	0.88		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.6	172	0.0650	1.78		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	13	0.0220	3.01		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.8	301	0.0220	1.04		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
22.2	655	Total			

100 YR PRE-DEVELOPMENT

Subcatchment 1S: 1S

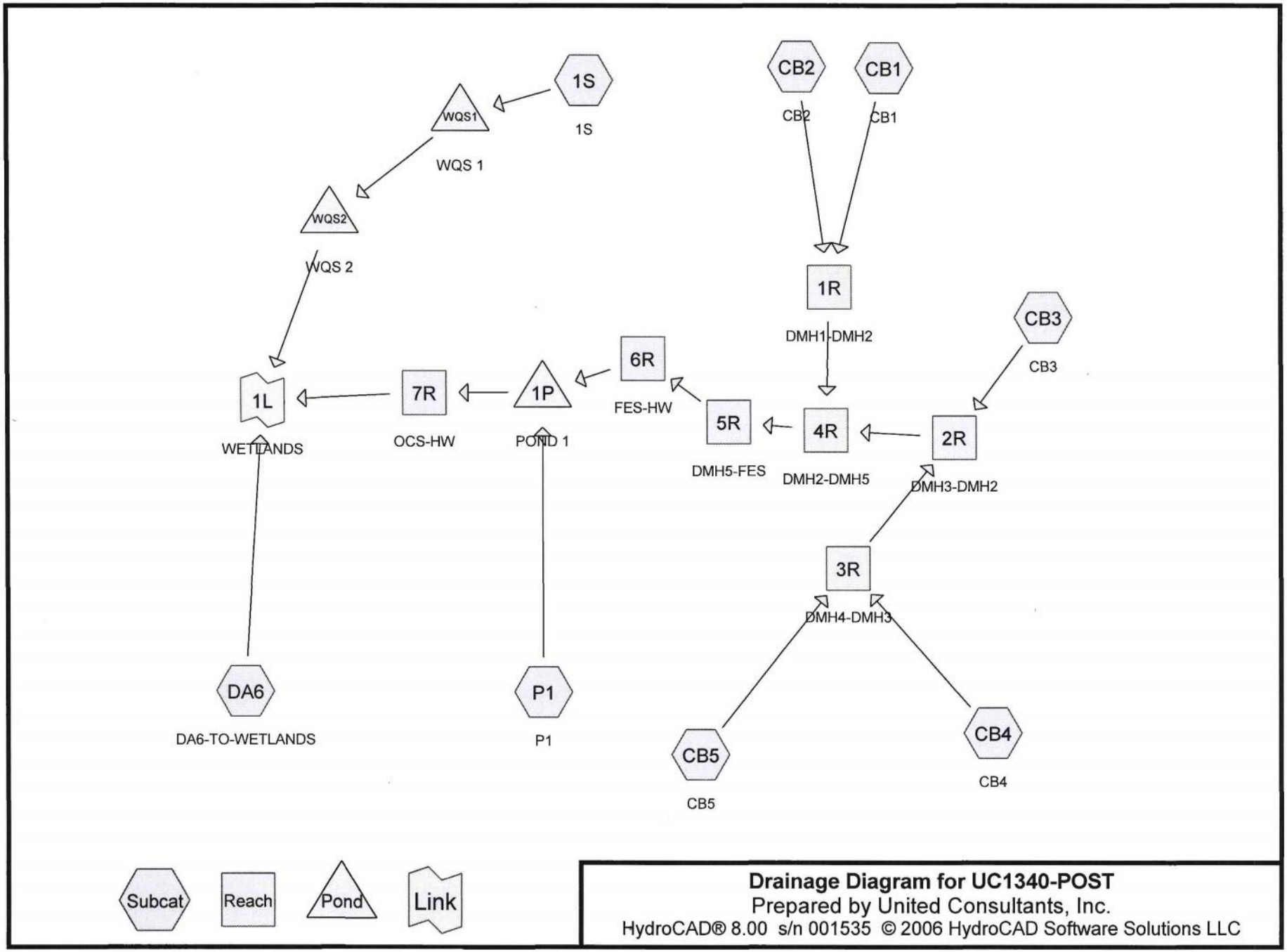
Runoff = 41.08 cfs @ 12.31 hrs, Volume= 4.544 af, Depth= 3.99"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR-NOAA Rainfall=8.26"

Area (sf)	CN	Description
26,517	98	Paved parking & roofs
365,308	61	>75% Grass cover, Good, HSG B
105,060	74	>75% Grass cover, Good, HSG C
76,931	55	Woods, Good, HSG B
21,529	70	Woods, Good, HSG C
595,345	64	Weighted Average
568,828		Pervious Area
26,517		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.3	42	0.0110	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.37"
2.4	127	0.0310	0.88		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.6	172	0.0650	1.78		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	13	0.0220	3.01		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.8	301	0.0220	1.04		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
22.2	655	Total			

APPENDIX D


1S
1S
WQS1
WQS 1
WQS2
WQS 2
CB2
CB2
CB1
CB1
1R
DMH1-DMH2
CB3
CB3
6R
FES-HW
1L
WETLANDS
7R
OCS-HW
1P
POND 1
5R
DMH5-FES
4R
DMH2-DMH5
2R
DMH3-DMH2
3R
DMH4-DMH3
DA6
DA6-TO-WETLANDS
P1
P1
CB5
CB5
CB4
CB4
Subcat
Reach
Pond
Link
Drainage Diagram for UC1340-POST
Prepared by United Consultants, Inc.
HydroCAD® 8.00 s/n 001535 © 2006 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcats)
1.140	55	Woods, Good, HSG B (CB1,CB3,DA6)
7.943	61	>75% Grass cover, Good, HSG B (1S,CB1,CB2,CB3,CB4,CB5,DA6,P1)
0.494	70	Woods, Good, HSG C (DA6)
2.386	74	>75% Grass cover, Good, HSG C (CB5,DA6,P1)
0.305	98	POND (P1)
1.403	98	Paved parking & roofs (1S,CB1,CB2,CB3,CB4,CB5,DA6,P1)
13.671		

2 YR POST-DEVELOPMENT

Subcatchment 1S: 1S

Runoff = 0.70 cfs @ 12.10 hrs, Volume= 0.054 af, Depth= 0.98"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YR-NOAA Rainfall=3.37"

Area (sf)	CN	Description
8,143	98	Paved parking & roofs
20,718	61	>75% Grass cover, Good, HSG B
28,861	71	Weighted Average
20,718		Pervious Area
8,143		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0280	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.37"
0.2	15	0.0280	1.17		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	28	0.0910	1.51		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.2	16	0.1250	1.77		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.0	5	0.1250	2.47		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.0	5	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	5	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	89	0.0300	3.52		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	32	0.0460	4.35		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.1	245	Total			

Subcatchment CB1: CB1

Runoff = 0.26 cfs @ 12.35 hrs, Volume= 0.037 af, Depth= 0.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YR-NOAA Rainfall=3.37"

Area (sf)	CN	Description
4,591	98	Paved parking & roofs
7,412	61	>75% Grass cover, Good, HSG B
22,990	55	Woods, Good, HSG B
34,993	62	Weighted Average
30,402		Pervious Area
4,591		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.37"
2.5	109	0.0210	0.72		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.8	160	0.0375	0.97		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.8	62	0.0678	1.30		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.1	12	0.1667	2.04		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.1	7	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.0	5	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	5	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	86	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	21	0.0100	4.91	3.86	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
19.0	517	Total			

Subcatchment CB2: CB2

Runoff = 0.25 cfs @ 12.13 hrs, Volume= 0.020 af, Depth= 1.15"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YR-NOAA Rainfall=3.37"

Area (sf)	CN	Description
3,240	98	Paved parking & roofs
5,920	61	>75% Grass cover, Good, HSG B
9,160	74	Weighted Average
5,920		Pervious Area
3,240		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0100	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.37"
1.3	53	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	10	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.0	11	0.0190	6.77	5.32	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
8.6	124	Total			

Subcatchment CB3: CB3

Runoff = 0.32 cfs @ 12.23 hrs, Volume= 0.038 af, Depth= 0.64"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YR-NOAA Rainfall=3.37"

Area (sf)	CN	Description
3,207	98	Paved parking & roofs
25,212	61	>75% Grass cover, Good, HSG B
2,608	55	Woods, Good, HSG B
31,027	64	Weighted Average
27,820		Pervious Area
3,207		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0380	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.37"
1.2	77	0.0227	1.05		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.1	92	0.0435	1.46		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.1	66	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	27	0.1850	3.01		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	25	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	22	0.0220	1.04		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.0	5	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	5	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	24	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	21	0.0100	4.91	3.86	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
13.9	414	Total			

Subcatchment CB4: CB4

Runoff = 1.27 cfs @ 12.10 hrs, Volume= 0.096 af, Depth= 1.04"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YR-NOAA Rainfall=3.37"

Area (sf)	CN	Description
14,187	98	Paved parking & roofs
34,440	61	>75% Grass cover, Good, HSG B
48,627	72	Weighted Average
34,440		Pervious Area
14,187		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	50	0.0440	0.21		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.37"
0.5	64	0.0781	1.96		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	63	0.0645	1.78		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	46	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.0	5	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	5	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	25	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	21	0.0100	5.70	7.00	**Circular Channel (pipe),** Diam= 15.0" Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
6.0	279	Total			

Subcatchment CB5: CB5

Runoff = 0.76 cfs @ 12.09 hrs, Volume= 0.054 af, Depth= 1.68"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YR-NOAA Rainfall=3.37"

Area (sf)	CN	Description
8,897	98	Paved parking & roofs
6,242	61	>75% Grass cover, Good, HSG B
1,715	74	>75% Grass cover, Good, HSG C
16,854	82	Weighted Average
7,957		Pervious Area
8,897		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	5	0.0200	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.37"
0.1	5	0.0200	0.78		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.37"
0.9	5	0.0200	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.37"
1.2	201	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.9					**Direct Entry, MIN TC**
0.0	12	0.0100	4.91	3.86	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
6.0	228	Total			

Subcatchment DA6: DA6-TO-WETLANDS

Runoff = 4.15 cfs @ 12.33 hrs, Volume= 0.525 af, Depth= 0.73"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YR-NOAA Rainfall=3.37"

Area (sf)	CN	Description
13,120	98	Paved parking & roofs
215,109	61	>75% Grass cover, Good, HSG B
102,048	74	>75% Grass cover, Good, HSG C
24,053	55	Woods, Good, HSG B
21,529	70	Woods, Good, HSG C
375,859	66	Weighted Average
362,739		Pervious Area
13,120		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	13	0.0340	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.37"
3.5	37	0.0340	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.37"
1.8	101	0.0180	0.94		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.8	61	0.0330	1.27		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
4.3	357	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.6	225	0.0090	0.66		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	17	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	32	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
20.0	843	Total			

Subcatchment P1: P1

Runoff = 1.58 cfs @ 12.09 hrs, Volume= 0.116 af, Depth= 1.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YR-NOAA Rainfall=3.37"

Area (sf)	CN	Description
5,726	98	Paved parking & roofs
30,929	61	>75% Grass cover, Good, HSG B
155	74	>75% Grass cover, Good, HSG C
13,301	98	POND
50,111	75	Weighted Average
31,084		Pervious Area
19,027		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	50	0.0300	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.37"
0.2	16	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	40	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.7	58	0.0340	1.29		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.0	164	Total			

Reach 1R: DMH1-DMH2

Inflow Area = 1.014 ac, Inflow Depth = 0.68" for 2YR-NOAA event
Inflow = 0.41 cfs @ 12.28 hrs, Volume= 0.057 af
Outflow = 0.40 cfs @ 12.33 hrs, Volume= 0.057 af, Atten= 0%, Lag= 3.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.25 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 1.03 fps, Avg. Travel Time= 3.9 min

Peak Storage= 43 cf @ 12.31 hrs, Average Depth at Peak Storage= 0.25'
Bank-Full Depth= 1.25', Capacity at Bank-Full= 4.44 cfs

15.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 238.0' Slope= 0.0040 '/'
Inlet Invert= 172.93', Outlet Invert= 171.97'

Reach 2R: DMH3-DMH2

Inflow Area = 2.216 ac, Inflow Depth = 1.02" for 2YR-NOAA event
Inflow = 2.21 cfs @ 12.11 hrs, Volume= 0.188 af
Outflow = 2.21 cfs @ 12.11 hrs, Volume= 0.188 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.09 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.91 fps, Avg. Travel Time= 0.1 min

Peak Storage= 7 cf @ 12.11 hrs, Average Depth at Peak Storage= 0.44'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 11.73 cfs

18.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 16.0' Slope= 0.0106 '/'
Inlet Invert= 171.89', Outlet Invert= 171.72'

Reach 3R: DMH4-DMH3

Inflow Area = 1.503 ac, Inflow Depth = 1.20" for 2YR-NOAA event
Inflow = 2.03 cfs @ 12.09 hrs, Volume= 0.150 af
Outflow = 2.02 cfs @ 12.10 hrs, Volume= 0.150 af, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.87 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.76 fps, Avg. Travel Time= 0.6 min

Peak Storage= 25 cf @ 12.10 hrs, Average Depth at Peak Storage= 0.43'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 11.38 cfs

18.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 60.0' Slope= 0.0100 '/'
Inlet Invert= 172.59', Outlet Invert= 171.99'

Reach 4R: DMH2-DMH5

Inflow Area = 3.229 ac, Inflow Depth = 0.91" for 2YR-NOAA event
Inflow = 2.42 cfs @ 12.12 hrs, Volume= 0.246 af
Outflow = 2.42 cfs @ 12.12 hrs, Volume= 0.246 af, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.58 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.37 fps, Avg. Travel Time= 0.6 min

Peak Storage= 36 cf @ 12.12 hrs, Average Depth at Peak Storage= 0.54'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 15.43 cfs

24.0" Diameter Pipe, n= 0.012
Length= 53.0' Slope= 0.0040 '/'
Inlet Invert= 171.22', Outlet Invert= 171.01'

Reach 5R: DMH5-FES

Inflow Area = 3.229 ac, Inflow Depth = 0.91" for 2YR-NOAA event
Inflow = 2.42 cfs @ 12.12 hrs, Volume= 0.246 af
Outflow = 2.42 cfs @ 12.13 hrs, Volume= 0.246 af, Atten= 0%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.60 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.38 fps, Avg. Travel Time= 0.9 min

Peak Storage= 52 cf @ 12.13 hrs, Average Depth at Peak Storage= 0.53'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 15.55 cfs

24.0" Diameter Pipe, n= 0.012
Length= 77.0' Slope= 0.0040 '/'
Inlet Invert= 170.91', Outlet Invert= 170.60'

Reach 6R: FES-HW

Inflow Area = 3.229 ac, Inflow Depth = 0.91" for 2YR-NOAA event
Inflow = 2.42 cfs @ 12.13 hrs, Volume= 0.246 af
Outflow = 2.41 cfs @ 12.14 hrs, Volume= 0.246 af, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.61 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.38 fps, Avg. Travel Time= 0.6 min

Peak Storage= 33 cf @ 12.14 hrs, Average Depth at Peak Storage= 0.53'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 15.66 cfs

24.0" Diameter Pipe, n= 0.012
Length= 49.0' Slope= 0.0041 '/'
Inlet Invert= 171.00', Outlet Invert= 170.80'

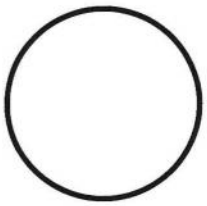
Reach 7R: OCS-HW

Inflow Area = 4.380 ac, Inflow Depth = 0.00" for 2YR-NOAA event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs, Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 16.09 cfs

18.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 28.0' Slope= 0.0200 '/'
Inlet Invert= 169.50', Outlet Invert= 168.94'



Pond 1P: POND 1

Inflow Area = 4.380 ac, Inflow Depth = 0.99" for 2YR-NOAA event
Inflow = 3.86 cfs @ 12.12 hrs, Volume= 0.362 af
Outflow = 0.09 cfs @ 22.53 hrs, Volume= 0.362 af, Atten= 98%, Lag= 624.8 min
Discarded = 0.09 cfs @ 22.53 hrs, Volume= 0.362 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 170.74' @ 22.53 hrs Surf.Area= 10,361 sf Storage= 11,583 cf

Plug-Flow detention time= 1,286.1 min calculated for 0.362 af (100% of inflow)
Center-of-Mass det. time= 1,286.3 min (2,155.2 - 869.0)

Volume	Invert	Avail.Storage	Storage Description
#1	169.50'	46,583 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
169.50	8,348	0	0
170.00	9,140	4,372	4,372
172.00	12,442	21,582	25,954
173.50	15,063	20,629	46,583

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**0.390 in/hr Exfiltration over Surface area**
#2	Primary	171.00'	**3.0" Vert. Orifice/Grate X 2.00** C= 0.600
#3	Primary	171.10'	**3.0" Vert. Orifice/Grate** C= 0.600
#4	Primary	171.50'	**12.0" Vert. Orifice/Grate** C= 0.600
#5	Primary	172.35'	**2.00' x 2.00' Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Discarded OutFlow Max=0.09 cfs @ 22.53 hrs HW=170.74' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=169.50' (Free Discharge)
├**2=Orifice/Grate** (Controls 0.00 cfs)
├**3=Orifice/Grate** (Controls 0.00 cfs)
├**4=Orifice/Grate** (Controls 0.00 cfs)
└**5=Orifice/Grate** (Controls 0.00 cfs)

Pond WQS1: WQS 1

Inflow Area = 0.663 ac, Inflow Depth = 0.98" for 2YR-NOAA event
Inflow = 0.70 cfs @ 12.10 hrs, Volume= 0.054 af
Outflow = 0.27 cfs @ 12.43 hrs, Volume= 0.050 af, Atten= 62%, Lag= 19.9 min
Primary = 0.27 cfs @ 12.43 hrs, Volume= 0.050 af

Routing by Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 169.68' @ 12.43 hrs Surf.Area= 856 sf Storage= 669 cf

Plug-Flow detention time= 142.4 min calculated for 0.049 af (91% of inflow)
Center-of-Mass det. time= 99.6 min (968.3 - 868.7)

Volume	Invert	Avail.Storage	Storage Description
#1	168.50'	2,110 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
168.50	276	0	0
170.00	1,013	967	967
171.00	1,273	1,143	2,110

Device	Routing	Invert	Outlet Devices
#1	Primary	170.00'	**13.5' 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
#2	Primary	169.00'	**30.0 deg Sharp-Crested Vee/Trap Weir** C= 2.61

Primary OutFlow Max=0.27 cfs @ 12.43 hrs HW=169.68' (Free Discharge)
├**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└**2=Sharp-Crested Vee/Trap Weir** (Weir Controls 0.27 cfs @ 2.15 fps)

Pond WQS2: WQS 2

Inflow Area = 0.663 ac, Inflow Depth > 0.90" for 2YR-NOAA event
Inflow = 0.27 cfs @ 12.43 hrs, Volume= 0.050 af
Outflow = 0.09 cfs @ 13.60 hrs, Volume= 0.042 af, Atten= 67%, Lag= 70.4 min
Primary = 0.09 cfs @ 13.60 hrs, Volume= 0.042 af

Routing by Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 168.94' @ 13.60 hrs Surf.Area= 938 sf Storage= 662 cf

Plug-Flow detention time= 271.2 min calculated for 0.042 af (85% of inflow)
Center-of-Mass det. time= 174.4 min (1,142.7 - 968.3)

Volume	Invert	Avail.Storage	Storage Description
#1	168.00'	1,936 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
168.00	473	0	0
169.50	1,216	1,267	1,267
170.00	1,461	669	1,936

Device	Routing	Invert	Outlet Devices
#1	Primary	169.50'	**16.0' 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
#2	Primary	168.50'	**30.0 deg Sharp-Crested Vee/Trap Weir** C= 2.61

Primary OutFlow Max=0.09 cfs @ 13.60 hrs HW=168.94' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└—**2=Sharp-Crested Vee/Trap Weir** (Weir Controls 0.09 cfs @ 1.73 fps)

Link 1L: WETLANDS

Inflow Area = 13.671 ac, Inflow Depth = 0.50" for 2YR-NOAA event
Inflow = 4.15 cfs @ 12.33 hrs, Volume= 0.568 af
Primary = 4.15 cfs @ 12.33 hrs, Volume= 0.568 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

10 YR POST-DEVELOPMENT

Subcatchment 1S: 1S

Runoff = 1.77 cfs @ 12.09 hrs, Volume= 0.128 af, Depth= 2.31"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YR-NOAA Rainfall=5.26"

Area (sf)	CN	Description
8,143	98	Paved parking & roofs
20,718	61	>75% Grass cover, Good, HSG B
28,861	71	Weighted Average
20,718		Pervious Area
8,143		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0280	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.37"
0.2	15	0.0280	1.17		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	28	0.0910	1.51		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.2	16	0.1250	1.77		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.0	5	0.1250	2.47		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.0	5	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	5	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	89	0.0300	3.52		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	32	0.0460	4.35		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.1	245	Total			

Subcatchment CB1: CB1

Runoff = 0.96 cfs @ 12.29 hrs, Volume= 0.107 af, Depth= 1.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YR-NOAA Rainfall=5.26"

Area (sf)	CN	Description
4,591	98	Paved parking & roofs
7,412	61	>75% Grass cover, Good, HSG B
22,990	55	Woods, Good, HSG B
34,993	62	Weighted Average
30,402		Pervious Area
4,591		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.37"
2.5	109	0.0210	0.72		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.8	160	0.0375	0.97		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.8	62	0.0678	1.30		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.1	12	0.1667	2.04		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.1	7	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.0	5	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	5	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	86	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	21	0.0100	4.91	3.86	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
19.0	517	Total			

Subcatchment CB2: CB2

Runoff = 0.58 cfs @ 12.12 hrs, Volume= 0.045 af, Depth= 2.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YR-NOAA Rainfall=5.26"

Area (sf)	CN	Description
3,240	98	Paved parking & roofs
5,920	61	>75% Grass cover, Good, HSG B
9,160	74	Weighted Average
5,920		Pervious Area
3,240		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0100	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.37"
1.3	53	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	10	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.0	11	0.0190	6.77	5.32	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
8.6	124	Total			

Subcatchment CB3: CB3

Runoff = 1.08 cfs @ 12.20 hrs, Volume= 0.104 af, Depth= 1.75"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YR-NOAA Rainfall=5.26"

Area (sf)	CN	Description
3,207	98	Paved parking & roofs
25,212	61	>75% Grass cover, Good, HSG B
2,608	55	Woods, Good, HSG B
31,027	64	Weighted Average
27,820		Pervious Area
3,207		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0380	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.37"
1.2	77	0.0227	1.05		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.1	92	0.0435	1.46		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.1	66	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	27	0.1850	3.01		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	25	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	22	0.0220	1.04		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.0	5	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	5	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	24	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	21	0.0100	4.91	3.86	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
13.9	414	Total			

Subcatchment CB4: CB4

Runoff = 3.12 cfs @ 12.09 hrs, Volume= 0.223 af, Depth= 2.40"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YR-NOAA Rainfall=5.26"

Area (sf)	CN	Description
14,187	98	Paved parking & roofs
34,440	61	>75% Grass cover, Good, HSG B
48,627	72	Weighted Average
34,440		Pervious Area
14,187		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	50	0.0440	0.21		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.37"
0.5	64	0.0781	1.96		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	63	0.0645	1.78		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	46	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.0	5	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	5	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	25	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	21	0.0100	5.70	7.00	**Circular Channel (pipe),** Diam= 15.0" Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
6.0	279	Total			

Subcatchment CB5: CB5

Runoff = 1.50 cfs @ 12.09 hrs, Volume= 0.107 af, Depth= 3.31"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YR-NOAA Rainfall=5.26"

Area (sf)	CN	Description
8,897	98	Paved parking & roofs
6,242	61	>75% Grass cover, Good, HSG B
1,715	74	>75% Grass cover, Good, HSG C
16,854	82	Weighted Average
7,957		Pervious Area
8,897		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	5	0.0200	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.37"
0.1	5	0.0200	0.78		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.37"
0.9	5	0.0200	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.37"
1.2	201	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.9					**Direct Entry, MIN TC**
0.0	12	0.0100	4.91	3.86	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
6.0	228	Total			

Subcatchment DA6: DA6-TO-WETLANDS

Runoff = 12.51 cfs @ 12.29 hrs, Volume= 1.371 af, Depth= 1.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YR-NOAA Rainfall=5.26"

Area (sf)	CN	Description
13,120	98	Paved parking & roofs
215,109	61	>75% Grass cover, Good, HSG B
102,048	74	>75% Grass cover, Good, HSG C
24,053	55	Woods, Good, HSG B
21,529	70	Woods, Good, HSG C
375,859	66	Weighted Average
362,739		Pervious Area
13,120		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	13	0.0340	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.37"
3.5	37	0.0340	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.37"
1.8	101	0.0180	0.94		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.8	61	0.0330	1.27		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
4.3	357	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.6	225	0.0090	0.66		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	17	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	32	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
20.0	843	Total			

Subcatchment P1: P1

Runoff = 3.59 cfs @ 12.09 hrs, Volume= 0.255 af, Depth= 2.66"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YR-NOAA Rainfall=5.26"

Area (sf)	CN	Description
5,726	98	Paved parking & roofs
30,929	61	>75% Grass cover, Good, HSG B
155	74	>75% Grass cover, Good, HSG C
13,301	98	POND
50,111	75	Weighted Average
31,084		Pervious Area
19,027		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	50	0.0300	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.37"
0.2	16	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	40	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.7	58	0.0340	1.29		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.0	164	Total			

Reach 1R: DMH1-DMH2

Inflow Area = 1.014 ac, Inflow Depth = 1.80" for 10YR-NOAA event
Inflow = 1.32 cfs @ 12.24 hrs, Volume= 0.152 af
Outflow = 1.32 cfs @ 12.27 hrs, Volume= 0.152 af, Atten= 0%, Lag= 2.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.16 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 1.26 fps, Avg. Travel Time= 3.1 min

Peak Storage= 99 cf @ 12.25 hrs, Average Depth at Peak Storage= 0.47'
Bank-Full Depth= 1.25', Capacity at Bank-Full= 4.44 cfs

15.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 238.0' Slope= 0.0040 '/'
Inlet Invert= 172.93', Outlet Invert= 171.97'

Reach 2R: DMH3-DMH2

Inflow Area = 2.216 ac, Inflow Depth = 2.35" for 10YR-NOAA event
Inflow = 5.36 cfs @ 12.10 hrs, Volume= 0.434 af
Outflow = 5.35 cfs @ 12.10 hrs, Volume= 0.434 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.49 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 2.28 fps, Avg. Travel Time= 0.1 min

Peak Storage= 13 cf @ 12.10 hrs, Average Depth at Peak Storage= 0.71'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 11.73 cfs

18.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 16.0' Slope= 0.0106 '/'
Inlet Invert= 171.89', Outlet Invert= 171.72'

Reach 3R: DMH4-DMH3

Inflow Area = 1.503 ac, Inflow Depth = 2.63" for 10YR-NOAA event
Inflow = 4.62 cfs @ 12.09 hrs, Volume= 0.330 af
Outflow = 4.61 cfs @ 12.09 hrs, Volume= 0.330 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.10 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.08 fps, Avg. Travel Time= 0.5 min

Peak Storage= 45 cf @ 12.09 hrs, Average Depth at Peak Storage= 0.66'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 11.38 cfs

18.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 60.0' Slope= 0.0100 '/'
Inlet Invert= 172.59', Outlet Invert= 171.99'

Reach 4R: DMH2-DMH5

Inflow Area = 3.229 ac, Inflow Depth = 2.18" for 10YR-NOAA event
Inflow = 6.23 cfs @ 12.11 hrs, Volume= 0.586 af
Outflow = 6.23 cfs @ 12.12 hrs, Volume= 0.586 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.65 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.65 fps, Avg. Travel Time= 0.5 min

Peak Storage= 71 cf @ 12.12 hrs, Average Depth at Peak Storage= 0.88'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 15.43 cfs

24.0" Diameter Pipe, n= 0.012
Length= 53.0' Slope= 0.0040 '/'
Inlet Invert= 171.22', Outlet Invert= 171.01'

Reach 5R: DMH5-FES

Inflow Area = 3.229 ac, Inflow Depth = 2.18" for 10YR-NOAA event
Inflow = 6.23 cfs @ 12.12 hrs, Volume= 0.586 af
Outflow = 6.21 cfs @ 12.13 hrs, Volume= 0.586 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.67 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.66 fps, Avg. Travel Time= 0.8 min

Peak Storage= 102 cf @ 12.12 hrs, Average Depth at Peak Storage= 0.88'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 15.55 cfs

24.0" Diameter Pipe, n= 0.012
Length= 77.0' Slope= 0.0040 '/'
Inlet Invert= 170.91', Outlet Invert= 170.60'

Reach 6R: FES-HW

Inflow Area = 3.229 ac, Inflow Depth = 2.18" for 10YR-NOAA event
Inflow = 6.21 cfs @ 12.13 hrs, Volume= 0.586 af
Outflow = 6.21 cfs @ 12.13 hrs, Volume= 0.586 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.70 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.66 fps, Avg. Travel Time= 0.5 min

Peak Storage= 65 cf @ 12.13 hrs, Average Depth at Peak Storage= 0.88'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 15.66 cfs

24.0" Diameter Pipe, n= 0.012
Length= 49.0' Slope= 0.0041 '/'
Inlet Invert= 171.00', Outlet Invert= 170.80'

Reach 7R: OCS-HW

Inflow Area = 4.380 ac, Inflow Depth = 0.99" for 10YR-NOAA event
Inflow = 0.55 cfs @ 14.95 hrs, Volume= 0.360 af
Outflow = 0.55 cfs @ 14.95 hrs, Volume= 0.360 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.25 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.13 fps, Avg. Travel Time= 0.1 min

Peak Storage= 4 cf @ 14.95 hrs, Average Depth at Peak Storage= 0.19'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 16.09 cfs

18.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 28.0' Slope= 0.0200 '/'
Inlet Invert= 169.50', Outlet Invert= 168.94'

Pond 1P: POND 1

Inflow Area = 4.380 ac, Inflow Depth = 2.31" for 10YR-NOAA event
Inflow = 9.55 cfs @ 12.11 hrs, Volume= 0.842 af
Outflow = 0.66 cfs @ 14.95 hrs, Volume= 0.842 af, Atten= 93%, Lag= 169.9 min
Discarded = 0.11 cfs @ 14.95 hrs, Volume= 0.482 af
Primary = 0.55 cfs @ 14.95 hrs, Volume= 0.360 af

Routing by Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 171.63' @ 14.95 hrs Surf.Area= 11,824 sf Storage= 21,413 cf

Plug-Flow detention time= 1,000.9 min calculated for 0.842 af (100% of inflow)
Center-of-Mass det. time= 1,000.9 min (1,845.5 - 844.7)

Volume	Invert	Avail.Storage	Storage Description
#1	169.50'	46,583 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
169.50	8,348	0	0
170.00	9,140	4,372	4,372
172.00	12,442	21,582	25,954
173.50	15,063	20,629	46,583

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**0.390 in/hr Exfiltration over Surface area**
#2	Primary	171.00'	**3.0" Vert. Orifice/Grate X 2.00** C= 0.600
#3	Primary	171.10'	**3.0" Vert. Orifice/Grate** C= 0.600
#4	Primary	171.50'	**12.0" Vert. Orifice/Grate** C= 0.600
#5	Primary	172.35'	**2.00' x 2.00' Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Discarded OutFlow Max=0.11 cfs @ 14.95 hrs HW=171.63' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=0.55 cfs @ 14.95 hrs HW=171.63' (Free Discharge)
├**2=Orifice/Grate** (Orifice Controls 0.33 cfs @ 3.41 fps)
├**3=Orifice/Grate** (Orifice Controls 0.15 cfs @ 3.05 fps)
├**4=Orifice/Grate** (Orifice Controls 0.07 cfs @ 1.21 fps)
└**5=Orifice/Grate** (Controls 0.00 cfs)

Pond WQS1: WQS 1

Inflow Area = 0.663 ac, Inflow Depth = 2.31" for 10YR-NOAA event
Inflow = 1.77 cfs @ 12.09 hrs, Volume= 0.128 af
Outflow = 1.63 cfs @ 12.13 hrs, Volume= 0.123 af, Atten= 8%, Lag= 2.1 min
Primary = 1.63 cfs @ 12.13 hrs, Volume= 0.123 af

Routing by Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 170.08' @ 12.13 hrs Surf.Area= 1,033 sf Storage= 1,045 cf

Plug-Flow detention time= 74.6 min calculated for 0.123 af (96% of inflow)
Center-of-Mass det. time= 54.1 min (896.6 - 842.5)

Volume	Invert	Avail.Storage	Storage Description
#1	168.50'	2,110 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
168.50	276	0	0
170.00	1,013	967	967
171.00	1,273	1,143	2,110

Device	Routing	Invert	Outlet Devices
#1	Primary	170.00'	**13.5' 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
#2	Primary	169.00'	**30.0 deg Sharp-Crested Vee/Trap Weir** C= 2.61

Primary OutFlow Max=1.63 cfs @ 12.13 hrs HW=170.08' (Free Discharge)
├**1=Broad-Crested Rectangular Weir** (Weir Controls 0.79 cfs @ 0.77 fps)
└**2=Sharp-Crested Vee/Trap Weir** (Weir Controls 0.84 cfs @ 2.71 fps)

Pond WQS2: WQS 2

Inflow Area = 0.663 ac, Inflow Depth = 2.23" for 10YR-NOAA event
Inflow = 1.63 cfs @ 12.13 hrs, Volume= 0.123 af
Outflow = 0.62 cfs @ 12.50 hrs, Volume= 0.116 af, Atten= 62%, Lag= 22.6 min
Primary = 0.62 cfs @ 12.50 hrs, Volume= 0.116 af

Routing by Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 169.46' @ 12.50 hrs Surf.Area= 1,194 sf Storage= 1,213 cf

Plug-Flow detention time= 123.8 min calculated for 0.116 af (94% of inflow)
Center-of-Mass det. time= 80.7 min (977.4 - 896.6)

Volume	Invert	Avail.Storage	Storage Description
#1	168.00'	1,936 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
168.00	473	0	0
169.50	1,216	1,267	1,267
170.00	1,461	669	1,936

Device	Routing	Invert	Outlet Devices
#1	Primary	169.50'	**16.0' 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
#2	Primary	168.50'	**30.0 deg Sharp-Crested Vee/Trap Weir** C= 2.61

Primary OutFlow Max=0.62 cfs @ 12.50 hrs HW=169.46' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└—**2=Sharp-Crested Vee/Trap Weir** (Weir Controls 0.62 cfs @ 2.55 fps)

Link 1L: WETLANDS

Inflow Area = 13.671 ac, Inflow Depth = 1.62" for 10YR-NOAA event
Inflow = 12.98 cfs @ 12.29 hrs, Volume= 1.847 af
Primary = 12.98 cfs @ 12.29 hrs, Volume= 1.847 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

100 YR POST-DEVELOPMENT

Subcatchment 1S: 1S

Runoff = 3.72 cfs @ 12.09 hrs, Volume= 0.265 af, Depth= 4.81"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR-NOAA Rainfall=8.26"

Area (sf)	CN	Description
8,143	98	Paved parking & roofs
20,718	61	>75% Grass cover, Good, HSG B
28,861	71	Weighted Average
20,718		Pervious Area
8,143		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0280	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.37"
0.2	15	0.0280	1.17		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	28	0.0910	1.51		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.2	16	0.1250	1.77		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.0	5	0.1250	2.47		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.0	5	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	5	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	89	0.0300	3.52		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	32	0.0460	4.35		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.1	245	Total			

Subcatchment CB1: CB1

Runoff = 2.41 cfs @ 12.27 hrs, Volume= 0.252 af, Depth= 3.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR-NOAA Rainfall=8.26"

Area (sf)	CN	Description
4,591	98	Paved parking & roofs
7,412	61	>75% Grass cover, Good, HSG B
22,990	55	Woods, Good, HSG B
34,993	62	Weighted Average
30,402		Pervious Area
4,591		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.37"
2.5	109	0.0210	0.72		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.8	160	0.0375	0.97		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.8	62	0.0678	1.30		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.1	12	0.1667	2.04		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.1	7	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.0	5	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	5	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	86	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	21	0.0100	4.91	3.86	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
19.0	517	Total			

Subcatchment CB2: CB2

Runoff = 1.16 cfs @ 12.12 hrs, Volume= 0.090 af, Depth= 5.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR-NOAA Rainfall=8.26"

Area (sf)	CN	Description
3,240	98	Paved parking & roofs
5,920	61	>75% Grass cover, Good, HSG B
9,160	74	Weighted Average
5,920		Pervious Area
3,240		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0100	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.37"
1.3	53	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	10	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.0	11	0.0190	6.77	5.32	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
8.6	124	Total			

Subcatchment CB3: CB3

Runoff = 2.58 cfs @ 12.19 hrs, Volume= 0.237 af, Depth= 3.99"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR-NOAA Rainfall=8.26"

Area (sf)	CN	Description
3,207	98	Paved parking & roofs
25,212	61	>75% Grass cover, Good, HSG B
2,608	55	Woods, Good, HSG B
31,027	64	Weighted Average
27,820		Pervious Area
3,207		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0380	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.37"
1.2	77	0.0227	1.05		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.1	92	0.0435	1.46		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.1	66	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	27	0.1850	3.01		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	25	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	22	0.0220	1.04		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.0	5	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	5	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	24	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	21	0.0100	4.91	3.86	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
13.9	414	Total			

Subcatchment CB4: CB4

Runoff = 6.44 cfs @ 12.09 hrs, Volume= 0.458 af, Depth= 4.92"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR-NOAA Rainfall=8.26"

Area (sf)	CN	Description
14,187	98	Paved parking & roofs
34,440	61	>75% Grass cover, Good, HSG B
48,627	72	Weighted Average
34,440		Pervious Area
14,187		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	50	0.0440	0.21		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.37"
0.5	64	0.0781	1.96		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	63	0.0645	1.78		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	46	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.0	5	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	5	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	25	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	21	0.0100	5.70	7.00	**Circular Channel (pipe),** Diam= 15.0" Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
6.0	279	Total			

Subcatchment CB5: CB5

Runoff = 2.70 cfs @ 12.09 hrs, Volume= 0.197 af, Depth= 6.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR-NOAA Rainfall=8.26"

Area (sf)	CN	Description
8,897	98	Paved parking & roofs
6,242	61	>75% Grass cover, Good, HSG B
1,715	74	>75% Grass cover, Good, HSG C
16,854	82	Weighted Average
7,957		Pervious Area
8,897		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	5	0.0200	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.37"
0.1	5	0.0200	0.78		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.37"
0.9	5	0.0200	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.37"
1.2	201	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.9					**Direct Entry, MIN TC**
0.0	12	0.0100	4.91	3.86	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
6.0	228	Total			

Subcatchment DA6: DA6-TO-WETLANDS

Runoff = 28.72 cfs @ 12.28 hrs, Volume= 3.036 af, Depth= 4.22"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR-NOAA Rainfall=8.26"

Area (sf)	CN	Description
13,120	98	Paved parking & roofs
215,109	61	>75% Grass cover, Good, HSG B
102,048	74	>75% Grass cover, Good, HSG C
24,053	55	Woods, Good, HSG B
21,529	70	Woods, Good, HSG C
375,859	66	Weighted Average
362,739		Pervious Area
13,120		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	13	0.0340	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.37"
3.5	37	0.0340	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.37"
1.8	101	0.0180	0.94		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.8	61	0.0330	1.27		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
4.3	357	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.6	225	0.0090	0.66		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	17	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	32	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
20.0	843	Total			

Subcatchment P1: P1

Runoff = 7.08 cfs @ 12.09 hrs, Volume= 0.506 af, Depth= 5.28"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR-NOAA Rainfall=8.26"

Area (sf)	CN	Description
5,726	98	Paved parking & roofs
30,929	61	>75% Grass cover, Good, HSG B
155	74	>75% Grass cover, Good, HSG C
13,301	98	POND
50,111	75	Weighted Average
31,084		Pervious Area
19,027		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	50	0.0300	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.37"
0.2	16	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	40	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.7	58	0.0340	1.29		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.0	164	Total			

Reach 1R: DMH1-DMH2

Inflow Area = 1.014 ac, Inflow Depth = 4.05" for 100YR-NOAA event
Inflow = 3.14 cfs @ 12.22 hrs, Volume= 0.342 af
Outflow = 3.14 cfs @ 12.25 hrs, Volume= 0.342 af, Atten= 0%, Lag= 1.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.93 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 1.50 fps, Avg. Travel Time= 2.6 min

Peak Storage= 190 cf @ 12.24 hrs, Average Depth at Peak Storage= 0.77'
Bank-Full Depth= 1.25', Capacity at Bank-Full= 4.44 cfs

15.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 238.0' Slope= 0.0040 '/'
Inlet Invert= 172.93', Outlet Invert= 171.97'

Reach 2R: DMH3-DMH2

Inflow Area = 2.216 ac, Inflow Depth = 4.83" for 100YR-NOAA event
Inflow = 11.02 cfs @ 12.10 hrs, Volume= 0.892 af
Outflow = 11.01 cfs @ 12.10 hrs, Volume= 0.892 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.55 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 2.68 fps, Avg. Travel Time= 0.1 min

Peak Storage= 23 cf @ 12.10 hrs, Average Depth at Peak Storage= 1.15'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 11.73 cfs

18.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 16.0' Slope= 0.0106 '/'
Inlet Invert= 171.89', Outlet Invert= 171.72'

Reach 3R: DMH4-DMH3

Inflow Area = 1.503 ac, Inflow Depth = 5.23" for 100YR-NOAA event
Inflow = 9.14 cfs @ 12.09 hrs, Volume= 0.655 af
Outflow = 9.12 cfs @ 12.09 hrs, Volume= 0.655 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.16 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.43 fps, Avg. Travel Time= 0.4 min

Peak Storage= 77 cf @ 12.09 hrs, Average Depth at Peak Storage= 1.02'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 11.38 cfs

18.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 60.0' Slope= 0.0100 '/'
Inlet Invert= 172.59', Outlet Invert= 171.99'

Reach 4R: DMH2-DMH5

Inflow Area = 3.229 ac, Inflow Depth = 4.58" for 100YR-NOAA event
Inflow = 13.26 cfs @ 12.11 hrs, Volume= 1.234 af
Outflow = 13.24 cfs @ 12.12 hrs, Volume= 1.234 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.52 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.95 fps, Avg. Travel Time= 0.5 min

Peak Storage= 127 cf @ 12.11 hrs, Average Depth at Peak Storage= 1.43'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 15.43 cfs

24.0" Diameter Pipe, n= 0.012
Length= 53.0' Slope= 0.0040 '/'
Inlet Invert= 171.22', Outlet Invert= 171.01'

Reach 5R: DMH5-FES

Inflow Area = 3.229 ac, Inflow Depth = 4.58" for 100YR-NOAA event
Inflow = 13.24 cfs @ 12.12 hrs, Volume= 1.234 af
Outflow = 13.23 cfs @ 12.12 hrs, Volume= 1.234 af, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.56 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.95 fps, Avg. Travel Time= 0.7 min

Peak Storage= 183 cf @ 12.12 hrs, Average Depth at Peak Storage= 1.42'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 15.55 cfs

24.0" Diameter Pipe, n= 0.012
Length= 77.0' Slope= 0.0040 '/'
Inlet Invert= 170.91', Outlet Invert= 170.60'

Reach 6R: FES-HW

Inflow Area = 3.229 ac, Inflow Depth = 4.58" for 100YR-NOAA event
Inflow = 13.23 cfs @ 12.12 hrs, Volume= 1.234 af
Outflow = 13.21 cfs @ 12.13 hrs, Volume= 1.234 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.59 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.96 fps, Avg. Travel Time= 0.4 min

Peak Storage= 116 cf @ 12.13 hrs, Average Depth at Peak Storage= 1.41'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 15.66 cfs

24.0" Diameter Pipe, n= 0.012
Length= 49.0' Slope= 0.0041 '/'
Inlet Invert= 171.00', Outlet Invert= 170.80'

Reach 7R: OCS-HW

Inflow Area = 4.380 ac, Inflow Depth = 3.36" for 100YR-NOAA event
Inflow = 6.52 cfs @ 12.53 hrs, Volume= 1.226 af
Outflow = 6.52 cfs @ 12.53 hrs, Volume= 1.226 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.63 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.98 fps, Avg. Travel Time= 0.1 min

Peak Storage= 21 cf @ 12.53 hrs, Average Depth at Peak Storage= 0.66'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 16.09 cfs

18.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 28.0' Slope= 0.0200 '/'
Inlet Invert= 169.50', Outlet Invert= 168.94'

Pond 1P: POND 1

Inflow Area = 4.380 ac, Inflow Depth = 4.77" for 100YR-NOAA event
Inflow = 19.83 cfs @ 12.11 hrs, Volume= 1.740 af
Outflow = 6.64 cfs @ 12.53 hrs, Volume= 1.740 af, Atten= 66%, Lag= 25.4 min
Discarded = 0.12 cfs @ 12.53 hrs, Volume= 0.514 af
Primary = 6.52 cfs @ 12.53 hrs, Volume= 1.226 af

Routing by Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 172.58' @ 12.53 hrs Surf.Area= 13,448 sf Storage= 33,407 cf

Plug-Flow detention time= 555.5 min calculated for 1.739 af (100% of inflow)
Center-of-Mass det. time= 555.8 min (1,380.3 - 824.6)

Volume	Invert	Avail.Storage	Storage Description
#1	169.50'	46,583 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
169.50	8,348	0	0
170.00	9,140	4,372	4,372
172.00	12,442	21,582	25,954
173.50	15,063	20,629	46,583

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**0.390 in/hr Exfiltration over Surface area**
#2	Primary	171.00'	**3.0" Vert. Orifice/Grate X 2.00** C= 0.600
#3	Primary	171.10'	**3.0" Vert. Orifice/Grate** C= 0.600
#4	Primary	171.50'	**12.0" Vert. Orifice/Grate** C= 0.600
#5	Primary	172.35'	**2.00' x 2.00' Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Discarded OutFlow Max=0.12 cfs @ 12.53 hrs HW=172.58' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=6.52 cfs @ 12.53 hrs HW=172.58' (Free Discharge)
├**2=Orifice/Grate** (Orifice Controls 0.57 cfs @ 5.80 fps)
├**3=Orifice/Grate** (Orifice Controls 0.27 cfs @ 5.60 fps)
├**4=Orifice/Grate** (Orifice Controls 2.87 cfs @ 3.65 fps)
└**5=Orifice/Grate** (Weir Controls 2.80 cfs @ 1.55 fps)

Pond WQS1: WQS 1

Inflow Area = 0.663 ac, Inflow Depth = 4.81" for 100YR-NOAA event
Inflow = 3.72 cfs @ 12.09 hrs, Volume= 0.265 af
Outflow = 3.68 cfs @ 12.10 hrs, Volume= 0.261 af, Atten= 1%, Lag= 0.7 min
Primary = 3.68 cfs @ 12.10 hrs, Volume= 0.261 af

Routing by Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 170.17' @ 12.10 hrs Surf.Area= 1,057 sf Storage= 1,142 cf

Plug-Flow detention time= 45.5 min calculated for 0.261 af (98% of inflow)
Center-of-Mass det. time= 34.9 min (856.3 - 821.4)

Volume	Invert	Avail.Storage	Storage Description
#1	168.50'	2,110 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
168.50	276	0	0
170.00	1,013	967	967
171.00	1,273	1,143	2,110

Device	Routing	Invert	Outlet Devices
#1	Primary	170.00'	**13.5' 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
#2	Primary	169.00'	**30.0 deg Sharp-Crested Vee/Trap Weir** C= 2.61

Primary OutFlow Max=3.67 cfs @ 12.10 hrs HW=170.17' (Free Discharge)
├**1=Broad-Crested Rectangular Weir** (Weir Controls 2.64 cfs @ 1.15 fps)
└**2=Sharp-Crested Vee/Trap Weir** (Weir Controls 1.03 cfs @ 2.82 fps)

Pond WQS2: WQS 2

Inflow Area = 0.663 ac, Inflow Depth = 4.72" for 100YR-NOAA event
Inflow = 3.68 cfs @ 12.10 hrs, Volume= 0.261 af
Outflow = 3.64 cfs @ 12.11 hrs, Volume= 0.253 af, Atten= 1%, Lag= 0.8 min
Primary = 3.64 cfs @ 12.11 hrs, Volume= 0.253 af

Routing by Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 169.65' @ 12.11 hrs Surf.Area= 1,290 sf Storage= 1,456 cf

Plug-Flow detention time= 68.2 min calculated for 0.253 af (97% of inflow)
Center-of-Mass det. time= 46.3 min (902.6 - 856.3)

Volume	Invert	Avail.Storage	Storage Description
#1	168.00'	1,936 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
168.00	473	0	0
169.50	1,216	1,267	1,267
170.00	1,461	669	1,936

Device	Routing	Invert	Outlet Devices
#1	Primary	169.50'	**16.0' 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
#2	Primary	168.50'	**30.0 deg Sharp-Crested Vee/Trap Weir** C= 2.61

Primary OutFlow Max=3.63 cfs @ 12.11 hrs HW=169.65' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 2.63 cfs @ 1.09 fps)
└—**2=Sharp-Crested Vee/Trap Weir** (Weir Controls 0.99 cfs @ 2.80 fps)

Link 1L: WETLANDS

Inflow Area = 13.671 ac, Inflow Depth = 3.96" for 100YR-NOAA event
Inflow = 33.22 cfs @ 12.29 hrs, Volume= 4.515 af
Primary = 33.22 cfs @ 12.29 hrs, Volume= 4.515 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

APPENDIX E

De Minimus Storm-water Discharge Calculation

Impervious Areas
To Deep Sump Hooded Catch Basins, Sediment Forebay and Pond 1 – 34,122 sq. ft.
To Sediment Forebay and Water Quality Swales – 8,143 sq. ft.

TSS Removal
To Ponds 1 - 85%
To Sediment Forebay and Water Quality Swales 78%

Pond 1 – 34,122 x .85 = 29,004
To Sediment Forebay and Water Quality Swales – 8,143 x .78 = 6,352

29,004 + 6,352 = 35,356

34,122 + 8,143 = 42,265

35,356
42,268 = 83.6% which is greater than 80%

Pre-treatment - To Pond 1

V

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: Donovan Estates

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)
Sediment Forebay	0.25	1.00	0.25	0.75
	0.00	0.75	0.00	0.75
	0.00	0.75	0.00	0.75
	0.00	0.75	0.00	0.75
	0.00	0.75	0.00	0.75

Total TSS Removal = 25%

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

Project: UC1340
Prepared By: RRG
Date: Jan-26

*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: Donovan Estates

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)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Infiltration Basin	**0.80**	**0.75**	**0.60**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**

Total TSS Removal = **85%**

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

Project: UC1340
Prepared By: RRG
Date: Sep-25

*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: Donovan Estates

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)
Sediment Forebay	0.25	1.00	0.25	0.75
Water Quality Swale - Wet	0.70	0.75	0.53	0.23
	0.00	0.23	0.00	0.23
	0.00	0.23	0.00	0.23
	0.00	0.23	0.00	0.23

Total TSS Removal = 78%

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

Project: UC1340
Prepared By: RRG
Date: Sep-25

*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 F

Guelph Permeameter Calculations

Input

Result

Support: all@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 5
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.4800

$\alpha^* =$ 0.12 (cm^{-1})

$C =$ 0.80315
$Q =$ 0.28176

$K_{fs} =$ 5.12E-04 cm/sec
3.07E-02 cm/min
5.12E-06 m/sec
1.21E-02 inch/min
2.02E-04 inch/sec

$\Phi_m =$ 4.27E-03 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 10
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.9100

$\alpha^* =$ 0.12 (cm^{-1})

$C =$ 1.28754
$Q =$ 0.53417

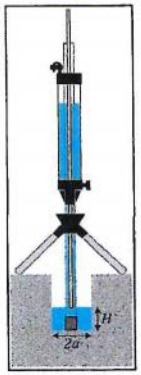
$K_{fs} =$ 5.79E-04 cm/sec
3.47E-02 cm/min
5.79E-06 m/ses
1.37E-02 inch/min
2.28E-04 inch/sec

$\Phi_m =$ 4.82E-03 (cm^2/min)

Average

$K_{fs} =$ 5.46E-04 cm/sec
3.27E-02 cm/min
5.46E-06 m/s
1.29E-02 inch/min
2.15E-04 inch/sec

$\Phi_m =$ 4.55E-03 (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1

Enter the first water Head Height ("H1" in cm): 5
Enter the second water Head Height ("H2" in cm): 10

Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0.12 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min): 0.4800

Steady State Rate of Water Level Change ("R2" in cm/min): 0.9100

1.95

$Q_1 =$ 0.01728

$Q_2 =$ 0.03278

$C_1 =$ 0.80315

$C_2 =$ 1.28754

$G_1 =$ 0.00496

$G_2 =$ 0.00397

$G_3 =$ 0.05569

$G_4 =$ 0.02415

$K_{fs} =$ 4.45E-05 cm/sec
2.67E-03 cm/min
4.45E-07 m/sec
1.05E-03 inch/min
1.75E-05 inch/sec

$\Phi_m =$ 1.71E-04 (cm^2/min)

PT # 2

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm), and α^* is macroscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1996).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.635}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.635}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.685}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.685}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.734}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.734}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.734}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.734}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm), H_2 is the second head of water established in borehole (cm) and C_1s Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_1^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	$G_4 = \frac{(2H_2^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$

Guelph Permeameter Data Sheet

Investigator: CARLOS DIGITAL Date: 6/23/25

Location: 47 PORTRIDGE ST Test Id: PT #2

Depth of hole: 30" Radius: FRENCH 3cm (standard calcs assume 3 cm radius)

Reservoirs used during test (check one): Combined: ✓ Inner only: _____

Reservoir constant used: 35,22

Water level in well = 5 cm

Time *t* (min)	D*t* (min)	Water level in reservoir *h* (cm)	D*h* (cm)	Rate of change D*h*/ D*t*
0		18		
3:40	3,67	20	2	0,55
13:37	9,88	25	5	0,51
25:00	11,38	30	5	0,44
36:09	11,15	35	5	0,45
47:09	11,0	40	5	0,46
59:26	12,28	46	6	0,49
1:08:0	8,57	50	4	0,47
10:09	10,02	55	5	0,50
14:51		60	5	
29:36	14,65	65	5	0,34

Steady rate for 3 consecutive readings (R_1): 0,48

Water level in well = 10 cm

Time *t* (min)	D*t* (min)	Water level in reservoir *h* (cm)	D*h* (cm)	Rate of change D*h*/ D*t*
0		15		
9:22	9,37	20	5	0,53
15:02	5,40	25	5	0,93
20:41	5,65	30	5	0,89
26:22	5,85	35	5	0,86
32:03	5,68	40	5	0,88
37:34	5,52	45	5	0,91
42:55	5,35	50	5	0,94
48:32	5,62	55	5	0,89
53:54	5,37	60	5	0,93
59:11	5,28	65	5	0,94
1 04:40	5,48	70	5	0,91
1 12:27	7,78	75	5	0,64

Steady rate for 3 consecutive readings (R_2): 0,91

Comments:

K_{sat} = 0.0129 in/min = 0.77 in/hr

GP FIELD DATA SHEET

SECTION 1: SITE INFORMATION

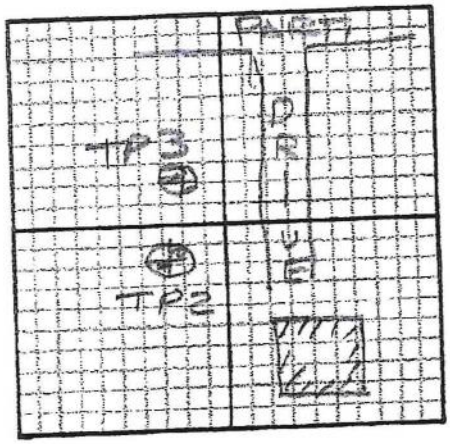
Date 6/23/25 Investigator CARLOS QUINTAL

Site Location 47 PARMBRIDGE ST, FRANKLIN

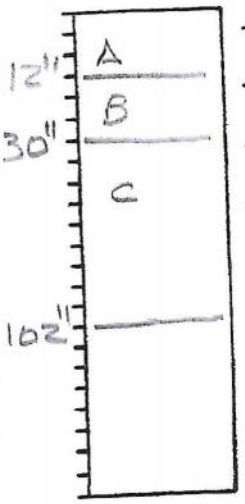
Dominant Soil Type(s) CHARLTON HOLLIS PEAR OUTCROP

Site Map:

TP#2



Soil Profile Description (horizon depth, texture, structure, color, etc.):



Presence of special soil conditions (mottling, water table depth, hardpan, induration, compacted layers, etc.):

water @ 60"

mottles @ 52" (7.5 Y 6/4)

Comments and Notes (topography, slope, vegetation, etc.):

SOILMOISTURE EQUIPMENT CORP.
P.O. Box 30025, Santa Barbara, CA 93130 USA
Phone: 805-964-3525 - Fax: (805) 683-2189 - Email: sales@soilmoisture.com
Website: http://www.soilmoisture.com

SOILMOISTURE®

Guelph Permeameter Calculations

Input

Result

Support: ai@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 5
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 2.1300

$\alpha^* =$ 0.12 (cm^{-1})

$C =$ 0.80315
$Q =$ 1.25031

$K_{fs} =$ 2.27E-03 cm/sec
1.36E-01 cm/min
2.27E-05 m/sec
5.37E-02 inch/min
8.95E-04 inch/sec

$\Phi_m =$ 1.90E-02 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 10
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 3.0300

$\alpha^* =$ 0.12 (cm^{-1})

$C =$ 1.28754
$Q =$ 1.77861

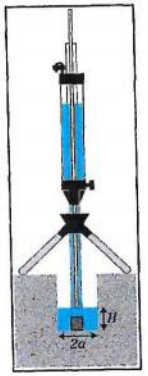
$K_{fs} =$ 1.93E-03 cm/sec
1.16E-01 cm/min
1.93E-05 m/sec
4.56E-02 inch/min
7.59E-04 inch/sec

$\Phi_m =$ 1.61E-02 (cm^2/min)

Average

$K_{fs} =$ 2.10E-03 cm/sec
1.26E-01 cm/min
2.10E-05 m/s
4.96E-02 inch/min
8.27E-04 inch/sec

$\Phi_m =$ 1.75E-02 (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1

Enter the first water Head Height ("H1" in cm): 5
Enter the second water Head Height ("H2" in cm): 10

Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0.12 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min): 2.1600

Steady State Rate of Water Level Change ("R2" in cm/min): 3.0300

1.95

$Q_1 =$ 0.07776

$Q_2 =$ 0.10908

$C_1 =$ 0.80315

$C_2 =$ 1.28754

$G_1 =$ 0.00496

$G_2 =$ 0.00397

$G_3 =$ 0.05569

$G_4 =$ 0.02415

$K_{fs} =$ 4.79E-05 cm/sec
2.88E-03 cm/min
4.79E-07 m/sec
1.13E-03 inch/min
1.89E-05 inch/sec

$\Phi_m =$ 1.70E-03 (cm^2/min)

PT # 3

Calculation formulas related to shape factor (C): Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is macroscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zeng et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.635}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.635}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.03	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.724}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.724}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.724}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.724}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm), H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	$G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_2Q_1 - G_4Q_2$

Guelph Permeameter Data Sheet

Investigator: CARLOS QUINTAL Date: 6/23/25

Location: 47 PARTRIDGE ST Test Id: PT #3

Depth of hole: 33" Radius: 3 cm (standard calcs assume 3 cm radius)

Reservoirs used during test (check one): Combined: ✓ Inner only: _____

Reservoir constant used: 35,22

Water level in well = 5 cm

Time t (min)	Dt (min)	Water level in reservoir h (cm)	Dh (cm)	Rate of change Dh/ Dt
0		18		
1:16	1.27	20	2	1,58
3:02	1.93	25	5	2,59
5:19	2.28	30	5	2,19
7:35	2.27	35	5	2,21
9:51	2.27	40	5	2,21
12:17	2,43	45	5	2,06
12:37	2.33	50	5	2,14
14:40	2.43	55	5	2,06
4:12	2.53	60	5	1,97
6:25	2.22	65	5	2,26
8:55	2.50	70	5	2,00
11:20	2,42	75	5	2,07

Steady rate for 3 consecutive readings (R_1): 2,16

Water level in well = 10 cm

Time t (min)	Dt (min)	Water level in reservoir h (cm)	Dh (cm)	Rate of change Dh/ Dt
0		18		
0:24	0.40	20	2	5,00
2:01	1.62	25	5	3,09
3:38	1.62	30	5	3,09
5:17	1.65	35	5	3,03
6:59	1.70	40	5	2,94
8:45	1.77	45	5	2,83
10:23	1.63	50	5	3,06
11:55	1.37	55	5	3,66
13:35	1.67	60	5	3,00
15:19	1.73	65	5	2,89
16:58	1.65	70	5	3,03
18:49	1.85	75	5	2,70

Steady rate for 3 consecutive readings (R_2): 3,03

Comments:

K_{SAT} = 0,0496 in/min = 2.98 in/hr

GP FIELD DATA SHEET

SECTION 1: SITE INFORMATION

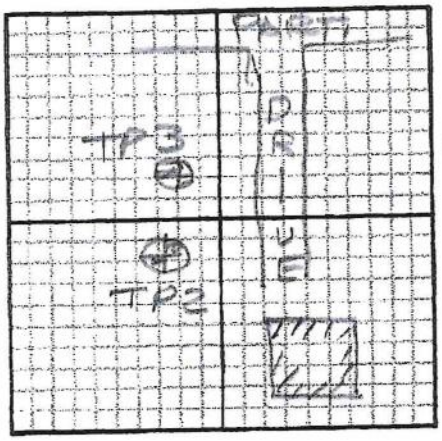
Date 6/23/25 Investigator CARLOS QUINTAL

Site Location 47 PARTRIDGE ST, FRANKLIN

Dominant Soil Type(s) CHARLTON HOLLIS ROCK OUTCROP

Site Map:

TP#3



Soil Profile Description (horizon depth, texture, structure, color, etc.):

Depth		Description
6"	A	FSL
24"	B	FSL
108"		GRAVELLY SL

Presence of special soil conditions (mottling, water table depth, hardpan, induration, compacted layers, etc.):

MOTTLES @ 52"

WATER @ 60"

Comments and Notes (topography, slope, vegetation, etc.):

SOILMOISTURE EQUIPMENT CORP.
P.O. Box 30025, Santa Barbara, CA 93130 USA
Phone: 805-964-3525 - Fax: (805) 683-2189 - Email: sales@soilmoisture.com
Website: http://www.soilmoisture.com

SOILMOISTURE

Guelph Permeameter Calculations

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type(enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 5
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 1.3000

$\alpha^* =$ 0.12 (cm^{-1})

$C =$ 0.80315
$Q =$ 0.7631

$K_{fs} =$ 1.39E-03 cm/sec
8.33E-02 cm/min
1.39E-05 m/sec
3.28E-02 inch/min
5.48E-04 inch/sec

$\Phi_m =$ 1.16E-02 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 10
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 2.2900

$\alpha^* =$ 0.12 (cm^{-1})

$C =$ 1.28754
$Q =$ 1.34423

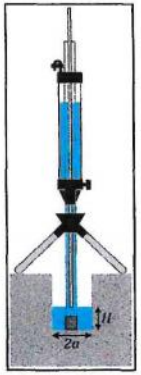
$K_{fs} =$ 1.46E-03 cm/sec
8.74E-02 cm/min
1.46E-05 m/sec
3.44E-02 inch/min
5.73E-04 inch/sec

$\Phi_m =$ 1.21E-02 (cm^2/min)

Average

$K_{fs} =$ 1.42E-03 cm/sec
8.53E-02 cm/min
1.42E-05 m/s
3.36E-02 inch/min
5.60E-04 inch/sec

$\Phi_m =$ 1.19E-02 (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1

Enter the first water Head Height ("H1" in cm): 5
Enter the second water Head Height ("H2" in cm): 10

Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0.12 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min): 1.3000

Steady State Rate of Water Level Change ("R2" in cm/min): 2.2900

1.95

$Q_1 =$ 0.0468

$Q_2 =$ 0.08244

$C_1 =$ 0.80315

$C_2 =$ 1.28754

$G_1 =$ 0.00496

$G_2 =$ 0.00397

$G_3 =$ 0.05569

$G_4 =$ 0.02415

$K_{fs} =$ 9.55E-05 cm/sec
5.73E-03 cm/min
9.55E-07 m/sec
2.26E-03 inch/min
3.76E-05 inch/sec

$\Phi_m =$ 6.16E-04 (cm^2/min)

Calculation formula related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is macroscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.632}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.632}$
Soils which are both fer textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.623}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.623}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Course and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/h), K_{fs} is Soil saturated hydraulic conductivity (cm/h), Φ_m is Soil matric flux potential (cm^2/h), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm), H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_1^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

PT-6

Guelph Permeameter Data Sheet

Investigator: ARIES QUINTAL Date: 12/18/25

Location: 47 PARTRIDGE ST, PA Test Id: PT-6

Depth of hole: 29" Radius: 3 cm (standard calcs assume 3 cm radius)

Reservoirs used during test (check one): Combined: ✓ Inner only: _____

Reservoir constant used: 35.22

PT-6

Water level in well = 5 cm				
Time t (min)	Dt (min)	Water level in reservoir h (cm)	Dh (cm)	Rate of change Dh/ Dt
0		17		
2:17	2.28	20	3	1.31
6:07	3.83	25	5	1.30
10:05	3.97	30	5	1.26
14:01	3.93	35	5	1.27
17:55	3.93	40	5	1.27
21:50	3.92	45	5	1.28
25:30	3.67	50	5	1.36
29:20	3.83	55	5	1.30
33:10	3.67	60	5	1.36

Steady rate for 3 consecutive readings (R_1): 1.30

Water level in well = 10 cm				
Time t (min)	Dt (min)	Water level in reservoir h (cm)	Dh (cm)	Rate of change Dh/ Dt
0		15		
2:14	2.23	20	5	2.24
4:34	2.33	25	5	2.14
6:38	2.07	30	5	2.42
8:42	2.07	35	5	2.42
10:50	2.13	40	5	2.34
12:58	2.13	45	5	2.34
15:05	2.12	50	5	2.36
17:30	2.27	55	5	2.20
19:50	2.33	60	5	2.14

Steady rate for 3 consecutive readings (R_2): 2.29

Comments:

K_{SAT} = 0.0336 in/min = 2.02 in/hr

Guelph Permeameter Calculations

Input

Result

Support: ai@soilmoisture.com

Head #1

Reservoir Type(enter "1" for Combined and "2" for Inner reservoir):	1
Enter water Head Height ("H" in cm):	5
Enter the Borehole Radius ("a" in cm):	3
Enter the soil texture-structure category (enter one of the below numbers):	3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):	0.8400
$\alpha^* =$	0.12 (cm^{-1})
$C =$	0.80315
$Q =$	0.49308
$K_{fs} =$	8.97E-04 cm/sec
	5.38E-02 cm/min
	8.97E-06 m/sec
	2.12E-02 inch/min
	3.53E-04 inch/sec
$\Phi_m =$	7.47E-03 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):	1
Enter water Head Height ("H" in cm):	10
Enter the Borehole Radius ("a" in cm):	3
Enter the soil texture-structure category (enter one of the below numbers):	3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):	1.5700
$\alpha^* =$	0.12 (cm^{-1})
$C =$	1.28754
$Q =$	0.92159
$K_{fs} =$	9.99E-04 cm/sec
	5.99E-02 cm/min
	9.99E-06 m/ses
	2.36E-02 inch/min
	3.93E-04 inch/sec
$\Phi_m =$	8.32E-03 (cm^2/min)

Average

$K_{fs} =$	9.48E-04 cm/sec
	5.69E-02 cm/min
	9.48E-06 m/s
	2.24E-02 inch/min
	3.73E-04 inch/sec
$\Phi_m =$	7.90E-03 (cm^2/min)

Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):	1
Enter the first water Head Height ("H1" in cm):	5
Enter the second water Head Height ("H2" in cm):	10
Enter the Borehole Radius ("a" in cm):	3
Enter the soil texture-structure category (enter one of the below numbers):	3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$	0.12 (cm^{-1})
Steady State Rate of Water Level Change ("R1" in cm/min):	0.8400
Steady State Rate of Water Level Change ("R2" in cm/min):	1.5700
	1.95
$Q_1 =$	0.03024
$Q_2 =$	0.05652
$C_1 =$	0.80315
$C_2 =$	1.28754
$G_1 =$	0.00498
$G_2 =$	0.00397
$G_3 =$	0.05589
$G_4 =$	0.02415
$K_{fs} =$	7.47E-05 cm/sec
	4.48E-03 cm/min
	7.47E-07 m/sec
	1.76E-03 inch/min
	2.94E-05 inch/sec
$\Phi_m =$	3.19E-04 (cm^2/min)

Calculation formula related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm), and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C need to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.655}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.655}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.655}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.655}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{C_1}\right)}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	$\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_3Q_2 - G_4Q_1$ $G_3 = \frac{(2H_1^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

P1-5

Guelph Permeameter Data Sheet

Investigator: CARLOS QUINTAL Date: 12/18/25

Location: 47 CARTRIDGE ST FR, Test Id: PT 5

Depth of hole: 30" Radius: 3 CM (standard calcs assume 3 cm radius)

Reservoirs used during test (check one): Combined: ✓ Inner only: _____

Reservoir constant used: 35,22

PT 5

Water level in well = 5 cm				
Time t (min)	Dt (min)	Water level in reservoir h (cm)	Dh (cm)	Rate of change Dh/ Dt
0		17		
3:25	3.42	20	3	0,88
9:53	6.47	25	5	0,77
16:15	6,37	30	5	0,78
22:10	5,92	35	5	0,85
28:18	6,13	40	5	0,82
34:31	6,22	45	5	0,80
40:20	5,82	50	5	0,86
46:17	5,95	55	5	0,84
51:58	5,68	60	5	0,88
58:01	6 03	65	5	0,83
Steady rate for 3 consecutive readings (R_1):				0.84

Water level in well = 10 cm				
Time t (min)	Dt (min)	Water level in reservoir h (cm)	Dh (cm)	Rate of change Dh/ Dt
0		14		
4:14	4.23	21	7	1,65
6:52	2,63	25	4	1,52
10:06	3,23	30	5	1,55
13:12	3.10	35	5	1,61
16:26	3,23	40	5	1,55
19:39	3,22	45	5	1,55
22:55	3,27	50	5	1,53
26:07	3,20	55	5	1,56
29:13	3,10	60	5	1,61
32:18	3,08	65	5	1,62
Steady rate for 3 consecutive readings (R_2):				1,57

Comments:

K_{SAT} = 0,0224 in/min = 1,34 in/Hr

GP FIELD DATA SHEET

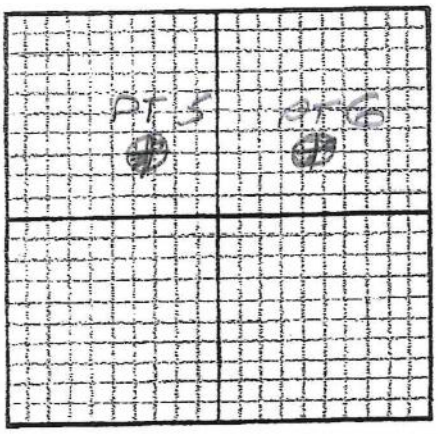
SECTION 1: SITE INFORMATION

Date 12/18/25 Investigator CARLOS A RIVERA

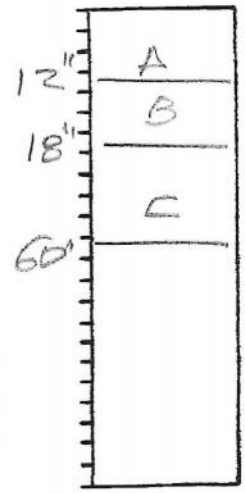
Site Location 47 PARTRIDGE ST - FRANKLIN

Dominant Soil Type(s) WOODBRIDGE FINE SANDY LOAM

Site Map:



Soil Profile Description (horizon depth, texture, structure, color, etc.):



Depth	Description
A	SL
B	SL
C	FSL

Presence of special soil conditions (mottling, water table depth, hardpan, induration, compacted layers, etc.):

Comments and Notes (topography, slope, vegetation, etc.):

SOILMOISTURE EQUIPMENT CORP.
P.O. Box 30025, Santa Barbara, CA 93130 USA
Phone: 805-964-3525 - Fax: (805) 683-2189 - Email: sales@soilmoisture.com
Website: http://www.soilmoisture.com

SOILMOISTURE

Soil Map—Norfolk and Suffolk Counties, Massachusetts
(47 Partridge Street Franklin)

Map Scale: 1:2,970 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 40 80 160 240

Feet: 0 100 200 400 600

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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 20, Aug 27, 2024

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

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

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
5	Saco silt loam, frequently ponded, 0 to 1 percent slopes, frequently flooded	11.1	26.8%
103C	Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes	3.9	9.4%
260B	Sudbury fine sandy loam, 2 to 8 percent slopes	2.7	6.5%
307C	Paxton fine sandy loam, 8 to 15 percent slopes, extremely stony	1.3	3.1%
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	19.0	45.9%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	3.4	8.3%
Totals for Area of Interest		**41.5**	**100.0%**

Norfolk and Suffolk Counties, Massachusetts

310B—Woodbridge fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2t2ql
Elevation: 0 to 1,470 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Woodbridge, fine sandy loam, and similar soils: 82 percent
Minor components: 18 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Woodbridge, Fine Sandy Loam

Setting

Landform: Ground moraines, drumlins, hills
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 7 inches: fine sandy loam
Bw1 - 7 to 18 inches: fine sandy loam
Bw2 - 18 to 30 inches: fine sandy loam
Cd - 30 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C/D

Ecological site: F144AY037MA - Moist Dense Till Uplands
Hydric soil rating: No

Minor Components

Paxton

Percent of map unit: 10 percent
Landform: Drumlins, ground moraines, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Ridgebury

Percent of map unit: 8 percent
Landform: Depressions, ground moraines, hills, drainageways
Landform position (two-dimensional): Toeslope, backslope, footslope
Landform position (three-dimensional): Base slope, head slope, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 20, Aug 27, 2024

Norfolk and Suffolk Counties, Massachusetts

103C—Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2wzp1
Elevation: 0 to 1,390 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Charlton, extremely stony, and similar soils: 50 percent
Hollis, extremely stony, and similar soils: 20 percent
Rock outcrop: 10 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Charlton, Extremely Stony

Setting

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

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 4 inches: fine sandy loam
Bw - 4 to 27 inches: gravelly fine sandy loam
C - 27 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 8 to 15 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Description of Hollis, Extremely Stony

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 7 inches: gravelly fine sandy loam
Bw - 7 to 16 inches: gravelly fine sandy loam
2R - 16 to 26 inches: bedrock

Properties and qualities

Slope: 8 to 15 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 8 to 23 inches to lithic bedrock
Drainage class: Somewhat excessively drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144AY033MA - Shallow Dry Till Uplands
Hydric soil rating: No

Description of Rock Outcrop

Setting

Landform: Ridges, hills
Parent material: Igneous and metamorphic rock

Typical profile

R - 0 to 79 inches: bedrock

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Available water supply, 0 to 60 inches: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Woodbridge, extremely stony

Percent of map unit: 8 percent
Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Canton, extremely stony

Percent of map unit: 5 percent
Landform: Moraines, hills, ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Chatfield, extremely stony

Percent of map unit: 5 percent
Landform: Ridges, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest
Down-slope shape: Convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Ridgebury, extremely stony

Percent of map unit: 2 percent
Landform: Hills, drainageways, drumlins, depressions, ground moraines
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave

Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 20, Aug 27, 2024

APPENDIX G

CHECKLIST FOR DESIGNERS

GOALS and NEEDS Addressed:

1. Create a visually appealing community
2. Stabilize and increase property values
3. Encourage low impact development
4. Preserve the Town's historic and cultural heritage
5. Protect Franklin's natural environment, including habitat, water resources, and ecosystem services

FRANKLIN POLICY:
Subdivision plans and site plans for all forms of development shall adhere to the principles of environmental and aesthetic compatibility and energy-efficient design.

BEST DEVELOPMENT PRACTICES The site plan should be designed to address the following to the maximum extent practicable	Incorporated into Project?
Unique natural features have been preserved *(the development program should either avoid altering or showcase significant natural features)*	N/A
Native vegetation planted in disturbed areas as needed to enhance or restore habitat	✓
Historic and cultural resources have been preserved (*the development program should either avoid altering or showcase significant historic and cultural features)*	N/A
Clearing, grading, and building placement consider view sheds	✓
Cut and fill have been minimized	✓
Buildings blend into the natural topography	✓
Buildings are oriented to the sun and wind for maximum energy efficiency *Vegetated protection from northwest (winter) winds is provided* *Deciduous species planted or retained close to the East, South and West building edges*	✓
Conforms to §185-31 of the Town of Franklin Zoning Code and/or Chapter 300 of the Town of Franklin Subdivision Regulations	✓ with waiver requests

GOALS and NEEDS addressed:

1. Protect local and regional wetlands and water bodies;
2. Maximize groundwater recharge to retain a viable local groundwater supply; and
3. Minimize pollutants in stormwater runoff.

FRANKLIN POLICY: In addition to MassDEP's Stormwater Management Standards, all new development projects in Franklin must meet the following performance measures. All redevelopment projects shall meet the standards and if they fail to meet the standards, shall retrofit or expand existing stormwater management systems to improve existing conditions.

1. Post-development peak discharge rates and volumes from the site shall not exceed pre-development peak discharge rates and volumes from the site.
2. All drainage facilities proposed shall utilize best management practices as outlined in the Massachusetts Stormwater Management Standards.
3. All sites will have an Operation and Maintenance plan to insure future compliance.

Additionally, new development projects must:

1. Retain the volume of runoff equivalent to, or greater than, one (1.0) inch multiplied by the total post-construction impervious surface area on the site AND/OR
2. Remove 90% of the average annual load of Total Suspended Solids (TSS) generated from the total post-construction impervious area on the site AND 60% of the average annual load of Total Phosphorus (TP) generated from the total post-construction impervious surface area on the site.

And redevelopment projects must:

1. Retain the volume of runoff equivalent to, or greater than, 0.80 inch multiplied by the total post-construction impervious surface area on the site AND/OR
2. Remove 80% of the average annual post-construction load of Total Suspended Solids (TSS) generated from the total post-construction impervious area on the site AND 50% of the average annual load of Total Phosphorus (TP) generated from the total post-construction impervious surface area on the site.

BEST DEVELOPMENT PRACTICES The site plan should be designed to address the following to the maximum extent practicable	Incorporated into Project?
Vegetated swales *(recommended to convey runoff from roadways & parking lots)*	✓
Vegetated filter strips *(recommended to filter and infiltrate runoff from roadways, parking lots, and driveways; use along roadsides and parking lots)*	
Constructed wetlands *(preferred method for stormwater retention & pollutant removal)*	
Bioretention cells (*rain gardens) (recommended on residential lots and parking lot islands)*	
Pervious paving surfaces *(recommended in overflow parking and low-traffic areas)*	
Sediment Forebays *(use in combination with other BDP)*	✓
Roof gardens *(encouraged on flat or gently sloped commercial and industrial rooftops)*	
Retention/Detention basins *(may be used in series with other practices to provide pre-treatment)*	✓
Recharge Systems *(suitable for all areas of development)*	✓
Drain pipe/catch basin systems *(as required to collect runoff when other systems are not practical)*	✓
If utilizing drain pipe and/or catch basin systems, have you documented that other systems are infeasible?	✓ Prel. many subdivision

Erosion & Sedimentation Control

Checklist for Designers

GOALS and NEEDS addressed:

1. Minimize clearing and regrading
2. Prevent erosion and sedimentation

FRANKLIN POLICIES:

a) Any proposed project on a previously undeveloped site shall accommodate the development program in a way that minimizes clearing and re-grading, especially in areas of steep slopes, erosion-prone soils, or sensitive vegetation. For redevelopment projects, the site plan shall concentrate development in previously-disturbed areas to the extent possible.

b) As a condition of approval, every proposed project shall submit and adhere to an erosion control plan that addresses soil stabilization, sediment retention, perimeter protection, construction scheduling, and traffic area stabilization and dust control.

c) If the proposed project is in an area under conservation jurisdiction, the project will require permitting deemed appropriate by the Conservation Commission.

BEST DEVELOPMENT PRACTICES The site plan should be designed to address the following to the maximum extent practicable.	Incorporated into Project?
Clearing and re-grading have been minimized	✓
Plan identifies sensitive areas to be protected and areas that are suitable for development	✓
Conservation Permits have been obtained *(when applicable)*	Applying For

The erosion and sedimentation control plan addresses:
• Soil stabilization
  ○ *(cover or stabilize erodible surfaces not in immediate use)*
• Sediment retention
  ○ *(runoff interceptors and sediment traps/ponds)*
• Perimeter protection
  ○ *(vegetated buffers, compost socks or straw wattles at limit of work)*
• Construction scheduling
  ○ *(minimize disturbed area at any given time)*
• Traffic area stabilization
  ○ *(crushed rock or similar at construction vehicle entrance and parking areas)*
• Dust control
  ○ *(plan for stabilizing dry, dust-prone surfaces when necessary)*
• Vegetation
  ○ *(preserve existing vegetation and/or identify areas to be revegetated including proposed planting species, quantity and planting specifications)*
	✓

GOALS and NEEDS addressed:

1. Stabilize water use at a sustainable level;
2. Create landscapes that minimize habitat destruction and maximize habitat value;
3. Encourage the development of landscapes that provide environmental quality and visual relief through the planting of native or naturalized species

FRANKLIN POLICIES:

a) Site plans and landscape plans for all proposed projects shall take appropriate steps, as outlined in the Guidebook, to minimize water use for irrigation and to allow for natural recharge of groundwater. Landscape plans shall follow the guidelines in the Guidebook for selecting species that are most appropriate to the site conditions.

b) Native and habitat-creating species shall be used in all landscape plans to the maximum extent possible while still meeting the site's landscaping needs. Invasive species may not be planted in Franklin under any condition. Refer to the Massachusetts Prohibited Plant list for more information.

c) Actively promote the Town of Franklin's Water Conservation Measures.

BEST DEVELOPMENT PRACTICES The site plan must address all of the following principles.	Incorporated into Project?
Retain and Recharge water on site *(install bio-retention cells, vegetated filter strips and minimize lawn areas where feasible)*	✓
Preserve natural vegetation to the maximum extent practicable	✓
Irrigation system is water efficient *(if an in-ground irrigation system is proposed, it is a water efficient system with timers and automatic sensors to prevent overwatering)*	
Preserve soil permeability *(minimize disturbing existing landscapes. Prepare new planting beds in accordance to the Planting Bed Guidelines on p. 13, and install 1-2" of shredded pine bark mulch on new planting areas)*	✓
Minimize the use of turf grass *(when applicable, reduce the size of the lawn area; instead, plant a bio-retention cell, use alternative, drought tolerant groundcover)*	✓
Specify variety of native and naturalized species *(species from the plant list have been incorporated into the landscape design, and no invasive species are used. Refer to the Plant Species Section and the Massachusetts Prohibited Plant List)*	✓
Species are appropriate to the soil, site, and microclimate conditions *(select appropriate species from the plant list in this guidebook)*	✓

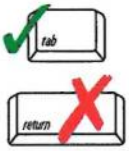
APPENDIX H

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

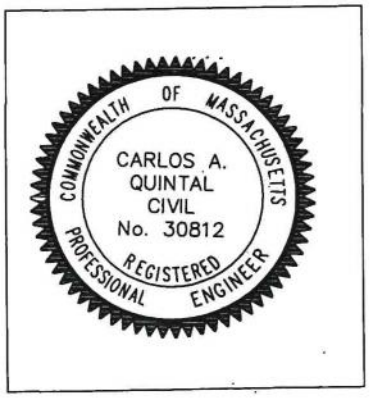
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



Signature and Date 1/20/26

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 I

Operation and Maintenance Plan

FOR
Definitive Subdivision
Donovan Estates

LOCATED IN
FRANKLIN, MASSACHUSETTS

PREPARED FOR
Donovan Family Realty Trust
47 Partridge Street
Franklin, MA 02038

PREPARED BY
UNITED CONSULTANTS, INC.
850 FRANKLIN STREET, SUITE 11D
WRENTHAM, MA. 02093

DATE: September 3, 2025
Revised: January 16, 2026

Operation and Maintenance Plan

Good House Keeping Measures

1. The roadway and driveway will receive the minimum amount of sand and salt. Snow will be stored at the roadway edges in windrows consistent with Town of Franklin Snow plowing of roadways.
2. The site landscaping will consist of turf lawn, mulch with trees, shrubs, and existing wooded areas. Minimal amounts of fertilizers, herbicides and pesticides will be applied.
3. The site will be stabilized with landscaped areas with mulch and native seed mixes. This will improve the existing site coverage.

Long Term Pollution Prevention Plan

The owner shall employ good housekeeping measures, which include removing trash and debris from the site, keeping trash in receptacles and complying with the long-term operation and maintenance plan.
The owner does not plan to store materials or waste products on the site.
The owner will have routine inspections and maintenance completed for the Storm-water BMP's. See the Operation and Maintenance Plan Stormwater Facilities Plan for details and schedule.
Typical hazardous materials for single family residences are anticipated. All hazardous materials shall be stored within the houses.
The owner's shall apply the minimum amounts of fertilizers, herbicides and pesticides.
The houses will be serviced by Town water and sewer.
Town trash receptacles are expected to provide refuse storage and will be emptied and disposed of offsite.
The owner will designate an emergency contact person prior to commencing construction.
Snow will be stored at the roadway edges in windrows consistent with Town of Franklin Snow plowing of roadways.
The owner will apply the minimum amount of sand and salt necessary. The roadway will be swept by the Town of Franklin DPW based on their street sweeping program.
Sand piles will not be stored on site.

Operation and Maintenance Plan Reference

An operation and maintenance schedule for the construction period and the post-development period has been provided on the Operation and Maintenance Plan Stormwater Facilities Plan.
Refer to the O&M plan (Sheet 5) for the location of the proposed grading and drainage easement.

During the construction period and after completion the future Owner shall be responsible for the operation and maintenance of the site and the drainage system.
Upon completion of the construction work the Town of Franklin shall be responsible for the maintenance of the drainage facilities.
The yearly estimated operation and maintenance budget is $2,500.

During Construction:

The owner will provide documentation which will be submitted to the Franklin DPW confirming when maintenance has been satisfactorily completed.

The maintenance in the maintenance agreement may be amended to achieve the purpose of the bylaws by mutual agreement of the Director of the DPW and the responsible parties.

The owner of the stormwater management system will notify the Director of changes in ownership or assignment of financial responsibility.

The owner will provide future property owners with a copy of the O&M plan and the Stormwater Facilities plan and inform them of the responsibilities of the stormwater system inspections and maintenance.

The owner shall contract with a company which provides emergency response, spill containment and remediation.
The owner will have a spill prevention kit on site for any spills containing oil or gas.
The owners shall employ a landscape professional who is qualified in fertilizer and pesticide applications.
Landscape professionals shall have spill containment for all fertilizers and pesticides.

The owner will provide documentation which will be submitted to the Franklin DPW confirming when maintenance has been satisfactorily completed.

The owner of the stormwater management system will notify the Director of changes in ownership or assignment of financial responsibility.

During Construction the Future Owner will be the party responsible.

_____

Name Title

Note: This document shall be signed and submitted with SWPPP and the Town of Franklin Stormwater Permit.

Yearly Inspection and Maintenance Log

Page 1

Lot 2 Forge Parkway
Franklin, Massachusetts

Road Sweeping and Curb Inspection – Per Town of Franklin Street Sweeping and Inspection Plan

Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____

Roadway sweeping should be completed by a mechanical or vacuum sweeper.

Notes:

Deep Sump Hooded Catch Basins - Per Town of Franklin Catch Basin Cleaning and Inspection Plan

Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____

Cleaning Performed

Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____

Notes:

Sediment Forebay– Per Town of Franklin Drainage Facility Inspection Plan

Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____

Cleaning Performed:

Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____

Infiltration Pond – Per Town of Franklin Drainage Facility Inspection Plan

Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____

Cleaning Performed:

Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____

Sediment Forebay and Water Quality Swales – Per Town of Franklin Drainage Facility Inspection Plan

Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____

Cleaning Performed:

Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____

Notes:

Landscape Area Inspection – 4 times per year

Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____

Work Performed Repairs completed:

Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____

Inspect the area with grass for bare spots and erosion. Repair eroded areas with loam and seed to provide adequate coverage. Inspect landscaped areas for erosion and weeds. Fix erosion and apply additional mulch or landscape stone as necessary.

Inspect and clean pretreatment BMP's every six months and after every major storm event (2 year return frequency). Check the inlet and outlet pipes to determine if they are clogged. Remove accumulated sediment, trash, debris, leaves, lawn clippings from mowing.

Inspect the infiltration area after the first several rainfall events, after all major storms, and on regularly scheduled dates every six months.

Inspect the infiltration area 24 hours to several days after a rain event, to look for ponded water at the surface of the trench. If water is present in may be that the infiltration area is clogged. If so then rehabilitation of the bottom of the trench shall be completed including removing all accumulated sediment, scarifying and till the bottom area, remove and replace the stone media.

APPENDIX J

In Compliance with DEP Storm-water Management Standard 10

Definitive Subdivision "**Donovan Estates**"

No Illicit discharges to the storm-water management system, including wastewater discharges and discharges of storm-water contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, oil, or grease are proposed and shall not be allowed.

The site map located in Appendix J shall be part of this Illicit Discharge Compliance Statement.

During Construction the future owner will be the responsible party.

_____

Name Title

Note: Once ownership of an approved Subdivisions is secured this document shall be signed and submitted with SWPPP and the Town of Franklin Stormwater Permit.

APPENDIX K

Rip Rap Sizing Calculations

Into Sediment Forebay at Wet Swale

Rip Rap Calculator

I want to find the... ...

- (●) average rock diameter (D_{50})
- ( ) rip rap volume
- ( ) both D_{50} and rip rap volume

^ Rip rap specifications

Water velocity (V) i ...

4.35 ft/s

Isbash constant (C) ...

- (●) Highly turbulent (0.86)
- ( ) Low turbulence (1.2)

Gravitational acceleration (g) ...

32.17 ft/s²

Specific gravity (S) i ...

2.75

Average rock diameter (D_{50}) ...

2.727 in

Rip Rap Sizing Calculations

Into Sediment Forebay at Pond 1

Rip Rap Calculator

I want to find the... ...

- (•) average rock diameter (D_{50})
- ( ) rip rap volume
- ( ) both D_{50} and rip rap volume

Rip rap specifications

Water velocity (V) i ...

5.56 ft/s

Isbash constant (C) ...

- (•) Highly turbulent (0.86)
- ( ) Low turbulence (1.2)

Gravitational acceleration (g) ...

32.17 ft/s²

Specific gravity (S) i ...

2.75

Average rock diameter (D_{50}) ...

4.455 in

Share result

Reload calculator

Clear all changes

Did we solve your problem today? Yes No

Rip Rap Sizing Calculations

Into Pond 1

Rip Rap Calculator

I want to find the... ...

- (●) average rock diameter (D_{50})
- ( ) rip rap volume
- ( ) both D_{50} and rip rap volume

^ Rip rap specifications

Water velocity (V) i ...

5.59 ft/s

Isbash constant (C) ...

- (●) Highly turbulent (0.86)
- ( ) Low turbulence (1.2)

Gravitational acceleration (g) ...

32.17 ft/s²

Specific gravity (S) i ...

2.75

Average rock diameter (D_{50}) ...

4.503 in

Rip Rap Sizing Calculations

Out of Pond 1

Rip Rap Calculator

I want to find the... ...

- (•) average rock diameter (D_{50})
- ( ) rip rap volume
- ( ) both D_{50} and rip rap volume

Rip rap specifications

Water velocity (V) i ...

8.63 ft/s

Isbash constant (C) ...

- (•) Highly turbulent (0.86)
- ( ) Low turbulence (1.2)

Gravitational acceleration (g) ...

32.17 ft/s²

Specific gravity (S) i ...

2.75

Average rock diameter (D_{50}) ...

10.732 in

Share result

Reload calculator

Clear all changes

Did we solve your problem today? Yes No

APPENDIX L