horizons Engineering

5 Railroad Street, Newmarket, NH 03857 Ph 603-659-4979 Fax 603-659-4627

2021-10-04

Re: Mulhern residential subdivision – drainage report revisions
Tax Map 10, Lot 8-6
91 Bagdad Rd, Durham NH 03824

Dear Mr. Reine;

Attached is brief summary of the modifications made to the proposed stormwater drainage for the Mulhern subdivision since the previously submitted drainage report dated 2021-04-21. The changes that have been made are considered minor and with little impact to the results of the HydroCAD model.

1. Additional residential buildings have been proposed.

The new site plan shows an increase to the impervious roof area by less than 6000 ft^2. Please note that the building footprints shown are to establish feasibility and for illustration only. The exact footprint of the buildings may vary. A total of 6000 ft^2 of impervious area was added in the HydroCAD model to account for these modifications (3000 ft^2 to 7aS and 7bS).

2. Modified inverts of proposed box culvert at the first wetlands crossing

The slope of the box culvert was changed slightly. The change in slope has a negligible impact on the flow at the culvert and at the downstream point of analysis (POA 1).

The impacts that these changes have are minimal and are reported in the enclosed runoff flow and volume summary, and the post-development HydroCAD model output. Please contact me if you have any questions or would like to discuss the project further.

Best regards,

Michael J. Sievert, PE

STATE OF NEW HAMPSHIRE
MICHAEL J. SIEVERT
No. 8397
LICENSED
PROFESSIONAL ENGINEER

Stormwater Runoff flow and volume summary

Pre values refer to the pre-development model outputs from the previous stormwater drainage report dated 2021-04-21 that was submitted to the town of Durham

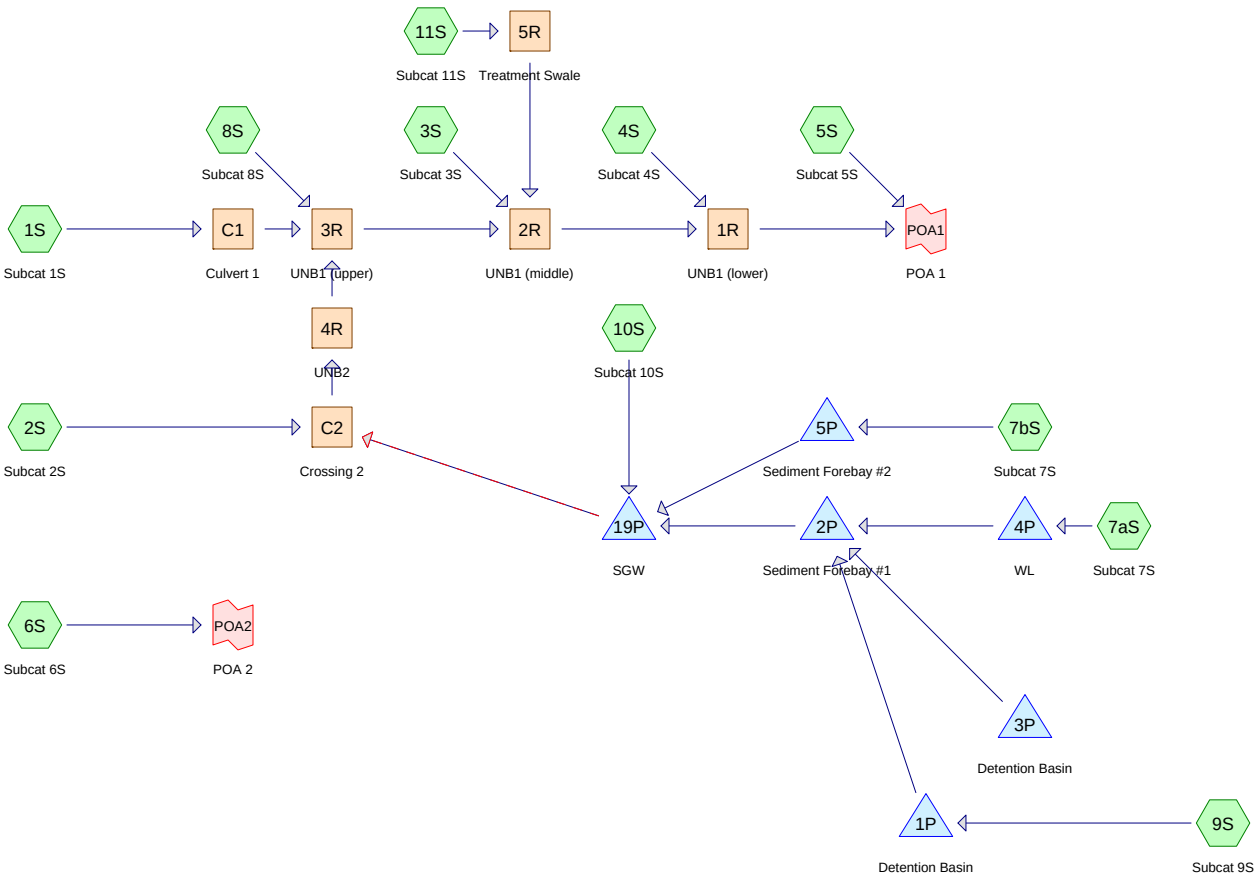
Post(1) values refer to the post-development model outputs from the previous stormwater drainage report dated 2021-04-21 that was submitted to the town of Durham.

Post(2) values refer to the revised post-development model outputs accounting for the increased residential units and impervious roof areas.

Peak flow of direct runoff [ft3]				
Storm		Pre	Post(1)	Post(2)
25-YR	POA 1	120.67	120.57	120.64
	POA 2	1.19	0.64	0.64
10-YR	POA 1	82.99	82.17	82.21
	POA 2	0.75	0.43	0.43
2-YR	POA 1	38.75	36.01	35.99
	POA 2	0.27	0.19	0.19
1 inch	POA 1	0.13	0.15	0.15
	POA 2	0.00	0.00	0.00

Direct runoff volume [ft3/s]

Storm		Pre	Postv1	Postv2
25-YR	POA 1	676,521	694,148	694,830
	POA 2	3,887	2,090	2,090
10-YR	POA 1	466,928	481,393	481,941
	POA 2	2,494	1,403	1,403
2-YR	POA 1	225,895	235,307	235,595
	POA 2	1,006	634	634
1 inch	POA 1	4,846	5,272	5,272
	POA 2	0	3	3



Subcat Reach Pond Link

Routing Diagram for NM19063_Post02
Prepared by Horizons Engineering
HydroCAD® 10.00-25 s/n 08064 © 2019 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
61,137	61	>75% Grass cover, Good, HSG B (2S, 4S, 5S, 6S, 7aS, 9S)
300,405	74	>75% Grass cover, Good, HSG C (1S, 2S, 4S, 5S, 8S)
250,669	80	>75% Grass cover, Good, HSG D (1S, 2S, 3S, 4S, 5S, 6S, 7aS, 7bS, 8S, 9S, 10S, 11S)
19,703	98	Paved parking, HSG B (2S, 4S, 5S, 6S, 7aS, 9S)
66,778	98	Paved parking, HSG C (1S, 2S, 5S, 8S)
59,530	98	Paved parking, HSG D (1S, 2S, 3S, 4S, 7aS, 7bS, 8S, 9S, 10S, 11S)
13,245	98	Roofs, HSG B (2S, 5S, 6S, 7aS, 9S)
34,101	98	Roofs, HSG C (1S, 2S, 4S, 5S, 8S)
26,085	98	Roofs, HSG D (1S, 2S, 7aS, 7bS, 8S, 9S)
14,273	30	Woods, Good, HSG A (3S, 4S, 5S)
111,720	55	Woods, Good, HSG B (2S, 4S, 5S, 6S)
615,310	70	Woods, Good, HSG C (1S, 2S, 3S, 4S, 5S, 7aS, 8S)
477,002	77	Woods, Good, HSG D (1S, 2S, 3S, 4S, 5S, 6S, 7aS, 8S)
2,049,957	**75**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
14,273	HSG A	3S, 4S, 5S
205,805	HSG B	2S, 4S, 5S, 6S, 7aS, 9S
1,016,593	HSG C	1S, 2S, 3S, 4S, 5S, 7aS, 8S
813,286	HSG D	1S, 2S, 3S, 4S, 5S, 6S, 7aS, 7bS, 8S, 9S, 10S, 11S
0	Other	
2,049,957		**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Subcat 1S Runoff Area=10.720 ac 18.93% Impervious Runoff Depth=0.06"
Flow Length=1,506' Tc=18.5 min CN=78 Runoff=0.09 cfs 2,271 cf

Subcatchment 2S: Subcat 2S Runoff Area=18.899 ac 5.85% Impervious Runoff Depth=0.02"
Flow Length=1,517' Tc=25.2 min CN=73 Runoff=0.03 cfs 1,174 cf

Subcatchment 3S: Subcat 3S Runoff Area=1.859 ac 0.53% Impervious Runoff Depth=0.02"
Flow Length=450' Tc=13.6 min CN=74 Runoff=0.00 cfs 157 cf

Subcatchment 4S: Subcat 4S Runoff Area=2.905 ac 2.35% Impervious Runoff Depth=0.00"
Flow Length=350' Tc=6.9 min CN=70 Runoff=0.00 cfs 49 cf

Subcatchment 5S: Subcat 5S Runoff Area=4.547 ac 5.37% Impervious Runoff Depth=0.01"
Flow Length=600' Tc=16.2 min CN=71 Runoff=0.01 cfs 130 cf

Subcatchment 6S: Subcat 6S Runoff Area=0.162 ac 12.98% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=70 Runoff=0.00 cfs 3 cf

Subcatchment 7aS: Subcat 7S Runoff Area=45,742 sf 26.80% Impervious Runoff Depth=0.15"
Tc=10.0 min CN=84 Runoff=0.11 cfs 579 cf

Subcatchment 7bS: Subcat 7S Runoff Area=20,568 sf 41.79% Impervious Runoff Depth=0.25"
Tc=10.0 min CN=88 Runoff=0.10 cfs 434 cf

Subcatchment 8S: Subcat 8S Runoff Area=193,279 sf 8.93% Impervious Runoff Depth=0.06"
Tc=10.0 min CN=78 Runoff=0.04 cfs 940 cf

Subcatchment 9S: Subcat 9S Runoff Area=61,773 sf 33.66% Impervious Runoff Depth=0.15"
Tc=10.0 min CN=84 Runoff=0.14 cfs 782 cf

Subcatchment 10S: Subcat 10S Runoff Area=16,281 sf 10.26% Impervious Runoff Depth=0.11"
Tc=6.0 min CN=82 Runoff=0.03 cfs 155 cf

Subcatchment 11S: Subcat 11S Runoff Area=0.217 ac 77.49% Impervious Runoff Depth=0.50"
Tc=6.0 min CN=94 Runoff=0.12 cfs 398 cf

Reach 1R: UNB1 (lower) Avg. Flow Depth=0.02' Max Vel=0.92 fps Inflow=0.15 cfs 5,142 cf
n=0.013 L=596.0' S=0.0070 '/' Capacity=858.75 cfs Outflow=0.15 cfs 5,142 cf

Reach 2R: UNB1 (middle) Avg. Flow Depth=0.02' Max Vel=0.91 fps Inflow=0.16 cfs 5,093 cf
n=0.013 L=594.0' S=0.0069 '/' Capacity=849.89 cfs Outflow=0.15 cfs 5,093 cf

Reach 3R: UNB1 (upper) Avg. Flow Depth=0.01' Max Vel=1.03 fps Inflow=0.14 cfs 4,539 cf
n=0.013 L=430.0' S=0.0088 '/' Capacity=961.66 cfs Outflow=0.14 cfs 4,539 cf

Reach 4R: UNB2 Avg. Flow Depth=0.03' Max Vel=1.18 fps Inflow=0.04 cfs 1,329 cf
n=0.025 L=228.0' S=0.0539 '/' Capacity=209.49 cfs Outflow=0.04 cfs 1,329 cf

Reach 5R: Treatment Swale Avg. Flow Depth=0.06' Max Vel=0.16 fps Inflow=0.12 cfs 398 cf
n=0.150 L=107.0' S=0.0100 '/' Capacity=9.14 cfs Outflow=0.08 cfs 398 cf

Reach C1: Culvert 1 Avg. Flow Depth=0.01' Max Vel=2.14 fps Inflow=0.09 cfs 2,271 cf
60.0" x 24.0" Box Pipe n=0.013 L=20.0' S=0.0650 '/' Capacity=232.87 cfs Outflow=0.09 cfs 2,271 cf

Reach C2: Crossing 2 Avg. Flow Depth=0.00' Max Vel=1.67 fps Inflow=0.04 cfs 1,329 cf
108.0" x 144.0" Ellipse Pipe w/ 72.0" inside fill n=0.030 L=20.0' S=0.0200 '/' Capacity=416.21 cfs Outflow=0.04 cfs 1,329 cf

Pond 1P: Detention Basin Peak Elev=46.14' Storage=782 cf Inflow=0.14 cfs 782 cf
18.0" Round Culvert n=0.013 L=50.0' S=0.0100 '/' Outflow=0.00 cfs 0 cf

Pond 2P: Sediment Forebay #1 Peak Elev=46.00' Storage=0 cf Inflow=0.00 cfs 0 cf
Outflow=0.00 cfs 0 cf

Pond 3P: Detention Basin Peak Elev=0.00' Storage=0 cf
18.0" Round Culvert n=0.013 L=50.0' S=0.0100 '/' Primary=0.00 cfs 0 cf

Pond 4P: WL Peak Elev=51.06' Storage=579 cf Inflow=0.11 cfs 579 cf
18.0" Round Culvert n=0.013 L=44.0' S=0.0205 '/' Outflow=0.00 cfs 0 cf

Pond 5P: Sediment Forebay #2 Peak Elev=51.65' Storage=434 cf Inflow=0.10 cfs 434 cf
Outflow=0.00 cfs 0 cf

Pond 19P: SGW Peak Elev=45.70' Storage=0 cf Inflow=0.03 cfs 155 cf
Primary=0.03 cfs 155 cf Secondary=0.00 cfs 0 cf Outflow=0.03 cfs 155 cf

Link POA1: POA 1 Inflow=0.15 cfs 5,272 cf
Primary=0.15 cfs 5,272 cf

Link POA2: POA 2 Inflow=0.00 cfs 3 cf
Primary=0.00 cfs 3 cf

Total Runoff Area = 2,049,957 sf Runoff Volume = 7,068 cf Average Runoff Depth = 0.04"
89.30% Pervious = 1,830,516 sf 10.70% Impervious = 219,442 sf

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Subcat 1S Runoff Area=10.720 ac 18.93% Impervious Runoff Depth=1.58"
Flow Length=1,506' Tc=18.5 min CN=78 Runoff=12.29 cfs 61,540 cf

Subcatchment 2S: Subcat 2S Runoff Area=18.899 ac 5.85% Impervious Runoff Depth=1.25"
Flow Length=1,517' Tc=25.2 min CN=73 Runoff=14.27 cfs 86,040 cf

Subcatchment 3S: Subcat 3S Runoff Area=1.859 ac 0.53% Impervious Runoff Depth=1.32"
Flow Length=450' Tc=13.6 min CN=74 Runoff=2.00 cfs 8,883 cf

Subcatchment 4S: Subcat 4S Runoff Area=2.905 ac 2.35% Impervious Runoff Depth=1.08"
Flow Length=350' Tc=6.9 min CN=70 Runoff=3.23 cfs 11,353 cf

Subcatchment 5S: Subcat 5S Runoff Area=4.547 ac 5.37% Impervious Runoff Depth=1.13"
Flow Length=600' Tc=16.2 min CN=71 Runoff=3.80 cfs 18,723 cf

Subcatchment 6S: Subcat 6S Runoff Area=0.162 ac 12.98% Impervious Runoff Depth=1.08"
Tc=6.0 min CN=70 Runoff=0.19 cfs 634 cf

Subcatchment 7aS: Subcat 7S Runoff Area=45,742 sf 26.80% Impervious Runoff Depth=2.03"
Tc=10.0 min CN=84 Runoff=2.03 cfs 7,742 cf

Subcatchment 7bS: Subcat 7S Runoff Area=20,568 sf 41.79% Impervious Runoff Depth=2.37"
Tc=10.0 min CN=88 Runoff=1.05 cfs 4,061 cf

Subcatchment 8S: Subcat 8S Runoff Area=193,279 sf 8.93% Impervious Runoff Depth=1.58"
Tc=10.0 min CN=78 Runoff=6.64 cfs 25,472 cf

Subcatchment 9S: Subcat 9S Runoff Area=61,773 sf 33.66% Impervious Runoff Depth=2.03"
Tc=10.0 min CN=84 Runoff=2.74 cfs 10,455 cf

Subcatchment 10S: Subcat 10S Runoff Area=16,281 sf 10.26% Impervious Runoff Depth=1.87"
Tc=6.0 min CN=82 Runoff=0.78 cfs 2,542 cf

Subcatchment 11S: Subcat 11S Runoff Area=0.217 ac 77.49% Impervious Runoff Depth=2.94"
Tc=6.0 min CN=94 Runoff=0.66 cfs 2,323 cf

Reach 1R: UNB1 (lower) Avg. Flow Depth=0.51' Max Vel=5.57 fps Inflow=32.74 cfs 216,873 cf
n=0.013 L=596.0' S=0.0070 '/' Capacity=858.75 cfs Outflow=32.61 cfs 216,873 cf

Reach 2R: UNB1 (middle) Avg. Flow Depth=0.50' Max Vel=5.47 fps Inflow=31.64 cfs 205,520 cf
n=0.013 L=594.0' S=0.0069 '/' Capacity=849.89 cfs Outflow=31.51 cfs 205,520 cf

Reach 3R: UNB1 (upper) Avg. Flow Depth=0.45' Max Vel=5.81 fps Inflow=29.77 cfs 194,313 cf
n=0.013 L=430.0' S=0.0088 '/' Capacity=961.66 cfs Outflow=29.71 cfs 194,313 cf

Reach 4R: UNB2 Avg. Flow Depth=0.58' Max Vel=7.19 fps Inflow=14.99 cfs 107,302 cf
n=0.025 L=228.0' S=0.0539 '/' Capacity=209.49 cfs Outflow=14.97 cfs 107,302 cf

Reach 5R: Treatment Swale Avg. Flow Depth=0.20' Max Vel=0.32 fps Inflow=0.66 cfs 2,323 cf
n=0.150 L=107.0' S=0.0100 '/' Capacity=9.14 cfs Outflow=0.57 cfs 2,323 cf

Reach C1: Culvert 1 Avg. Flow Depth=0.23' Max Vel=10.46 fps Inflow=12.29 cfs 61,540 cf
60.0" x 24.0" Box Pipe n=0.013 L=20.0' S=0.0650 '/' Capacity=232.87 cfs Outflow=12.29 cfs 61,540 cf

Reach C2: Crossing 2 Avg. Flow Depth=0.44' Max Vel=3.82 fps Inflow=14.98 cfs 107,302 cf
108.0" x 144.0" Ellipse Pipe w/ 72.0" inside fill n=0.030 L=20.0' S=0.0200 '/' Capacity=416.21 cfs Outflow=14.99 cfs 107,302 cf

Pond 1P: Detention Basin Peak Elev=47.58' Storage=2,434 cf Inflow=2.74 cfs 10,455 cf
18.0" Round Culvert n=0.013 L=50.0' S=0.0100 '/' Outflow=2.13 cfs 8,841 cf

Pond 2P: Sediment Forebay #1 Peak Elev=47.57' Storage=1,152 cf Inflow=3.72 cfs 15,743 cf
Outflow=3.68 cfs 15,129 cf

Pond 3P: Detention Basin Peak Elev=0.00' Storage=0 cf
18.0" Round Culvert n=0.013 L=50.0' S=0.0100 '/' Primary=0.00 cfs 0 cf

Pond 4P: WL Peak Elev=51.87' Storage=1,700 cf Inflow=2.03 cfs 7,742 cf
18.0" Round Culvert n=0.013 L=44.0' S=0.0205 '/' Outflow=1.59 cfs 6,902 cf

Pond 5P: Sediment Forebay #2 Peak Elev=52.12' Storage=832 cf Inflow=1.05 cfs 4,061 cf
Outflow=0.91 cfs 3,590 cf

Pond 19P: SGW Peak Elev=47.57' Storage=5,318 cf Inflow=4.91 cfs 21,261 cf
Primary=0.76 cfs 20,464 cf Secondary=0.35 cfs 798 cf Outflow=1.11 cfs 21,262 cf

Link POA1: POA 1 Inflow=35.99 cfs 235,595 cf
Primary=35.99 cfs 235,595 cf

Link POA2: POA 2 Inflow=0.19 cfs 634 cf
Primary=0.19 cfs 634 cf

Total Runoff Area = 2,049,957 sf Runoff Volume = 239,767 cf Average Runoff Depth = 1.40"
89.30% Pervious = 1,830,516 sf 10.70% Impervious = 219,442 sf

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Subcat 1S Runoff Area=10.720 ac 18.93% Impervious Runoff Depth=3.11"
Flow Length=1,506' Tc=18.5 min CN=78 Runoff=24.39 cfs 120,878 cf

Subcatchment 2S: Subcat 2S Runoff Area=18.899 ac 5.85% Impervious Runoff Depth=2.65"
Flow Length=1,517' Tc=25.2 min CN=73 Runoff=31.41 cfs 181,562 cf

Subcatchment 3S: Subcat 3S Runoff Area=1.859 ac 0.53% Impervious Runoff Depth=2.74"
Flow Length=450' Tc=13.6 min CN=74 Runoff=4.27 cfs 18,465 cf

Subcatchment 4S: Subcat 4S Runoff Area=2.905 ac 2.35% Impervious Runoff Depth=2.38"
Flow Length=350' Tc=6.9 min CN=70 Runoff=7.45 cfs 25,133 cf

Subcatchment 5S: Subcat 5S Runoff Area=4.547 ac 5.37% Impervious Runoff Depth=2.47"
Flow Length=600' Tc=16.2 min CN=71 Runoff=8.69 cfs 40,771 cf

Subcatchment 6S: Subcat 6S Runoff Area=0.162 ac 12.98% Impervious Runoff Depth=2.38"
Tc=6.0 min CN=70 Runoff=0.43 cfs 1,403 cf

Subcatchment 7aS: Subcat 7S Runoff Area=45,742 sf 26.80% Impervious Runoff Depth=3.69"
Tc=10.0 min CN=84 Runoff=3.63 cfs 14,080 cf

Subcatchment 7bS: Subcat 7S Runoff Area=20,568 sf 41.79% Impervious Runoff Depth=4.11"
Tc=10.0 min CN=88 Runoff=1.78 cfs 7,040 cf

Subcatchment 8S: Subcat 8S Runoff Area=193,279 sf 8.93% Impervious Runoff Depth=3.11"
Tc=10.0 min CN=78 Runoff=13.10 cfs 50,033 cf

Subcatchment 9S: Subcat 9S Runoff Area=61,773 sf 33.66% Impervious Runoff Depth=3.69"
Tc=10.0 min CN=84 Runoff=4.90 cfs 19,015 cf

Subcatchment 10S: Subcat 10S Runoff Area=16,281 sf 10.26% Impervious Runoff Depth=3.49"
Tc=6.0 min CN=82 Runoff=1.44 cfs 4,740 cf

Subcatchment 11S: Subcat 11S Runoff Area=0.217 ac 77.49% Impervious Runoff Depth=4.76"
Tc=6.0 min CN=94 Runoff=1.04 cfs 3,759 cf

Reach 1R: UNB1 (lower) Avg. Flow Depth=0.81' Max Vel=7.34 fps Inflow=74.61 cfs 441,170 cf
n=0.013 L=596.0' S=0.0070 '/' Capacity=858.75 cfs Outflow=74.41 cfs 441,170 cf

Reach 2R: UNB1 (middle) Avg. Flow Depth=0.80' Max Vel=7.21 fps Inflow=72.09 cfs 416,037 cf
n=0.013 L=594.0' S=0.0069 '/' Capacity=849.89 cfs Outflow=71.87 cfs 416,037 cf

Reach 3R: UNB1 (upper) Avg. Flow Depth=0.73' Max Vel=7.70 fps Inflow=68.28 cfs 393,812 cf
n=0.013 L=430.0' S=0.0088 '/' Capacity=961.66 cfs Outflow=68.18 cfs 393,812 cf

Reach 4R: UNB2 Avg. Flow Depth=0.90' Max Vel=9.53 fps Inflow=38.43 cfs 222,902 cf
n=0.025 L=228.0' S=0.0539 '/' Capacity=209.49 cfs Outflow=38.40 cfs 222,902 cf

Reach 5R: Treatment Swale Avg. Flow Depth=0.27' Max Vel=0.39 fps Inflow=1.04 cfs 3,759 cf
n=0.150 L=107.0' S=0.0100 '/' Capacity=9.14 cfs Outflow=0.92 cfs 3,759 cf

Reach C1: Culvert 1 Avg. Flow Depth=0.36' Max Vel=13.51 fps Inflow=24.39 cfs 120,878 cf
60.0" x 24.0" Box Pipe n=0.013 L=20.0' S=0.0650 '/' Capacity=232.87 cfs Outflow=24.39 cfs 120,878 cf

Reach C2: Crossing 2 Avg. Flow Depth=0.80' Max Vel=5.38 fps Inflow=38.43 cfs 222,902 cf
108.0" x 144.0" Ellipse Pipe w/ 72.0" inside fill n=0.030 L=20.0' S=0.0200 '/' Capacity=416.21 cfs Outflow=38.43 cfs 222,902 cf

Pond 1P: Detention Basin Peak Elev=48.13' Storage=3,451 cf Inflow=4.90 cfs 19,015 cf
18.0" Round Culvert n=0.013 L=50.0' S=0.0100 '/' Outflow=3.25 cfs 17,401 cf

Pond 2P: Sediment Forebay #1 Peak Elev=48.00' Storage=1,662 cf Inflow=6.20 cfs 30,641 cf
Outflow=5.80 cfs 30,027 cf

Pond 3P: Detention Basin Peak Elev=0.00' Storage=0 cf
18.0" Round Culvert n=0.013 L=50.0' S=0.0100 '/' Primary=0.00 cfs 0 cf

Pond 4P: WL Peak Elev=52.11' Storage=2,172 cf Inflow=3.63 cfs 14,080 cf
18.0" Round Culvert n=0.013 L=44.0' S=0.0205 '/' Outflow=2.95 cfs 13,241 cf

Pond 5P: Sediment Forebay #2 Peak Elev=52.27' Storage=973 cf Inflow=1.78 cfs 7,040 cf
Outflow=1.60 cfs 6,570 cf

Pond 19P: SGW Peak Elev=47.96' Storage=6,915 cf Inflow=7.92 cfs 41,336 cf
Primary=0.82 cfs 28,492 cf Secondary=6.39 cfs 12,848 cf Outflow=7.21 cfs 41,340 cf

Link POA1: POA 1 Inflow=82.21 cfs 481,941 cf
Primary=82.21 cfs 481,941 cf

Link POA2: POA 2 Inflow=0.43 cfs 1,403 cf
Primary=0.43 cfs 1,403 cf

Total Runoff Area = 2,049,957 sf Runoff Volume = 486,879 cf Average Runoff Depth = 2.85"
89.30% Pervious = 1,830,516 sf 10.70% Impervious = 219,442 sf

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Subcat 1S Runoff Area=10.720 ac 18.93% Impervious Runoff Depth=4.40"
Flow Length=1,506' Tc=18.5 min CN=78 Runoff=34.39 cfs 171,308 cf

Subcatchment 2S: Subcat 2S Runoff Area=18.899 ac 5.85% Impervious Runoff Depth=3.87"
Flow Length=1,517' Tc=25.2 min CN=73 Runoff=46.11 cfs 265,248 cf

Subcatchment 3S: Subcat 3S Runoff Area=1.859 ac 0.53% Impervious Runoff Depth=3.97"
Flow Length=450' Tc=13.6 min CN=74 Runoff=6.20 cfs 26,807 cf

Subcatchment 4S: Subcat 4S Runoff Area=2.905 ac 2.35% Impervious Runoff Depth=3.55"
Flow Length=350' Tc=6.9 min CN=70 Runoff=11.13 cfs 37,454 cf

Subcatchment 5S: Subcat 5S Runoff Area=4.547 ac 5.37% Impervious Runoff Depth=3.66"
Flow Length=600' Tc=16.2 min CN=71 Runoff=12.95 cfs 60,348 cf

Subcatchment 6S: Subcat 6S Runoff Area=0.162 ac 12.98% Impervious Runoff Depth=3.55"
Tc=6.0 min CN=70 Runoff=0.64 cfs 2,090 cf

Subcatchment 7aS: Subcat 7S Runoff Area=45,742 sf 26.80% Impervious Runoff Depth=5.06"
Tc=10.0 min CN=84 Runoff=4.90 cfs 19,303 cf

Subcatchment 7bS: Subcat 7S Runoff Area=20,568 sf 41.79% Impervious Runoff Depth=5.52"
Tc=10.0 min CN=88 Runoff=2.35 cfs 9,454 cf

Subcatchment 8S: Subcat 8S Runoff Area=193,279 sf 8.93% Impervious Runoff Depth=4.40"
Tc=10.0 min CN=78 Runoff=18.41 cfs 70,906 cf

Subcatchment 9S: Subcat 9S Runoff Area=61,773 sf 33.66% Impervious Runoff Depth=5.06"
Tc=10.0 min CN=84 Runoff=6.62 cfs 26,068 cf

Subcatchment 10S: Subcat 10S Runoff Area=16,281 sf 10.26% Impervious Runoff Depth=4.84"
Tc=6.0 min CN=82 Runoff=1.96 cfs 6,568 cf

Subcatchment 11S: Subcat 11S Runoff Area=0.217 ac 77.49% Impervious Runoff Depth=6.21"
Tc=6.0 min CN=94 Runoff=1.34 cfs 4,901 cf

Reach 1R: UNB1 (lower) Avg. Flow Depth=1.01' Max Vel=8.28 fps Inflow=108.83 cfs 634,482 cf
n=0.013 L=596.0' S=0.0070 '/' Capacity=858.75 cfs Outflow=108.60 cfs 634,482 cf

Reach 2R: UNB1 (middle) Avg. Flow Depth=0.99' Max Vel=8.12 fps Inflow=104.81 cfs 597,028 cf
n=0.013 L=594.0' S=0.0069 '/' Capacity=849.89 cfs Outflow=104.57 cfs 597,028 cf

Reach 3R: UNB1 (upper) Avg. Flow Depth=0.90' Max Vel=8.69 fps Inflow=99.10 cfs 565,320 cf
n=0.013 L=430.0' S=0.0088 '/' Capacity=961.66 cfs Outflow=99.02 cfs 565,320 cf

Reach 4R: UNB2 Avg. Flow Depth=1.08' Max Vel=10.69 fps Inflow=56.44 cfs 323,105 cf
n=0.025 L=228.0' S=0.0539 '/' Capacity=209.49 cfs Outflow=56.41 cfs 323,105 cf

Reach 5R: Treatment Swale Avg. Flow Depth=0.31' Max Vel=0.43 fps Inflow=1.34 cfs 4,901 cf
n=0.150 L=107.0' S=0.0100 '/' Capacity=9.14 cfs Outflow=1.19 cfs 4,901 cf

Reach C1: Culvert 1 Avg. Flow Depth=0.45' Max Vel=15.31 fps Inflow=34.39 cfs 171,308 cf
60.0" x 24.0" Box Pipe n=0.013 L=20.0' S=0.0650 '/' Capacity=232.87 cfs Outflow=34.38 cfs 171,308 cf

Reach C2: Crossing 2 Avg. Flow Depth=1.02' Max Vel=6.17 fps Inflow=56.44 cfs 323,105 cf
108.0" x 144.0" Ellipse Pipe w/ 72.0" inside fill n=0.030 L=20.0' S=0.0200 '/' Capacity=416.21 cfs Outflow=56.44 cfs 323,105 cf

Pond 1P: Detention Basin Peak Elev=48.50' Storage=4,251 cf Inflow=6.62 cfs 26,068 cf
18.0" Round Culvert n=0.013 L=50.0' S=0.0100 '/' Outflow=4.80 cfs 24,454 cf

Pond 2P: Sediment Forebay #1 Peak Elev=48.19' Storage=1,914 cf Inflow=8.82 cfs 42,917 cf
Outflow=8.63 cfs 42,303 cf

Pond 3P: Detention Basin Peak Elev=0.00' Storage=0 cf
18.0" Round Culvert n=0.013 L=50.0' S=0.0100 '/' Primary=0.00 cfs 0 cf

Pond 4P: WL Peak Elev=52.27' Storage=2,532 cf Inflow=4.90 cfs 19,303 cf
18.0" Round Culvert n=0.013 L=44.0' S=0.0205 '/' Outflow=4.02 cfs 18,463 cf

Pond 5P: Sediment Forebay #2 Peak Elev=52.37' Storage=1,072 cf Inflow=2.35 cfs 9,454 cf
Outflow=2.14 cfs 8,984 cf

Pond 19P: SGW Peak Elev=48.11' Storage=7,592 cf Inflow=11.54 cfs 57,855 cf
Primary=0.85 cfs 34,321 cf Secondary=10.21 cfs 23,536 cf Outflow=11.06 cfs 57,857 cf

Link POA1: POA 1 Inflow=120.64 cfs 694,830 cf
Primary=120.64 cfs 694,830 cf

Link POA2: POA 2 Inflow=0.64 cfs 2,090 cf
Primary=0.64 cfs 2,090 cf

Total Runoff Area = 2,049,957 sf Runoff Volume = 700,456 cf Average Runoff Depth = 4.10"
89.30% Pervious = 1,830,516 sf 10.70% Impervious = 219,442 sf

Summary for Subcatchment 1S: Subcat 1S

Runoff = 24.39 cfs @ 12.27 hrs, Volume= 120,878 cf, Depth= 3.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-YR+15% (NRCC D) Rainfall=5.46"

Area (ac)	CN	Description
3.343	74	>75% Grass cover, Good, HSG C
1.116	80	>75% Grass cover, Good, HSG D
1.088	98	Paved parking, HSG C
0.515	98	Paved parking, HSG D
0.349	98	Roofs, HSG C
0.078	98	Roofs, HSG D
3.574	70	Woods, Good, HSG C
0.658	77	Woods, Good, HSG D
10.720	78	Weighted Average
8.691		81.07% Pervious Area
2.029		18.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	20	0.0700	0.20		**Sheet Flow, A-->B** Grass: Short n= 0.150 P2= 3.14"
16.1	1,000	0.0220	1.04		**Shallow Concentrated Flow, B-->C** Short Grass Pasture Kv= 7.0 fps
0.7	486	0.0494	11.09	44.37	**Parabolic Channel, C-->D** W=4.00' D=1.50' Area=4.0 sf Perim=5.2' n= 0.025
18.5	1,506	Total			

Summary for Subcatchment 2S: Subcat 2S

Runoff = 31.41 cfs @ 12.35 hrs, Volume= 181,562 cf, Depth= 2.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-YR+15% (NRCC D) Rainfall=5.46"

Area (ac)	CN	Description
1.000	61	>75% Grass cover, Good, HSG B
2.094	74	>75% Grass cover, Good, HSG C
1.285	80	>75% Grass cover, Good, HSG D
0.321	98	Paved parking, HSG B
0.175	98	Paved parking, HSG C
0.046	98	Paved parking, HSG D
0.198	98	Roofs, HSG B
0.280	98	Roofs, HSG C
0.086	98	Roofs, HSG D
2.187	55	Woods, Good, HSG B
4.889	70	Woods, Good, HSG C
6.338	77	Woods, Good, HSG D
18.899	73	Weighted Average
17.793		94.15% Pervious Area
1.106		5.85% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	100	0.0450	0.23		**Sheet Flow, A-->B** Grass: Short n= 0.150 P2= 3.14"
16.2	800	0.0270	0.82		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
1.8	617	0.0270	5.71	16.38	**Trap/Vee/Rect Channel Flow, C-->D** Bot.W=2.00' D=0.70' Z= 3.0 '/' Top.W=6.20' n= 0.025
25.2	1,517	Total			

Summary for Subcatchment 3S: Subcat 3S

Runoff = 4.27 cfs @ 12.22 hrs, Volume= 18,465 cf, Depth= 2.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-YR+15% (NRCC D) Rainfall=5.46"

Area (ac)	CN	Description
0.248	80	>75% Grass cover, Good, HSG D
0.010	98	Paved parking, HSG D
0.092	30	Woods, Good, HSG A
0.278	70	Woods, Good, HSG C
1.231	77	Woods, Good, HSG D
1.859	74	Weighted Average
1.849		99.47% Pervious Area
0.010		0.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.6	100	0.1200	0.16		**Sheet Flow, A-->B**
					Woods: Light underbrush n= 0.400 P2= 3.14"
3.0	350	0.1500	1.94		**Shallow Concentrated Flow, B-->C**
					Woodland Kv= 5.0 fps
13.6	450	Total			

Summary for Subcatchment 4S: Subcat 4S

Runoff = 7.45 cfs @ 12.14 hrs, Volume= 25,133 cf, Depth= 2.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-YR+15% (NRCC D) Rainfall=5.46"

Area (ac)	CN	Description
0.057	61	>75% Grass cover, Good, HSG B
0.195	74	>75% Grass cover, Good, HSG C
0.058	80	>75% Grass cover, Good, HSG D
0.001	98	Paved parking, HSG B
0.000	98	Paved parking, HSG D
0.067	98	Roofs, HSG C
0.154	30	Woods, Good, HSG A
0.086	55	Woods, Good, HSG B
1.580	70	Woods, Good, HSG C
0.707	77	Woods, Good, HSG D
2.905	70	Weighted Average
2.837		97.65% Pervious Area
0.068		2.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	100	0.1100	0.33		**Sheet Flow, A-->B**
					Grass: Short n= 0.150 P2= 3.14"
1.9	250	0.2000	2.24		**Shallow Concentrated Flow, B-->C**
					Woodland Kv= 5.0 fps
6.9	350	Total			

Summary for Subcatchment 5S: Subcat 5S

Runoff = 8.69 cfs @ 12.25 hrs, Volume= 40,771 cf, Depth= 2.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-YR+15% (NRCC D) Rainfall=5.46"

Area (ac)	CN	Description
0.085	61	>75% Grass cover, Good, HSG B
0.858	74	>75% Grass cover, Good, HSG C
0.036	80	>75% Grass cover, Good, HSG D
0.007	98	Paved parking, HSG B
0.195	98	Paved parking, HSG C
0.026	98	Roofs, HSG B
0.016	98	Roofs, HSG C
0.082	30	Woods, Good, HSG A
0.254	55	Woods, Good, HSG B
2.845	70	Woods, Good, HSG C
0.143	77	Woods, Good, HSG D
4.547	71	Weighted Average
4.303		94.63% Pervious Area
0.244		5.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.4	100	0.1000	0.15		**Sheet Flow, A-->B** Woods: Light underbrush n= 0.400 P2= 3.14"
4.8	500	0.1200	1.73		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
16.2	600	Total			

Summary for Subcatchment 6S: Subcat 6S

Runoff = 0.43 cfs @ 12.13 hrs, Volume= 1,403 cf, Depth= 2.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-YR+15% (NRCC D) Rainfall=5.46"

Area (ac)	CN	Description
0.053	61	>75% Grass cover, Good, HSG B
0.021	80	>75% Grass cover, Good, HSG D
0.008	98	Paved parking, HSG B
0.013	98	Roofs, HSG B
0.038	55	Woods, Good, HSG B
0.029	77	Woods, Good, HSG D
0.162	70	Weighted Average
0.141		87.02% Pervious Area
0.021		12.98% Impervious Area

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

Summary for Subcatchment 7aS: Subcat 7S

Runoff = 3.63 cfs @ 12.17 hrs, Volume= 14,080 cf, Depth= 3.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-YR+15% (NRCC D) Rainfall=5.46"

Area (sf)	CN	Description
1,591	61	>75% Grass cover, Good, HSG B
30,722	80	>75% Grass cover, Good, HSG D
1,215	98	Paved parking, HSG B
4,753	98	Paved parking, HSG D
1,132	98	Roofs, HSG B
5,158	98	Roofs, HSG D
67	70	Woods, Good, HSG C
1,104	77	Woods, Good, HSG D
45,742	84	Weighted Average
33,484		73.20% Pervious Area
12,258		26.80% Impervious Area

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

Summary for Subcatchment 7bS: Subcat 7S

Runoff = 1.78 cfs @ 12.17 hrs, Volume= 7,040 cf, Depth= 4.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-YR+15% (NRCC D) Rainfall=5.46"

Area (sf)	CN	Description
11,973	80	>75% Grass cover, Good, HSG D
4,173	98	Paved parking, HSG D
4,422	98	Roofs, HSG D
20,568	88	Weighted Average
11,973		58.21% Pervious Area
8,595		41.79% Impervious Area

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

Summary for Subcatchment 8S: Subcat 8S

Runoff = 13.10 cfs @ 12.17 hrs, Volume= 50,033 cf, Depth= 3.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-YR+15% (NRCC D) Rainfall=5.46"

Area (sf)	CN	Description
17,711	74	>75% Grass cover, Good, HSG C
37,323	80	>75% Grass cover, Good, HSG D
3,275	98	Paved parking, HSG C
7,792	98	Paved parking, HSG D
3,097	98	Roofs, HSG C
3,102	98	Roofs, HSG D
41,730	70	Woods, Good, HSG C
79,249	77	Woods, Good, HSG D
193,279	78	Weighted Average
176,013		91.07% Pervious Area
17,266		8.93% Impervious Area

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

Summary for Subcatchment 9S: Subcat 9S

Runoff = 4.90 cfs @ 12.17 hrs, Volume= 19,015 cf, Depth= 3.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-YR+15% (NRCC D) Rainfall=5.46"

Area (sf)	CN	Description
7,504	61	>75% Grass cover, Good, HSG B
33,476	80	>75% Grass cover, Good, HSG D
3,804	98	Paved parking, HSG B
8,940	98	Paved parking, HSG D
1,773	98	Roofs, HSG B
6,276	98	Roofs, HSG D
61,773	84	Weighted Average
40,980		66.34% Pervious Area
20,793		33.66% Impervious Area

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

Summary for Subcatchment 10S: Subcat 10S

Runoff = 1.44 cfs @ 12.13 hrs, Volume= 4,740 cf, Depth= 3.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-YR+15% (NRCC D) Rainfall=5.46"

Area (sf)	CN	Description
14,610	80	>75% Grass cover, Good, HSG D
1,670	98	Paved parking, HSG D
16,281	82	Weighted Average
14,610		89.74% Pervious Area
1,670		10.26% Impervious Area

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

Summary for Subcatchment 11S: Subcat 11S

Runoff = 1.04 cfs @ 12.13 hrs, Volume= 3,759 cf, Depth= 4.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-YR+15% (NRCC D) Rainfall=5.46"

Area (ac)	CN	Description
0.049	80	>75% Grass cover, Good, HSG D
0.169	98	Paved parking, HSG D
0.217	94	Weighted Average
0.049		22.51% Pervious Area
0.169		77.49% Impervious Area

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

Summary for Reach 1R: UNB1 (lower)

Inflow Area = 1,844,828 sf, 11.27% Impervious, Inflow Depth = 2.87" for 10-YR+15% (NRCC D) event
Inflow = 74.61 cfs @ 12.31 hrs, Volume= 441,170 cf
Outflow = 74.41 cfs @ 12.32 hrs, Volume= 441,170 cf, Atten= 0%, Lag= 1.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 7.34 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 1.71 fps, Avg. Travel Time= 5.8 min

Peak Storage= 6,041 cf @ 12.32 hrs
Average Depth at Peak Storage= 0.81'
Bank-Full Depth= 3.00' Flow Area= 57.0 sf, Capacity= 858.75 cfs

10.00' x 3.00' deep channel, n= 0.013 Corrugated PE, smooth interior
Side Slope Z-value= 3.0 '/' Top Width= 28.00'
Length= 596.0' Slope= 0.0070 '/'
Inlet Invert= 14.10', Outlet Invert= 9.90'

‡

Summary for Reach 2R: UNB1 (middle)

Inflow Area = 1,718,293 sf, 11.93% Impervious, Inflow Depth = 2.91" for 10-YR+15% (NRCC D) event
Inflow = 72.09 cfs @ 12.30 hrs, Volume= 416,037 cf
Outflow = 71.87 cfs @ 12.31 hrs, Volume= 416,037 cf, Atten= 0%, Lag= 1.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 7.21 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 1.67 fps, Avg. Travel Time= 5.9 min

Peak Storage= 5,923 cf @ 12.31 hrs
Average Depth at Peak Storage= 0.80'
Bank-Full Depth= 3.00' Flow Area= 57.0 sf, Capacity= 849.89 cfs

10.00' x 3.00' deep channel, n= 0.013 Corrugated PE, smooth interior
Side Slope Z-value= 3.0 '/' Top Width= 28.00'
Length= 594.0' Slope= 0.0069 '/'
Inlet Invert= 18.20', Outlet Invert= 14.10'

‡

Summary for Reach 3R: UNB1 (upper)

Inflow Area = 1,627,842 sf, 12.11% Impervious, Inflow Depth = 2.90" for 10-YR+15% (NRCC D) event
Inflow = 68.28 cfs @ 12.30 hrs, Volume= 393,812 cf
Outflow = 68.18 cfs @ 12.31 hrs, Volume= 393,812 cf, Atten= 0%, Lag= 0.6 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 7.70 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 1.90 fps, Avg. Travel Time= 3.8 min

Peak Storage= 3,807 cf @ 12.31 hrs
Average Depth at Peak Storage= 0.73'
Bank-Full Depth= 3.00' Flow Area= 57.0 sf, Capacity= 961.66 cfs

10.00' x 3.00' deep channel, n= 0.013 Corrugated PE, smooth interior
Side Slope Z-value= 3.0 '/' Top Width= 28.00'
Length= 430.0' Slope= 0.0088 '/'
Inlet Invert= 22.00', Outlet Invert= 18.20'

‡

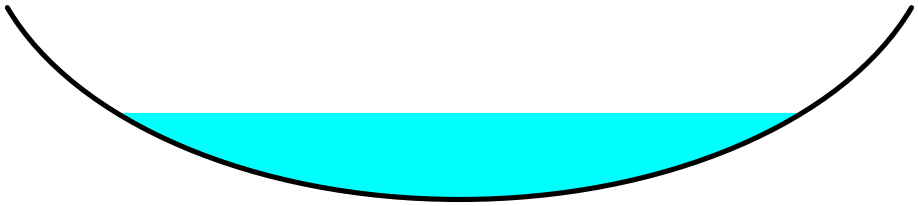
Summary for Reach 4R: UNB2

Inflow Area = 967,604 sf, 9.46% Impervious, Inflow Depth = 2.76" for 10-YR+15% (NRCC D) event
Inflow = 38.43 cfs @ 12.35 hrs, Volume= 222,902 cf
Outflow = 38.40 cfs @ 12.35 hrs, Volume= 222,902 cf, Atten= 0%, Lag= 0.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 9.53 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 2.23 fps, Avg. Travel Time= 1.7 min

Peak Storage= 918 cf @ 12.35 hrs
Average Depth at Peak Storage= 0.90'
Bank-Full Depth= 2.00' Flow Area= 13.3 sf, Capacity= 209.49 cfs

10.00' x 2.00' deep Parabolic Channel, n= 0.025 Earth, clean & winding
Length= 228.0' Slope= 0.0539 '/'
Inlet Invert= 34.30', Outlet Invert= 22.00'



Summary for Reach 5R: Treatment Swale

Inflow Area = 9,473 sf, 77.49% Impervious, Inflow Depth = 4.76" for 10-YR+15% (NRCC D) event
Inflow = 1.04 cfs @ 12.13 hrs, Volume= 3,759 cf
Outflow = 0.92 cfs @ 12.16 hrs, Volume= 3,759 cf, Atten= 12%, Lag= 2.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 0.39 fps, Min. Travel Time= 4.6 min
Avg. Velocity = 0.10 fps, Avg. Travel Time= 18.4 min

Peak Storage= 253 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.27'
Bank-Full Depth= 1.00' Flow Area= 11.0 sf, Capacity= 9.14 cfs

8.00' x 1.00' deep channel, n= 0.150
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 107.0' Slope= 0.0100 '/'
Inlet Invert= 44.40', Outlet Invert= 43.33'

‡

Summary for Reach C1: Culvert 1

Inflow Area = 466,959 sf, 18.93% Impervious, Inflow Depth = 3.11" for 10-YR+15% (NRCC D) event
Inflow = 24.39 cfs @ 12.27 hrs, Volume= 120,878 cf
Outflow = 24.39 cfs @ 12.27 hrs, Volume= 120,878 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 13.51 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 4.29 fps, Avg. Travel Time= 0.1 min

Peak Storage= 36 cf @ 12.27 hrs
Average Depth at Peak Storage= 0.36'
Bank-Full Depth= 2.00' Flow Area= 10.0 sf, Capacity= 232.87 cfs

60.0" W x 24.0" H Box Pipe
n= 0.013
Length= 20.0' Slope= 0.0650 '/'
Inlet Invert= 41.00', Outlet Invert= 39.70'

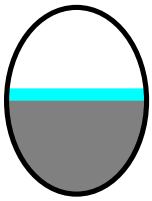
Summary for Reach C2: Crossing 2

Inflow Area = 967,604 sf, 9.46% Impervious, Inflow Depth = 2.76" for 10-YR+15% (NRCC D) event
Inflow = 38.43 cfs @ 12.35 hrs, Volume= 222,902 cf
Outflow = 38.43 cfs @ 12.35 hrs, Volume= 222,902 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 5.38 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.89 fps, Avg. Travel Time= 0.2 min

Peak Storage= 143 cf @ 12.35 hrs
Average Depth at Peak Storage= 6.80' above invert (0.80' above fill)
Bank-Full Depth= 12.00' above invert (6.00' above fill) Flow Area= 42.4 sf, Capacity= 416.21 cfs

108.0" W x 144.0" H Ellipse Pipe w/ 72.0" inside fill
n= 0.030 Earth, grassed & winding
Length= 20.0' Slope= 0.0200 '/'
Inlet Invert= 0.00', Outlet Invert= -0.40'



Summary for Pond 1P: Detention Basin

Inflow Area = 61,773 sf, 33.66% Impervious, Inflow Depth = 3.69" for 10-YR+15% (NRCC D) event
Inflow = 4.90 cfs @ 12.17 hrs, Volume= 19,015 cf
Outflow = 3.25 cfs @ 12.23 hrs, Volume= 17,401 cf, Atten= 34%, Lag= 3.6 min
Primary = 3.25 cfs @ 12.23 hrs, Volume= 17,401 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 48.13' @ 12.28 hrs Surf.Area= 2,039 sf Storage= 3,451 cf

Plug-Flow detention time= 90.6 min calculated for 17,397 cf (91% of inflow)
Center-of-Mass det. time= 44.4 min (872.6 - 828.2)

Volume	Invert	Avail.Storage	Storage Description
#1	44.00'	5,489 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
44.00	100	37.5	0	0	100
46.00	666	100.0	683	683	798
48.00	1,950	232.0	2,504	3,186	4,301
49.00	2,675	251.0	2,303	5,489	5,070

Device	Routing	Invert	Outlet Devices
#1	Primary	46.50'	**18.0" Round Culvert** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 46.50' / 46.00' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf

Primary OutFlow Max=3.19 cfs @ 12.23 hrs HW=48.10' TW=47.95' (Dynamic Tailwater)
↑**1=Culvert** (Outlet Controls 3.19 cfs @ 2.10 fps)

Summary for Pond 2P: Sediment Forebay #1

Inflow Area = 107,515 sf, 30.74% Impervious, Inflow Depth = 3.42" for 10-YR+15% (NRCC D) event
Inflow = 6.20 cfs @ 12.23 hrs, Volume= 30,641 cf
Outflow = 5.80 cfs @ 12.27 hrs, Volume= 30,027 cf, Atten= 7%, Lag= 1.9 min
Primary = 5.80 cfs @ 12.27 hrs, Volume= 30,027 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2

Peak Elev= 48.00' @ 12.30 hrs Surf.Area= 1,300 sf Storage= 1,662 cf

Plug-Flow detention time= 23.5 min calculated for 30,027 cf (98% of inflow)
Center-of-Mass det. time= 11.3 min (881.2 - 870.0)

Volume	Invert	Avail.Storage	Storage Description
#1	46.00'	3,156 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
46.00	437	86.0	0	0	437
48.00	1,300	159.0	1,660	1,660	1,881
49.00	1,699	174.0	1,495	3,156	2,312

Device	Routing	Invert	Outlet Devices
#1	Primary	47.00'	**6.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=5.84 cfs @ 12.27 hrs HW=47.99' TW=47.94' (Dynamic Tailwater)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 5.84 cfs @ 0.98 fps)

Summary for Pond 3P: Detention Basin

Volume	Invert	Avail.Storage	Storage Description
#1	46.00'	7,117 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
46.00	641	100.0	0	0	641
50.00	3,253	214.0	7,117	7,117	3,558

Device	Routing	Invert	Outlet Devices
#1	Primary	46.50'	**18.0" Round Culvert** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 46.50' / 46.00' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' TW=46.00' (Dynamic Tailwater)
└**1=Culvert** (Controls 0.00 cfs)

Summary for Pond 4P: WL

Inflow Area = 45,742 sf, 26.80% Impervious, Inflow Depth = 3.69" for 10-YR+15% (NRCC D) event
Inflow = 3.63 cfs @ 12.17 hrs, Volume= 14,080 cf
Outflow = 2.95 cfs @ 12.24 hrs, Volume= 13,241 cf, Atten= 19%, Lag= 3.8 min
Primary = 2.95 cfs @ 12.24 hrs, Volume= 13,241 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 52.11' @ 12.24 hrs Surf.Area= 2,158 sf Storage= 2,172 cf

Plug-Flow detention time= 71.9 min calculated for 13,238 cf (94% of inflow)
Center-of-Mass det. time= 38.3 min (866.5 - 828.2)

Volume	Invert	Avail.Storage	Storage Description
#1	50.00'	4,635 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
50.00	223	74.0	0	0	223
52.00	2,030	185.0	1,951	1,951	2,525
53.00	3,398	227.0	2,685	4,635	3,918

Device	Routing	Invert	Outlet Devices
#1	Primary	51.30'	**18.0" Round Culvert** L= 44.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.30' / 50.40' S= 0.0205 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=2.95 cfs @ 12.24 hrs HW=52.11' TW=47.96' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 2.95 cfs @ 3.06 fps)

Summary for Pond 5P: Sediment Forebay #2

Inflow Area = 20,568 sf, 41.79% Impervious, Inflow Depth = 4.11" for 10-YR+15% (NRCC D) event
Inflow = 1.78 cfs @ 12.17 hrs, Volume= 7,040 cf
Outflow = 1.60 cfs @ 12.21 hrs, Volume= 6,570 cf, Atten= 10%, Lag= 2.6 min
Primary = 1.60 cfs @ 12.21 hrs, Volume= 6,570 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 52.27' @ 12.21 hrs Surf.Area= 980 sf Storage= 973 cf

Plug-Flow detention time= 78.9 min calculated for 6,568 cf (93% of inflow)
Center-of-Mass det. time= 41.0 min (853.2 - 812.2)

Volume	Invert	Avail.Storage	Storage Description
#1	51.00'	3,256 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
51.00	565	97.4	0	0	565
52.00	885	116.2	719	719	902
54.00	1,695	153.9	2,537	3,256	1,756

Device	Routing	Invert	Outlet Devices
#1	Primary	48.80'	**12.0" Round Culvert** L= 53.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 48.80' / 46.80' S= 0.0377 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	51.70'	**18.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=1.60 cfs @ 12.21 hrs HW=52.27' TW=47.86' (Dynamic Tailwater)
↑**1=Culvert** (Passes 1.60 cfs of 6.52 cfs potential flow)
↑**2=Orifice/Grate** (Orifice Controls 1.60 cfs @ 2.58 fps)

Summary for Pond 19P: SGW

Inflow Area = 144,364 sf, 30.01% Impervious, Inflow Depth = 3.44" for 10-YR+15% (NRCC D) event
Inflow = 7.92 cfs @ 12.24 hrs, Volume= 41,336 cf
Outflow = 7.21 cfs @ 12.31 hrs, Volume= 41,340 cf, Atten= 9%, Lag= 4.2 min
Primary = 0.82 cfs @ 12.31 hrs, Volume= 28,492 cf
Secondary = 6.39 cfs @ 12.31 hrs, Volume= 12,848 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 47.96' @ 12.31 hrs Surf.Area= 7,652 sf Storage= 6,915 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 61.1 min (932.2 - 871.1)

Volume	Invert	Avail.Storage	Storage Description
#1	45.70'	1,911 cf	**Cell #1 (Irregular)** Listed below (Recalc)
#2	45.70'	2,064 cf	**Cell #2 (Irregular)** Listed below (Recalc)
#3	47.20'	8,095 cf	**+46.8 (Irregular)** Listed below (Recalc)
		12,070 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
45.70	1,003	123.2	0	0	1,003
46.80	1,401	142.1	1,316	1,316	1,428
47.20	1,576	149.6	595	1,911	1,611

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
45.70	1,089	130.8	0	0	1,089
46.80	1,510	149.7	1,423	1,423	1,538
47.20	1,694	157.2	640	2,064	1,731

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
47.20	3,404	310.3	0	0	3,404
48.00	4,441	354.0	3,129	3,129	5,729
49.00	5,511	370.0	4,966	8,095	6,720

Device	Routing	Invert	Outlet Devices
#1	Secondary	47.50'	**8.0' long x 4.0' breadth Emergency spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32
#2	Primary	45.30'	**6.0" Round Control device outlet (to outfall)** L= 44.0' CPP, square edge headwall, Ke= 0.500

Inlet / Outlet Invert= 45.30' / 44.80' S= 0.0114 '/' Cc= 0.900
n= 0.020 Corrugated PE, corrugated interior, Flow Area= 0.20 sf

#3	Device 2	45.00'	**4.0" Vert. 4" Ø oriface** C= 0.600
#4	Device 2	47.20'	**24.0" Horiz. 24" Ø high flow by-pass** C= 0.600
			Limited to weir flow at low heads

Primary OutFlow Max=0.82 cfs @ 12.31 hrs HW=47.96' TW=6.78' (Dynamic Tailwater)
└─**2=Control device outlet (to outfall)** (Barrel Controls 0.82 cfs @ 4.19 fps)
  ├─**3=4" Ø oriface** (Passes < 0.68 cfs potential flow)
  └─**4=24" Ø high flow by-pass** (Passes < 13.16 cfs potential flow)

Secondary OutFlow Max=6.39 cfs @ 12.31 hrs HW=47.96' TW=6.78' (Dynamic Tailwater)
└─**1=Emergency spillway** (Weir Controls 6.39 cfs @ 1.75 fps)

Summary for Link POA1: POA 1

Inflow Area = 2,042,895 sf, 10.70% Impervious, Inflow Depth = 2.83" for 10-YR+15% (NRCC D) event
Inflow = 82.21 cfs @ 12.31 hrs, Volume= 481,941 cf
Primary = 82.21 cfs @ 12.31 hrs, Volume= 481,941 cf, Atten= 0%, Lag= 0.0 min

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

Summary for Link POA2: POA 2

Inflow Area = 7,062 sf, 12.98% Impervious, Inflow Depth = 2.38" for 10-YR+15% (NRCC D) event
Inflow = 0.43 cfs @ 12.13 hrs, Volume= 1,403 cf
Primary = 0.43 cfs @ 12.13 hrs, Volume= 1,403 cf, Atten= 0%, Lag= 0.0 min

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

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2021-10-04 T15:35:50

FINAL APPROVAL BY DURHAM PLANNING BOARD.
CERTIFIED BY MICHAEL BEHRENDT, TOWN PLANNER
CERTIFIED _____
DATE _____

NO.	REVISIONS	DATE	INT.
3.	REVISED BUILDING LAYOUT	10/04/21	MCS
2.	REVISED PER ENGINEERING REVIEW	4/20/21	MCS
1.	REVISED DRAINAGE DESIGN	2/11/21	MCS
0.	INITIAL SUBMISSION TO THE DURHAM PLANNING BOARD	12/9/20	MCS

SEAL

DATE ISSUED: 10/28/20
SCALE: 1"=30'
DESIGNED BY: MCS
DRAWN BY: MCS
APPROVED BY: MJS
DWG FILE: NM19063_Hydro_03.dwg

POST-DEVELOPMENT
CONDITIONS PLAN
prepared for
MULHERN
TAX MAP 10, LOT 8-6
93 BAGDAD ROAD, DURHAM, NH 03824

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