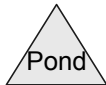
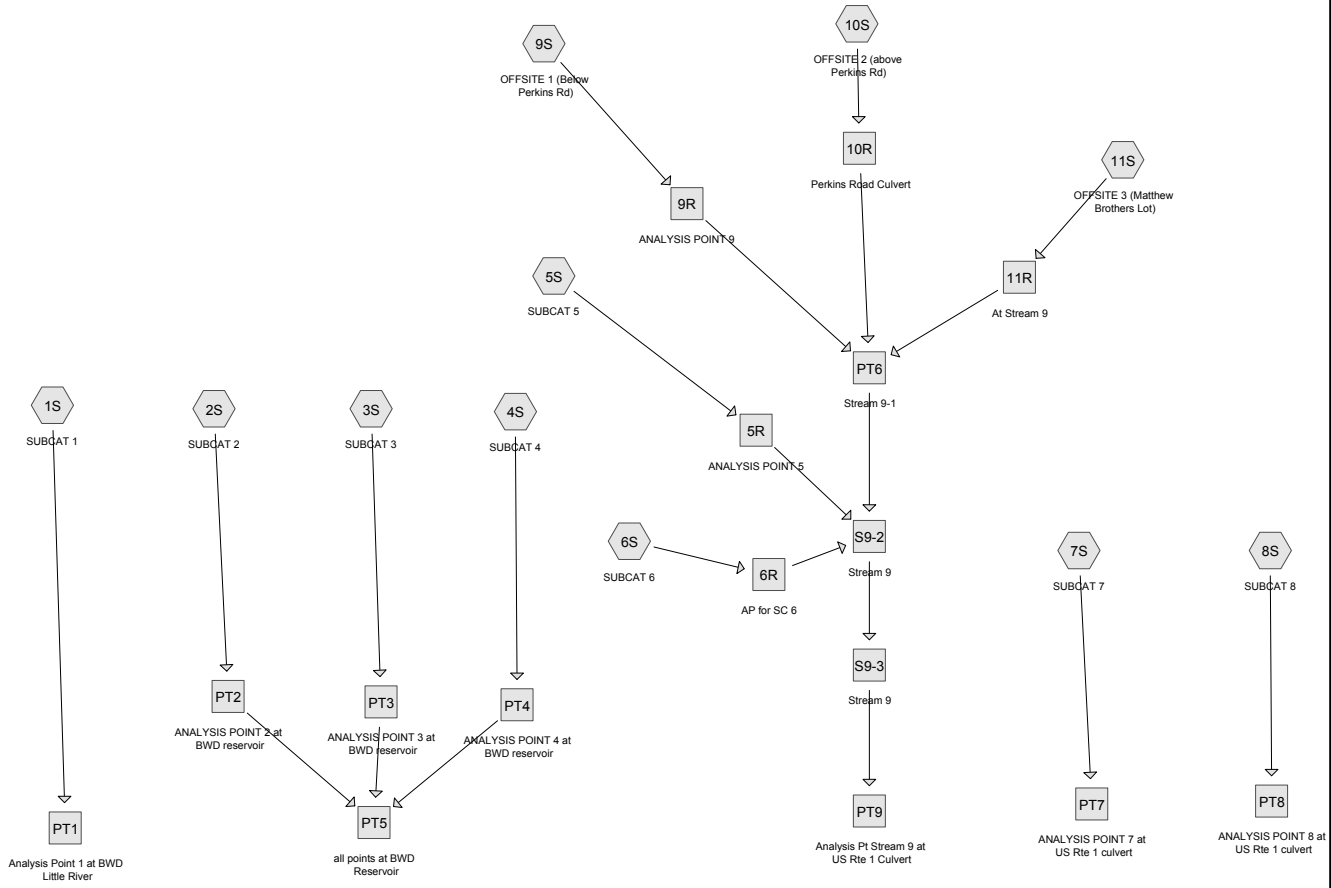


## **APPENDIX D**

Pre-Development HydroCAD and Backup Calculations



**Routing Diagram for pre conditions**  
 Prepared by Ransom Consulting, Printed 4/21/2019  
 HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

**pre conditions**

Prepared by Ransom Consulting

Printed 4/21/2019

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

Page 2

**Area Listing (all nodes)**

Area (acres)	CN	Description (subcatchment-numbers)
3.049	74	>75% Grass cover, Good, HSG C (3S, 4S, 5S, 6S, 9S)
59.528	74	>75% Grass cover, Good, HSG C/D (2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 10S, 11S)
1.194	80	>75% Grass cover, Good, HSG D (6S)
0.179	96	Gravel (6S)
0.088	94	Gravel roads, HSG C/D (9S)
5.078	98	Impervious (6S, 9S, 10S, 11S)
5.217	70	Woods, Good, HSG C (1S, 3S, 4S, 6S)
41.291	70	Woods, Good, HSG C/D (1S, 2S, 4S, 6S, 7S, 8S, 10S, 11S)
0.735	77	Woods, Good, HSG D (6S)
<b>116.358</b>	<b>74</b>	<b>TOTAL AREA</b>

**pre conditions**

Prepared by Ransom Consulting

Printed 4/21/2019

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

Page 3

**Soil Listing (all nodes)**

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
109.172	HSG C	1S, 2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 10S, 11S
1.929	HSG D	6S
5.257	Other	6S, 9S, 10S, 11S
<b>116.358</b>		<b>TOTAL AREA</b>

**pre conditions**

Prepared by Ransom Consulting

Printed 4/21/2019

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

Page 4

**Ground Covers (all nodes)**

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	62.577	1.194	0.000	63.770	>75% Grass cover, Good	2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 10S, 11S
0.000	0.000	0.000	0.000	0.179	0.179	Gravel	6S
0.000	0.000	0.088	0.000	0.000	0.088	Gravel roads	9S
0.000	0.000	0.000	0.000	5.078	5.078	Impervious	6S, 9S, 10S, 11S
0.000	0.000	46.507	0.735	0.000	47.243	Woods, Good	1S, 2S, 3S, 4S, 6S, 7S, 8S, 10S, 11S
<b>0.000</b>	<b>0.000</b>	<b>109.172</b>	<b>1.929</b>	<b>5.257</b>	<b>116.358</b>	<b>TOTAL AREA</b>	

**pre conditions**

Prepared by Ransom Consulting

Printed 4/21/2019

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

Page 5

**Pipe Listing (all nodes)**

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	10R	75.50	75.00	25.0	0.0200	0.013	24.0	0.0	0.0
2	PT7	21.60	18.30	83.0	0.0398	0.013	18.0	0.0	0.0
3	PT8	23.40	18.60	76.0	0.0632	0.011	36.0	24.0	0.0
4	PT9	20.00	14.00	93.0	0.0645	0.011	36.0	0.0	0.0

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 2-year Rainfall=2.90"

Printed 4/21/2019

Page 6

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

<b>Subcatchment1S: SUBCAT 1</b>	Runoff Area=316,158 sf 0.00% Impervious Runoff Depth>0.58" Flow Length=898' Tc=57.7 min CN=70 Runoff=1.92 cfs 0.348 af
<b>Subcatchment2S: SUBCAT 2</b>	Runoff Area=692,288 sf 0.00% Impervious Runoff Depth>0.56" Flow Length=1,533' Tc=101.5 min CN=70 Runoff=2.92 cfs 0.741 af
<b>Subcatchment3S: SUBCAT 3</b>	Runoff Area=391,117 sf 0.00% Impervious Runoff Depth>0.66" Flow Length=1,335' Tc=48.7 min CN=72 Runoff=3.11 cfs 0.495 af
<b>Subcatchment4S: SUBCAT 4</b>	Runoff Area=254,691 sf 0.00% Impervious Runoff Depth>0.67" Flow Length=1,170' Tc=30.2 min CN=72 Runoff=2.58 cfs 0.326 af
<b>Subcatchment5S: SUBCAT 5</b>	Runoff Area=231,278 sf 0.00% Impervious Runoff Depth>0.76" Flow Length=839' Tc=31.3 min CN=74 Runoff=2.69 cfs 0.335 af
<b>Subcatchment6S: SUBCAT 6</b>	Runoff Area=342,649 sf 10.21% Impervious Runoff Depth>0.85" Flow Length=445' Tc=41.6 min CN=76 Runoff=3.99 cfs 0.558 af
<b>Subcatchment7S: SUBCAT 7</b>	Runoff Area=96,383 sf 0.00% Impervious Runoff Depth>0.57" Flow Length=541' Tc=64.7 min CN=70 Runoff=0.55 cfs 0.106 af
<b>Subcatchment8S: SUBCAT 8</b>	Runoff Area=14,976 sf 0.00% Impervious Runoff Depth>0.62" Flow Length=276' Tc=34.7 min CN=71 Runoff=0.13 cfs 0.018 af
<b>Subcatchment9S: OFFSITE 1 (Below</b>	Runoff Area=570,508 sf 4.47% Impervious Runoff Depth>0.80" Flow Length=1,353' Tc=35.1 min CN=75 Runoff=6.75 cfs 0.878 af
<b>Subcatchment10S: OFFSITE 2 (above</b>	Runoff Area=1,644,982 sf 2.57% Impervious Runoff Depth>0.73" Flow Length=2,221' Tc=94.2 min CN=74 Runoff=10.03 cfs 2.307 af
<b>Subcatchment11S: OFFSITE 3 (Matthew</b>	Runoff Area=513,527 sf 23.06% Impervious Runoff Depth>0.97" Flow Length=532' Tc=6.8 min CN=78 Runoff=13.59 cfs 0.953 af
<b>Reach 5R: ANALYSISPOINT 5</b>	Inflow=2.69 cfs 0.335 af Outflow=2.69 cfs 0.335 af
<b>Reach 6R: AP for SC 6</b>	Inflow=3.99 cfs 0.558 af Outflow=3.99 cfs 0.558 af
<b>Reach 9R: ANALYSISPOINT 9</b>	Inflow=6.75 cfs 0.878 af Outflow=6.75 cfs 0.878 af
<b>Reach 10R: Perkins Road Culvert</b>	Avg. Flow Depth=0.77' Max Vel=9.01 fps Inflow=10.03 cfs 2.307 af 24.0" Round Pipe n=0.013 L=25.0' S=0.0200 ' /' Capacity=31.99 cfs Outflow=10.03 cfs 2.307 af
<b>Reach 11R: At Stream 9</b>	Inflow=13.59 cfs 0.953 af Outflow=13.59 cfs 0.953 af

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 2-year Rainfall=2.90"

Printed 4/21/2019

Page 7

**Reach PT1: Analysis Point 1 at BWD Little River**

Inflow=1.92 cfs 0.348 af  
Outflow=1.92 cfs 0.348 af

**Reach PT2: ANALYSISPOINT 2 at BWD reservoir**

Inflow=2.92 cfs 0.741 af  
Outflow=2.92 cfs 0.741 af

**Reach PT3: ANALYSISPOINT 3 at BWD reservoir**

Inflow=3.11 cfs 0.495 af  
Outflow=3.11 cfs 0.495 af

**Reach PT4: ANALYSISPOINT 4 at BWD reservoir**

Inflow=2.58 cfs 0.326 af  
Outflow=2.58 cfs 0.326 af

**Reach PT5: all points at BWD Reservoir**

Inflow=6.18 cfs 1.561 af  
Outflow=6.18 cfs 1.561 af

**Reach PT6: Stream 9-1**

Avg. Flow Depth=0.64' Max Vel=3.81 fps Inflow=15.78 cfs 4.137 af  
n=0.030 L=483.0' S=0.0145 '/' Capacity=535.88 cfs Outflow=14.92 cfs 4.122 af

**Reach PT7: ANALYSISPOINT 7 at US**

Avg. Flow Depth=0.17' Max Vel=5.08 fps Inflow=0.55 cfs 0.106 af  
18.0" Round Pipe n=0.013 L=83.0' S=0.0398 '/' Capacity=20.95 cfs Outflow=0.55 cfs 0.106 af

**Reach PT8: ANALYSISPOINT 8 at US**

Avg. Flow Depth=0.02' Max Vel=2.48 fps Inflow=0.13 cfs 0.018 af  
36.0" x 24.0" Box Pipe n=0.011 L=76.0' S=0.0632 '/' Capacity=144.91 cfs Outflow=0.13 cfs 0.018 af

**Reach PT9: Analysis Pt Stream 9 at**

Avg. Flow Depth=0.63' Max Vel=18.00 fps Inflow=19.61 cfs 4.954 af  
36.0" Round Pipe n=0.011 L=93.0' S=0.0645 '/' Capacity=200.22 cfs Outflow=19.61 cfs 4.954 af

**Reach S9-2: Stream 9**

Avg. Flow Depth=0.64' Max Vel=4.85 fps Inflow=19.89 cfs 5.015 af  
n=0.030 L=1,580.0' S=0.0233 '/' Capacity=161.21 cfs Outflow=19.65 cfs 4.967 af

**Reach S9-3: Stream 9**

Avg. Flow Depth=0.65' Max Vel=4.37 fps Inflow=19.65 cfs 4.967 af  
n=0.030 L=364.0' S=0.0199 '/' Capacity=177.67 cfs Outflow=19.61 cfs 4.954 af

**Total Runoff Area = 116.358 ac Runoff Volume = 7.063 af Average Runoff Depth = 0.73"**  
**95.64% Pervious = 111.280 ac 4.36% Impervious = 5.078 ac**



**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development

Type III 24-hr 2-year Rainfall=2.90"

Printed 4/21/2019

Page 8

**Summary for Subcatchment 1S: SUBCAT 1**

Runoff = 1.92 cfs @ 12.89 hrs, Volume= 0.348 af, Depth> 0.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-year Rainfall=2.90"

	Area (sf)	CN	Description
*	303,390	70	Woods, Good, HSG C/D
	12,768	70	Woods, Good, HSG C
	316,158	70	Weighted Average
	316,158		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.6	88	0.0450	0.06		<b>Sheet Flow, a-b</b> Woods: Dense underbrush n= 0.800 P2= 2.90"
3.5	65	0.0150	0.31		<b>Shallow Concentrated Flow, b-c</b> Forest w/Heavy Litter Kv= 2.5 fps
2.0	72	0.0550	0.59		<b>Shallow Concentrated Flow, c-d</b> Forest w/Heavy Litter Kv= 2.5 fps
25.6	470	0.0150	0.31		<b>Shallow Concentrated Flow, d-e</b> Forest w/Heavy Litter Kv= 2.5 fps
1.0	203	0.1000	3.41	13.64	<b>Trap/Vee/Rect Channel Flow, e-f</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100 Earth, dense brush, high stage
57.7	898	Total			

**Summary for Subcatchment 2S: SUBCAT 2**

Runoff = 2.92 cfs @ 13.53 hrs, Volume= 0.741 af, Depth> 0.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-year Rainfall=2.90"

	Area (sf)	CN	Description
*	653,559	70	Woods, Good, HSG C/D
*	38,729	74	>75% Grass cover, Good, HSG C/D
	692,288	70	Weighted Average
	692,288		100.00% Pervious Area

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 2-year Rainfall=2.90"

Printed 4/21/2019

Page 9

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
55.7	134	0.0150	0.04		<b>Sheet Flow, a-b</b> Woods: Dense underbrush n= 0.800 P2= 2.90"
5.8	175	0.0400	0.50		<b>Shallow Concentrated Flow, b-c</b> Forest w/Heavy Litter Kv= 2.5 fps
13.3	199	0.0100	0.25		<b>Shallow Concentrated Flow, c-d</b> Forest w/Heavy Litter Kv= 2.5 fps
1.2	41	0.0490	0.55		<b>Shallow Concentrated Flow, d-e</b> Forest w/Heavy Litter Kv= 2.5 fps
22.1	468	0.0200	0.35		<b>Shallow Concentrated Flow, e-f</b> Forest w/Heavy Litter Kv= 2.5 fps
3.4	516	0.0550	2.53	10.11	<b>Trap/Vee/Rect Channel Flow, f-g</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100 Earth, dense brush, high stage
101.5	1,533	Total			

**Summary for Subcatchment 3S: SUBCAT 3**

Runoff = 3.11 cfs @ 12.74 hrs, Volume= 0.495 af, Depth> 0.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-year Rainfall=2.90"

Area (sf)	CN	Description
* 205,588	74	>75% Grass cover, Good, HSG C/D
22,290	74	>75% Grass cover, Good, HSG C
163,239	70	Woods, Good, HSG C
391,117	72	Weighted Average
391,117		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.1	115	0.0400	0.10		<b>Sheet Flow, a-b</b> Woods: Light underbrush n= 0.400 P2= 2.90"
3.4	155	0.0230	0.76		<b>Shallow Concentrated Flow, b-c</b> Woodland Kv= 5.0 fps
9.3	372	0.0090	0.66		<b>Shallow Concentrated Flow, c-d</b> Short Grass Pasture Kv= 7.0 fps
2.3	134	0.0190	0.96		<b>Shallow Concentrated Flow, d-e</b> Short Grass Pasture Kv= 7.0 fps
12.6	254	0.0180	0.34		<b>Shallow Concentrated Flow, e-f</b> Forest w/Heavy Litter Kv= 2.5 fps
2.0	305	0.0560	2.55	10.21	<b>Trap/Vee/Rect Channel Flow, f-g</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100 Earth, dense brush, high stage
48.7	1,335	Total			

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 2-year Rainfall=2.90"

Printed 4/21/2019

Page 10

**Summary for Subcatchment 4S: SUBCAT 4**

Runoff = 2.58 cfs @ 12.48 hrs, Volume= 0.326 af, Depth> 0.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-year Rainfall=2.90"

	Area (sf)	CN	Description
*	130,853	74	>75% Grass cover, Good, HSG C/D
	26,033	74	>75% Grass cover, Good, HSG C
	40,857	70	Woods, Good, HSG C
*	56,948	70	Woods, Good, HSG C/D
	254,691	72	Weighted Average
	254,691		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.9	135	0.0270	0.13		<b>Sheet Flow, a-b</b> Grass: Dense n= 0.240 P2= 2.90"
7.8	462	0.0200	0.99		<b>Shallow Concentrated Flow, b-c</b> Short Grass Pasture Kv= 7.0 fps
2.2	184	0.0380	1.36		<b>Shallow Concentrated Flow, c-d</b> Short Grass Pasture Kv= 7.0 fps
3.3	389	0.0330	1.96	7.83	<b>Trap/Vee/Rect Channel Flow, d-e</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100 Earth, dense brush, high stage
30.2	1,170	Total			

**Summary for Subcatchment 5S: SUBCAT 5**

Runoff = 2.69 cfs @ 12.49 hrs, Volume= 0.335 af, Depth> 0.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-year Rainfall=2.90"

	Area (sf)	CN	Description
*	156,287	74	>75% Grass cover, Good, HSG C/D
	74,991	74	>75% Grass cover, Good, HSG C
	231,278	74	Weighted Average
	231,278		100.00% Pervious Area

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 2-year Rainfall=2.90"

Printed 4/21/2019

Page 11

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.0	198	0.0270	0.14		<b>Sheet Flow, a-b</b> Grass: Dense n= 0.240 P2= 2.90"
2.9	146	0.0140	0.83		<b>Shallow Concentrated Flow, b-c</b> Short Grass Pasture Kv= 7.0 fps
3.8	285	0.0320	1.25		<b>Shallow Concentrated Flow, c-d</b> Short Grass Pasture Kv= 7.0 fps
1.6	210	0.0430	2.24	8.94	<b>Trap/Vee/Rect Channel Flow, d-e</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100 Earth, dense brush, high stage
31.3	839	Total			

**Summary for Subcatchment 6S: SUBCAT 6**

Runoff = 3.99 cfs @ 12.62 hrs, Volume= 0.558 af, Depth> 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-year Rainfall=2.90"

Area (sf)	CN	Description
* 142,888	70	Woods, Good, HSG C/D
10,372	70	Woods, Good, HSG C
* 61,952	74	>75% Grass cover, Good, HSG C/D
635	74	>75% Grass cover, Good, HSG C
51,989	80	>75% Grass cover, Good, HSG D
* 7,818	96	Gravel
* 34,971	98	Impervious
32,024	77	Woods, Good, HSG D
342,649	76	Weighted Average
307,678		89.79% Pervious Area
34,971		10.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.0	67	0.0150	0.03		<b>Sheet Flow, a-b</b> Woods: Dense underbrush n= 0.800 P2= 2.90"
5.2	92	0.0140	0.30		<b>Shallow Concentrated Flow, b-c</b> Forest w/Heavy Litter Kv= 2.5 fps
1.8	74	0.0100	0.70		<b>Shallow Concentrated Flow, c-d</b> Short Grass Pasture Kv= 7.0 fps
1.7	163	0.0550	1.64		<b>Shallow Concentrated Flow, d-e</b> Short Grass Pasture Kv= 7.0 fps
0.8	39	0.1000	0.79		<b>Shallow Concentrated Flow, e-f</b> Forest w/Heavy Litter Kv= 2.5 fps
0.1	10	0.5000	1.77		<b>Shallow Concentrated Flow, f-g</b> Forest w/Heavy Litter Kv= 2.5 fps
41.6	445	Total			

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 2-year Rainfall=2.90"

Printed 4/21/2019

Page 12

**Summary for Subcatchment 7S: SUBCAT 7**

Runoff = 0.55 cfs @ 12.99 hrs, Volume= 0.106 af, Depth> 0.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-year Rainfall=2.90"

Area (sf)	CN	Description
* 93,505	70	Woods, Good, HSG C/D
* 2,878	74	>75% Grass cover, Good, HSG C/D
96,383	70	Weighted Average
96,383		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
54.6	172	0.0260	0.05		<b>Sheet Flow, a-b</b> Woods: Dense underbrush n= 0.800 P2= 2.90"
2.8	112	0.0700	0.66		<b>Shallow Concentrated Flow, b-c</b> Forest w/Heavy Litter Kv= 2.5 fps
0.2	13	0.2300	1.20		<b>Shallow Concentrated Flow, c-d</b> Forest w/Heavy Litter Kv= 2.5 fps
6.6	171	0.0300	0.43		<b>Shallow Concentrated Flow, d-e</b> Forest w/Heavy Litter Kv= 2.5 fps
0.5	73	0.0600	2.64	10.56	<b>Trap/Vee/Rect Channel Flow, e-f</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100 Earth, dense brush, high stage
64.7	541	Total			

**Summary for Subcatchment 8S: SUBCAT 8**

Runoff = 0.13 cfs @ 12.55 hrs, Volume= 0.018 af, Depth> 0.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-year Rainfall=2.90"

Area (sf)	CN	Description
* 12,652	70	Woods, Good, HSG C/D
* 2,324	74	>75% Grass cover, Good, HSG C/D
14,976	71	Weighted Average
14,976		100.00% Pervious Area

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development

Type III 24-hr 2-year Rainfall=2.90"

Printed 4/21/2019

Page 13

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.0	67	0.0150	0.03		<b>Sheet Flow, a-b</b> Woods: Dense underbrush n= 0.800 P2= 2.90"
1.1	43	0.0700	0.66		<b>Shallow Concentrated Flow, b-c</b> Forest w/Heavy Litter Kv= 2.5 fps
0.1	14	0.7100	2.11		<b>Shallow Concentrated Flow, c-d</b> Forest w/Heavy Litter Kv= 2.5 fps
1.5	152	0.0240	1.67	6.68	<b>Trap/Vee/Rect Channel Flow, d-e</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100
34.7	276	Total			

**Summary for Subcatchment 9S: OFFSITE 1 (Below Perkins Rd)**

Runoff = 6.75 cfs @ 12.53 hrs, Volume= 0.878 af, Depth> 0.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-year Rainfall=2.90"

Area (sf)	CN	Description
* 25,513	98	Impervious
* 532,320	74	>75% Grass cover, Good, HSG C/D
* 3,818	94	Gravel roads, HSG C/D
8,857	74	>75% Grass cover, Good, HSG C
570,508	75	Weighted Average
544,995		95.53% Pervious Area
25,513		4.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	15	0.2000	2.25		<b>Sheet Flow, a-b</b> Smooth surfaces n= 0.011 P2= 2.90"
12.6	373	0.0050	0.49		<b>Shallow Concentrated Flow, b-c</b> Short Grass Pasture Kv= 7.0 fps
13.1	715	0.0170	0.91		<b>Shallow Concentrated Flow, c-d</b> Short Grass Pasture Kv= 7.0 fps
9.3	250	0.0320	0.45		<b>Shallow Concentrated Flow, d-e</b> Forest w/Heavy Litter Kv= 2.5 fps
35.1	1,353	Total			

**Summary for Subcatchment 10S: OFFSITE 2 (above Perkins Rd)**

Runoff = 10.03 cfs @ 13.35 hrs, Volume= 2.307 af, Depth> 0.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-year Rainfall=2.90"

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 2-year Rainfall=2.90"

Printed 4/21/2019

Page 14

Area (sf)	CN	Description
* 298,066	70	Woods, Good, HSG C/D
* 42,276	98	Impervious
* 1,304,640	74	>75% Grass cover, Good, HSG C/D
1,644,982	74	Weighted Average
1,602,706		97.43% Pervious Area
42,276		2.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
45.2	141	0.0280	0.05		<b>Sheet Flow, a-b</b> Woods: Dense underbrush n= 0.800 P2= 2.90"
15.3	384	0.0280	0.42		<b>Shallow Concentrated Flow, b-c</b> Forest w/Heavy Litter Kv= 2.5 fps
2.5	227	0.0480	1.53		<b>Shallow Concentrated Flow, c-d</b> Short Grass Pasture Kv= 7.0 fps
18.6	780	0.0100	0.70		<b>Shallow Concentrated Flow, d-e</b> Short Grass Pasture Kv= 7.0 fps
12.6	689	0.0170	0.91		<b>Shallow Concentrated Flow, e-f</b> Short Grass Pasture Kv= 7.0 fps
94.2	2,221	Total			

**Summary for Subcatchment 11S: OFFSITE 3 (Matthew Brothers Lot)**

Runoff = 13.59 cfs @ 12.11 hrs, Volume= 0.953 af, Depth> 0.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-year Rainfall=2.90"

Area (sf)	CN	Description
* 118,437	98	Impervious
* 237,621	70	Woods, Good, HSG C/D
* 157,469	74	>75% Grass cover, Good, HSG C/D
513,527	78	Weighted Average
395,090		76.94% Pervious Area
118,437		23.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	16	0.1870	2.22		<b>Sheet Flow, a-b</b> Smooth surfaces n= 0.011 P2= 2.90"
4.7	419	0.0100	1.50		<b>Shallow Concentrated Flow, b-c</b> Grassed Waterway Kv= 15.0 fps
2.0	97	0.1000	0.79		<b>Shallow Concentrated Flow, c-d</b> Forest w/Heavy Litter Kv= 2.5 fps
6.8	532	Total			

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 2-year Rainfall=2.90"

Printed 4/21/2019

Page 15

**Summary for Reach 5R: ANALYSIS POINT 5**

Inflow Area = 5.309 ac, 0.00% Impervious, Inflow Depth > 0.76" for 2-year event  
Inflow = 2.69 cfs @ 12.49 hrs, Volume= 0.335 af  
Outflow = 2.69 cfs @ 12.49 hrs, Volume= 0.335 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach 6R: AP for SC 6**

Inflow Area = 7.866 ac, 10.21% Impervious, Inflow Depth > 0.85" for 2-year event  
Inflow = 3.99 cfs @ 12.62 hrs, Volume= 0.558 af  
Outflow = 3.99 cfs @ 12.62 hrs, Volume= 0.558 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach 9R: ANALYSIS POINT 9**

Inflow Area = 13.097 ac, 4.47% Impervious, Inflow Depth > 0.80" for 2-year event  
Inflow = 6.75 cfs @ 12.53 hrs, Volume= 0.878 af  
Outflow = 6.75 cfs @ 12.53 hrs, Volume= 0.878 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach 10R: Perkins Road Culvert**

Inflow Area = 37.764 ac, 2.57% Impervious, Inflow Depth > 0.73" for 2-year event  
Inflow = 10.03 cfs @ 13.35 hrs, Volume= 2.307 af  
Outflow = 10.03 cfs @ 13.36 hrs, Volume= 2.307 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs / 2

Max. Velocity= 9.01 fps, Min. Travel Time= 0.0 min

Avg. Velocity = 5.80 fps, Avg. Travel Time= 0.1 min

Peak Storage= 28 cf @ 13.35 hrs

Average Depth at Peak Storage= 0.77'

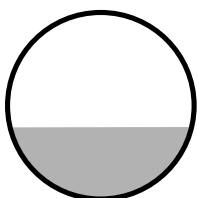
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 31.99 cfs

24.0" Round Pipe

n= 0.013 Corrugated PE, smooth interior

Length= 25.0' Slope= 0.0200 '/'

Inlet Invert= 75.50', Outlet Invert= 75.00'





**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 2-year Rainfall=2.90"

Printed 4/21/2019

Page 16

**Summary for Reach 11R: At Stream 9**

Inflow Area = 11.789 ac, 23.06% Impervious, Inflow Depth > 0.97" for 2-year event  
Inflow = 13.59 cfs @ 12.11 hrs, Volume= 0.953 af  
Outflow = 13.59 cfs @ 12.11 hrs, Volume= 0.953 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach PT1: Analysis Point 1 at BWD Little River**

Inflow Area = 7.258 ac, 0.00% Impervious, Inflow Depth > 0.58" for 2-year event  
Inflow = 1.92 cfs @ 12.89 hrs, Volume= 0.348 af  
Outflow = 1.92 cfs @ 12.89 hrs, Volume= 0.348 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach PT2: ANALYSIS POINT 2 at BWD reservoir**

Inflow Area = 15.893 ac, 0.00% Impervious, Inflow Depth > 0.56" for 2-year event  
Inflow = 2.92 cfs @ 13.53 hrs, Volume= 0.741 af  
Outflow = 2.92 cfs @ 13.53 hrs, Volume= 0.741 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach PT3: ANALYSIS POINT 3 at BWD reservoir**

Inflow Area = 8.979 ac, 0.00% Impervious, Inflow Depth > 0.66" for 2-year event  
Inflow = 3.11 cfs @ 12.74 hrs, Volume= 0.495 af  
Outflow = 3.11 cfs @ 12.74 hrs, Volume= 0.495 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach PT4: ANALYSIS POINT 4 at BWD reservoir**

Inflow Area = 5.847 ac, 0.00% Impervious, Inflow Depth > 0.67" for 2-year event  
Inflow = 2.58 cfs @ 12.48 hrs, Volume= 0.326 af  
Outflow = 2.58 cfs @ 12.48 hrs, Volume= 0.326 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach PT5: all points at BWD Reservoir**

Inflow Area = 30.718 ac, 0.00% Impervious, Inflow Depth > 0.61" for 2-year event  
Inflow = 6.18 cfs @ 12.74 hrs, Volume= 1.561 af  
Outflow = 6.18 cfs @ 12.74 hrs, Volume= 1.561 af, Atten= 0%, Lag= 0.0 min

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach PT6: Stream 9-1**

Inflow Area =	62.650 ac,	6.82% Impervious,	Inflow Depth > 0.79"	for 2-year event
Inflow =	15.78 cfs @	12.12 hrs,	Volume=	4.137 af
Outflow =	14.92 cfs @	12.19 hrs,	Volume=	4.122 af, Atten= 5%, Lag= 4.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Max. Velocity= 3.81 fps, Min. Travel Time= 2.1 min

Avg. Velocity = 2.35 fps, Avg. Travel Time= 3.4 min

Peak Storage= 1,935 cf @ 12.15 hrs

Average Depth at Peak Storage= 0.64'

Bank-Full Depth= 4.00' Flow Area= 52.0 sf, Capacity= 535.88 cfs

5.00' x 4.00' deep channel, n= 0.030 Stream, clean & straight

Side Slope Z-value= 2.0 ' ' Top Width= 21.00'

Length= 483.0' Slope= 0.0145 ' '

Inlet Invert= 71.00', Outlet Invert= 64.00'



**Summary for Reach PT7: ANALYSIS POINT 7 at US Rte 1 culvert**

Inflow Area =	2.213 ac,	0.00% Impervious,	Inflow Depth > 0.57"	for 2-year event
Inflow =	0.55 cfs @	12.99 hrs,	Volume=	0.106 af
Outflow =	0.55 cfs @	13.00 hrs,	Volume=	0.106 af, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Max. Velocity= 5.08 fps, Min. Travel Time= 0.3 min

Avg. Velocity = 3.22 fps, Avg. Travel Time= 0.4 min

Peak Storage= 9 cf @ 12.99 hrs

Average Depth at Peak Storage= 0.17'

Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 20.95 cfs

18.0" Round Pipe

n= 0.013 Corrugated PE, smooth interior

Length= 83.0' Slope= 0.0398 ' '

Inlet Invert= 21.60', Outlet Invert= 18.30'

**pre conditions**

Prepared by Ransom Consulting

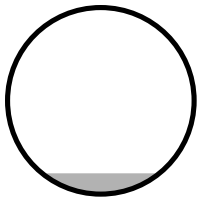
HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development

Type III 24-hr 2-year Rainfall=2.90"

Printed 4/21/2019

Page 18



**Summary for Reach PT8: ANALYSIS POINT 8 at US Rte 1 culvert**

Inflow Area = 0.344 ac, 0.00% Impervious, Inflow Depth > 0.62" for 2-year event  
Inflow = 0.13 cfs @ 12.55 hrs, Volume= 0.018 af  
Outflow = 0.13 cfs @ 12.57 hrs, Volume= 0.018 af, Atten= 0%, Lag= 1.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Max. Velocity= 2.48 fps, Min. Travel Time= 0.5 min  
Avg. Velocity = 2.48 fps, Avg. Travel Time= 0.5 min

Peak Storage= 4 cf @ 12.56 hrs  
Average Depth at Peak Storage= 0.02'  
Bank-Full Depth= 2.00' Flow Area= 6.0 sf, Capacity= 144.91 cfs

36.0" W x 24.0" H Box Pipe  
n= 0.011 Concrete pipe, straight & clean  
Length= 76.0' Slope= 0.0632 '/'  
Inlet Invert= 23.40', Outlet Invert= 18.60'



**Summary for Reach PT9: Analysis Pt Stream 9 at US Rte 1 Culvert**

Inflow Area = 75.825 ac, 6.70% Impervious, Inflow Depth > 0.78" for 2-year event  
Inflow = 19.61 cfs @ 12.73 hrs, Volume= 4.954 af  
Outflow = 19.61 cfs @ 12.73 hrs, Volume= 4.954 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Max. Velocity= 18.00 fps, Min. Travel Time= 0.1 min  
Avg. Velocity = 11.40 fps, Avg. Travel Time= 0.1 min

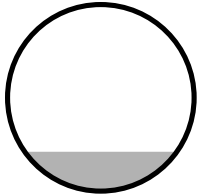
Peak Storage= 101 cf @ 12.73 hrs  
Average Depth at Peak Storage= 0.63'  
Bank-Full Depth= 3.00' Flow Area= 7.1 sf, Capacity= 200.22 cfs

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

36.0" Round Pipe  
n= 0.011 Concrete pipe, straight & clean  
Length= 93.0' Slope= 0.0645 '/'  
Inlet Invert= 20.00', Outlet Invert= 14.00'



**Summary for Reach S9-2: Stream 9**

Inflow Area = 75.825 ac, 6.70% Impervious, Inflow Depth > 0.79" for 2-year event  
Inflow = 19.89 cfs @ 12.53 hrs, Volume= 5.015 af  
Outflow = 19.65 cfs @ 12.69 hrs, Volume= 4.967 af, Atten= 1%, Lag= 9.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Max. Velocity= 4.85 fps, Min. Travel Time= 5.4 min  
Avg. Velocity = 2.88 fps, Avg. Travel Time= 9.1 min

Peak Storage= 6,408 cf @ 12.60 hrs  
Average Depth at Peak Storage= 0.64'  
Bank-Full Depth= 2.00' Flow Area= 18.0 sf, Capacity= 161.21 cfs

5.00' x 2.00' deep channel, n= 0.030 Stream, clean & straight  
Side Slope Z-value= 2.0 '/' Top Width= 13.00'  
Length= 1,580.0' Slope= 0.0233 '/'  
Inlet Invert= 64.00', Outlet Invert= 27.25'



**Summary for Reach S9-3: Stream 9**

Inflow Area = 75.825 ac, 6.70% Impervious, Inflow Depth > 0.79" for 2-year event  
Inflow = 19.65 cfs @ 12.69 hrs, Volume= 4.967 af  
Outflow = 19.61 cfs @ 12.73 hrs, Volume= 4.954 af, Atten= 0%, Lag= 2.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Max. Velocity= 4.37 fps, Min. Travel Time= 1.4 min  
Avg. Velocity = 2.65 fps, Avg. Travel Time= 2.3 min

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development

Type III 24-hr 2-year Rainfall=2.90"

Printed 4/21/2019

Page 20

Peak Storage= 1,638 cf @ 12.71 hrs

Average Depth at Peak Storage= 0.65'

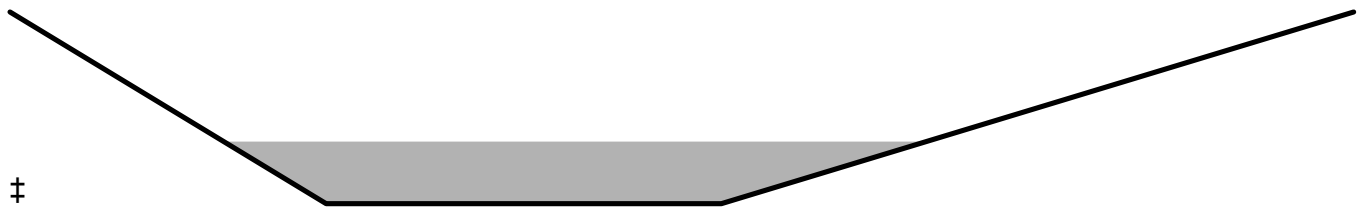
Bank-Full Depth= 2.00' Flow Area= 22.0 sf, Capacity= 177.67 cfs

5.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding

Side Slope Z-value= 2.0 4.0 ' / ' Top Width= 17.00'

Length= 364.0' Slope= 0.0199 ' / '

Inlet Invert= 27.25', Outlet Invert= 20.00'



**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 10-year Rainfall=4.20"

Printed 4/21/2019

Page 21

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

<b>Subcatchment1S: SUBCAT 1</b>	Runoff Area=316,158 sf 0.00% Impervious Runoff Depth>1.31" Flow Length=898' Tc=57.7 min CN=70 Runoff=4.77 cfs 0.792 af
<b>Subcatchment2S: SUBCAT 2</b>	Runoff Area=692,288 sf 0.00% Impervious Runoff Depth>1.28" Flow Length=1,533' Tc=101.5 min CN=70 Runoff=7.25 cfs 1.695 af
<b>Subcatchment3S: SUBCAT 3</b>	Runoff Area=391,117 sf 0.00% Impervious Runoff Depth>1.44" Flow Length=1,335' Tc=48.7 min CN=72 Runoff=7.24 cfs 1.081 af
<b>Subcatchment4S: SUBCAT 4</b>	Runoff Area=254,691 sf 0.00% Impervious Runoff Depth>1.46" Flow Length=1,170' Tc=30.2 min CN=72 Runoff=6.00 cfs 0.710 af
<b>Subcatchment5S: SUBCAT 5</b>	Runoff Area=231,278 sf 0.00% Impervious Runoff Depth>1.59" Flow Length=839' Tc=31.3 min CN=74 Runoff=5.90 cfs 0.704 af
<b>Subcatchment6S: SUBCAT 6</b>	Runoff Area=342,649 sf 10.21% Impervious Runoff Depth>1.73" Flow Length=445' Tc=41.6 min CN=76 Runoff=8.32 cfs 1.132 af
<b>Subcatchment7S: SUBCAT 7</b>	Runoff Area=96,383 sf 0.00% Impervious Runoff Depth>1.30" Flow Length=541' Tc=64.7 min CN=70 Runoff=1.36 cfs 0.241 af
<b>Subcatchment8S: SUBCAT 8</b>	Runoff Area=14,976 sf 0.00% Impervious Runoff Depth>1.39" Flow Length=276' Tc=34.7 min CN=71 Runoff=0.31 cfs 0.040 af
<b>Subcatchment9S: OFFSITE 1 (Below</b>	Runoff Area=570,508 sf 4.47% Impervious Runoff Depth>1.66" Flow Length=1,353' Tc=35.1 min CN=75 Runoff=14.44 cfs 1.811 af
<b>Subcatchment10S: OFFSITE 2 (above</b>	Runoff Area=1,644,982 sf 2.57% Impervious Runoff Depth>1.55" Flow Length=2,221' Tc=94.2 min CN=74 Runoff=22.26 cfs 4.868 af
<b>Subcatchment11S: OFFSITE 3 (Matthew</b>	Runoff Area=513,527 sf 23.06% Impervious Runoff Depth>1.90" Flow Length=532' Tc=6.8 min CN=78 Runoff=27.08 cfs 1.865 af
<b>Reach 5R: ANALYSISPOINT 5</b>	Inflow=5.90 cfs 0.704 af Outflow=5.90 cfs 0.704 af
<b>Reach 6R: AP for SC 6</b>	Inflow=8.32 cfs 1.132 af Outflow=8.32 cfs 1.132 af
<b>Reach 9R: ANALYSISPOINT 9</b>	Inflow=14.44 cfs 1.811 af Outflow=14.44 cfs 1.811 af
<b>Reach 10R: Perkins Road Culvert</b>	Avg. Flow Depth=1.23' Max Vel=11.00 fps Inflow=22.26 cfs 4.868 af 24.0" Round Pipe n=0.013 L=25.0' S=0.0200 ' /' Capacity=31.99 cfs Outflow=22.25 cfs 4.868 af
<b>Reach 11R: At Stream 9</b>	Inflow=27.08 cfs 1.865 af Outflow=27.08 cfs 1.865 af

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 10-year Rainfall=4.20"

Printed 4/21/2019

Page 22

**Reach PT1: Analysis Point 1 at BWD Little River**

Inflow=4.77 cfs 0.792 af  
Outflow=4.77 cfs 0.792 af

**Reach PT2: ANALYSISPOINT 2 at BWD reservoir**

Inflow=7.25 cfs 1.695 af  
Outflow=7.25 cfs 1.695 af

**Reach PT3: ANALYSISPOINT 3 at BWD reservoir**

Inflow=7.24 cfs 1.081 af  
Outflow=7.24 cfs 1.081 af

**Reach PT4: ANALYSISPOINT 4 at BWD reservoir**

Inflow=6.00 cfs 0.710 af  
Outflow=6.00 cfs 0.710 af

**Reach PT5: all points at BWD Reservoir**

Inflow=14.99 cfs 3.485 af  
Outflow=14.99 cfs 3.485 af

**Reach PT6: Stream 9-1**

Avg. Flow Depth=0.99' Max Vel=4.84 fps Inflow=34.26 cfs 8.544 af  
n=0.030 L=483.0' S=0.0145 '/' Capacity=535.88 cfs Outflow=32.89 cfs 8.523 af

**Reach PT7: ANALYSISPOINT 7 at US**

Avg. Flow Depth=0.26' Max Vel=6.67 fps Inflow=1.36 cfs 0.241 af  
18.0" Round Pipe n=0.013 L=83.0' S=0.0398 '/' Capacity=20.95 cfs Outflow=1.36 cfs 0.240 af

**Reach PT8: ANALYSISPOINT 8 at US**

Avg. Flow Depth=0.03' Max Vel=3.45 fps Inflow=0.31 cfs 0.040 af  
36.0" x 24.0" Box Pipe n=0.011 L=76.0' S=0.0632 '/' Capacity=144.91 cfs Outflow=0.31 cfs 0.040 af

**Reach PT9: Analysis Pt Stream 9 at**

Avg. Flow Depth=0.94' Max Vel=22.55 fps Inflow=42.91 cfs 10.273 af  
36.0" Round Pipe n=0.011 L=93.0' S=0.0645 '/' Capacity=200.22 cfs Outflow=42.90 cfs 10.272 af

**Reach S9-2: Stream 9**

Avg. Flow Depth=1.00' Max Vel=6.17 fps Inflow=43.38 cfs 10.359 af  
n=0.030 L=1,580.0' S=0.0233 '/' Capacity=161.21 cfs Outflow=42.98 cfs 10.290 af

**Reach S9-3: Stream 9**

Avg. Flow Depth=0.98' Max Vel=5.49 fps Inflow=42.98 cfs 10.290 af  
n=0.030 L=364.0' S=0.0199 '/' Capacity=177.67 cfs Outflow=42.91 cfs 10.273 af

**Total Runoff Area = 116.358 ac Runoff Volume = 14.938 af Average Runoff Depth = 1.54"**  
**95.64% Pervious = 111.280 ac 4.36% Impervious = 5.078 ac**

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development

Type III 24-hr 10-year Rainfall=4.20"

Printed 4/21/2019

Page 23

**Summary for Subcatchment 1S: SUBCAT 1**

Runoff = 4.77 cfs @ 12.83 hrs, Volume= 0.792 af, Depth> 1.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-year Rainfall=4.20"

	Area (sf)	CN	Description
*	303,390	70	Woods, Good, HSG C/D
	12,768	70	Woods, Good, HSG C
	316,158	70	Weighted Average
	316,158		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.6	88	0.0450	0.06		<b>Sheet Flow, a-b</b> Woods: Dense underbrush n= 0.800 P2= 2.90"
3.5	65	0.0150	0.31		<b>Shallow Concentrated Flow, b-c</b> Forest w/Heavy Litter Kv= 2.5 fps
2.0	72	0.0550	0.59		<b>Shallow Concentrated Flow, c-d</b> Forest w/Heavy Litter Kv= 2.5 fps
25.6	470	0.0150	0.31		<b>Shallow Concentrated Flow, d-e</b> Forest w/Heavy Litter Kv= 2.5 fps
1.0	203	0.1000	3.41	13.64	<b>Trap/Vee/Rect Channel Flow, e-f</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100 Earth, dense brush, high stage
57.7	898	Total			

**Summary for Subcatchment 2S: SUBCAT 2**

Runoff = 7.25 cfs @ 13.43 hrs, Volume= 1.695 af, Depth> 1.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-year Rainfall=4.20"

	Area (sf)	CN	Description
*	653,559	70	Woods, Good, HSG C/D
*	38,729	74	>75% Grass cover, Good, HSG C/D
	692,288	70	Weighted Average
	692,288		100.00% Pervious Area



**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 10-year Rainfall=4.20"

Printed 4/21/2019

Page 24

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
55.7	134	0.0150	0.04		<b>Sheet Flow, a-b</b> Woods: Dense underbrush n= 0.800 P2= 2.90"
5.8	175	0.0400	0.50		<b>Shallow Concentrated Flow, b-c</b> Forest w/Heavy Litter Kv= 2.5 fps
13.3	199	0.0100	0.25		<b>Shallow Concentrated Flow, c-d</b> Forest w/Heavy Litter Kv= 2.5 fps
1.2	41	0.0490	0.55		<b>Shallow Concentrated Flow, d-e</b> Forest w/Heavy Litter Kv= 2.5 fps
22.1	468	0.0200	0.35		<b>Shallow Concentrated Flow, e-f</b> Forest w/Heavy Litter Kv= 2.5 fps
3.4	516	0.0550	2.53	10.11	<b>Trap/Vee/Rect Channel Flow, f-g</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100 Earth, dense brush, high stage
101.5	1,533	Total			

**Summary for Subcatchment 3S: SUBCAT 3**

Runoff = 7.24 cfs @ 12.70 hrs, Volume= 1.081 af, Depth> 1.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-year Rainfall=4.20"

Area (sf)	CN	Description
* 205,588	74	>75% Grass cover, Good, HSG C/D
22,290	74	>75% Grass cover, Good, HSG C
163,239	70	Woods, Good, HSG C
391,117	72	Weighted Average
391,117		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.1	115	0.0400	0.10		<b>Sheet Flow, a-b</b> Woods: Light underbrush n= 0.400 P2= 2.90"
3.4	155	0.0230	0.76		<b>Shallow Concentrated Flow, b-c</b> Woodland Kv= 5.0 fps
9.3	372	0.0090	0.66		<b>Shallow Concentrated Flow, c-d</b> Short Grass Pasture Kv= 7.0 fps
2.3	134	0.0190	0.96		<b>Shallow Concentrated Flow, d-e</b> Short Grass Pasture Kv= 7.0 fps
12.6	254	0.0180	0.34		<b>Shallow Concentrated Flow, e-f</b> Forest w/Heavy Litter Kv= 2.5 fps
2.0	305	0.0560	2.55	10.21	<b>Trap/Vee/Rect Channel Flow, f-g</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100 Earth, dense brush, high stage
48.7	1,335	Total			

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 10-year Rainfall=4.20"

Printed 4/21/2019

Page 25

**Summary for Subcatchment 4S: SUBCAT 4**

Runoff = 6.00 cfs @ 12.45 hrs, Volume= 0.710 af, Depth> 1.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-year Rainfall=4.20"

	Area (sf)	CN	Description
*	130,853	74	>75% Grass cover, Good, HSG C/D
	26,033	74	>75% Grass cover, Good, HSG C
	40,857	70	Woods, Good, HSG C
*	56,948	70	Woods, Good, HSG C/D
	254,691	72	Weighted Average
	254,691		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.9	135	0.0270	0.13		<b>Sheet Flow, a-b</b> Grass: Dense n= 0.240 P2= 2.90"
7.8	462	0.0200	0.99		<b>Shallow Concentrated Flow, b-c</b> Short Grass Pasture Kv= 7.0 fps
2.2	184	0.0380	1.36		<b>Shallow Concentrated Flow, c-d</b> Short Grass Pasture Kv= 7.0 fps
3.3	389	0.0330	1.96	7.83	<b>Trap/Vee/Rect Channel Flow, d-e</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100 Earth, dense brush, high stage
30.2	1,170	Total			

**Summary for Subcatchment 5S: SUBCAT 5**

Runoff = 5.90 cfs @ 12.46 hrs, Volume= 0.704 af, Depth> 1.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-year Rainfall=4.20"

	Area (sf)	CN	Description
*	156,287	74	>75% Grass cover, Good, HSG C/D
	74,991	74	>75% Grass cover, Good, HSG C
	231,278	74	Weighted Average
	231,278		100.00% Pervious Area

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 10-year Rainfall=4.20"

Printed 4/21/2019

Page 26

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.0	198	0.0270	0.14		<b>Sheet Flow, a-b</b> Grass: Dense n= 0.240 P2= 2.90"
2.9	146	0.0140	0.83		<b>Shallow Concentrated Flow, b-c</b> Short Grass Pasture Kv= 7.0 fps
3.8	285	0.0320	1.25		<b>Shallow Concentrated Flow, c-d</b> Short Grass Pasture Kv= 7.0 fps
1.6	210	0.0430	2.24	8.94	<b>Trap/Vee/Rect Channel Flow, d-e</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100 Earth, dense brush, high stage
31.3	839	Total			

**Summary for Subcatchment 6S: SUBCAT 6**

Runoff = 8.32 cfs @ 12.59 hrs, Volume= 1.132 af, Depth> 1.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-year Rainfall=4.20"

Area (sf)	CN	Description
* 142,888	70	Woods, Good, HSG C/D
10,372	70	Woods, Good, HSG C
* 61,952	74	>75% Grass cover, Good, HSG C/D
635	74	>75% Grass cover, Good, HSG C
51,989	80	>75% Grass cover, Good, HSG D
* 7,818	96	Gravel
* 34,971	98	Impervious
32,024	77	Woods, Good, HSG D
342,649	76	Weighted Average
307,678		89.79% Pervious Area
34,971		10.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.0	67	0.0150	0.03		<b>Sheet Flow, a-b</b> Woods: Dense underbrush n= 0.800 P2= 2.90"
5.2	92	0.0140	0.30		<b>Shallow Concentrated Flow, b-c</b> Forest w/Heavy Litter Kv= 2.5 fps
1.8	74	0.0100	0.70		<b>Shallow Concentrated Flow, c-d</b> Short Grass Pasture Kv= 7.0 fps
1.7	163	0.0550	1.64		<b>Shallow Concentrated Flow, d-e</b> Short Grass Pasture Kv= 7.0 fps
0.8	39	0.1000	0.79		<b>Shallow Concentrated Flow, e-f</b> Forest w/Heavy Litter Kv= 2.5 fps
0.1	10	0.5000	1.77		<b>Shallow Concentrated Flow, f-g</b> Forest w/Heavy Litter Kv= 2.5 fps
41.6	445	Total			

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 10-year Rainfall=4.20"

Printed 4/21/2019

Page 27

**Summary for Subcatchment 7S: SUBCAT 7**

Runoff = 1.36 cfs @ 12.92 hrs, Volume= 0.241 af, Depth> 1.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-year Rainfall=4.20"

Area (sf)	CN	Description
* 93,505	70	Woods, Good, HSG C/D
* 2,878	74	>75% Grass cover, Good, HSG C/D
96,383	70	Weighted Average
96,383		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
54.6	172	0.0260	0.05		<b>Sheet Flow, a-b</b> Woods: Dense underbrush n= 0.800 P2= 2.90"
2.8	112	0.0700	0.66		<b>Shallow Concentrated Flow, b-c</b> Forest w/Heavy Litter Kv= 2.5 fps
0.2	13	0.2300	1.20		<b>Shallow Concentrated Flow, c-d</b> Forest w/Heavy Litter Kv= 2.5 fps
6.6	171	0.0300	0.43		<b>Shallow Concentrated Flow, d-e</b> Forest w/Heavy Litter Kv= 2.5 fps
0.5	73	0.0600	2.64	10.56	<b>Trap/Vee/Rect Channel Flow, e-f</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100 Earth, dense brush, high stage
64.7	541	Total			

**Summary for Subcatchment 8S: SUBCAT 8**

Runoff = 0.31 cfs @ 12.52 hrs, Volume= 0.040 af, Depth> 1.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-year Rainfall=4.20"

Area (sf)	CN	Description
* 12,652	70	Woods, Good, HSG C/D
* 2,324	74	>75% Grass cover, Good, HSG C/D
14,976	71	Weighted Average
14,976		100.00% Pervious Area

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 10-year Rainfall=4.20"

Printed 4/21/2019

Page 28

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.0	67	0.0150	0.03		<b>Sheet Flow, a-b</b> Woods: Dense underbrush n= 0.800 P2= 2.90"
1.1	43	0.0700	0.66		<b>Shallow Concentrated Flow, b-c</b> Forest w/Heavy Litter Kv= 2.5 fps
0.1	14	0.7100	2.11		<b>Shallow Concentrated Flow, c-d</b> Forest w/Heavy Litter Kv= 2.5 fps
1.5	152	0.0240	1.67	6.68	<b>Trap/Vee/Rect Channel Flow, d-e</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100
34.7	276	Total			

**Summary for Subcatchment 9S: OFFSITE 1 (Below Perkins Rd)**

Runoff = 14.44 cfs @ 12.51 hrs, Volume= 1.811 af, Depth> 1.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-year Rainfall=4.20"

Area (sf)	CN	Description
* 25,513	98	Impervious
* 532,320	74	>75% Grass cover, Good, HSG C/D
* 3,818	94	Gravel roads, HSG C/D
8,857	74	>75% Grass cover, Good, HSG C
570,508	75	Weighted Average
544,995		95.53% Pervious Area
25,513		4.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	15	0.2000	2.25		<b>Sheet Flow, a-b</b> Smooth surfaces n= 0.011 P2= 2.90"
12.6	373	0.0050	0.49		<b>Shallow Concentrated Flow, b-c</b> Short Grass Pasture Kv= 7.0 fps
13.1	715	0.0170	0.91		<b>Shallow Concentrated Flow, c-d</b> Short Grass Pasture Kv= 7.0 fps
9.3	250	0.0320	0.45		<b>Shallow Concentrated Flow, d-e</b> Forest w/Heavy Litter Kv= 2.5 fps
35.1	1,353	Total			

**Summary for Subcatchment 10S: OFFSITE 2 (above Perkins Rd)**

Runoff = 22.26 cfs @ 13.30 hrs, Volume= 4.868 af, Depth> 1.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-year Rainfall=4.20"

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 10-year Rainfall=4.20"

Printed 4/21/2019

Page 29

Area (sf)	CN	Description
* 298,066	70	Woods, Good, HSG C/D
* 42,276	98	Impervious
* 1,304,640	74	>75% Grass cover, Good, HSG C/D
1,644,982	74	Weighted Average
1,602,706		97.43% Pervious Area
42,276		2.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
45.2	141	0.0280	0.05		<b>Sheet Flow, a-b</b> Woods: Dense underbrush n= 0.800 P2= 2.90"
15.3	384	0.0280	0.42		<b>Shallow Concentrated Flow, b-c</b> Forest w/Heavy Litter Kv= 2.5 fps
2.5	227	0.0480	1.53		<b>Shallow Concentrated Flow, c-d</b> Short Grass Pasture Kv= 7.0 fps
18.6	780	0.0100	0.70		<b>Shallow Concentrated Flow, d-e</b> Short Grass Pasture Kv= 7.0 fps
12.6	689	0.0170	0.91		<b>Shallow Concentrated Flow, e-f</b> Short Grass Pasture Kv= 7.0 fps
94.2	2,221	Total			

**Summary for Subcatchment 11S: OFFSITE 3 (Matthew Brothers Lot)**

Runoff = 27.08 cfs @ 12.10 hrs, Volume= 1.865 af, Depth> 1.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-year Rainfall=4.20"

Area (sf)	CN	Description
* 118,437	98	Impervious
* 237,621	70	Woods, Good, HSG C/D
* 157,469	74	>75% Grass cover, Good, HSG C/D
513,527	78	Weighted Average
395,090		76.94% Pervious Area
118,437		23.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	16	0.1870	2.22		<b>Sheet Flow, a-b</b> Smooth surfaces n= 0.011 P2= 2.90"
4.7	419	0.0100	1.50		<b>Shallow Concentrated Flow, b-c</b> Grassed Waterway Kv= 15.0 fps
2.0	97	0.1000	0.79		<b>Shallow Concentrated Flow, c-d</b> Forest w/Heavy Litter Kv= 2.5 fps
6.8	532	Total			

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

**Summary for Reach 5R: ANALYSIS POINT 5**

Inflow Area = 5.309 ac, 0.00% Impervious, Inflow Depth > 1.59" for 10-year event  
Inflow = 5.90 cfs @ 12.46 hrs, Volume= 0.704 af  
Outflow = 5.90 cfs @ 12.46 hrs, Volume= 0.704 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach 6R: AP for SC 6**

Inflow Area = 7.866 ac, 10.21% Impervious, Inflow Depth > 1.73" for 10-year event  
Inflow = 8.32 cfs @ 12.59 hrs, Volume= 1.132 af  
Outflow = 8.32 cfs @ 12.59 hrs, Volume= 1.132 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach 9R: ANALYSIS POINT 9**

Inflow Area = 13.097 ac, 4.47% Impervious, Inflow Depth > 1.66" for 10-year event  
Inflow = 14.44 cfs @ 12.51 hrs, Volume= 1.811 af  
Outflow = 14.44 cfs @ 12.51 hrs, Volume= 1.811 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach 10R: Perkins Road Culvert**

Inflow Area = 37.764 ac, 2.57% Impervious, Inflow Depth > 1.55" for 10-year event  
Inflow = 22.26 cfs @ 13.30 hrs, Volume= 4.868 af  
Outflow = 22.25 cfs @ 13.30 hrs, Volume= 4.868 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs / 2

Max. Velocity= 11.00 fps, Min. Travel Time= 0.0 min

Avg. Velocity = 6.58 fps, Avg. Travel Time= 0.1 min

Peak Storage= 51 cf @ 13.30 hrs

Average Depth at Peak Storage= 1.23'

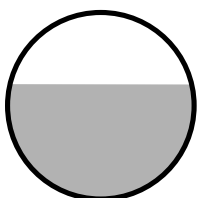
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 31.99 cfs

24.0" Round Pipe

n= 0.013 Corrugated PE, smooth interior

Length= 25.0' Slope= 0.0200 '/'

Inlet Invert= 75.50', Outlet Invert= 75.00'



**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 10-year Rainfall=4.20"

Printed 4/21/2019

Page 31

**Summary for Reach 11R: At Stream 9**

Inflow Area = 11.789 ac, 23.06% Impervious, Inflow Depth > 1.90" for 10-year event  
Inflow = 27.08 cfs @ 12.10 hrs, Volume= 1.865 af  
Outflow = 27.08 cfs @ 12.10 hrs, Volume= 1.865 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach PT1: Analysis Point 1 at BWD Little River**

Inflow Area = 7.258 ac, 0.00% Impervious, Inflow Depth > 1.31" for 10-year event  
Inflow = 4.77 cfs @ 12.83 hrs, Volume= 0.792 af  
Outflow = 4.77 cfs @ 12.83 hrs, Volume= 0.792 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach PT2: ANALYSIS POINT 2 at BWD reservoir**

Inflow Area = 15.893 ac, 0.00% Impervious, Inflow Depth > 1.28" for 10-year event  
Inflow = 7.25 cfs @ 13.43 hrs, Volume= 1.695 af  
Outflow = 7.25 cfs @ 13.43 hrs, Volume= 1.695 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach PT3: ANALYSIS POINT 3 at BWD reservoir**

Inflow Area = 8.979 ac, 0.00% Impervious, Inflow Depth > 1.44" for 10-year event  
Inflow = 7.24 cfs @ 12.70 hrs, Volume= 1.081 af  
Outflow = 7.24 cfs @ 12.70 hrs, Volume= 1.081 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach PT4: ANALYSIS POINT 4 at BWD reservoir**

Inflow Area = 5.847 ac, 0.00% Impervious, Inflow Depth > 1.46" for 10-year event  
Inflow = 6.00 cfs @ 12.45 hrs, Volume= 0.710 af  
Outflow = 6.00 cfs @ 12.45 hrs, Volume= 0.710 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach PT5: all points at BWD Reservoir**

Inflow Area = 30.718 ac, 0.00% Impervious, Inflow Depth > 1.36" for 10-year event  
Inflow = 14.99 cfs @ 12.70 hrs, Volume= 3.485 af  
Outflow = 14.99 cfs @ 12.70 hrs, Volume= 3.485 af, Atten= 0%, Lag= 0.0 min



**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach PT6: Stream 9-1**

Inflow Area =	62.650 ac,	6.82% Impervious,	Inflow Depth > 1.64"	for 10-year event
Inflow =	34.26 cfs @	12.11 hrs,	Volume=	8.544 af
Outflow =	32.89 cfs @	12.17 hrs,	Volume=	8.523 af, Atten= 4%, Lag= 3.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Max. Velocity= 4.84 fps, Min. Travel Time= 1.7 min  
 Avg. Velocity = 2.74 fps, Avg. Travel Time= 2.9 min

Peak Storage= 3,327 cf @ 12.14 hrs  
 Average Depth at Peak Storage= 0.99'  
 Bank-Full Depth= 4.00' Flow Area= 52.0 sf, Capacity= 535.88 cfs

5.00' x 4.00' deep channel, n= 0.030 Stream, clean & straight  
 Side Slope Z-value= 2.0 ' ' Top Width= 21.00'  
 Length= 483.0' Slope= 0.0145 ' '  
 Inlet Invert= 71.00', Outlet Invert= 64.00'



**Summary for Reach PT7: ANALYSIS POINT 7 at US Rte 1 culvert**

Inflow Area =	2.213 ac,	0.00% Impervious,	Inflow Depth > 1.30"	for 10-year event
Inflow =	1.36 cfs @	12.92 hrs,	Volume=	0.241 af
Outflow =	1.36 cfs @	12.93 hrs,	Volume=	0.240 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Max. Velocity= 6.67 fps, Min. Travel Time= 0.2 min  
 Avg. Velocity = 3.80 fps, Avg. Travel Time= 0.4 min

Peak Storage= 17 cf @ 12.92 hrs  
 Average Depth at Peak Storage= 0.26'  
 Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 20.95 cfs

18.0" Round Pipe  
 n= 0.013 Corrugated PE, smooth interior  
 Length= 83.0' Slope= 0.0398 ' '  
 Inlet Invert= 21.60', Outlet Invert= 18.30'

**pre conditions**

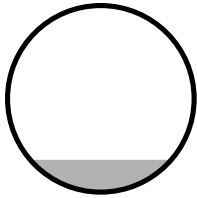
Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 10-year Rainfall=4.20"

Printed 4/21/2019

Page 33



**Summary for Reach PT8: ANALYSIS POINT 8 at US Rte 1 culvert**

Inflow Area = 0.344 ac, 0.00% Impervious, Inflow Depth > 1.39" for 10-year event  
Inflow = 0.31 cfs @ 12.52 hrs, Volume= 0.040 af  
Outflow = 0.31 cfs @ 12.53 hrs, Volume= 0.040 af, Atten= 0%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Max. Velocity= 3.45 fps, Min. Travel Time= 0.4 min  
Avg. Velocity = 2.53 fps, Avg. Travel Time= 0.5 min

Peak Storage= 7 cf @ 12.52 hrs  
Average Depth at Peak Storage= 0.03'  
Bank-Full Depth= 2.00' Flow Area= 6.0 sf, Capacity= 144.91 cfs

36.0" W x 24.0" H Box Pipe  
n= 0.011 Concrete pipe, straight & clean  
Length= 76.0' Slope= 0.0632 '/'  
Inlet Invert= 23.40', Outlet Invert= 18.60'



**Summary for Reach PT9: Analysis Pt Stream 9 at US Rte 1 Culvert**

Inflow Area = 75.825 ac, 6.70% Impervious, Inflow Depth > 1.63" for 10-year event  
Inflow = 42.91 cfs @ 12.67 hrs, Volume= 10.273 af  
Outflow = 42.90 cfs @ 12.67 hrs, Volume= 10.272 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Max. Velocity= 22.55 fps, Min. Travel Time= 0.1 min  
Avg. Velocity = 13.08 fps, Avg. Travel Time= 0.1 min

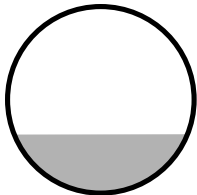
Peak Storage= 177 cf @ 12.67 hrs  
Average Depth at Peak Storage= 0.94'  
Bank-Full Depth= 3.00' Flow Area= 7.1 sf, Capacity= 200.22 cfs

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

36.0" Round Pipe  
n= 0.011 Concrete pipe, straight & clean  
Length= 93.0' Slope= 0.0645 '/'  
Inlet Invert= 20.00', Outlet Invert= 14.00'



**Summary for Reach S9-2: Stream 9**

Inflow Area = 75.825 ac, 6.70% Impervious, Inflow Depth > 1.64" for 10-year event  
Inflow = 43.38 cfs @ 12.51 hrs, Volume= 10.359 af  
Outflow = 42.98 cfs @ 12.64 hrs, Volume= 10.290 af, Atten= 1%, Lag= 7.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Max. Velocity= 6.17 fps, Min. Travel Time= 4.3 min  
Avg. Velocity = 3.37 fps, Avg. Travel Time= 7.8 min

Peak Storage= 11,030 cf @ 12.57 hrs  
Average Depth at Peak Storage= 1.00'  
Bank-Full Depth= 2.00' Flow Area= 18.0 sf, Capacity= 161.21 cfs

5.00' x 2.00' deep channel, n= 0.030 Stream, clean & straight  
Side Slope Z-value= 2.0 '/' Top Width= 13.00'  
Length= 1,580.0' Slope= 0.0233 '/'  
Inlet Invert= 64.00', Outlet Invert= 27.25'



**Summary for Reach S9-3: Stream 9**

Inflow Area = 75.825 ac, 6.70% Impervious, Inflow Depth > 1.63" for 10-year event  
Inflow = 42.98 cfs @ 12.64 hrs, Volume= 10.290 af  
Outflow = 42.91 cfs @ 12.67 hrs, Volume= 10.273 af, Atten= 0%, Lag= 2.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Max. Velocity= 5.49 fps, Min. Travel Time= 1.1 min  
Avg. Velocity = 3.08 fps, Avg. Travel Time= 2.0 min

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development

Type III 24-hr 10-year Rainfall=4.20"

Printed 4/21/2019

Page 35

Peak Storage= 2,850 cf @ 12.65 hrs

Average Depth at Peak Storage= 0.98'

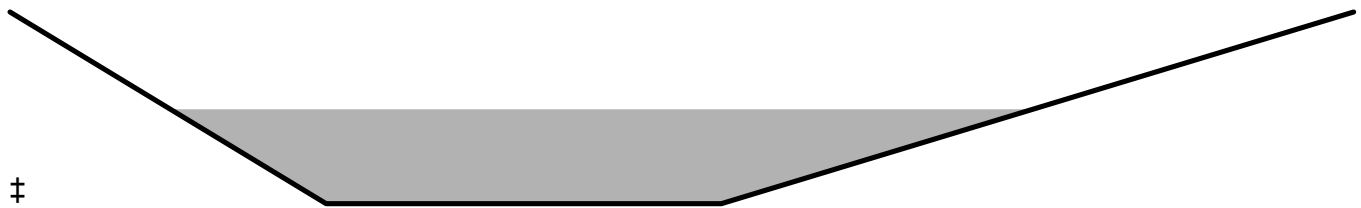
Bank-Full Depth= 2.00' Flow Area= 22.0 sf, Capacity= 177.67 cfs

5.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding

Side Slope Z-value= 2.0 4.0 ' / ' Top Width= 17.00'

Length= 364.0' Slope= 0.0199 ' / '

Inlet Invert= 27.25', Outlet Invert= 20.00'



**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 25-year Rainfall=5.20"

Printed 4/21/2019

Page 36

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

<b>Subcatchment1S: SUBCAT 1</b>	Runoff Area=316,158 sf 0.00% Impervious Runoff Depth>1.97" Flow Length=898' Tc=57.7 min CN=70 Runoff=7.33 cfs 1.193 af
<b>Subcatchment2S: SUBCAT 2</b>	Runoff Area=692,288 sf 0.00% Impervious Runoff Depth>1.93" Flow Length=1,533' Tc=101.5 min CN=70 Runoff=11.16 cfs 2.559 af
<b>Subcatchment3S: SUBCAT 3</b>	Runoff Area=391,117 sf 0.00% Impervious Runoff Depth>2.14" Flow Length=1,335' Tc=48.7 min CN=72 Runoff=10.85 cfs 1.601 af
<b>Subcatchment4S: SUBCAT 4</b>	Runoff Area=254,691 sf 0.00% Impervious Runoff Depth>2.16" Flow Length=1,170' Tc=30.2 min CN=72 Runoff=8.98 cfs 1.051 af
<b>Subcatchment5S: SUBCAT 5</b>	Runoff Area=231,278 sf 0.00% Impervious Runoff Depth>2.32" Flow Length=839' Tc=31.3 min CN=74 Runoff=8.65 cfs 1.026 af
<b>Subcatchment6S: SUBCAT 6</b>	Runoff Area=342,649 sf 10.21% Impervious Runoff Depth>2.48" Flow Length=445' Tc=41.6 min CN=76 Runoff=11.99 cfs 1.626 af
<b>Subcatchment7S: SUBCAT 7</b>	Runoff Area=96,383 sf 0.00% Impervious Runoff Depth>1.97" Flow Length=541' Tc=64.7 min CN=70 Runoff=2.09 cfs 0.363 af
<b>Subcatchment8S: SUBCAT 8</b>	Runoff Area=14,976 sf 0.00% Impervious Runoff Depth>2.07" Flow Length=276' Tc=34.7 min CN=71 Runoff=0.48 cfs 0.059 af
<b>Subcatchment9S: OFFSITE 1 (Below</b>	Runoff Area=570,508 sf 4.47% Impervious Runoff Depth>2.40" Flow Length=1,353' Tc=35.1 min CN=75 Runoff=20.97 cfs 2.620 af
<b>Subcatchment10S: OFFSITE 2 (above</b>	Runoff Area=1,644,982 sf 2.57% Impervious Runoff Depth>2.26" Flow Length=2,221' Tc=94.2 min CN=74 Runoff=32.78 cfs 7.112 af
<b>Subcatchment11S: OFFSITE 3 (Matthew</b>	Runoff Area=513,527 sf 23.06% Impervious Runoff Depth>2.69" Flow Length=532' Tc=6.8 min CN=78 Runoff=38.24 cfs 2.640 af
<b>Reach 5R: ANALYSISPOINT 5</b>	Inflow=8.65 cfs 1.026 af Outflow=8.65 cfs 1.026 af
<b>Reach 6R: AP for SC 6</b>	Inflow=11.99 cfs 1.626 af Outflow=11.99 cfs 1.626 af
<b>Reach 9R: ANALYSISPOINT 9</b>	Inflow=20.97 cfs 2.620 af Outflow=20.97 cfs 2.620 af
<b>Reach 10R: Perkins Road Culvert</b>	Avg. Flow Depth=1.69' Max Vel=11.61 fps Inflow=32.78 cfs 7.112 af 24.0" Round Pipe n=0.013 L=25.0' S=0.0200 ' ' Capacity=31.99 cfs Outflow=32.77 cfs 7.112 af
<b>Reach 11R: At Stream 9</b>	Inflow=38.24 cfs 2.640 af Outflow=38.24 cfs 2.640 af

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 25-year Rainfall=5.20"

Printed 4/21/2019

Page 37

**Reach PT1: Analysis Point 1 at BWD Little River**

Inflow=7.33 cfs 1.193 af  
Outflow=7.33 cfs 1.193 af

**Reach PT2: ANALYSISPOINT 2 at BWD reservoir**

Inflow=11.16 cfs 2.559 af  
Outflow=11.16 cfs 2.559 af

**Reach PT3: ANALYSISPOINT 3 at BWD reservoir**

Inflow=10.85 cfs 1.601 af  
Outflow=10.85 cfs 1.601 af

**Reach PT4: ANALYSISPOINT 4 at BWD reservoir**

Inflow=8.98 cfs 1.051 af  
Outflow=8.98 cfs 1.051 af

**Reach PT5: all points at BWD Reservoir**

Inflow=22.88 cfs 5.211 af  
Outflow=22.88 cfs 5.211 af

**Reach PT6: Stream 9-1**

Avg. Flow Depth=1.22' Max Vel=5.41 fps Inflow=50.22 cfs 12.372 af  
n=0.030 L=483.0' S=0.0145 '/' Capacity=535.88 cfs Outflow=48.36 cfs 12.346 af

**Reach PT7: ANALYSISPOINT 7 at US**

Avg. Flow Depth=0.32' Max Vel=7.57 fps Inflow=2.09 cfs 0.363 af  
18.0" Round Pipe n=0.013 L=83.0' S=0.0398 '/' Capacity=20.95 cfs Outflow=2.08 cfs 0.363 af

**Reach PT8: ANALYSISPOINT 8 at US**

Avg. Flow Depth=0.04' Max Vel=3.93 fps Inflow=0.48 cfs 0.059 af  
36.0" x 24.0" Box Pipe n=0.011 L=76.0' S=0.0632 '/' Capacity=144.91 cfs Outflow=0.48 cfs 0.059 af

**Reach PT9: Analysis Pt Stream 9 at**

Avg. Flow Depth=1.16' Max Vel=25.08 fps Inflow=62.97 cfs 14.895 af  
36.0" Round Pipe n=0.011 L=93.0' S=0.0645 '/' Capacity=200.22 cfs Outflow=62.97 cfs 14.894 af

**Reach S9-2: Stream 9**

Avg. Flow Depth=1.23' Max Vel=6.90 fps Inflow=63.56 cfs 14.998 af  
n=0.030 L=1,580.0' S=0.0233 '/' Capacity=161.21 cfs Outflow=63.09 cfs 14.916 af

**Reach S9-3: Stream 9**

Avg. Flow Depth=1.20' Max Vel=6.11 fps Inflow=63.09 cfs 14.916 af  
n=0.030 L=364.0' S=0.0199 '/' Capacity=177.67 cfs Outflow=62.97 cfs 14.895 af

**Total Runoff Area = 116.358 ac Runoff Volume = 21.851 af Average Runoff Depth = 2.25"**  
**95.64% Pervious = 111.280 ac 4.36% Impervious = 5.078 ac**

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 25-year Rainfall=5.20"

Printed 4/21/2019

Page 38

**Summary for Subcatchment 1S: SUBCAT 1**

Runoff = 7.33 cfs @ 12.81 hrs, Volume= 1.193 af, Depth> 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-year Rainfall=5.20"

	Area (sf)	CN	Description
*	303,390	70	Woods, Good, HSG C/D
	12,768	70	Woods, Good, HSG C
	316,158	70	Weighted Average
	316,158		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.6	88	0.0450	0.06		<b>Sheet Flow, a-b</b> Woods: Dense underbrush n= 0.800 P2= 2.90"
3.5	65	0.0150	0.31		<b>Shallow Concentrated Flow, b-c</b> Forest w/Heavy Litter Kv= 2.5 fps
2.0	72	0.0550	0.59		<b>Shallow Concentrated Flow, c-d</b> Forest w/Heavy Litter Kv= 2.5 fps
25.6	470	0.0150	0.31		<b>Shallow Concentrated Flow, d-e</b> Forest w/Heavy Litter Kv= 2.5 fps
1.0	203	0.1000	3.41	13.64	<b>Trap/Vee/Rect Channel Flow, e-f</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100 Earth, dense brush, high stage
57.7	898	Total			

**Summary for Subcatchment 2S: SUBCAT 2**

Runoff = 11.16 cfs @ 13.41 hrs, Volume= 2.559 af, Depth> 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-year Rainfall=5.20"

	Area (sf)	CN	Description
*	653,559	70	Woods, Good, HSG C/D
*	38,729	74	>75% Grass cover, Good, HSG C/D
	692,288	70	Weighted Average
	692,288		100.00% Pervious Area

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 25-year Rainfall=5.20"

Printed 4/21/2019

Page 39

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
55.7	134	0.0150	0.04		<b>Sheet Flow, a-b</b> Woods: Dense underbrush n= 0.800 P2= 2.90"
5.8	175	0.0400	0.50		<b>Shallow Concentrated Flow, b-c</b> Forest w/Heavy Litter Kv= 2.5 fps
13.3	199	0.0100	0.25		<b>Shallow Concentrated Flow, c-d</b> Forest w/Heavy Litter Kv= 2.5 fps
1.2	41	0.0490	0.55		<b>Shallow Concentrated Flow, d-e</b> Forest w/Heavy Litter Kv= 2.5 fps
22.1	468	0.0200	0.35		<b>Shallow Concentrated Flow, e-f</b> Forest w/Heavy Litter Kv= 2.5 fps
3.4	516	0.0550	2.53	10.11	<b>Trap/Vee/Rect Channel Flow, f-g</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100 Earth, dense brush, high stage
101.5	1,533	Total			

**Summary for Subcatchment 3S: SUBCAT 3**

Runoff = 10.85 cfs @ 12.69 hrs, Volume= 1.601 af, Depth> 2.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-year Rainfall=5.20"

Area (sf)	CN	Description
205,588	74	>75% Grass cover, Good, HSG C/D
22,290	74	>75% Grass cover, Good, HSG C
163,239	70	Woods, Good, HSG C
391,117	72	Weighted Average
391,117		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.1	115	0.0400	0.10		<b>Sheet Flow, a-b</b> Woods: Light underbrush n= 0.400 P2= 2.90"
3.4	155	0.0230	0.76		<b>Shallow Concentrated Flow, b-c</b> Woodland Kv= 5.0 fps
9.3	372	0.0090	0.66		<b>Shallow Concentrated Flow, c-d</b> Short Grass Pasture Kv= 7.0 fps
2.3	134	0.0190	0.96		<b>Shallow Concentrated Flow, d-e</b> Short Grass Pasture Kv= 7.0 fps
12.6	254	0.0180	0.34		<b>Shallow Concentrated Flow, e-f</b> Forest w/Heavy Litter Kv= 2.5 fps
2.0	305	0.0560	2.55	10.21	<b>Trap/Vee/Rect Channel Flow, f-g</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100 Earth, dense brush, high stage
48.7	1,335	Total			



**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 25-year Rainfall=5.20"

Printed 4/21/2019

Page 40

**Summary for Subcatchment 4S: SUBCAT 4**

Runoff = 8.98 cfs @ 12.43 hrs, Volume= 1.051 af, Depth> 2.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-year Rainfall=5.20"

	Area (sf)	CN	Description
*	130,853	74	>75% Grass cover, Good, HSG C/D
	26,033	74	>75% Grass cover, Good, HSG C
	40,857	70	Woods, Good, HSG C
*	56,948	70	Woods, Good, HSG C/D
	254,691	72	Weighted Average
	254,691		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.9	135	0.0270	0.13		<b>Sheet Flow, a-b</b> Grass: Dense n= 0.240 P2= 2.90"
7.8	462	0.0200	0.99		<b>Shallow Concentrated Flow, b-c</b> Short Grass Pasture Kv= 7.0 fps
2.2	184	0.0380	1.36		<b>Shallow Concentrated Flow, c-d</b> Short Grass Pasture Kv= 7.0 fps
3.3	389	0.0330	1.96	7.83	<b>Trap/Vee/Rect Channel Flow, d-e</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100 Earth, dense brush, high stage
30.2	1,170	Total			

**Summary for Subcatchment 5S: SUBCAT 5**

Runoff = 8.65 cfs @ 12.45 hrs, Volume= 1.026 af, Depth> 2.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-year Rainfall=5.20"

	Area (sf)	CN	Description
*	156,287	74	>75% Grass cover, Good, HSG C/D
	74,991	74	>75% Grass cover, Good, HSG C
	231,278	74	Weighted Average
	231,278		100.00% Pervious Area

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 25-year Rainfall=5.20"

Printed 4/21/2019

Page 41

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.0	198	0.0270	0.14		<b>Sheet Flow, a-b</b> Grass: Dense n= 0.240 P2= 2.90"
2.9	146	0.0140	0.83		<b>Shallow Concentrated Flow, b-c</b> Short Grass Pasture Kv= 7.0 fps
3.8	285	0.0320	1.25		<b>Shallow Concentrated Flow, c-d</b> Short Grass Pasture Kv= 7.0 fps
1.6	210	0.0430	2.24	8.94	<b>Trap/Vee/Rect Channel Flow, d-e</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100 Earth, dense brush, high stage
31.3	839	Total			

**Summary for Subcatchment 6S: SUBCAT 6**

Runoff = 11.99 cfs @ 12.58 hrs, Volume= 1.626 af, Depth> 2.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-year Rainfall=5.20"

Area (sf)	CN	Description
* 142,888	70	Woods, Good, HSG C/D
10,372	70	Woods, Good, HSG C
* 61,952	74	>75% Grass cover, Good, HSG C/D
635	74	>75% Grass cover, Good, HSG C
51,989	80	>75% Grass cover, Good, HSG D
* 7,818	96	Gravel
* 34,971	98	Impervious
32,024	77	Woods, Good, HSG D
342,649	76	Weighted Average
307,678		89.79% Pervious Area
34,971		10.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.0	67	0.0150	0.03		<b>Sheet Flow, a-b</b> Woods: Dense underbrush n= 0.800 P2= 2.90"
5.2	92	0.0140	0.30		<b>Shallow Concentrated Flow, b-c</b> Forest w/Heavy Litter Kv= 2.5 fps
1.8	74	0.0100	0.70		<b>Shallow Concentrated Flow, c-d</b> Short Grass Pasture Kv= 7.0 fps
1.7	163	0.0550	1.64		<b>Shallow Concentrated Flow, d-e</b> Short Grass Pasture Kv= 7.0 fps
0.8	39	0.1000	0.79		<b>Shallow Concentrated Flow, e-f</b> Forest w/Heavy Litter Kv= 2.5 fps
0.1	10	0.5000	1.77		<b>Shallow Concentrated Flow, f-g</b> Forest w/Heavy Litter Kv= 2.5 fps
41.6	445	Total			

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

**Summary for Subcatchment 7S: SUBCAT 7**

Runoff = 2.09 cfs @ 12.90 hrs, Volume= 0.363 af, Depth> 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-year Rainfall=5.20"

Area (sf)	CN	Description
* 93,505	70	Woods, Good, HSG C/D
* 2,878	74	>75% Grass cover, Good, HSG C/D
96,383	70	Weighted Average
96,383		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
54.6	172	0.0260	0.05		<b>Sheet Flow, a-b</b> Woods: Dense underbrush n= 0.800 P2= 2.90"
2.8	112	0.0700	0.66		<b>Shallow Concentrated Flow, b-c</b> Forest w/Heavy Litter Kv= 2.5 fps
0.2	13	0.2300	1.20		<b>Shallow Concentrated Flow, c-d</b> Forest w/Heavy Litter Kv= 2.5 fps
6.6	171	0.0300	0.43		<b>Shallow Concentrated Flow, d-e</b> Forest w/Heavy Litter Kv= 2.5 fps
0.5	73	0.0600	2.64	10.56	<b>Trap/Vee/Rect Channel Flow, e-f</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100 Earth, dense brush, high stage
64.7	541	Total			

**Summary for Subcatchment 8S: SUBCAT 8**

Runoff = 0.48 cfs @ 12.50 hrs, Volume= 0.059 af, Depth> 2.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-year Rainfall=5.20"

Area (sf)	CN	Description
* 12,652	70	Woods, Good, HSG C/D
* 2,324	74	>75% Grass cover, Good, HSG C/D
14,976	71	Weighted Average
14,976		100.00% Pervious Area

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 25-year Rainfall=5.20"

Printed 4/21/2019

Page 43

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.0	67	0.0150	0.03		<b>Sheet Flow, a-b</b> Woods: Dense underbrush n= 0.800 P2= 2.90"
1.1	43	0.0700	0.66		<b>Shallow Concentrated Flow, b-c</b> Forest w/Heavy Litter Kv= 2.5 fps
0.1	14	0.7100	2.11		<b>Shallow Concentrated Flow, c-d</b> Forest w/Heavy Litter Kv= 2.5 fps
1.5	152	0.0240	1.67	6.68	<b>Trap/Vee/Rect Channel Flow, d-e</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100
34.7	276	Total			

**Summary for Subcatchment 9S: OFFSITE 1 (Below Perkins Rd)**

Runoff = 20.97 cfs @ 12.50 hrs, Volume= 2.620 af, Depth> 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-year Rainfall=5.20"

Area (sf)	CN	Description
* 25,513	98	Impervious
* 532,320	74	>75% Grass cover, Good, HSG C/D
* 3,818	94	Gravel roads, HSG C/D
8,857	74	>75% Grass cover, Good, HSG C
570,508	75	Weighted Average
544,995		95.53% Pervious Area
25,513		4.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	15	0.2000	2.25		<b>Sheet Flow, a-b</b> Smooth surfaces n= 0.011 P2= 2.90"
12.6	373	0.0050	0.49		<b>Shallow Concentrated Flow, b-c</b> Short Grass Pasture Kv= 7.0 fps
13.1	715	0.0170	0.91		<b>Shallow Concentrated Flow, c-d</b> Short Grass Pasture Kv= 7.0 fps
9.3	250	0.0320	0.45		<b>Shallow Concentrated Flow, d-e</b> Forest w/Heavy Litter Kv= 2.5 fps
35.1	1,353	Total			

**Summary for Subcatchment 10S: OFFSITE 2 (above Perkins Rd)**

Runoff = 32.78 cfs @ 13.29 hrs, Volume= 7.112 af, Depth> 2.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-year Rainfall=5.20"

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 25-year Rainfall=5.20"

Printed 4/21/2019

Page 44

Area (sf)	CN	Description
* 298,066	70	Woods, Good, HSG C/D
* 42,276	98	Impervious
* 1,304,640	74	>75% Grass cover, Good, HSG C/D
1,644,982	74	Weighted Average
1,602,706		97.43% Pervious Area
42,276		2.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
45.2	141	0.0280	0.05		<b>Sheet Flow, a-b</b> Woods: Dense underbrush n= 0.800 P2= 2.90"
15.3	384	0.0280	0.42		<b>Shallow Concentrated Flow, b-c</b> Forest w/Heavy Litter Kv= 2.5 fps
2.5	227	0.0480	1.53		<b>Shallow Concentrated Flow, c-d</b> Short Grass Pasture Kv= 7.0 fps
18.6	780	0.0100	0.70		<b>Shallow Concentrated Flow, d-e</b> Short Grass Pasture Kv= 7.0 fps
12.6	689	0.0170	0.91		<b>Shallow Concentrated Flow, e-f</b> Short Grass Pasture Kv= 7.0 fps
94.2	2,221	Total			

**Summary for Subcatchment 11S: OFFSITE 3 (Matthew Brothers Lot)**

Runoff = 38.24 cfs @ 12.10 hrs, Volume= 2.640 af, Depth> 2.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-year Rainfall=5.20"

Area (sf)	CN	Description
* 118,437	98	Impervious
* 237,621	70	Woods, Good, HSG C/D
* 157,469	74	>75% Grass cover, Good, HSG C/D
513,527	78	Weighted Average
395,090		76.94% Pervious Area
118,437		23.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	16	0.1870	2.22		<b>Sheet Flow, a-b</b> Smooth surfaces n= 0.011 P2= 2.90"
4.7	419	0.0100	1.50		<b>Shallow Concentrated Flow, b-c</b> Grassed Waterway Kv= 15.0 fps
2.0	97	0.1000	0.79		<b>Shallow Concentrated Flow, c-d</b> Forest w/Heavy Litter Kv= 2.5 fps
6.8	532	Total			

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

**Summary for Reach 5R: ANALYSIS POINT 5**

Inflow Area = 5.309 ac, 0.00% Impervious, Inflow Depth > 2.32" for 25-year event  
Inflow = 8.65 cfs @ 12.45 hrs, Volume= 1.026 af  
Outflow = 8.65 cfs @ 12.45 hrs, Volume= 1.026 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach 6R: AP for SC 6**

Inflow Area = 7.866 ac, 10.21% Impervious, Inflow Depth > 2.48" for 25-year event  
Inflow = 11.99 cfs @ 12.58 hrs, Volume= 1.626 af  
Outflow = 11.99 cfs @ 12.58 hrs, Volume= 1.626 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach 9R: ANALYSIS POINT 9**

Inflow Area = 13.097 ac, 4.47% Impervious, Inflow Depth > 2.40" for 25-year event  
Inflow = 20.97 cfs @ 12.50 hrs, Volume= 2.620 af  
Outflow = 20.97 cfs @ 12.50 hrs, Volume= 2.620 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach 10R: Perkins Road Culvert**

Inflow Area = 37.764 ac, 2.57% Impervious, Inflow Depth > 2.26" for 25-year event  
Inflow = 32.78 cfs @ 13.29 hrs, Volume= 7.112 af  
Outflow = 32.77 cfs @ 13.29 hrs, Volume= 7.112 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs / 2

Max. Velocity= 11.61 fps, Min. Travel Time= 0.0 min

Avg. Velocity = 7.03 fps, Avg. Travel Time= 0.1 min

Peak Storage= 71 cf @ 13.29 hrs

Average Depth at Peak Storage= 1.69'

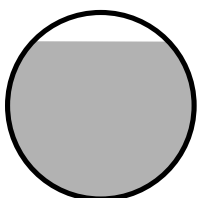
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 31.99 cfs

24.0" Round Pipe

n= 0.013 Corrugated PE, smooth interior

Length= 25.0' Slope= 0.0200 '/'

Inlet Invert= 75.50', Outlet Invert= 75.00'



**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 25-year Rainfall=5.20"

Printed 4/21/2019

Page 46

**Summary for Reach 11R: At Stream 9**

Inflow Area = 11.789 ac, 23.06% Impervious, Inflow Depth > 2.69" for 25-year event  
Inflow = 38.24 cfs @ 12.10 hrs, Volume= 2.640 af  
Outflow = 38.24 cfs @ 12.10 hrs, Volume= 2.640 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach PT1: Analysis Point 1 at BWD Little River**

Inflow Area = 7.258 ac, 0.00% Impervious, Inflow Depth > 1.97" for 25-year event  
Inflow = 7.33 cfs @ 12.81 hrs, Volume= 1.193 af  
Outflow = 7.33 cfs @ 12.81 hrs, Volume= 1.193 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach PT2: ANALYSIS POINT 2 at BWD reservoir**

Inflow Area = 15.893 ac, 0.00% Impervious, Inflow Depth > 1.93" for 25-year event  
Inflow = 11.16 cfs @ 13.41 hrs, Volume= 2.559 af  
Outflow = 11.16 cfs @ 13.41 hrs, Volume= 2.559 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach PT3: ANALYSIS POINT 3 at BWD reservoir**

Inflow Area = 8.979 ac, 0.00% Impervious, Inflow Depth > 2.14" for 25-year event  
Inflow = 10.85 cfs @ 12.69 hrs, Volume= 1.601 af  
Outflow = 10.85 cfs @ 12.69 hrs, Volume= 1.601 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach PT4: ANALYSIS POINT 4 at BWD reservoir**

Inflow Area = 5.847 ac, 0.00% Impervious, Inflow Depth > 2.16" for 25-year event  
Inflow = 8.98 cfs @ 12.43 hrs, Volume= 1.051 af  
Outflow = 8.98 cfs @ 12.43 hrs, Volume= 1.051 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach PT5: all points at BWD Reservoir**

Inflow Area = 30.718 ac, 0.00% Impervious, Inflow Depth > 2.04" for 25-year event  
Inflow = 22.88 cfs @ 12.68 hrs, Volume= 5.211 af  
Outflow = 22.88 cfs @ 12.68 hrs, Volume= 5.211 af, Atten= 0%, Lag= 0.0 min

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach PT6: Stream 9-1**

Inflow Area = 62.650 ac, 6.82% Impervious, Inflow Depth > 2.37" for 25-year event  
Inflow = 50.22 cfs @ 12.11 hrs, Volume= 12.372 af  
Outflow = 48.36 cfs @ 12.16 hrs, Volume= 12.346 af, Atten= 4%, Lag= 3.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Max. Velocity= 5.41 fps, Min. Travel Time= 1.5 min  
Avg. Velocity = 2.96 fps, Avg. Travel Time= 2.7 min

Peak Storage= 4,366 cf @ 12.14 hrs  
Average Depth at Peak Storage= 1.22'  
Bank-Full Depth= 4.00' Flow Area= 52.0 sf, Capacity= 535.88 cfs

5.00' x 4.00' deep channel, n= 0.030 Stream, clean & straight  
Side Slope Z-value= 2.0 ' ' Top Width= 21.00'  
Length= 483.0' Slope= 0.0145 ' '  
Inlet Invert= 71.00', Outlet Invert= 64.00'



**Summary for Reach PT7: ANALYSIS POINT 7 at US Rte 1 culvert**

Inflow Area = 2.213 ac, 0.00% Impervious, Inflow Depth > 1.97" for 25-year event  
Inflow = 2.09 cfs @ 12.90 hrs, Volume= 0.363 af  
Outflow = 2.08 cfs @ 12.91 hrs, Volume= 0.363 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Max. Velocity= 7.57 fps, Min. Travel Time= 0.2 min  
Avg. Velocity = 4.12 fps, Avg. Travel Time= 0.3 min

Peak Storage= 23 cf @ 12.90 hrs  
Average Depth at Peak Storage= 0.32'  
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 20.95 cfs

18.0" Round Pipe  
n= 0.013 Corrugated PE, smooth interior  
Length= 83.0' Slope= 0.0398 ' '  
Inlet Invert= 21.60', Outlet Invert= 18.30'



**pre conditions**

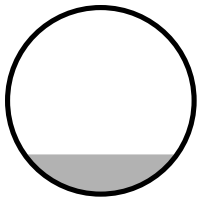
Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 25-year Rainfall=5.20"

Printed 4/21/2019

Page 48



**Summary for Reach PT8: ANALYSIS POINT 8 at US Rte 1 culvert**

Inflow Area = 0.344 ac, 0.00% Impervious, Inflow Depth > 2.07" for 25-year event  
Inflow = 0.48 cfs @ 12.50 hrs, Volume= 0.059 af  
Outflow = 0.48 cfs @ 12.51 hrs, Volume= 0.059 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Max. Velocity= 3.93 fps, Min. Travel Time= 0.3 min  
Avg. Velocity = 2.58 fps, Avg. Travel Time= 0.5 min

Peak Storage= 9 cf @ 12.50 hrs  
Average Depth at Peak Storage= 0.04'  
Bank-Full Depth= 2.00' Flow Area= 6.0 sf, Capacity= 144.91 cfs

36.0" W x 24.0" H Box Pipe  
n= 0.011 Concrete pipe, straight & clean  
Length= 76.0' Slope= 0.0632 '/'  
Inlet Invert= 23.40', Outlet Invert= 18.60'



**Summary for Reach PT9: Analysis Pt Stream 9 at US Rte 1 Culvert**

Inflow Area = 75.825 ac, 6.70% Impervious, Inflow Depth > 2.36" for 25-year event  
Inflow = 62.97 cfs @ 12.65 hrs, Volume= 14.895 af  
Outflow = 62.97 cfs @ 12.65 hrs, Volume= 14.894 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Max. Velocity= 25.08 fps, Min. Travel Time= 0.1 min  
Avg. Velocity = 14.03 fps, Avg. Travel Time= 0.1 min

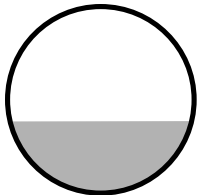
Peak Storage= 233 cf @ 12.65 hrs  
Average Depth at Peak Storage= 1.16'  
Bank-Full Depth= 3.00' Flow Area= 7.1 sf, Capacity= 200.22 cfs

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

36.0" Round Pipe  
n= 0.011 Concrete pipe, straight & clean  
Length= 93.0' Slope= 0.0645 '/'  
Inlet Invert= 20.00', Outlet Invert= 14.00'



**Summary for Reach S9-2: Stream 9**

Inflow Area = 75.825 ac, 6.70% Impervious, Inflow Depth > 2.37" for 25-year event  
Inflow = 63.56 cfs @ 12.51 hrs, Volume= 14.998 af  
Outflow = 63.09 cfs @ 12.62 hrs, Volume= 14.916 af, Atten= 1%, Lag= 6.7 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Max. Velocity= 6.90 fps, Min. Travel Time= 3.8 min  
Avg. Velocity = 3.65 fps, Avg. Travel Time= 7.2 min

Peak Storage= 14,468 cf @ 12.55 hrs  
Average Depth at Peak Storage= 1.23'  
Bank-Full Depth= 2.00' Flow Area= 18.0 sf, Capacity= 161.21 cfs

5.00' x 2.00' deep channel, n= 0.030 Stream, clean & straight  
Side Slope Z-value= 2.0 '/' Top Width= 13.00'  
Length= 1,580.0' Slope= 0.0233 '/'  
Inlet Invert= 64.00', Outlet Invert= 27.25'



**Summary for Reach S9-3: Stream 9**

Inflow Area = 75.825 ac, 6.70% Impervious, Inflow Depth > 2.36" for 25-year event  
Inflow = 63.09 cfs @ 12.62 hrs, Volume= 14.916 af  
Outflow = 62.97 cfs @ 12.65 hrs, Volume= 14.895 af, Atten= 0%, Lag= 1.9 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Max. Velocity= 6.11 fps, Min. Travel Time= 1.0 min  
Avg. Velocity = 3.32 fps, Avg. Travel Time= 1.8 min

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development

Type III 24-hr 25-year Rainfall=5.20"

Printed 4/21/2019

Page 50

Peak Storage= 3,757 cf @ 12.63 hrs

Average Depth at Peak Storage= 1.20'

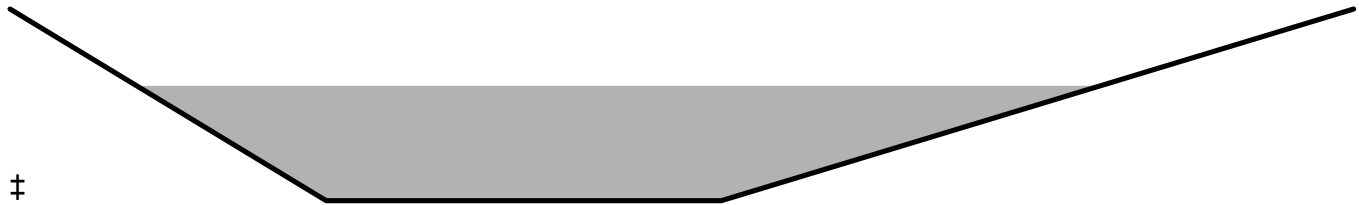
Bank-Full Depth= 2.00' Flow Area= 22.0 sf, Capacity= 177.67 cfs

5.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding

Side Slope Z-value= 2.0 4.0 ' / ' Top Width= 17.00'

Length= 364.0' Slope= 0.0199 ' / '

Inlet Invert= 27.25', Outlet Invert= 20.00'



**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 100-year Rainfall=7.20"

Printed 4/21/2019

Page 51

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

<b>Subcatchment1S: SUBCAT 1</b>	Runoff Area=316,158 sf 0.00% Impervious Runoff Depth>3.46" Flow Length=898' Tc=57.7 min CN=70 Runoff=12.93 cfs 2.090 af
<b>Subcatchment2S: SUBCAT 2</b>	Runoff Area=692,288 sf 0.00% Impervious Runoff Depth>3.39" Flow Length=1,533' Tc=101.5 min CN=70 Runoff=19.74 cfs 4.494 af
<b>Subcatchment3S: SUBCAT 3</b>	Runoff Area=391,117 sf 0.00% Impervious Runoff Depth>3.68" Flow Length=1,335' Tc=48.7 min CN=72 Runoff=18.64 cfs 2.750 af
<b>Subcatchment4S: SUBCAT 4</b>	Runoff Area=254,691 sf 0.00% Impervious Runoff Depth>3.70" Flow Length=1,170' Tc=30.2 min CN=72 Runoff=15.44 cfs 1.803 af
<b>Subcatchment5S: SUBCAT 5</b>	Runoff Area=231,278 sf 0.00% Impervious Runoff Depth>3.91" Flow Length=839' Tc=31.3 min CN=74 Runoff=14.53 cfs 1.729 af
<b>Subcatchment6S: SUBCAT 6</b>	Runoff Area=342,649 sf 10.21% Impervious Runoff Depth>4.11" Flow Length=445' Tc=41.6 min CN=76 Runoff=19.71 cfs 2.692 af
<b>Subcatchment7S: SUBCAT 7</b>	Runoff Area=96,383 sf 0.00% Impervious Runoff Depth>3.45" Flow Length=541' Tc=64.7 min CN=70 Runoff=3.68 cfs 0.636 af
<b>Subcatchment8S: SUBCAT 8</b>	Runoff Area=14,976 sf 0.00% Impervious Runoff Depth>3.59" Flow Length=276' Tc=34.7 min CN=71 Runoff=0.83 cfs 0.103 af
<b>Subcatchment9S: OFFSITE 1 (Below</b>	Runoff Area=570,508 sf 4.47% Impervious Runoff Depth>4.01" Flow Length=1,353' Tc=35.1 min CN=75 Runoff=34.83 cfs 4.375 af
<b>Subcatchment10S: OFFSITE 2 (above</b>	Runoff Area=1,644,982 sf 2.57% Impervious Runoff Depth>3.82" Flow Length=2,221' Tc=94.2 min CN=74 Runoff=55.26 cfs 12.013 af
<b>Subcatchment11S: OFFSITE 3 (Matthew</b>	Runoff Area=513,527 sf 23.06% Impervious Runoff Depth>4.37" Flow Length=532' Tc=6.8 min CN=78 Runoff=61.36 cfs 4.292 af
<b>Reach 5R: ANALYSISPOINT 5</b>	Inflow=14.53 cfs 1.729 af Outflow=14.53 cfs 1.729 af
<b>Reach 6R: AP for SC 6</b>	Inflow=19.71 cfs 2.692 af Outflow=19.71 cfs 2.692 af
<b>Reach 9R: ANALYSISPOINT 9</b>	Inflow=34.83 cfs 4.375 af Outflow=34.83 cfs 4.375 af
<b>Reach 10R: Perkins Road Culvert</b>	Avg. Flow Depth=2.00' Max Vel=11.61 fps Inflow=55.26 cfs 12.013 af 24.0" Round Pipe n=0.013 L=25.0' S=0.0200 ' ' Capacity=31.99 cfs Outflow=31.99 cfs 12.014 af
<b>Reach 11R: At Stream 9</b>	Inflow=61.36 cfs 4.292 af Outflow=61.36 cfs 4.292 af

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 100-year Rainfall=7.20"

Printed 4/21/2019

Page 52

**Reach PT1: Analysis Point 1 at BWD Little River**

Inflow=12.93 cfs 2.090 af  
Outflow=12.93 cfs 2.090 af

**Reach PT2: ANALYSISPOINT 2 at BWD reservoir**

Inflow=19.74 cfs 4.494 af  
Outflow=19.74 cfs 4.494 af

**Reach PT3: ANALYSISPOINT 3 at BWD reservoir**

Inflow=18.64 cfs 2.750 af  
Outflow=18.64 cfs 2.750 af

**Reach PT4: ANALYSISPOINT 4 at BWD reservoir**

Inflow=15.44 cfs 1.803 af  
Outflow=15.44 cfs 1.803 af

**Reach PT5: all points at BWD Reservoir**

Inflow=40.15 cfs 9.047 af  
Outflow=40.15 cfs 9.047 af

**Reach PT6: Stream 9-1**

Avg. Flow Depth=1.60' Max Vel=6.26 fps Inflow=84.29 cfs 20.681 af  
n=0.030 L=483.0' S=0.0145 '/' Capacity=535.88 cfs Outflow=81.42 cfs 20.647 af

**Reach PT7: ANALYSISPOINT 7 at US**

Avg. Flow Depth=0.43' Max Vel=8.92 fps Inflow=3.68 cfs 0.636 af  
18.0" Round Pipe n=0.013 L=83.0' S=0.0398 '/' Capacity=20.95 cfs Outflow=3.68 cfs 0.635 af

**Reach PT8: ANALYSISPOINT 8 at US**

Avg. Flow Depth=0.06' Max Vel=4.91 fps Inflow=0.83 cfs 0.103 af  
36.0" x 24.0" Box Pipe n=0.011 L=76.0' S=0.0632 '/' Capacity=144.91 cfs Outflow=0.83 cfs 0.103 af

**Reach PT9: AnalysisPt Stream 9 at**

Avg. Flow Depth=1.55' Max Vel=28.72 fps Inflow=105.90 cfs 24.934 af  
36.0" Round Pipe n=0.011 L=93.0' S=0.0645 '/' Capacity=200.22 cfs Outflow=105.88 cfs 24.932 af

**Reach S9-2: Stream 9**

Avg. Flow Depth=1.61' Max Vel=7.99 fps Inflow=106.62 cfs 25.068 af  
n=0.030 L=1,580.0' S=0.0233 '/' Capacity=161.21 cfs Outflow=106.06 cfs 24.961 af

**Reach S9-3: Stream 9**

Avg. Flow Depth=1.56' Max Vel=7.04 fps Inflow=106.06 cfs 24.961 af  
n=0.030 L=364.0' S=0.0199 '/' Capacity=177.67 cfs Outflow=105.90 cfs 24.934 af

**Total Runoff Area = 116.358 ac Runoff Volume = 36.977 af Average Runoff Depth = 3.81"**  
**95.64% Pervious = 111.280 ac 4.36% Impervious = 5.078 ac**

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development

Type III 24-hr 100-year Rainfall=7.20"

Printed 4/21/2019

Page 53

**Summary for Subcatchment 1S: SUBCAT 1**

Runoff = 12.93 cfs @ 12.78 hrs, Volume= 2.090 af, Depth> 3.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-year Rainfall=7.20"

	Area (sf)	CN	Description
*	303,390	70	Woods, Good, HSG C/D
	12,768	70	Woods, Good, HSG C
	316,158	70	Weighted Average
	316,158		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.6	88	0.0450	0.06		<b>Sheet Flow, a-b</b> Woods: Dense underbrush n= 0.800 P2= 2.90"
3.5	65	0.0150	0.31		<b>Shallow Concentrated Flow, b-c</b> Forest w/Heavy Litter Kv= 2.5 fps
2.0	72	0.0550	0.59		<b>Shallow Concentrated Flow, c-d</b> Forest w/Heavy Litter Kv= 2.5 fps
25.6	470	0.0150	0.31		<b>Shallow Concentrated Flow, d-e</b> Forest w/Heavy Litter Kv= 2.5 fps
1.0	203	0.1000	3.41	13.64	<b>Trap/Vee/Rect Channel Flow, e-f</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100 Earth, dense brush, high stage
57.7	898	Total			

**Summary for Subcatchment 2S: SUBCAT 2**

Runoff = 19.74 cfs @ 13.39 hrs, Volume= 4.494 af, Depth> 3.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-year Rainfall=7.20"

	Area (sf)	CN	Description
*	653,559	70	Woods, Good, HSG C/D
*	38,729	74	>75% Grass cover, Good, HSG C/D
	692,288	70	Weighted Average
	692,288		100.00% Pervious Area

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 100-year Rainfall=7.20"

Printed 4/21/2019

Page 54

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
55.7	134	0.0150	0.04		<b>Sheet Flow, a-b</b> Woods: Dense underbrush n= 0.800 P2= 2.90"
5.8	175	0.0400	0.50		<b>Shallow Concentrated Flow, b-c</b> Forest w/Heavy Litter Kv= 2.5 fps
13.3	199	0.0100	0.25		<b>Shallow Concentrated Flow, c-d</b> Forest w/Heavy Litter Kv= 2.5 fps
1.2	41	0.0490	0.55		<b>Shallow Concentrated Flow, d-e</b> Forest w/Heavy Litter Kv= 2.5 fps
22.1	468	0.0200	0.35		<b>Shallow Concentrated Flow, e-f</b> Forest w/Heavy Litter Kv= 2.5 fps
3.4	516	0.0550	2.53	10.11	<b>Trap/Vee/Rect Channel Flow, f-g</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100 Earth, dense brush, high stage
101.5	1,533	Total			

**Summary for Subcatchment 3S: SUBCAT 3**

Runoff = 18.64 cfs @ 12.67 hrs, Volume= 2.750 af, Depth> 3.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-year Rainfall=7.20"

Area (sf)	CN	Description
205,588	74	>75% Grass cover, Good, HSG C/D
22,290	74	>75% Grass cover, Good, HSG C
163,239	70	Woods, Good, HSG C
391,117	72	Weighted Average
391,117		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.1	115	0.0400	0.10		<b>Sheet Flow, a-b</b> Woods: Light underbrush n= 0.400 P2= 2.90"
3.4	155	0.0230	0.76		<b>Shallow Concentrated Flow, b-c</b> Woodland Kv= 5.0 fps
9.3	372	0.0090	0.66		<b>Shallow Concentrated Flow, c-d</b> Short Grass Pasture Kv= 7.0 fps
2.3	134	0.0190	0.96		<b>Shallow Concentrated Flow, d-e</b> Short Grass Pasture Kv= 7.0 fps
12.6	254	0.0180	0.34		<b>Shallow Concentrated Flow, e-f</b> Forest w/Heavy Litter Kv= 2.5 fps
2.0	305	0.0560	2.55	10.21	<b>Trap/Vee/Rect Channel Flow, f-g</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100 Earth, dense brush, high stage
48.7	1,335	Total			

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 100-year Rainfall=7.20"

Printed 4/21/2019

Page 55

**Summary for Subcatchment 4S: SUBCAT 4**

Runoff = 15.44 cfs @ 12.42 hrs, Volume= 1.803 af, Depth> 3.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-year Rainfall=7.20"

	Area (sf)	CN	Description
*	130,853	74	>75% Grass cover, Good, HSG C/D
	26,033	74	>75% Grass cover, Good, HSG C
	40,857	70	Woods, Good, HSG C
*	56,948	70	Woods, Good, HSG C/D
	254,691	72	Weighted Average
	254,691		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.9	135	0.0270	0.13		<b>Sheet Flow, a-b</b> Grass: Dense n= 0.240 P2= 2.90"
7.8	462	0.0200	0.99		<b>Shallow Concentrated Flow, b-c</b> Short Grass Pasture Kv= 7.0 fps
2.2	184	0.0380	1.36		<b>Shallow Concentrated Flow, c-d</b> Short Grass Pasture Kv= 7.0 fps
3.3	389	0.0330	1.96	7.83	<b>Trap/Vee/Rect Channel Flow, d-e</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100 Earth, dense brush, high stage
30.2	1,170	Total			

**Summary for Subcatchment 5S: SUBCAT 5**

Runoff = 14.53 cfs @ 12.43 hrs, Volume= 1.729 af, Depth> 3.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-year Rainfall=7.20"

	Area (sf)	CN	Description
*	156,287	74	>75% Grass cover, Good, HSG C/D
	74,991	74	>75% Grass cover, Good, HSG C
	231,278	74	Weighted Average
	231,278		100.00% Pervious Area



**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 100-year Rainfall=7.20"

Printed 4/21/2019

Page 56

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.0	198	0.0270	0.14		<b>Sheet Flow, a-b</b> Grass: Dense n= 0.240 P2= 2.90"
2.9	146	0.0140	0.83		<b>Shallow Concentrated Flow, b-c</b> Short Grass Pasture Kv= 7.0 fps
3.8	285	0.0320	1.25		<b>Shallow Concentrated Flow, c-d</b> Short Grass Pasture Kv= 7.0 fps
1.6	210	0.0430	2.24	8.94	<b>Trap/Vee/Rect Channel Flow, d-e</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100 Earth, dense brush, high stage
31.3	839	Total			

**Summary for Subcatchment 6S: SUBCAT 6**

Runoff = 19.71 cfs @ 12.57 hrs, Volume= 2.692 af, Depth> 4.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-year Rainfall=7.20"

Area (sf)	CN	Description
* 142,888	70	Woods, Good, HSG C/D
10,372	70	Woods, Good, HSG C
* 61,952	74	>75% Grass cover, Good, HSG C/D
635	74	>75% Grass cover, Good, HSG C
51,989	80	>75% Grass cover, Good, HSG D
* 7,818	96	Gravel
* 34,971	98	Impervious
32,024	77	Woods, Good, HSG D
342,649	76	Weighted Average
307,678		89.79% Pervious Area
34,971		10.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.0	67	0.0150	0.03		<b>Sheet Flow, a-b</b> Woods: Dense underbrush n= 0.800 P2= 2.90"
5.2	92	0.0140	0.30		<b>Shallow Concentrated Flow, b-c</b> Forest w/Heavy Litter Kv= 2.5 fps
1.8	74	0.0100	0.70		<b>Shallow Concentrated Flow, c-d</b> Short Grass Pasture Kv= 7.0 fps
1.7	163	0.0550	1.64		<b>Shallow Concentrated Flow, d-e</b> Short Grass Pasture Kv= 7.0 fps
0.8	39	0.1000	0.79		<b>Shallow Concentrated Flow, e-f</b> Forest w/Heavy Litter Kv= 2.5 fps
0.1	10	0.5000	1.77		<b>Shallow Concentrated Flow, f-g</b> Forest w/Heavy Litter Kv= 2.5 fps
41.6	445	Total			

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 100-year Rainfall=7.20"

Printed 4/21/2019

Page 57

**Summary for Subcatchment 7S: SUBCAT 7**

Runoff = 3.68 cfs @ 12.88 hrs, Volume= 0.636 af, Depth> 3.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-year Rainfall=7.20"

Area (sf)	CN	Description
* 93,505	70	Woods, Good, HSG C/D
* 2,878	74	>75% Grass cover, Good, HSG C/D
96,383	70	Weighted Average
96,383		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
54.6	172	0.0260	0.05		<b>Sheet Flow, a-b</b> Woods: Dense underbrush n= 0.800 P2= 2.90"
2.8	112	0.0700	0.66		<b>Shallow Concentrated Flow, b-c</b> Forest w/Heavy Litter Kv= 2.5 fps
0.2	13	0.2300	1.20		<b>Shallow Concentrated Flow, c-d</b> Forest w/Heavy Litter Kv= 2.5 fps
6.6	171	0.0300	0.43		<b>Shallow Concentrated Flow, d-e</b> Forest w/Heavy Litter Kv= 2.5 fps
0.5	73	0.0600	2.64	10.56	<b>Trap/Vee/Rect Channel Flow, e-f</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100 Earth, dense brush, high stage
64.7	541	Total			

**Summary for Subcatchment 8S: SUBCAT 8**

Runoff = 0.83 cfs @ 12.48 hrs, Volume= 0.103 af, Depth> 3.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-year Rainfall=7.20"

Area (sf)	CN	Description
* 12,652	70	Woods, Good, HSG C/D
* 2,324	74	>75% Grass cover, Good, HSG C/D
14,976	71	Weighted Average
14,976		100.00% Pervious Area

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 100-year Rainfall=7.20"

Printed 4/21/2019

Page 58

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.0	67	0.0150	0.03		<b>Sheet Flow, a-b</b> Woods: Dense underbrush n= 0.800 P2= 2.90"
1.1	43	0.0700	0.66		<b>Shallow Concentrated Flow, b-c</b> Forest w/Heavy Litter Kv= 2.5 fps
0.1	14	0.7100	2.11		<b>Shallow Concentrated Flow, c-d</b> Forest w/Heavy Litter Kv= 2.5 fps
1.5	152	0.0240	1.67	6.68	<b>Trap/Vee/Rect Channel Flow, d-e</b> Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.100
34.7	276	Total			

**Summary for Subcatchment 9S: OFFSITE 1 (Below Perkins Rd)**

Runoff = 34.83 cfs @ 12.48 hrs, Volume= 4.375 af, Depth> 4.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-year Rainfall=7.20"

Area (sf)	CN	Description
* 25,513	98	Impervious
* 532,320	74	>75% Grass cover, Good, HSG C/D
* 3,818	94	Gravel roads, HSG C/D
8,857	74	>75% Grass cover, Good, HSG C
570,508	75	Weighted Average
544,995		95.53% Pervious Area
25,513		4.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	15	0.2000	2.25		<b>Sheet Flow, a-b</b> Smooth surfaces n= 0.011 P2= 2.90"
12.6	373	0.0050	0.49		<b>Shallow Concentrated Flow, b-c</b> Short Grass Pasture Kv= 7.0 fps
13.1	715	0.0170	0.91		<b>Shallow Concentrated Flow, c-d</b> Short Grass Pasture Kv= 7.0 fps
9.3	250	0.0320	0.45		<b>Shallow Concentrated Flow, d-e</b> Forest w/Heavy Litter Kv= 2.5 fps
35.1	1,353	Total			

**Summary for Subcatchment 10S: OFFSITE 2 (above Perkins Rd)**

Runoff = 55.26 cfs @ 13.28 hrs, Volume= 12.013 af, Depth> 3.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-year Rainfall=7.20"

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 100-year Rainfall=7.20"

Printed 4/21/2019

Page 59

Area (sf)	CN	Description
* 298,066	70	Woods, Good, HSG C/D
* 42,276	98	Impervious
* 1,304,640	74	>75% Grass cover, Good, HSG C/D
1,644,982	74	Weighted Average
1,602,706		97.43% Pervious Area
42,276		2.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
45.2	141	0.0280	0.05		<b>Sheet Flow, a-b</b> Woods: Dense underbrush n= 0.800 P2= 2.90"
15.3	384	0.0280	0.42		<b>Shallow Concentrated Flow, b-c</b> Forest w/Heavy Litter Kv= 2.5 fps
2.5	227	0.0480	1.53		<b>Shallow Concentrated Flow, c-d</b> Short Grass Pasture Kv= 7.0 fps
18.6	780	0.0100	0.70		<b>Shallow Concentrated Flow, d-e</b> Short Grass Pasture Kv= 7.0 fps
12.6	689	0.0170	0.91		<b>Shallow Concentrated Flow, e-f</b> Short Grass Pasture Kv= 7.0 fps
94.2	2,221	Total			

**Summary for Subcatchment 11S: OFFSITE 3 (Matthew Brothers Lot)**

Runoff = 61.36 cfs @ 12.10 hrs, Volume= 4.292 af, Depth> 4.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-year Rainfall=7.20"

Area (sf)	CN	Description
* 118,437	98	Impervious
* 237,621	70	Woods, Good, HSG C/D
* 157,469	74	>75% Grass cover, Good, HSG C/D
513,527	78	Weighted Average
395,090		76.94% Pervious Area
118,437		23.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	16	0.1870	2.22		<b>Sheet Flow, a-b</b> Smooth surfaces n= 0.011 P2= 2.90"
4.7	419	0.0100	1.50		<b>Shallow Concentrated Flow, b-c</b> Grassed Waterway Kv= 15.0 fps
2.0	97	0.1000	0.79		<b>Shallow Concentrated Flow, c-d</b> Forest w/Heavy Litter Kv= 2.5 fps
6.8	532	Total			

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 100-year Rainfall=7.20"

Printed 4/21/2019

Page 60

**Summary for Reach 5R: ANALYSIS POINT 5**

Inflow Area = 5.309 ac, 0.00% Impervious, Inflow Depth > 3.91" for 100-year event  
Inflow = 14.53 cfs @ 12.43 hrs, Volume= 1.729 af  
Outflow = 14.53 cfs @ 12.43 hrs, Volume= 1.729 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach 6R: AP for SC 6**

Inflow Area = 7.866 ac, 10.21% Impervious, Inflow Depth > 4.11" for 100-year event  
Inflow = 19.71 cfs @ 12.57 hrs, Volume= 2.692 af  
Outflow = 19.71 cfs @ 12.57 hrs, Volume= 2.692 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach 9R: ANALYSIS POINT 9**

Inflow Area = 13.097 ac, 4.47% Impervious, Inflow Depth > 4.01" for 100-year event  
Inflow = 34.83 cfs @ 12.48 hrs, Volume= 4.375 af  
Outflow = 34.83 cfs @ 12.48 hrs, Volume= 4.375 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach 10R: Perkins Road Culvert**

Inflow Area = 37.764 ac, 2.57% Impervious, Inflow Depth > 3.82" for 100-year event  
Inflow = 55.26 cfs @ 13.28 hrs, Volume= 12.013 af  
Outflow = 31.99 cfs @ 12.75 hrs, Volume= 12.014 af, Atten= 42%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs / 2

Max. Velocity= 11.61 fps, Min. Travel Time= 0.0 min

Avg. Velocity = 7.35 fps, Avg. Travel Time= 0.1 min

Peak Storage= 79 cf @ 12.70 hrs

Average Depth at Peak Storage= 2.00'

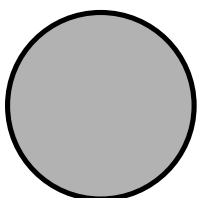
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 31.99 cfs

24.0" Round Pipe

n= 0.013 Corrugated PE, smooth interior

Length= 25.0' Slope= 0.0200 '/'

Inlet Invert= 75.50', Outlet Invert= 75.00'



**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development  
Type III 24-hr 100-year Rainfall=7.20"

Printed 4/21/2019

Page 61

**Summary for Reach 11R: At Stream 9**

Inflow Area = 11.789 ac, 23.06% Impervious, Inflow Depth > 4.37" for 100-year event  
Inflow = 61.36 cfs @ 12.10 hrs, Volume= 4.292 af  
Outflow = 61.36 cfs @ 12.10 hrs, Volume= 4.292 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach PT1: Analysis Point 1 at BWD Little River**

Inflow Area = 7.258 ac, 0.00% Impervious, Inflow Depth > 3.46" for 100-year event  
Inflow = 12.93 cfs @ 12.78 hrs, Volume= 2.090 af  
Outflow = 12.93 cfs @ 12.78 hrs, Volume= 2.090 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach PT2: ANALYSIS POINT 2 at BWD reservoir**

Inflow Area = 15.893 ac, 0.00% Impervious, Inflow Depth > 3.39" for 100-year event  
Inflow = 19.74 cfs @ 13.39 hrs, Volume= 4.494 af  
Outflow = 19.74 cfs @ 13.39 hrs, Volume= 4.494 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach PT3: ANALYSIS POINT 3 at BWD reservoir**

Inflow Area = 8.979 ac, 0.00% Impervious, Inflow Depth > 3.68" for 100-year event  
Inflow = 18.64 cfs @ 12.67 hrs, Volume= 2.750 af  
Outflow = 18.64 cfs @ 12.67 hrs, Volume= 2.750 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach PT4: ANALYSIS POINT 4 at BWD reservoir**

Inflow Area = 5.847 ac, 0.00% Impervious, Inflow Depth > 3.70" for 100-year event  
Inflow = 15.44 cfs @ 12.42 hrs, Volume= 1.803 af  
Outflow = 15.44 cfs @ 12.42 hrs, Volume= 1.803 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach PT5: all points at BWD Reservoir**

Inflow Area = 30.718 ac, 0.00% Impervious, Inflow Depth > 3.53" for 100-year event  
Inflow = 40.15 cfs @ 12.65 hrs, Volume= 9.047 af  
Outflow = 40.15 cfs @ 12.65 hrs, Volume= 9.047 af, Atten= 0%, Lag= 0.0 min

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Summary for Reach PT6: Stream 9-1**

Inflow Area = 62.650 ac, 6.82% Impervious, Inflow Depth > 3.96" for 100-year event  
Inflow = 84.29 cfs @ 12.11 hrs, Volume= 20.681 af  
Outflow = 81.42 cfs @ 12.16 hrs, Volume= 20.647 af, Atten= 3%, Lag= 2.8 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Max. Velocity= 6.26 fps, Min. Travel Time= 1.3 min  
Avg. Velocity = 3.32 fps, Avg. Travel Time= 2.4 min

Peak Storage= 6,341 cf @ 12.13 hrs  
Average Depth at Peak Storage= 1.60'  
Bank-Full Depth= 4.00' Flow Area= 52.0 sf, Capacity= 535.88 cfs

5.00' x 4.00' deep channel, n= 0.030 Stream, clean & straight  
Side Slope Z-value= 2.0 '/' Top Width= 21.00'  
Length= 483.0' Slope= 0.0145 '/'  
Inlet Invert= 71.00', Outlet Invert= 64.00'



**Summary for Reach PT7: ANALYSIS POINT 7 at US Rte 1 culvert**

Inflow Area = 2.213 ac, 0.00% Impervious, Inflow Depth > 3.45" for 100-year event  
Inflow = 3.68 cfs @ 12.88 hrs, Volume= 0.636 af  
Outflow = 3.68 cfs @ 12.88 hrs, Volume= 0.635 af, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Max. Velocity= 8.92 fps, Min. Travel Time= 0.2 min  
Avg. Velocity = 4.60 fps, Avg. Travel Time= 0.3 min

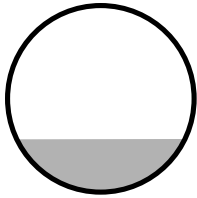
Peak Storage= 34 cf @ 12.88 hrs  
Average Depth at Peak Storage= 0.43'  
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 20.95 cfs

18.0" Round Pipe  
n= 0.013 Corrugated PE, smooth interior  
Length= 83.0' Slope= 0.0398 '/'  
Inlet Invert= 21.60', Outlet Invert= 18.30'

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC



**Summary for Reach PT8: ANALYSIS POINT 8 at US Rte 1 culvert**

Inflow Area = 0.344 ac, 0.00% Impervious, Inflow Depth > 3.59" for 100-year event  
Inflow = 0.83 cfs @ 12.48 hrs, Volume= 0.103 af  
Outflow = 0.83 cfs @ 12.49 hrs, Volume= 0.103 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Max. Velocity= 4.91 fps, Min. Travel Time= 0.3 min  
Avg. Velocity = 2.66 fps, Avg. Travel Time= 0.5 min

Peak Storage= 13 cf @ 12.49 hrs  
Average Depth at Peak Storage= 0.06'  
Bank-Full Depth= 2.00' Flow Area= 6.0 sf, Capacity= 144.91 cfs

36.0" W x 24.0" H Box Pipe  
n= 0.011 Concrete pipe, straight & clean  
Length= 76.0' Slope= 0.0632 '/'  
Inlet Invert= 23.40', Outlet Invert= 18.60'



**Summary for Reach PT9: Analysis Pt Stream 9 at US Rte 1 Culvert**

Inflow Area = 75.825 ac, 6.70% Impervious, Inflow Depth > 3.95" for 100-year event  
Inflow = 105.90 cfs @ 12.62 hrs, Volume= 24.934 af  
Outflow = 105.88 cfs @ 12.62 hrs, Volume= 24.932 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Max. Velocity= 28.72 fps, Min. Travel Time= 0.1 min  
Avg. Velocity = 15.60 fps, Avg. Travel Time= 0.1 min

Peak Storage= 343 cf @ 12.62 hrs  
Average Depth at Peak Storage= 1.55'  
Bank-Full Depth= 3.00' Flow Area= 7.1 sf, Capacity= 200.22 cfs

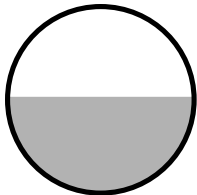


**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

36.0" Round Pipe  
n= 0.011 Concrete pipe, straight & clean  
Length= 93.0' Slope= 0.0645 '/'  
Inlet Invert= 20.00', Outlet Invert= 14.00'



**Summary for Reach S9-2: Stream 9**

Inflow Area = 75.825 ac, 6.70% Impervious, Inflow Depth > 3.97" for 100-year event  
Inflow = 106.62 cfs @ 12.50 hrs, Volume= 25.068 af  
Outflow = 106.06 cfs @ 12.59 hrs, Volume= 24.961 af, Atten= 1%, Lag= 5.8 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Max. Velocity= 7.99 fps, Min. Travel Time= 3.3 min  
Avg. Velocity = 4.10 fps, Avg. Travel Time= 6.4 min

Peak Storage= 20,992 cf @ 12.54 hrs  
Average Depth at Peak Storage= 1.61'  
Bank-Full Depth= 2.00' Flow Area= 18.0 sf, Capacity= 161.21 cfs

5.00' x 2.00' deep channel, n= 0.030 Stream, clean & straight  
Side Slope Z-value= 2.0 '/' Top Width= 13.00'  
Length= 1,580.0' Slope= 0.0233 '/'  
Inlet Invert= 64.00', Outlet Invert= 27.25'



**Summary for Reach S9-3: Stream 9**

Inflow Area = 75.825 ac, 6.70% Impervious, Inflow Depth > 3.95" for 100-year event  
Inflow = 106.06 cfs @ 12.59 hrs, Volume= 24.961 af  
Outflow = 105.90 cfs @ 12.62 hrs, Volume= 24.934 af, Atten= 0%, Lag= 1.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Max. Velocity= 7.04 fps, Min. Travel Time= 0.9 min  
Avg. Velocity = 3.71 fps, Avg. Travel Time= 1.6 min

**pre conditions**

Prepared by Ransom Consulting

HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

NAF Pre Development

Type III 24-hr 100-year Rainfall=7.20"

Printed 4/21/2019

Page 65

Peak Storage= 5,483 cf @ 12.60 hrs

Average Depth at Peak Storage= 1.56'

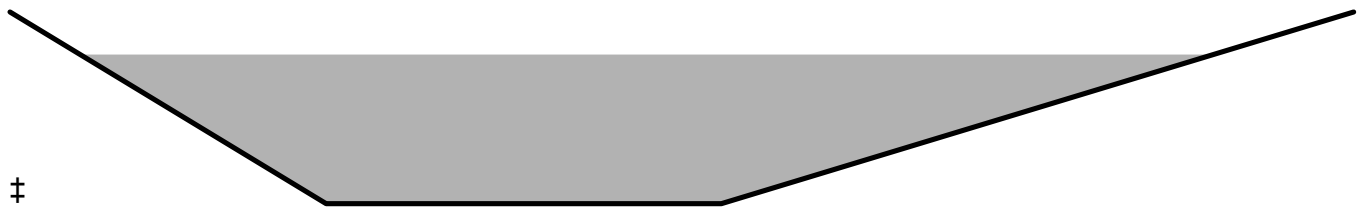
Bank-Full Depth= 2.00' Flow Area= 22.0 sf, Capacity= 177.67 cfs

5.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding

Side Slope Z-value= 2.0 4.0 ' / ' Top Width= 17.00'

Length= 364.0' Slope= 0.0199 ' / '

Inlet Invert= 27.25', Outlet Invert= 20.00'



NAF Stormer Pre-Conditions

2/12/19

Purpose: To determine the existing conditions of the site (land cover conditions, hydrologic characteristics, stormwater runoff volumes, and Tc paths).

Assumptions:

1. Soil classifications with corresponding hydrologic soil groups are based off of the HISS mapping/Delineation Report prepared for Ransom by Broadwater U.C.

<u>Soil Map Symbol</u>	<u>HSG</u>
PwA	C/D
SwA	C/D
PwC	C/D
PwB	C/D
PwD	C/D
BaA	C
UdA	D

2. Soils that have a HSG of "C/D" are classified as type C soils. This is a more conservative approach than using CN value of D soils.
3. AutoCAD 2016 used to determine areas, lengths of Tc Paths and Slopes using polylines.

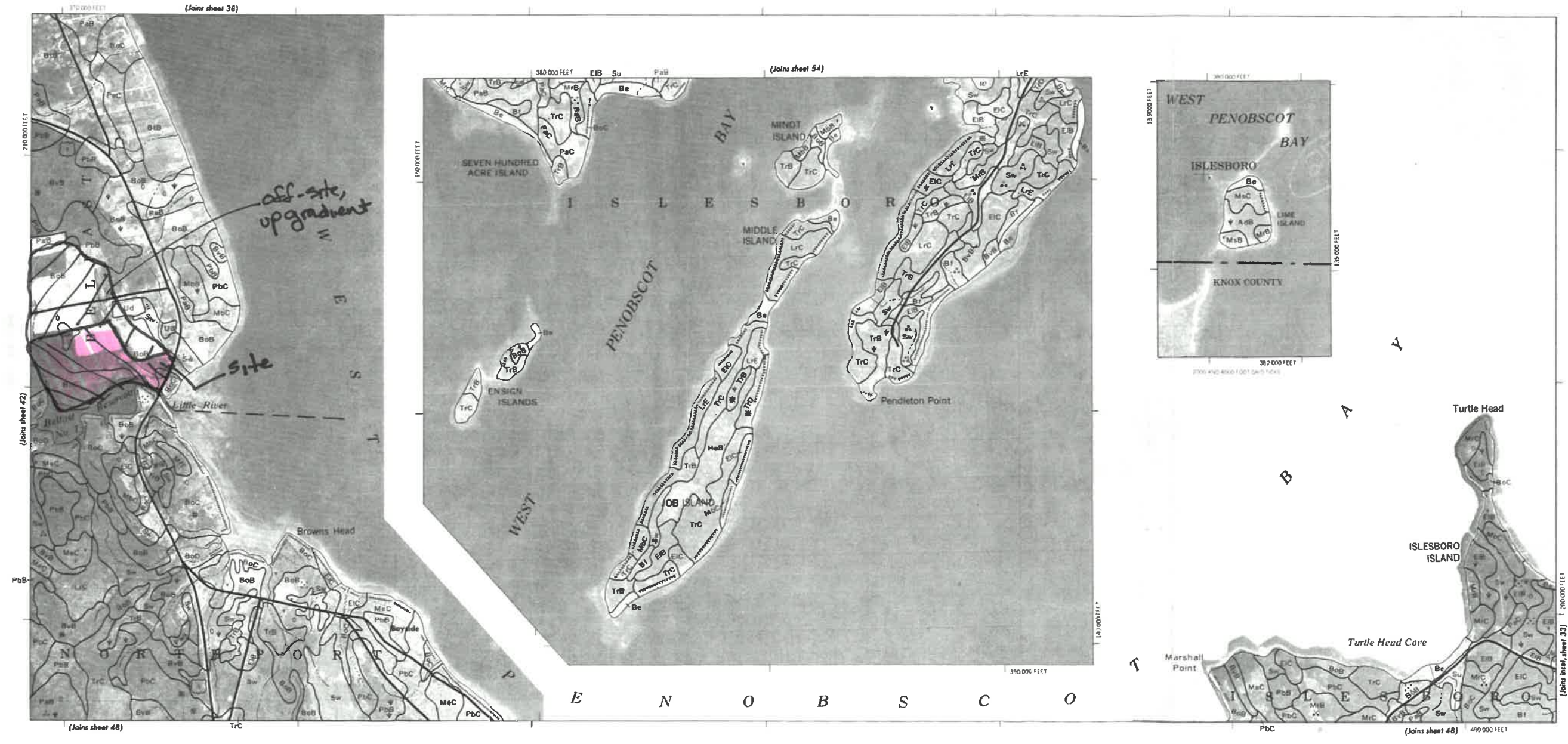
4. HydroCAD used to calculate ~~areas~~ flow rates, and  $T_c$  path times based on inputs provided.
5. Classified the site as Type III 24-hr rainfall based on Maine DEP, Chapter 500: stormwater management, Appendix H. 24-hr duration rainfalls for various return periods.
6. HydroCAD automatically selects/calculates the velocity factor, Mannings number, and  $T_c$  times based off of inputs selected.
7. Subcatchments 9 and 10 are runoff from offsite. Ransom used Lidar to determine contours/elevations of those areas.
8. "Field" is referred to as the Former Goldenrod Property. "Old field" is referred to as the only existing field now used for logging on the east side of the site.
9. Soil type/classification is assumed to all be type c/d soils in offsite subcatchments (Subcatchment 9, 10, & 11) besides BaA in Subcatchment 9. Refer to NRCS soils Map for Waldo County. Assumed

24

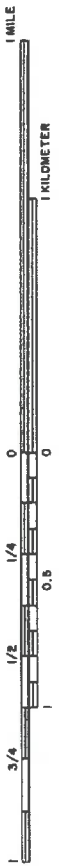
SJB  
4/17/19

SOIL SURVEY OF WALDO COUNTY, MAINE — SHEET NUMBER 43

This soil survey was compiled by the U.S. Department of Agriculture, Soil Conservation Service, and participating agencies. Base maps are copyrighted and prepared by the U.S. Department of the Interior, Geological Survey, from 1:250,000 scale photography. Contour lines are not shown. Contour interval is 10 feet. All elevations are in feet above sea level.



43



Joins sheet 23



22B  
4/17/19  
2B

**Table 5-1 - Hydrologic Soil Groups for Maine Soils**

This table provides information on the hydrologic soil series recognized in Maine and is current as of January 1, 2016. It is understood that these ratings may, and some probably will, change over time and with better data. The USDA - NRCS (Natural Resources Conservation Service) should be contacted for more accurate information.  
<http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>

HSG A	HSG A/D	HSG B	HSG B/D	HSG C	HSG C/D	HSG D
Adams	Au Gres	Agawam	Atherton	Becket	Boothbay #	Abram
Colton	Bucksport	Allagash	Belgrade	Chesuncook *	Buxton #	Aurelie
Croghan	Chocorua	Bangor	Charles	Conant	Chesuncook **	Bemis
Danforth	Kinsman	Berkshire	Cornish	Dixfield *	Dixfield **	Benson
Deerfield	Markey	Caribou	Elmwood +	Elliottsville	Dixmont	Biddeford
Eldridge	Moosabec	Charlton	Fredon	Howland *	Easton	Brayton
Enchanted	Naskeag	Fryeburg	Halsey	Linneus	Howland **	Burnham
Hermon	Naumburg	Hadley	Limerick	Mapleton	Lamoine	Cabot
Hinckley	Rifle	Hartland	Lovewell +	Marlow	Leicester	Canaan
Mahoosuc	Scarboro	Nicholville ^	Medomak	Melrose	Perham **	Canandaigua
Masardis	Searsport	Machias ^	Ninigret +	Paxton	Pushaw	Colonel
Merrimac	Sebago	Madawaska ^	Podunk +	Penquis	Ragmuff **	Creasey
Skowhegan	Togus	Monadnock	Raynham	Perham *	Peru **	Daigle
Stetson	Vassalboro	Ondawa	Red Hook	Peru *	Skerry *	Gouldsboro
Sunday	Walpole	Salmon	Roundabout	Plaisted	Surplus **	Hogback
Udipsamments	Waskish	Sheepscot ^	Rumney	Ragmuff *	Washburn	Hollis
Windsor			Saco	Rawsonville	Woodbridge	Knob Lock
			Scio +	Sisk		Lyman
			Sutton +	Skerry **		Monarda
			Swanton	Suffield		Monson
			Whately	Surplus *		Peacham
			Winooski +	Tunbridge		Pillsbury
			Wonsqueak	Winnecook		Ricker
						Ridgebury
						Saddleback
						Scantic
						Saugatuck
						Schoodic
						Swanville
						Telos
						Thorndike
						Westbury
						Whitman
			Soils (with *) are HSG C or C/D depending on depth to Cd (C horizon with a dense unconsolidated material) and depth to water table - (with **) most commonly HSG C/D			
			Soils (with +) are HSG B or B/D if aquic-redox is within 60cm			
			Soils (with ^) are HSG B if water table is below 60cm and Ksat of lower horizon greater than 10			
			Soils (with #) are HSG C - or C/D if aquic-redox is within 60cm			

Byfield, Massachusetts 978-465-1822  
 Providence, Rhode Island 401-433-2160  
 Portsmouth, New Hampshire 603-436-1490  
 Portland, Maine 207-772-2891  
 Hamilton, New Jersey 609-584-0090

PROJECT NO. 171.05027 SITE JAP  
 SHEET NO. 3 OF  
 CALCULATED BY MH DATE 2/12/19  
 CHECKED BY MPM  
 SCALE V/A SJB 4/17/19

## A. Subcatchment 1

1. Area (sq. ft.)	CN	Description
303,390	70	Good woods, HSG C/D
12,768	70	Good woods, HSG C
<b>Total: 316,158 ✓</b>		

\* Combined all soils w/ the same HSG and description. For example, PwA and PwC located in "Good woods" areas are added together.

## 2. Tc Path

a-b sheet flow  
 Woods: Dense Underbrush  
 Mannings No.: 0.8  
 Flow Length: 88 ft  
 2-yr 24-hr rain: 2.90 in.

$$\text{Slope} = \frac{Y_2 - Y_1}{\text{Flow length}} = \frac{(80 - 76) \text{ ft}}{88} = 0.045 \text{ ft/ft}$$

$$T_{t \text{ a-b}} = \frac{0.007 (nL)^{0.8}}{P^{0.5} S^{0.4}}$$

$$= \frac{0.007 [(0.8)(88 \text{ ft})]^{0.8}}{(2.90)^{0.5} (0.045)^{0.4}}$$

n = friction factor  
 L = flow length (ft)  
 P = rainfall (in.)  
 S = Slope (ft/ft)  
 T<sub>t</sub> = travel time (min.)

$$T_{t \text{ a-b}} = 25.6 \text{ min}$$

Use T<sub>c</sub> and T<sub>t</sub> generated from HydroCAD  
 Check in w/ formula

Byfield, Massachusetts 978-465-1822  
 Providence, Rhode Island 401-433-2160  
 Portsmouth, New Hampshire 603-436-1490  
 Portland, Maine 207-772-2891  
 Hamilton, New Jersey 609-584-0090

PROJECT NO. 171.05027 SITE NAF  
 SHEET NO. 4 OF \_\_\_\_\_  
 CALCULATED BY MH DATE 2/2/19  
 CHECKED BY MPM DATE \_\_\_\_\_  
 SCALE N/A SJB 4/17/19

b-c Shallow concentrated flow  
 Forest w/ Heavy Litter

Velocity Factor: 2.5 ft/s  
 Flow Length: 65 ft  
 Slope: 0.015 ft/ft  
 Elevations:  $y_2 = 76$  ft  $y_1 = 75$  ft

\* Average Velocity calculated by HydroCAD \*

$$T_{t \text{ b-c}} = \frac{L}{V} = \frac{65}{3600 \cdot 2.5} = \frac{34 \text{ ft}}{3600 \cdot 2.5}$$

$V = \text{avg. velocity (ft/s)}$   
 $L = \text{flow length (ft)}$

$$T_{t \text{ b-c}} = \frac{35}{2.5} \text{ min}$$

c-d Shallow concentrated flow  
 Forest w/ Heavy Litter

Vel. Factor: 2.5 ft/s  
 Flow length: 72 ft  
 Slope: 0.055 ft/ft  
 ( $y_2 = 75$  ft,  $y_1 = 71$  ft)

$$T_{t \text{ c-d}} = 2.0 \text{ min}$$

d-e Shallow conc. flow  
 Forest w/ Heavy Litter

Length: 470 ft  
 Slope: 0.015  
 ( $y_2 = 71$  ft,  $y_1 = 64$  ft)

$$T_c = (25.6 + 2.5 + 2.0 + 25.6 + 135) \text{ min}$$

$$T_{t \text{ d-e}} = 25.6 \text{ min}$$

$$T_c = 69.2 \text{ min}$$

e-f channel w/ 2' bottom 2:1 sideslopes  
~~Shallow conc. flow~~  
 Forest w/ Heavy Litter Earth, dense brush

Length: 203 ft  
 Slope: 0.1  
 ( $y_2 = 65$  ft,  $y_1 = 45$ )

$$T_{t \text{ c-f}} = 4.3 \text{ min}$$



Byfield, Massachusetts 978-465-1822  
 Providence, Rhode Island 401-433-2160  
 Portsmouth, New Hampshire 603-436-1490  
 Portland, Maine 207-772-2891  
 Hamilton, New Jersey 609-584-0090

PROJECT NO. 171.05027 SITE NAF  
 SHEET NO. 5 OF \_\_\_\_\_  
 CALCULATED BY MH DATE 2/12/19  
 CHECKED BY MPM DATE \_\_\_\_\_  
 SCALE N/A SJB 4/17/19

## B. Subcatchment 2

1.	<u>Area (sq. ft)</u>	<u>CN</u>	<u>Description</u>
	653559	70	Good woods, HSG C/D
	38729	74	>75% Grass, HSG C/D
	<u>Total: 692,288</u> ✓		

## 2. T<sub>c</sub> Path

a-b Sheet flow  
 Woods: dense underbrush  
 Manning's No. = 0.8  
 Flow length: 134 ft  
 P2 = 2.90 in.  
 Slope = 0.015 ft/ft  
 (y<sub>2</sub> = 80 ft, y<sub>1</sub> = 7.8 ft)

$$T_{t \text{ a-b}} = \frac{0.007 (0.8 \times 134 \text{ ft})^{0.8}}{(2.90 \text{ in})^{0.5} (0.015)^{0.4}} \left( \frac{60 \text{ min}}{1 \text{ hr}} \right)$$

$$T_{t \text{ a-b}} = 55.7 \text{ min}$$

b-c shallow conc. flow  
 Forest w/ Heavy Litter  
 Velocity Factor: 2.5 ft/s  
 Flow length: 175 ft  
 Slope: 0.04 ft/ft  
 (y<sub>2</sub> = 78 ft, y<sub>1</sub> = 71 ft)

$$T_{t \text{ b-c}} = 5.8 \text{ min}$$

Byfield, Massachusetts 978-465-1822  
 Providence, Rhode Island 401-433-2160  
 Portsmouth, New Hampshire 603-436-1490  
 Portland, Maine 207-772-2891  
 Hamilton, New Jersey 609-584-0090

PROJECT NO. 171,05027 SITE NAm  
 SHEET NO. 6 OF \_\_\_\_\_  
 CALCULATED BY MH DATE 3/2/19  
 CHECKED BY KPM DATE \_\_\_\_\_  
 SCALE N/A SJB 4/17/19

• c-d shallow conc. flow  
 Forest w/ Heavy Litter  
 Vel. Factor = 2.5 ft/s  
 Flow length = 199 ft  
 P2 = 2.9 in  
 Slope : 0.01 ft/ft  
 ( $y_2 = 71\text{ft}, y_1 = 69\text{ft}$ )  
 $T_t = 13.3\text{min}$   
 c-d

• e-f shallow conc. flow  
 Forest w/ Heavy Litter  
 length : 468 ft  
 Slope : 0.02  
 ( $y_2 = 67\text{ft}, y_1 = 58\text{ft}$ )  
 $T_t = 22.1\text{min}$   
 e-f

• d-e shallow conc. flow  
 Forest w/ heavy litter  
 length = 41 ft  
 Slope : 0.049  
 ( $y_2 = 69\text{ft}, y_1 = 67\text{ft}$ )  
 $T_t = 1.2\text{min}$   
 d-e

• f-g ~~shallow conc. flow~~ *Channel w/ 2' bottom 2:1 slopes*  
 Forest w/ litter  
 length : 511 ft  
 Slope : 0.055  
 ( $y_2 = 58\text{ft}, y_1 = 29.5\text{ft}$ )  
 $T_t = 14.4\text{min}$   
 f-g *Earthy, dense Brush*  
**3.4 min**

$T_c = 112\text{min}$   
**101.5 min**

### C. Subcatchment 3

1.	Area (sq. ft)	CN	Description
	205588	74	>75% grass, HSG C/D (Field)
	163,239	70	: Good Woods, HSG C
	22290	74	>75% grass, HSG C (Field)
Total: 391,117 ✓			

### 2. Tc Path

a-b sheet flow  
~~Grass, Dense~~ *Woods w/ Light*  
~~Mannings No: 0.24~~ *0.40*  
 Flow length : 115 ft  
 P2 = 2.9 in  
 Slope : 0.04 ft/ft  
 ( $y_2 = 71.5\text{ft}, y_1 = 70\text{ft}$ )  
 $T_t = 19.1\text{min}$   
 a-b

Byfield, Massachusetts 978-465-1822  
 Providence, Rhode Island 401-433-2160  
 Portsmouth, New Hampshire 603-436-1490  
 Portland, Maine 207-772-2891  
 Hamilton, New Jersey 609-584-0090

PROJECT NO. 171.25027 SITE NAP  
 SHEET NO. 7 OF \_\_\_\_\_  
 CALCULATED BY MH DATE 2/12/19  
 CHECKED BY MPM DATE \_\_\_\_\_  
 SCALE N/A SJB 4/17/19

~~$T_{t \text{ a-b}} = 0.007 (0.24 \times 300 \text{ ft})^{0.8}$~~   
 ~~$(2.9 \text{ ft})^{0.5} (0.029)^{0.4} (60 \text{ min})$~~

~~$T_{t \text{ a-b}} = 31.1 \text{ min}$~~

b-c Shallow conc. flow  
 Short Grass Pasture ~~wooded~~  
 Vel. Factor: 7 ft/s  
 Flow Length: 155 ft  
 Slope: 0.023 ft/ft  
 ( $y_2 = 70 \text{ ft}, y_1 = 66.5 \text{ ft}$ )

$T_{t \text{ b-c}} = 3.4 \text{ min}$

c-d Shallow conc. flow  
 Short Grass Pasture  
 Vel. Factor: 7 ft/s  
 Flow Length: 372 ft  
 Slope: 0.009 ft/ft  
 ( $y_2 = 66.5 \text{ ft}, y_1 = 63 \text{ ft}$ )

$T_{t \text{ c-d}} = 9.3 \text{ min}$

d-e Shallow conc. flow  
 Short grass pasture  
 length: 134 ft  
 Slope: 0.019  
 ( $y_2 = 63 \text{ ft}, y_1 = 60.5 \text{ ft}$ )  
 $T_{t \text{ d-e}} = 2.3 \text{ min}$

MKH

e-f Shallow conc. flow  
 Forest w/ heavy litter  
 Length: 254 ft  
 Slope: 0.018  
 ( $y_2 = 60.5 \text{ ft}, y_1 = 56 \text{ ft}$ )  
 $T_{t \text{ e-f}} = 12.6 \text{ min}$

*channel w/ 2' bottom;*  
 f-g ~~Shallow conc. flow~~ *2:1 sides*  
 Forest w/ heavy litter *earthy, dense brush*  
 Length: 305 ft  
 Slope: 0.056  
 ( $y_2 = 56 \text{ ft}, y_1 = 39 \text{ ft}$ )  
 $T_{t \text{ f-g}} = \frac{8.6 \text{ min}}{2}$

$T_c = 55.3 \text{ min}$

~~42.3~~  
 48.7

## D. Subcatchment 4

1. Area (sq. ft.)	CN	Description
130853	74	775% grass, HSG C/D (Field)
26033	74	775% grass, HSG C (Field)
40857	70	Good woods, HSG C
56948	70	Good woods, HSG C/D
<u>Total: 254,691</u> ✓		

## 2. T<sub>c</sub> Path

a-b sheet flow

Grass: Dense

Mannings No: 0.24

Flow Length: 135 ft

P<sub>2</sub>: 2.9 in

Slope: 0.027 ft/ft

(y<sub>2</sub> = 71.75 ft, y<sub>1</sub> = 68 ft)

$$T_{t \text{ a-b}} = \frac{0.007 (0.24 \times 135)^{0.8}}{(2.9 \text{ in})^{0.5} (0.027)^{0.4}} \quad (60 \text{ min})$$

$$T_{t \text{ a-b}} = 16.9 \text{ min}$$

b-c shallow conc. flow

Short grass pasture

Vel. Factor: 7 ft/s

Flow Length: 462 ft

Slope: 0.02

(y<sub>2</sub> = 68 ft, y<sub>1</sub> = 59 ft)

$$T_{t \text{ b-c}} = 7.8 \text{ min}$$



Byfield, Massachusetts 978-465-1822  
 Providence, Rhode Island 401-433-2160  
 Portsmouth, New Hampshire 603-436-1490  
 Portland, Maine 207-772-2891  
 Hamilton, New Jersey 609-584-0090

PROJECT NO. 171.25027 SITE NAF  
 SHEET NO. 9 OF \_\_\_\_\_  
 CALCULATED BY MH DATE 2/12/19  
 CHECKED BY MPM DATE \_\_\_\_\_  
 SCALE N/A SJB 4/17/19

c-d shallow conc. flow  
 Short grass pasture

Vel. Factor : 7.0 ft/s  
 Flow Length : 184 ft  
 Slope : 0.038  
 ( $y_2 = 59$  ft,  $y_1 = 52$  ft)  
 $T_t = 2.2$  min

c-d

channel w/ 2' bottom 2:1 slopes Earth, dense brush

d-e ~~shallow conc. flow~~

~~Forest w/ heavy litter~~  
~~Length : 389~~  
~~Slope : 0.033~~  
~~( $y_2 = 52$  ft,  $y_1 = 39$  ft)~~  
 ~~$T_t = 14.3$  min~~ **3.3 min.**

$T_c = \underline{41.2}$  min  
**30.2**

E. Subcatchment 5

1.	Area (sq. ft.)	CN	Description
<del>156,289</del>	<del>207,923</del>	74	> 75% grass, HSG C/D (Field)
<del>74,991</del>	<del>23,355</del>	74	> 75% grass HSG C (Field)
	Total: 231,278 ✓	70	Good woods

2.  $T_c$  Path

a-b sheet flow  
 Grass: Dense  
 Mannings No: 0.24  
 Flow Length: 198 ft  
 $P_2 = 2.9$  in  
 Slope: 0.027  
 ( $y_2 = 69.5$  ft,  $y_1 = 64$  ft)

$T_t = 23$  min  
 a-b

Byfield, Massachusetts 978-465-1822  
 Providence, Rhode Island 401-433-2160  
 Portsmouth, New Hampshire 603-436-1490  
 Portland, Maine 207-772-2891  
 Hamilton, New Jersey 609-584-0090

PROJECT NO. 171.DSD27 SITE NAF  
 SHEET NO. 10 OF \_\_\_\_\_  
 CALCULATED BY MH DATE 2/12/19  
 CHECKED BY MPM DATE \_\_\_\_\_  
 SCALE N/A SJB 4/17/19

~~$$T_{c \text{ a-b}} = \frac{0.007 (0.24 \times 300 \text{ ft})^{0.8}}{(2.9 \text{ in})^{0.5} (0.02)^{0.4}} (60 \text{ min})$$~~

$$T_{c \text{ a-b}} = 36.1 \text{ min}$$

MKH

b-c Shallow conc. flow  
 Short grass pasture  
 Vel. Factor: 7 ft/s  
 Flow Length: 146 ft  
 Slope: 0.014  
 ( $y_2 = 64 \text{ ft}, y_1 = 62 \text{ ft}$ )  
 $T_t = 2.9 \text{ min}$   
 b-c

d-e Shallow conc. flow  
 Forest w/ heavy litter  
 length: 210 ft  
 Slope: 0.043  
 ( $y_2 = 53 \text{ ft}, y_1 = 44 \text{ ft}$ )  
 $T_t = 8.1 \text{ min}$   
 d-e

Channel, 2' bottom 2:1 side earth, dense brush

$$T_c = 31.3$$
~~$$T_c = 37.8 \text{ min}$$~~

c-d Shallow conc. flow  
 Short grass pasture  
 length: 285 ft  
 Slope: 0.032  
 ( $y_2 = 62 \text{ ft}, y_1 = 53 \text{ ft}$ )  
 $T_t = 3.8 \text{ min}$   
 c-d

→ Discharge to Stream 9  
 New Reach - S9-2 (analysis 6)  
 Refer to page 21

## F. Subcatchment 6

1.	Area (sq. ft.)	CN	Description
	142,888	70	Good Woods, HSG C/D
	10,372	70	Good woods, HSG C
	6,195	74	>75% grass, HSG C/D
	635	74	>75% grass, HSG C
	51,989	80	>75% grass, HSG D
	7,818	96	Gravel, (NE of paved driveway)
	34,971	98	Impervious (Roofs, pavement)
	32,024	77	Good woods, HSG D
Total: 342,649 ✓			

Byfield, Massachusetts 978-465-1822  
Providence, Rhode Island 401-433-2160  
Portsmouth, New Hampshire 603-436-1490  
Portland, Maine 207-772-2891  
Hamilton, New Jersey 609-584-0090

PROJECT NO. 171-05027 SITE NAF  
SHEET NO. 11 OF  
CALCULATED BY MH DATE 2/12/19  
CHECKED BY MPM DATE  
SCALE N/A SJB 4/17/19

## 2. T<sub>c</sub> Path

- a-b Sheet flow

Woods: Dense Underbrush

Mannings No: 0.8

Flow length: 67 ft

P<sub>2</sub>: 2.9 in

Slope: 0.015

(y<sub>2</sub> = 57 ft, y<sub>1</sub> = 56 ft)

T<sub>t</sub> = 32 min

a-b

- b-c Shallow conc. flow

Forest w/ heavy litter

Length: 92 ft

Slope: 0.014 (y<sub>2</sub> = 56 ft, y<sub>1</sub> = 54.75 ft)

T<sub>t</sub> = 5.2 min

- c-d Shallow conc. flow

Short grass pasture

Flow length: 74 ft

P<sub>2</sub> = 2.9 in

Slope: 0.01

(y<sub>2</sub> = 54.75 ft, y<sub>1</sub> = 54 ft)

T<sub>t</sub> = 1.8 min

c-d

- d-e shallow conc. flow

Short grass pasture

Length: 163 ft

Slope: 0.055

(y<sub>2</sub> = 54 ft, y<sub>1</sub> = 45 ft)

T<sub>t</sub> = 1.7 min

d-e

Byfield, Massachusetts 978-465-1822  
 Providence, Rhode Island 401-433-2160  
 Portsmouth, New Hampshire 603-436-1490  
 Portland, Maine 207-772-2891  
 Hamilton, New Jersey 609-584-0090

PROJECT NO. 171.05027 SITE NAF  
 SHEET NO. 12 OF \_\_\_\_\_  
 CALCULATED BY MH DATE 2/12/19  
 CHECKED BY M.P.M. DATE \_\_\_\_\_  
 SCALE N/A SJB 4/17/19

• e-f Shallow conc. flow  
 Forest w/ heavy litter  
 length: 39 ft  
 Slope: 0.1  
 ( $y_2 = 45 \text{ ft}, y_1 = 41 \text{ ft}$ )  
 $T_t = 0.8 \text{ min}$   
 e-f

$T_c = 41.6 \text{ min}$

• f-g Shallow conc. flow  
 Forest w/ heavy litter  
 length: 10 ft  
 Slope: 0.5  
 ( $y_2 = 41 \text{ ft}, y_1 = 36 \text{ ft}$ )  
 $T_t = 0.1 \text{ min}$   
 f-g

into stream 9 @ reach 59-2  
 see sheets 20-21

new Reach - 59 - to 36" alt

• ~~g-h Shallow conc. flow~~  
~~Forest w/ heavy litter~~  
~~length: 568 ft~~  
~~Slope: 0.014~~  
~~( $y_2 = 36 \text{ ft}, y_1 = 28 \text{ ft}$ )~~  
 ~~$T_t = 32 \text{ min}$~~   
~~g-h~~

← Channel flow (stream 9)  
 5' bottom; 2:1 side slopes  
 Rocky, gravel

• ~~h-i Shallow conc. flow~~  
~~Grassed Waterway~~  
~~length: 350 ft~~  
~~Slope: 0.02~~  
~~( $y_2 = 28 \text{ ft}, y_1 = 20.75 \text{ ft}$ )~~  
 ~~$T_t = 2.7 \text{ min}$~~   
~~h-i~~

Channel flow (stream 9)  
 5' bottom; 2:1 side slopes  
 grassed

$T_c = 76.3 \text{ min}$



Byfield, Massachusetts 978-465-1822  
 Providence, Rhode Island 401-433-2160  
 Portsmouth, New Hampshire 603-436-1490  
 Portland, Maine 207-772-2891  
 Hamilton, New Jersey 609-584-0090

PROJECT NO. 171.05027 SITE NAP  
 SHEET NO. 13 OF \_\_\_\_\_  
 CALCULATED BY MH DATE 2/12/19  
 CHECKED BY MPM DATE \_\_\_\_\_  
 SCALE N/A SJB 4/17/19

## G. Subcatchment 7

1.	Area (sq. ft.)	CN	Description
	<del>93505</del>	70	Good woods, HSG C/D
	<del>2078</del>	74	> 75% grass, HSG C/D
Total:	94,383 ✓		

## 2. Tc Path

a-b sheet flow

Woods: Dense Underbrush

Mannings No: 0.8

Flow Length: 172 ft ✓

P2: 2.9 in

Slope: 0.026

( $y_2 = 45.5$  ft,  $y_1 = 41$  ft) ✓

$T_t = 54.6$  min

a-b

c-d shallow conc. flow

Forest w/ heavy litter

Length: 13 ft

Slope: 0.23

( $y_2 = 33$  ft,  $y_1 = 30$  ft)

$T_t = 0.2$  min

c-d

~~Shallow Channel Flow, Side~~  
 d-e ~~Shallow conc. flow~~ *channel*  
 Forest w/ heavy litter *dense*

Length: 171 ft ✓

Slope: 0.03

( $y_2 = 30$  ft,  $y_1 = 26$  ft) ✓

$T_t = 6.6$  min

d-e

b-c shallow conc. flow

Forest w/ Heavy Litter

Vel. Factor: 2.5 ft/s

Flow length: 112 ft

Slope: 0.07

( $y_2 = 41$  ft,  $y_1 = 33$  ft) ✓

$T_t = 2.8$  min

b-c

Byfield, Massachusetts 978-465-1822  
 Providence, Rhode Island 401-433-2160  
 Portsmouth, New Hampshire 603-436-1490  
 Portland, Maine 207-772-2891  
 Hamilton, New Jersey 609-584-0090

PROJECT NO. 171-05027 SITE UAF  
 SHEET NO. 14 OF \_\_\_\_\_  
 CALCULATED BY MH DATE 2/12/19  
 CHECKED BY MPM DATE \_\_\_\_\_  
 SCALE N/A SJB 4/17/19

channel 2' bottom 2:1 sides  
e-f shallow conc. flow  
~~Forest w/ Heavy Litter~~ earth, dense litter

Vel. Factor : 2.5 ft/c

Flow Length : 173'

Slope : 0.006

( $y_2 = 26$  ft,  $y_1 = 21.6$  (inv. whert))

$T_t = \underline{2 \text{ min}}$  0.5 min

e-f

$T_c = \underline{66.2 \text{ min}}$   
64.7 min.

Discharge through  
18" whert under Rt. 1  
 (assume HXB)  
 Inv. in = 21.6  
 Inv. out = 18.3  
L = 83'

## H. Subcatchment 8

1.	Area (sq. ft.)	CN	Description
	<u>12652</u>	<u>70</u>	Good woods, HSG C/D
	<u>2956</u>	<u>74</u>	75% grass, HSG C/D
	<u>Total: 15608</u> ✓		

## Q. $T_c$ Path

a-b sheet flow

Woods: Dense Underbrush

Mannings No: 0.8

Flow Length: 58 ft ✓

P2: 2.9 in

Slope: 0.017

( $y_2 = 41$  ft,  $40$  ft) ✓

$T_t = \underline{27.1 \text{ min}}$

a-b

Byfield, Massachusetts 978-465-1822  
 Providence, Rhode Island 401-433-2160  
 Portsmouth, New Hampshire 603-436-1490  
 Portland, Maine 207-772-2891  
 Hamilton, New Jersey 609-584-0090

PROJECT NO. 17-05027 SITE NAP  
 SHEET NO. 15 OF \_\_\_\_\_  
 CALCULATED BY MH DATE 2/12/19  
 CHECKED BY MPM DATE \_\_\_\_\_  
 SCALE N/A SJB 1/17/19

~~$T_{t \text{ a-b}} = \frac{0.007 (0.8 \times 112 \text{ ft})^{0.8}}{(2.9 \text{ in})^{0.5} (0.04)^{0.4}} (60)$~~

~~$T_{t \text{ a-b}} = 32.6 \text{ min}$~~

MKH

b-c Shallow conc. flow  
 Forest w/ Heavy Litter  
 Vel. Factor: 2.5 ft/s  
 Flow Length: 43 ft ✓  
 Slope: 0.07  
 ( $y_2 = 40 \text{ ft}$ ,  $y_1 = 37 \text{ ft}$ ) ✓  
 $T_{t \text{ b-c}} = 1.1 \text{ min}$

c-d Shallow conc. flow  
 Forest w/ Heavy Litter  
 Vel. Factor: 2.5 ft/s  
 Flow Length: 14 ft ✓  
 Slope: 0.71  
 ( $y_2 = 37 \text{ ft}$ ,  $y_1 = 27 \text{ ft}$ ) ✓  
 $T_{t \text{ c-d}} = 0.1 \text{ min}$

Channel of bottom; 2:1 sides, earth, dense brush  
 d-e ~~shallow conc. flow~~  
 Forest w/ heavy litter  
 Length: 152 ft  
 Slope: 0.024  
 ( $y_2 = 27 \text{ ft}$ ,  $y_1 = 23.4 \text{ ft}$ )

Discharge through  
 3'x2' culvert under Rt. 1  
 Inv. In = 23.4  
 Inv. out = 18.6  
 L = 76'  
 concrete

$T_{t \text{ d-e}} = \cancel{6.5 \text{ min}} \text{ } 1.5 \text{ min}$

$T_c = \cancel{34.8 \text{ min}}$   
 34.7 min



## I. Subcatchment 9 (offsite)

1. <u>Area (sq. ft)</u>	<u>CN</u>	<u>Description</u>
8857	74	>75% grass, HSG C
3818	94	Gravel Roads (Perkins)
25513	98	Impervious (Perkins/roads)
53,2320	74	>75% grass, HSG C/D
<u>Total: 570508</u>		

## 2. $T_c$ Path

Perkins Rd  
to  
Ditch

a-b sheet flow  
 Smooth surface  
 length: 15 ft  
 Slope: 0.2  
 ( $y_2 = 87 \text{ ft}, y_1 = 84 \text{ ft}$ )  
 $T_t = 0.1 \text{ min}$   
 a-b

d-e shallow conc. flow  
 Forest w/ heavy litter  
 length: 250 ft  
 Slope: 0.032  
 ( $y_2 = 70 \text{ ft}, y_1 = 62 \text{ ft}$ )  
 $T_t = 9.3 \text{ min}$   
 d-e

b-c shallow conc. flow  
 Short grass pasture  
 length: 373 ft  
 Slope: 0.005  
 ( $y_2 = 84 \text{ ft}, y_1 = 82 \text{ ft}$ )  
 $T_t = 12.6 \text{ min}$   
 b-c

$T_c = 35.1 \text{ min}$

To stream 9  
 into S9-1  
 see page 20

c-d shallow conc. flow  
 Short grass pasture  
 length: 715 ft  
 Slope: 0.017  
 ( $y_2 = 82 \text{ ft}, y_1 = 70 \text{ ft}$ )  
 $T_t = 13.1 \text{ min}$   
 c-d

## J. Subcatchment 10 (offsite) vPGradient of Perkins

Area (sq. ft.)	CN	Description
298066	70	Good woods, HSG C/D
42276	98	Impervious (Roadway)
1,304,640	74	>75% grass, HSG C/D
<u>Total: 1,644,982 ✓</u>		

## 2. Tc Path

a-b sheet flow

Woods: Dense Underbrush

Length: 141 ft ✓

Slope: 0.028

( $y_2 = 122$  ft,  $y_1 = 118$  ft) ✓

$T_t$   
a-b = 45.2 min

b-c shallow conc. flow

length: 384 ft ✓

Slope: 0.028

( $y_2 = 118$  ft,  $y_1 = 107$  ft) ✓

Forest w/ Heavy litter

$T_t = 15.3$  min

b-c

c-d shallow conc. flow

Short grass pasture

length: 227 ft ✓

Slope: 0.048

( $y_2 = 107$  ft,  $y_1 = 96$  ft) ✓

$T_t$   
c-d = 2.5 min

d-e shallow conc. flow

Short grass pasture

length: 780 ft ✓

Slope: 0.01

( $y_2 = 96$  ft,  $y_1 = 88$  ft) ✓

$T_t = 18.6$  min

d-e

Byfield, Massachusetts 978-465-1822  
 Providence, Rhode Island 401-433-2160  
 Portsmouth, New Hampshire 603-436-1490  
 Portland, Maine 207-772-2891  
 Hamilton, New Jersey 609-584-0090

PROJECT NO. 11.05027 SITE N/A  
 SHEET NO. 18 OF \_\_\_\_\_  
 CALCULATED BY MH DATE 2/12/19  
 CHECKED BY MPM DATE \_\_\_\_\_  
 SCALE N/A SJB 4/17/19

e-f shallow conc. flow  
 Short Grass Pasture  
 Length: 089 ft ✓  
 Slope: 0.017  
 ( $y_2 = 88$  ft,  $y_1 = 76$  ft) ✓  
 $T_t = 12.6$  min  
 d-e

$T_c = 94.2$  min

Discharge under Perkins through culvert. TO Start of Stream 9  
 24" round modelled as Reach 59  
 Assume 25' d w/ S=0.02  
 HDPE, smooth walled  
 assume inv. in = 75.5  
 calc. inv. out =  $75.5 - ((25)(0.02))$   
 = 75.0

K. Subcatchment 11 (offsite)

1.	Area (sq. ft.)	CN	Description
	118437	98	Impervious
	237621	70	Good woods, HSG C/D
	157469	74	>75% grass, HSG C/D
Total: 513527 ✓			

2. Tc Path

a-b Sheet Flow  
 Smooth Surface  
 Length: 116 ft  
 Slope: 0.187  
 ( $y_2 = 87$  ft,  $y_1 = 84$  ft)  
 $T_t = 0.1$  min  
 a-b

off of Perkins to ditch

b-c Shallow conc. flow  
 Grassed water way  
 Length: 419 ft Roadside ditch  
 Slope: 0.01  
 ( $y_2 = 84$  ft,  $y_1 = 80$  ft)  
 $T_t = 4.7$  min  
 b-c

Byfield, Massachusetts 978-465-1822  
 Providence, Rhode Island 401-433-2160  
 Portsmouth, New Hampshire 603-436-1490  
 Portland, Maine 207-772-2891  
 Hamilton, New Jersey 609-584-0090

PROJECT NO. 171.05027 SITE NAF  
 SHEET NO. 19 OF  
 CALCULATED BY MHT DATE 2/12/19  
 CHECKED BY MPM DATE  
 SCALE N/A SJB 4/17/19

## Subcatchment II

c-d Shallow conc. flow  
 Forest w/ heavy litter

Length 97 ft ✓

Slope: 0.1

( $y_2 = 80$  ft,  $y_1 = 70$  ft) ✓

$T_t = 2.0$  min

c-d

BRING INTO  
 Reach 59

→ to 59-1 see Page 20

~~a-h Shallow conc. flow  
 Forest w/ heavy litter~~

~~Length: 79 ft~~

~~Slope: 0.038~~

~~( $y_2 = 36$  ft,  $y_1 = 33$  ft)~~

~~$T_t = 2.7$  min~~

~~g-h~~

~~$T_c = 7.2$  min~~

d-e Shallow conc. flow  
 Forest w/ heavy litter

Length: 470 ft

Slope: 0.017

( $y_2 = 70$  ft,  $y_1 = 62$  ft)

$T_t = 2.4$  min

d-e

e-f shallow conc flow  
 Forest w/ heavy litter

Length: 26 ft

Slope: 0.15

( $y_2 = 62$  ft,  $y_1 = 58$  ft)

$T_t = 0.4$  min

e-f

f-g shallow conc. flow  
 Forest w/ heavy litter

Length: 877 ft

Slope: 0.025

( $y_2 = 58$  ft,  $y_1 = 36$  ft)

$T_t = 37$  min

f-g

$T_c = 6.8$  min

Reach S9 - 3 sections of Stream 9

Subcatch 11 discharges to upper portion of Stream 9 which follows  $\mathbb{R}$  along subcatch boundary between S11 and through 6 wooded on both sides of stream through to sub 6.

Channel averages 5' wide w/ 2:1 slopes

Discharge from subcatch 10 under Perkins Road @ begin of stream.

Discharge of culvert @ +/- 75, but culvert elevated from ditch/stream.

Segment 1: sub 10 discharge to Property line.

Assume 2:1 side slopes

5' channel bottom (average) assume  
N/A stream clean/straight  
Manning = 0.03

$$L = 483'$$

$$\Delta = 71-64$$

$$S = 0.014$$

depth: varies 6' to 8'  
assume 4' available for water depth  
(down stream limitations)



Stream 9: Section 2 along property boundary  
between where off site flow ends  
and the ground cover change from  
stream in the woods to grassed channel

Assume 2:1 slopes along length

Stream - winding  
Manning's  $s = 0.04$

5' channel bottom width

$L = 1580 \text{ ft.}$

$\Delta = 64' \text{ to } 27.25$

$s = 0.02$

depth: between 2' & 4'  
assume 2' flow depth max

Stream 9: Section 3 along roadway in grassed  
lined swale to culvert under Rt. 1  
(36")

Assume side slopes LT 2:1; RT 4:1

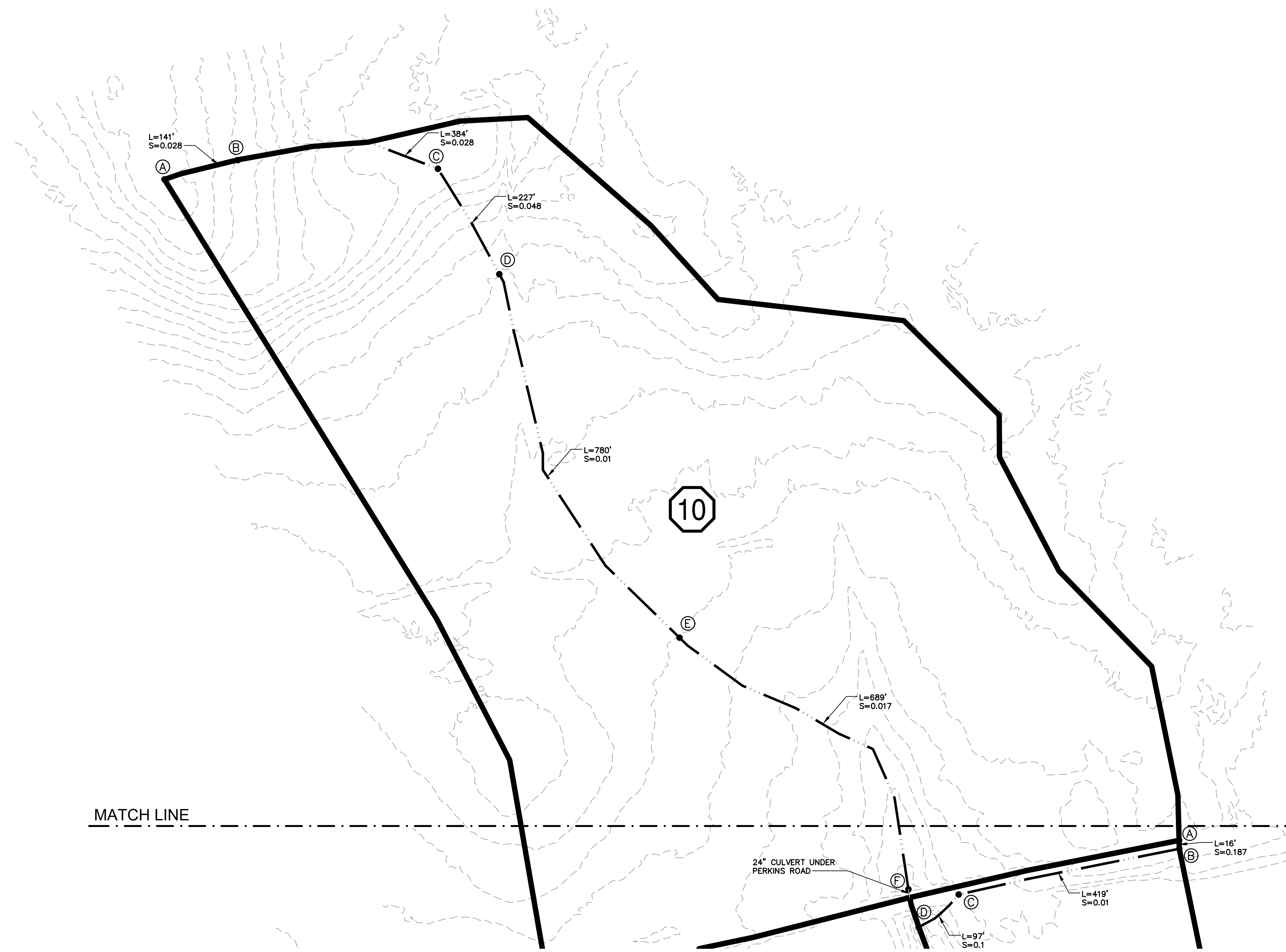
5' channel bottom width

$L = 364'$

$\Delta = 27.25 \text{ to } 20'$  (inv. of 36" culvert)

$s = 0.02$

culvert 1536"  
 $L = 93'$   
Inv. in = 20.0  
Inv. out = 14.0



**NOTE**  
 OFF-SITE TOPOGRAPHY PROVIDED BY  
 LIDAR SURVEY. CONTOURS ARE AT 2'  
 INTERVALS.

**LEGEND**

- SUBCATCHMENT BOUNDARY
- SUBCATCHMENT ID
- FLOW LINE BREAK POINTS
- HYDRAULIC FLOW LINE
- ANALYSIS POINT

MATCH LINE

**RANSOM** Consulting Engineers and Scientists

41 Hutchins Drive  
 Portland, Maine 04102  
 800.426.4262 | www.woodardcurran.com  
 COMMITMENT & INTEGRITY DRIVE RESULTS

REV	DESCRIPTION	DATE
0	ISSUED FOR PERMIT	5-14-19

**ISSUED FOR PERMIT**  
5-14-19

CURRENT ISSUE STATUS:

TRUE NORTH:

SMRT Architects and Engineers  
 144 Fore Street  
 Portland, Maine 04104  
 1.877.700.7678  
 www.smrtinc.com

**NORDIC AQUAFARMS  
 MULTIPHASE PROJECT**

158 HIGH STREET, BELFAST, MAINE

**PRE-DEVELOPMENT  
 WATERSHED PLAN -  
 OFF-SITE AREAS**

SCALE in FEET  
 1"=120'

PROJECT MANAGER: MPM	PROJECT NO: 171.05027
DRAWN BY: JAR	

CW-101

© copyright 2019 SMRT Inc.

NOT FOR CONSTRUCTION

