Reichhardt & Ebe
ENGINEERING INC

RECEIVED
JAN 17 2020
CITY OF SUMAS

January 13, 2019

Lakeport Reach, LLC
Unit 3A-33790 Industrial Ave
Abbotsford, BC V2S 7T9

RE: Sumas Concrete Products – Existing Culvert Evaluation

To: Ser Samulski

It is our understanding that there are concerns on whether the Sumas Concrete Products development will potentially lead to flooding of the areas upstream of the site. The following is intended to be a description of assumptions and processes used to determine capacities of the existing system on the north side of the Sumas Concrete Products Project, along Kneuman Rd. More specifically, the evaluation will determine if any parts of the system will require replacement or widening.

The general steps for evaluating system capacity is as follows: a contributing area was created using Lidar from the Puget Sound Lidar Consortium and Google Earth aerial views. The larger contributing area was broken into smaller basins and given characteristics using Google Earth as a reference. After the basins were determined, the Stormshed model was created to find design flows. Finally, flows from the Stormshed model were compared against the estimated capacity of the system elements.

Basin Analysis

To create an accurate model in Stormshed, each basin needed to have a fair representation of what was in it. Based on the topography and aerial imagery, each basin varied in size and included more than a few land uses, see the Contributing Basins exhibit for outline areas. Table 1 shows each Basin being characterized by land use type, hydrologic soil group, curve number CN, and acres.

The following assumptions were made during the evaluation:

1) Areas south of Halverstick Road appear to drain towards tributaries of Johnson Creek and is not included.
2) Basin 2 will enter at the northwest corner of Basin 1 via a culvert crossing under Kneuman Road.

Table 1: Contributing Basin Composition

Basin #	Land Use	Soil Group	CN	Acres
1	Open Space/Lawn	Soil Type C	90	14.5
	Pasture/Grassland	Soil Type C	74	36
	Forested	Soil Type C	73	14.5
	Gravel	Gravel	89	10
	Wetland	Impervious	100	4
	Roofs/Roads	Impervious	98	1
			Basin 1 Total	80
2	Open Space/Lawn	Soil Type C	86	18.2
	Pasture/Grassland	Soil Type C	74	72.8
	Forested	Soil Type C	73	54.6
	Roofs/Roads	Impervious	98	36.4
			Basin 2 Total	182
3	Open Space/Lawn	Soil Type C	86	91
	Pasture/Grassland	Soil Type C	74	401
	Forested	Soil Type C	70	364
	Wetland	Impervious	100	45.5
	Roofs/Roads	Impervious	98	45.5
			Basin 3 Total	947
			Analysis Total	1209

The primary hydrologic soil group for each basin was determined to be "C" using the NRCS Soil Survey. Group C made up a majority of each basin and it was considered to be conservative to ignore any group B soils within the basin. Using the soil group and land use, a CN based on Table 2.3.2 in Ecology's (ECY) 2014 Stormwater Management Manual for Western Washington (SWMMWW). Finally, the acres were visually estimated using the aerial view.

Stormshed Analysis and Existing System Evaluation

Alongside the information found in the Basin Analysis, the design precipitations for the Sumas area were determined using the 2 -year, 10-year and 100-year Isopluvial maps in the 2014 ECY SWMMWW. A 25-year precipitation was estimated with an Isopluvial map provided in Appendix E on the Whatcom County website. The values for the 2-year, 10-year, 25-year and 100-year events are 2.5-inches, 3.5-inches, 4-inches, and 4.5-inches, respectively. With the four storms included, the model had a 2-year peak flow of 57.6 CFS, a 10-year peak flow of 120.3 CFS, a 25-year peak flow of 160.7 CFS, and a 100-year peak flow of 226.1 CFS, see attached Stormshed Report.

Survey provided by Northwest Survey and GPS (NWS), provided a rough geometry of the water course, downstream of the existing culvert, located at the north end of the site along Kneuman Rd. A site visit

performed by Reichhardt & Ebe on January 10, 2020 provided rough geometry to the channel directly upstream of the culvert crossing, see attached Photo Report. During the site visit, it was discovered that there were corrugated metal (CMP) culverts downstream of the site appearing to be 4-feet in diameter. They were included in the evaluation for capacity comparisons.

The following assumptions were made during the evaluation:

1) Existing culvert is assumed to be 10-inches in diameter and installed at a 2% slope.
2) Any blockages in the upstream or downstream channel are far enough away to have little to no effect on the 10-inch culvert evaluation.
3) The upstream channel is trapezoidal in shape, at a slope 0.7%, has an average bottom width of 2-feet, an average depth of 6.5-feet, and side slopes of 1:1.
4) The downstream channel is trapezoidal in shape, at a slope of 0.43%, has an average bottom width of 28-feet, an average depth of 3.5-feet, and side slopes of 2:1.
5) Reaches appear to be weedy and have deep pools. Per Table 4.1 of "Open Channel Hydraulics", by Terry W. Sturm, use a Manning's coefficient = 0.070.
6) Downstream CMP culverts are 4-feet, at a slope of 0.50%, and will have Manning's coefficient = 0.030 per Table 4.1 of "Open Channel Hydraulics", by Terry W. Sturm.

Taking all the assumptions into consideration, the Manning's equation was used to calculate the estimated capacity of the upstream channel, downstream channel, existing 10-inch culvert, and 4-foot CMP culverts, see attached Open Channel worksheets. Table 2 summarizes the estimated capacities and design flows.

Table 2: Capacity Comparison

Reach	Estimated Capacity (cfs)	2-Year Flow (cfs)	Capacity?	10-Year Flow (cfs)	Capacity?	25-Year Flow (cfs)	Capacity?	100-Year Flow (cfs)	Capacity?
Upstream Channel	190.76	52.96	Yes	120.28	Yes	160.67	Yes	203.70	No
Existing Culvert	3.36	52.96	No	120.28	No	160.67	No	203.70	No
Downstream Channel	339.27	52.96	Yes	120.28	Yes	160.67	Yes	203.70	Yes
4-ft CMP Culvert	44.01	52.96	No	120.28	No	160.67	No	203.70	No

Through this evaluation, it has been determined that the existing culvert is undersized for the 2-year, 10-year, 25-year, and 100-year design events and will require replacement. The 10-inch culvert is undersized and can not convey any of the design flows.

It is recommended that a channel with similar characteristics to the upstream channel be installed in place of the culvert since they had adequate capacity for a majority of the design storms. It should be noted that the CMP culvert downstream has an estimated capacity of 44.01 CFS. If the existing culvert is replaced by a channel similar the upstream, it would have a capacity greater than the 4-foot CMP culverts in excess of the 25-year return frequency flow.

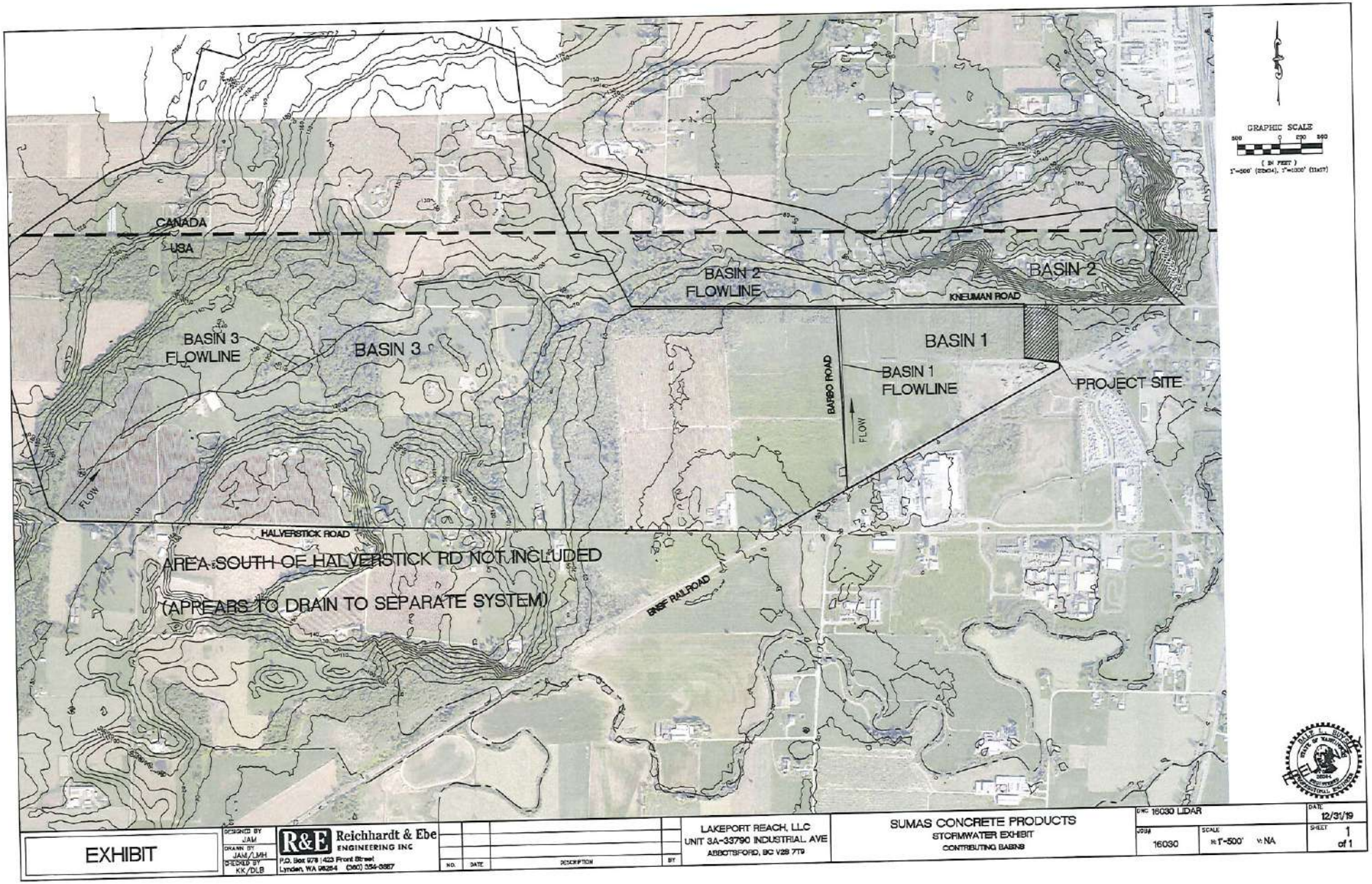
Per the site visit, it is also recommended that any blockages be addressed to increase efficiency of the creek to convey design flows. As shown in the photo survey, there are a few instances upstream and downstream that may need further evaluations. Most notably, flow is slow moving prior to the Sumas Creek 2004 Habitat.

Improvement area and faster after the improvement area. Addressing any issues in this area would reduce the flooding potential of the creek in the future.

In conclusion, it appears from our simplified analysis that the channel capacity is not the limiting factor. Obstructions within the Sumas Creek 2004 Habitat Improvement area, the downstream culvert crossings, and the Lakeport Reach 10-inch culvert may be the cause. Our recommendation to remove the 10-inch culvert and install a ditch cross section similar to the upstream channel would drastically increase flow potential to a point that issues would only be observed at a return frequency of greater than once every 25-years. This would match the existing upstream capacity and exceed the downstream culvert capacities.

Sincerely,

Dale L. Buys, P.E.
Reichhardt & Ebe Engineering, Inc.



EXHIBIT

DESIGNED BY JAM
DRAWN BY JAM/LMH
CHECKED BY KK/DLB

R&E Reichhardt & Ebe ENGINEERING INC
P.O. Box 978 | 423 Front Street
Lynden, WA 98264 (360) 354-3887

NO.	DATE	DESCRIPTION	BY

LAKEPORT REACH, LLC
UNIT 3A-33790 INDUSTRIAL AVE
ABBOTSFORD, BC V2S 7T9

SUMAS CONCRETE PRODUCTS
STORMWATER EXHIBIT
CONTRIBUTING BASINS

DWG 16030 LIDAR
JOB# 16030
SCALE: H: 1"=500' V: NA
DATE: 12/31/19
SHEET 1 of 1

Reichhardt & Ebe
ENGINEERING INC

RE: Sumas Concrete Products – Conveyance Photo Survey

A photo survey of the current conditions was performed January 10, 2020.

Photo 1: A view of the roadside ditch at the corner of Barbo Rd and Kneuman Rd. The current ditch conditions show a backed-up channel slow moving water with a fair amount of vegetation.

Photo 2: View of the ditch on the southside of Kneuman Rd looking east. Water is slow moving with a fair amount of vegetation. There is a fallen tree, potentially causing a blockage and slower moving flow in the ditch.

Photo 3: The ditch appears to bottleneck as it approaches the culvert crossing. Ditch continues to have a fair amount of vegetation.

Photo 4: Upstream of the culvert inlet. Flow depth is roughly 5.5-ft to 6.5-ft and the top width is roughly 13-ft to 15-ft in this area. Culvert is fully submerged and could not be surveyed at this time.

Photo 5: Ditch after the culvert crossing widens. Culvert is submerged and could not be surveyed at this time. Submergence is likely caused by an offsite downstream flow obstruction.

Photo 6: There appears to be a blockage in the channel just after the culvert crossing.

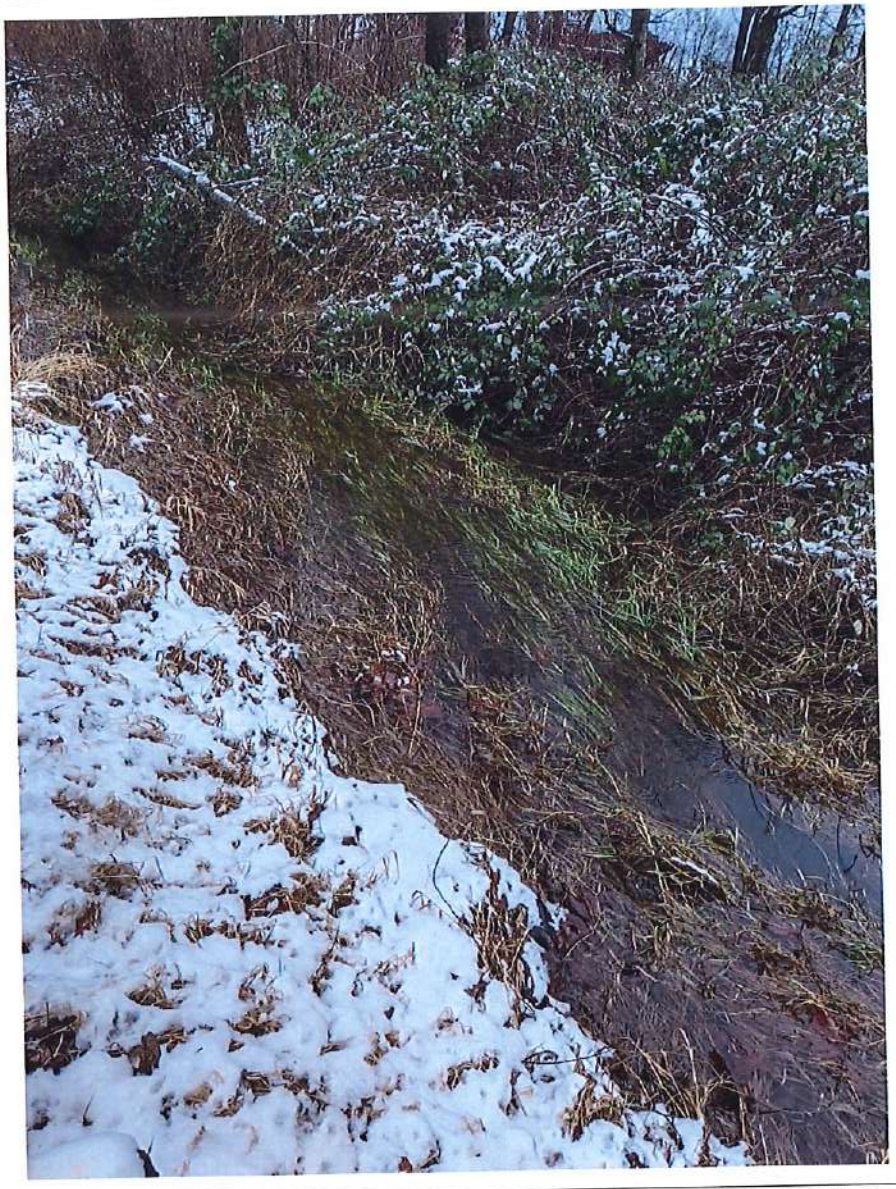
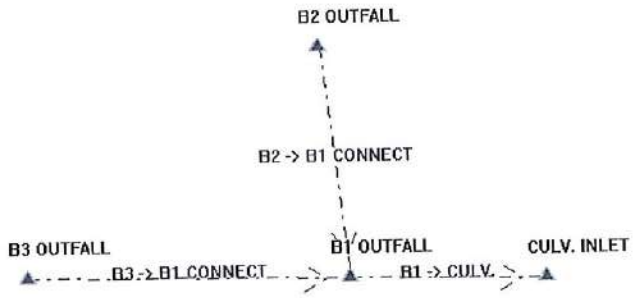


Photo 7: Creek downstream of the Sumas Creek 2004 Habitat Improvement area is flowing more freely than the upstream condition.

Photo 8: There are large culverts in the creek downstream of the project site. They were estimated visually to be roughly 4-ft in diameter. Conditions made it difficult to access the culverts safely for an accurate measurement.



Project Precips

[2 yr]	2.50 in
[10 yr]	3.50 in
[25 yr]	4.00 in
[100 yr]	4.50 in

Reach Records

Reach ID: B3 -> B1 CONNECT

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation	
Size	Material	Mannings n	Hyd params By		
	Corr Metal - normal		0.0800 Mannings Formula		
Length	Slope	Entrance Loss			
0.0010 ft	0.50 %				
Width	Bank Hgt	ss1	ss2		
1.0000 ft	1.0000 ft	0.00h:1v	0.00h:1v		
Up Node	Dn Node	Up Invert	Dn Invert		
B3 OUTFALL	B1 OUTFALL	0.0000 ft	0.0000 ft		

Conduit Constraints:

Min Vel	Max Vel	Min Cov	Min Slope	Max Slope	Min drop
2.0000 ft	15.0000 ft	3.0000 ft	0.5000 ft	2.0000 ft	0.0000 ft
In/Exfil	Hold Up	Hold Dn	Match Inv	Allow Smaller	
0.0000 in/hr	NO	NO	YES	NO	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
947.0000 ac	108.8979 cf	108.8979 cf	171.7813 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	1.0000 ft	

comment: Hydrograph not shifted, 0.00 min forwarded.Submerged or overtop bank condition.

Reach ID: B2 -> B1 CONNECT

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Corr Metal - normal		0.0800 Mannings Formula	
Length	Slope	Entrance Loss		
0.0010 ft	0.50 %			
Width	Bank Hgt	ss1	ss2	
1.0000 ft	1.0000 ft	0.00h:1v	0.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	

B2 OUTFALL	B1 OUTFALL	0.0000 ft	0.0000 ft

Conduit Constraints:

Min Vel	Max Vel	Min Cov	Min Slope	Max Slope	Min drop
2.0000 ft	15.0000 ft	3.0000 ft	0.5000 ft	2.0000 ft	0.0000 ft
In/Exfil	Hold Up	Hold Dn	Match Inv	Allow Smaller	
0.0000 in/hr	NO	NO	YES	NO	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
182.0000 ac	41.2996 cf	41.2996 cf	65.1482 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	1.0000 ft	

comment: Hydrograph not shifted, 0.00 min forwarded.Submerged or overtop bank condition.

Reach ID: B1 -> CULV.

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Corr Metal - normal		0.0800	Mannings Formula
Length	Slope	Entrance Loss		
0.0010 ft	0.50 %			
Width	Bank Hgt	ss1	ss2	
1.0000 ft	1.0000 ft	0.00h:1v	0.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
B1 OUTFALL	CULV. INLET	0.0000 ft	0.0000 ft	

Conduit Constraints:

Min Vel	Max Vel	Min Cov	Min Slope	Max Slope	Min drop
2.0000 ft	15.0000 ft	3.0000 ft	0.5000 ft	2.0000 ft	0.0000 ft
In/Exfil	Hold Up	Hold Dn	Match Inv	Allow Smaller	
0.0000 in/hr	NO	NO	YES	NO	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
1209.0000 ac	160.6723 cf	160.6723 cf	253.4531 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	1.0000 ft	

comment: Hydrograph not shifted, 0.00 min forwarded.Submerged or overtop bank condition.

Node Records

Node ID: CULV. INLET

Start El: 100.0000 ft
Contrib Basin:
Hgl Elev: 1.0000 ft

Max El: 108.0000 ft
Contrib Hyd:

Node ID: B1 OUTFALL

Start El: 100.0000 ft
Contrib Basin: BASIN 1

Max El: 108.0000 ft
Contrib Hyd:

Node ID: B2 OUTFALL

Start El: 100.0000 ft
Contrib Basin: BASIN 2

Max El: 108.0000 ft
Contrib Hyd:

Node ID: B3 OUTFALL

Start El: 100.0000 ft
Contrib Basin: BASIN 3

Max El: 108.0000 ft
Contrib Hyd:

Contributing Drainage Areas

BASIN 1 Event Summary:

BasinID	Peak Q (cfs)	Peak T (hrs)	Peak Vol (ac-ft)	Area ac	Method /Loss	Raintype	Event
BASIN 1	6.66	9.00	5.9939	80.00	SBUH/SCS	TYPE1A	2 yr
BASIN 1	14.33	8.67	11.0013	80.00	SBUH/SCS	TYPE1A	10 yr
BASIN 1	18.65	8.50	13.7133	80.00	SBUH/SCS	TYPE1A	25 yr
BASIN 1	23.21	8.50	16.5212	80.00	SBUH/SCS	TYPE1A	100 yr

Drainage Area: BASIN 1

Hyd Method: SBUH Hyd
Peak Factor: 484.00
Storm Dur: 24.00 hrs

Loss Method: SCS CN Number
SCS Abs: 0.20
Intv: 10.00 min

	Area	CN	TC
Pervious	80.0000 ac	80.19	1.06 hrs
Impervious	0.0000 ac	0.00	0.00 hrs
Total	80.0000 ac		

Supporting Data:

Pervious CN Data:

Open Space/Lawn	90.00	14.5000 ac
Pasture/Grassland	74.00	36.0000 ac
Forested	73.00	14.5000 ac
Gravel	89.00	10.0000 ac
Weland	100.00	4.0000 ac
Roof/Road	98.00	1.0000 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Channel	Natural earth with vegetation	2128.00 ft	0.30%	17.0000	38.09 min
Channel	Natural earth with vegetation	2152.00 ft	0.70%	17.0000	25.22 min

BASIN 2 Event Summary:

BasinID	Peak Q (cfs)	Peak T (hrs)	Peak Vol (ac-ft)	Area ac	Method /Loss	Raintype	Event
BASIN 2	14.49	9.00	13.2440	182.00	SBUH/SCS	TYPE1A	2 yr
BASIN 2	31.62	8.67	24.4940	182.00	SBUH/SCS	TYPE1A	10 yr
BASIN 2	41.30	8.50	30.6066	182.00	SBUH/SCS	TYPE1A	25 yr
BASIN 2	51.57	8.50	36.9427	182.00	SBUH/SCS	TYPE1A	100 yr

Drainage Area: BASIN 2

Hyd Method: SBUH Hyd
Peak Factor: 484.00
Storm Dur: 24.00 hrs

Loss Method: SCS CN Number
SCS Abs: 0.20
Intv: 10.00 min

	Area	CN	TC
Pervious	182.0000 ac	79.70	1.05 hrs
Impervious	0.0000 ac	0.00	0.00 hrs
Total	182.0000 ac		

Supporting Data:

Pervious CN Data:

Open Space/Lawn	86.00	18.2000 ac
Pasture/Grassland	74.00	72.8000 ac
Forested	73.00	54.6000 ac
Roof/Road	98.00	36.4000 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Grassy/farmlands	300.00 ft	7.70%	0.1300	15.15 min

Shallow	Grassy/farmlands	4475.00 ft	2.00%	11.0000	47.94 min	

BASIN 3 Event Summary:

BasinID	Peak Q (cfs)	Peak T (hrs)	Peak Vol (ac-ft)	Area ac	Method /Loss	Raintype	Event
BASIN 3	38.57	14.50	54.8717	947.00	SBUH/SCS	TYPE1A	2 yr
BASIN 3	81.98	10.67	107.8373	947.00	SBUH/SCS	TYPE1A	10 yr
BASIN 3	108.90	10.17	137.3025	947.00	SBUH/SCS	TYPE1A	25 yr
BASIN 3	138.02	10.00	168.1884	947.00	SBUH/SCS	TYPE1A	100 yr

Drainage Area: BASIN 3

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	947.0000 ac	76.02	2.87 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	947.0000 ac			

Supporting Data:

Pervious CN Data:

Open Space/Lawn	86.00	91.0000 ac
Pasture/Grassland	74.00	401.0000 ac
Forested	70.00	364.0000 ac
Wetland	100.00	45.5000 ac
Roof/Road	98.00	45.5000 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Grass/Farmland	300.00 ft	3.00%	0.1300	22.09 min
Shallow	Grass/Farmland	3547.00 ft	0.70%	11.0000	64.23 min
Channel	Forested	2423.00 ft	1.20%	10.0000	36.86 min
Channel	Natural earth with vegetation	4341.00 ft	0.70%	17.0000	50.87 min

Layout Hydrographs

Hydrograph ID: CULV. INLET - 2 yr

Area:	1209.0000 ac	Hyd Int:	10.00 min	Base Flow:	
Pending tt translation:	0.00 min				
Peak Flow:	52.9659 cfs	Peak Time:	10.67 hrs	Hyd Vol:	74.1103 acft

Hydrograph ID: CULV. INLET - 2 yr

Area:	1209.0000 ac	Hyd Int:	10.00 min	Base Flow:	
Pending tt translation:	0.00 min				
Peak Flow:	52.9659 cfs	Peak Time:	10.67 hrs	Hyd Vol:	74.1103 acft

Time	Flow	Time	Flow	Time	Flow
hr	cfs	hr	cfs	hr	cfs
6.00	0.0037	24.33	37.9655	42.33	0.0567
6.17	0.0452	24.50	35.1079	42.50	0.0535
6.33	0.1674	24.67	32.5166	42.67	0.0505
6.50	0.3742	24.83	30.1610	42.83	0.0476
6.67	0.6956	25.00	28.0147	43.00	0.0449
6.83	1.1336	25.17	26.0547	43.17	0.0424
7.00	1.7157	25.33	24.2609	43.33	0.0400
7.17	2.6429	25.50	22.6158	43.50	0.0377
7.33	3.9498	25.67	21.1041	43.67	0.0356
7.50	5.5162	25.83	19.7122	43.83	0.0336
7.67	10.0573	26.00	18.4284	44.00	0.0317
7.83	18.3811	26.17	17.2421	44.17	0.0299
8.00	28.3722	26.33	16.1443	44.33	0.0282
8.17	35.5273	26.50	15.1267	44.50	0.0266
8.33	39.2055	26.67	14.1822	44.67	0.0251
8.50	43.0619	26.83	13.3043	44.83	0.0237
8.67	45.8806	27.00	12.4874	45.00	0.0224
8.83	47.6514	27.17	11.7262	45.17	0.0211
9.00	49.5503	27.33	11.0163	45.33	0.0199
9.17	50.6925	27.50	10.3535	45.50	0.0188
9.33	51.0996	27.67	9.7342	45.67	0.0177
9.50	51.6534	27.83	9.1550	45.83	0.0167
9.67	52.0565	28.00	8.6128	46.00	0.0158
9.83	52.3062	28.17	8.1050	46.17	0.0149
10.00	52.6756	28.33	7.6290	46.33	0.0141
10.17	52.8575	28.50	7.1826	46.50	0.0133
10.33	52.8560	28.67	6.7638	46.67	0.0125
10.50	52.9644	28.83	6.3705	46.83	0.0118
10.67	52.9659	29.00	6.0012	47.00	0.0111
10.83	52.8615	29.17	5.6541	47.17	0.0105
11.00	52.8535	29.33	5.3279	47.33	0.0099
11.17	52.8242	29.50	5.0211	47.50	0.0094
11.33	52.7701	29.67	4.7325	47.67	0.0088
11.50	52.7923	29.83	4.4610	47.83	0.0083
11.67	52.7729	30.00	4.2055	48.00	0.0079
11.83	52.7114	30.17	3.9649	48.17	0.0074
12.00	52.7150	30.33	3.7384	48.33	0.0070
12.17	52.6646	30.50	3.5251	48.50	0.0066
12.33	52.5616	30.67	3.3241	48.67	0.0062
12.50	52.5179	30.83	3.1348	48.83	0.0059
12.67	52.4126	31.00	2.9565	49.00	0.0056
12.83	52.2485	31.17	2.7884	49.17	0.0052
13.00	52.1414	31.33	2.6300	49.33	0.0049
13.17	52.0841	31.50	2.4806	49.50	0.0047
13.33	52.0705	31.67	2.3399	49.67	0.0044
13.50	52.0953	31.83	2.2072	49.83	0.0042
13.67	52.0356	32.00	2.0820	50.00	0.0039
13.83	51.8973	32.17	1.9641	50.17	0.0037
14.00	51.8040	32.33	1.8528	50.33	0.0035
14.17	51.7503	32.50	1.7479	50.50	0.0033
14.33	51.7315	32.67	1.6490	50.67	0.0031
14.50	51.7436	32.83	1.5557	50.83	0.0029

14.67	51.6603	33.00	1.4677	51.00	0.0028
14.83	51.4892	33.17	1.3847	51.17	0.0026
15.00	51.3595	33.33	1.3064	51.33	0.0025
15.17	51.2665	33.50	1.2325	51.50	0.0023
15.33	51.2060	33.67	1.1628	51.67	0.0022
15.50	51.1743	33.83	1.0971	51.83	0.0021
15.67	51.0416	34.00	1.0351	52.00	0.0020
15.83	50.8162	34.17	0.9766	52.17	0.0018
16.00	50.6321	34.33	0.9215	52.33	0.0017
16.17	50.4847	34.50	0.8694	52.50	0.0016
16.33	50.3700	34.67	0.8203	52.67	0.0015
16.50	50.2842	34.83	0.7740	52.83	0.0015
16.67	50.2243	35.00	0.7302	53.00	0.0014
16.83	50.1876	35.17	0.6890	53.17	0.0013
17.00	50.1716	35.33	0.6501	53.33	0.0012
17.17	50.0423	35.50	0.6134	53.50	0.0012
17.33	49.8095	35.67	0.5787	53.67	0.0011
17.50	49.6140	35.83	0.5460	53.83	0.0010
17.67	49.4516	36.00	0.5152	54.00	0.0010
17.83	49.3187	36.17	0.4861	54.17	0.0009
18.00	49.2121	36.33	0.4587	54.33	0.0009
18.17	48.9941	36.50	0.4328	54.50	0.0008
18.33	48.6745	36.67	0.4084	54.67	0.0008
18.50	48.3969	36.83	0.3853	54.83	0.0007
18.67	48.1565	37.00	0.3636	55.00	0.0007
18.83	47.9495	37.17	0.3431	55.17	0.0006
19.00	47.7723	37.33	0.3237	55.33	0.0006
19.17	47.4840	37.50	0.3054	55.50	0.0006
19.33	47.0944	37.67	0.2882	55.67	0.0005
19.50	46.7501	37.83	0.2719	55.83	0.0005
19.67	46.4460	38.00	0.2566	56.00	0.0005
19.83	46.1778	38.17	0.2421	56.17	0.0005
20.00	45.9419	38.33	0.2284	56.33	0.0004
20.17	45.7348	38.50	0.2156	56.50	0.0004
20.33	45.5537	38.67	0.2034	56.67	0.0004
20.50	45.3960	38.83	0.1919	56.83	0.0004
20.67	45.2595	39.00	0.1811	57.00	0.0003
20.83	45.1422	39.17	0.1709	57.17	0.0003
21.00	45.0422	39.33	0.1612	57.33	0.0003
21.17	44.9580	39.50	0.1521	57.50	0.0003
21.33	44.8883	39.67	0.1435	57.67	0.0003
21.50	44.8316	39.83	0.1354	57.83	0.0003
21.67	44.7870	40.00	0.1278	58.00	0.0002
21.83	44.7533	40.17	0.1206	58.17	0.0002
22.00	44.7297	40.33	0.1138	58.33	0.0002
22.17	44.5707	40.50	0.1074	58.50	0.0002
22.33	44.2888	40.67	0.1013	58.67	0.0002
22.50	44.0399	40.83	0.0956	58.83	0.0002
22.67	43.8204	41.00	0.0902	59.00	0.0002
22.83	43.6271	41.17	0.0851	59.17	0.0002
23.00	43.4573	41.33	0.0803	59.33	0.0002
23.17	43.3086	41.50	0.0758	59.50	0.0001
23.33	43.1789	41.67	0.0715	59.67	0.0001
23.50	43.0664	41.83	0.0675	59.83	0.0001
23.67	42.9693	42.00	0.0637	60.00	0.0001
23.83	42.8861	42.17	0.0601	60.17	0.0001
24.00	42.8157	42.33	0.0567	60.33	0.0001
24.17	41.1242	42.50	0.0535	60.50	0.0001

Hydrograph ID: CULV. INLET - 10 yr

Area: 1209.0000 ac Hyd Int: 10.00 min Base Flow:
Pending tt translation: 0.00 min
Peak Flow: 120.2804 cfs Peak Time: 9.17 hrs Hyd Vol: 143.3329 acft

Hydrograph ID: CULV. INLET - 10 yr

Area: 1209.0000 ac Hyd Int: 10.00 min Base Flow:
Pending tt translation: 0.00 min

Peak Flow:	120.2804 cfs	Peak Time:	9.17 hrs	Hyd Vol:	143.3329 acft
Time	Flow	Time	Flow	Time	Flow
hr	cfs	hr	cfs	hr	cfs
4.83	0.0106	24.00	72.3910	43.00	0.0769
5.00	0.0843	24.17	69.5276	43.17	0.0726
5.17	0.2676	24.33	64.2499	43.33	0.0685
5.33	0.5519	24.50	59.4687	43.50	0.0646
5.50	0.9151	24.67	55.1268	43.67	0.0610
5.67	1.4026	24.83	51.1746	43.83	0.0575
5.83	2.0897	25.00	47.5689	44.00	0.0543
6.00	2.9857	25.17	44.2720	44.17	0.0512
6.17	4.2090	25.33	41.2510	44.33	0.0483
6.33	5.7681	25.50	38.4772	44.50	0.0456
6.50	7.5271	25.67	35.9253	44.67	0.0430
6.67	9.7892	25.83	33.5733	44.83	0.0406
6.83	12.5709	26.00	31.4017	45.00	0.0383
7.00	15.5553	26.17	29.3932	45.17	0.0362
7.17	19.2421	26.33	27.5328	45.33	0.0341
7.33	23.6420	26.50	25.8070	45.50	0.0322
7.50	28.2313	26.67	24.2038	45.67	0.0304
7.67	40.4601	26.83	22.7126	45.83	0.0287
7.83	61.1597	27.00	21.3240	46.00	0.0270
8.00	83.4299	27.17	20.0294	46.17	0.0255
8.17	97.9954	27.33	18.8213	46.33	0.0241
8.33	104.3111	27.50	17.6927	46.50	0.0227
8.50	110.8168	27.67	16.6376	46.67	0.0214
8.67	115.0692	27.83	15.6504	46.83	0.0202
8.83	117.1282	28.00	14.7259	47.00	0.0191
9.00	119.4449	28.17	13.8597	47.17	0.0180
9.17	120.2804	28.33	13.0476	47.33	0.0170
9.33	119.7017	28.50	12.2856	47.50	0.0160
9.50	119.4619	28.67	11.5705	47.67	0.0151
9.67	118.9816	28.83	10.8989	47.83	0.0143
9.83	118.2554	29.00	10.2679	48.00	0.0135
10.00	117.8082	29.17	9.6749	48.17	0.0127
10.17	117.0529	29.33	9.1173	48.33	0.0120
10.33	115.9969	29.50	8.5929	48.50	0.0113
10.50	115.1943	29.67	8.0996	48.67	0.0107
10.67	114.2356	29.83	7.6353	48.83	0.0101
10.83	113.1208	30.00	7.1983	49.00	0.0095
11.00	112.2254	30.17	6.7869	49.17	0.0090
11.17	111.3288	30.33	6.3994	49.33	0.0085
11.33	110.4217	30.50	6.0345	49.50	0.0080
11.50	109.6884	30.67	5.6907	49.67	0.0075
11.67	108.9108	30.83	5.3668	49.83	0.0071
11.83	108.0861	31.00	5.0615	50.00	0.0067
12.00	107.4084	31.17	4.7739	50.17	0.0063
12.17	106.6597	31.33	4.5028	50.33	0.0060
12.33	105.8415	31.50	4.2472	50.50	0.0056
12.50	105.1549	31.67	4.0063	50.67	0.0053
12.67	104.3810	31.83	3.7791	50.83	0.0050
12.83	103.5239	32.00	3.5650	51.00	0.0047
13.00	102.7903	32.17	3.3630	51.17	0.0045
13.17	102.1661	32.33	3.1726	51.33	0.0042
13.33	101.6389	32.50	2.9930	51.50	0.0040
13.50	101.1977	32.67	2.8236	51.67	0.0038
13.67	100.6238	32.83	2.6638	51.83	0.0035
13.83	99.9273	33.00	2.5132	52.00	0.0033
14.00	99.3263	33.17	2.3710	52.17	0.0032
14.17	98.8104	33.33	2.2370	52.33	0.0030
14.33	98.3704	33.50	2.1105	52.50	0.0028
14.50	97.9983	33.67	1.9912	52.67	0.0026
14.67	97.4722	33.83	1.8787	52.83	0.0025
14.83	96.8051	34.00	1.7726	53.00	0.0024
15.00	96.2228	34.17	1.6724	53.17	0.0022
15.17	95.7164	34.33	1.5780	53.33	0.0021
15.33	95.2779	34.50	1.4888	53.50	0.0020
15.50	94.9003	34.67	1.4047	53.67	0.0019
15.67	94.3578	34.83	1.3254	53.83	0.0018

15.83	93.6649	35.00	1.2506	54.00	0.0017
16.00	93.0535	35.17	1.1799	54.17	0.0016
16.17	92.5151	35.33	1.1133	54.33	0.0015
16.33	92.0420	35.50	1.0504	54.50	0.0014
16.50	91.6275	35.67	0.9911	54.67	0.0013
16.67	91.2658	35.83	0.9351	54.83	0.0012
16.83	90.9517	36.00	0.8823	55.00	0.0012
17.00	90.6807	36.17	0.8325	55.17	0.0011
17.17	90.2230	36.33	0.7855	55.33	0.0010
17.33	89.5956	36.50	0.7411	55.50	0.0010
17.50	89.0388	36.67	0.6993	55.67	0.0009
17.67	88.5454	36.83	0.6599	55.83	0.0009
17.83	88.1088	37.00	0.6226	56.00	0.0008
18.00	87.7232	37.17	0.5875	56.17	0.0008
18.17	87.1545	37.33	0.5543	56.33	0.0007
18.33	86.4194	37.50	0.5230	56.50	0.0007
18.50	85.7613	37.67	0.4935	56.67	0.0007
18.67	85.1722	37.83	0.4657	56.83	0.0006
18.83	84.6450	38.00	0.4394	57.00	0.0006
19.00	84.1735	38.17	0.4146	57.17	0.0006
19.17	83.5197	38.33	0.3912	57.33	0.0005
19.33	82.7004	38.50	0.3691	57.50	0.0005
19.50	81.9623	38.67	0.3483	57.67	0.0005
19.67	81.2969	38.83	0.3287	57.83	0.0004
19.83	80.6966	39.00	0.3101	58.00	0.0004
20.00	80.1550	39.17	0.2926	58.17	0.0004
20.17	79.6662	39.33	0.2761	58.33	0.0004
20.33	79.2252	39.50	0.2605	58.50	0.0003
20.50	78.8275	39.67	0.2458	58.67	0.0003
20.67	78.4690	39.83	0.2319	58.83	0.0003
20.83	78.1461	40.00	0.2189	59.00	0.0003
21.00	77.8559	40.17	0.2065	59.17	0.0003
21.17	77.5953	40.33	0.1948	59.33	0.0003
21.33	77.3620	40.50	0.1839	59.50	0.0002
21.50	77.1535	40.67	0.1735	59.67	0.0002
21.67	76.9679	40.83	0.1637	59.83	0.0002
21.83	76.8033	41.00	0.1545	60.00	0.0002
22.00	76.6581	41.17	0.1457	60.17	0.0002
22.17	76.2906	41.33	0.1375	60.33	0.0002
22.33	75.7217	41.50	0.1298	60.50	0.0002
22.50	75.2102	41.67	0.1224	60.67	0.0002
22.67	74.7498	41.83	0.1155	60.83	0.0002
22.83	74.3353	42.00	0.1090	61.00	0.0001
23.00	73.9620	42.17	0.1029	61.17	0.0001
23.17	73.6260	42.33	0.0970	61.33	0.0001
23.33	73.3236	42.50	0.0916	61.50	0.0001
23.50	73.0516	42.67	0.0864	61.67	0.0001
23.67	72.8071	42.83	0.0815	61.83	0.0001
23.83	72.5876	43.00	0.0769	62.00	0.0001

Hydrograph ID: CULV. INLET - 25 yr

Area:	1209.0000 ac	Hyd Int:	10.00 min	Base Flow:	
Pending tt translation:	0.00 min				
Peak Flow:	160.6723 cfs	Peak Time:	9.17 hrs	Hyd Vol:	181.6227 acft

Hydrograph ID: CULV. INLET - 25 yr

Area:	1209.0000 ac	Hyd Int:	10.00 min	Base Flow:	
Pending tt translation:	0.00 min				
Peak Flow:	160.6723 cfs	Peak Time:	9.17 hrs	Hyd Vol:	181.6227 acft

Time	Flow	Time	Flow	Time	Flow
hr	cfs	hr	cfs	hr	cfs
4.33	0.0061	23.83	87.8470	43.17	0.0882
4.50	0.0635	24.00	87.5794	43.33	0.0832
4.67	0.2301	24.17	84.1133	43.50	0.0785
4.83	0.5108	24.33	77.7518	43.67	0.0741
5.00	0.8823	24.50	71.9862	43.83	0.0699

5.17	1.3893	24.67	66.7481	44.00	0.0659
5.33	2.1143	24.83	61.9782	44.17	0.0622
5.50	3.0728	25.00	57.6246	44.33	0.0587
5.67	4.3214	25.17	53.6423	44.50	0.0554
5.83	5.8523	25.33	49.9919	44.67	0.0523
6.00	7.5758	25.50	46.6390	44.83	0.0493
6.17	9.7171	25.67	43.5533	45.00	0.0465
6.33	12.2821	25.83	40.7083	45.17	0.0439
6.50	15.0247	26.00	38.0806	45.33	0.0414
6.67	18.4293	26.17	35.6498	45.50	0.0391
6.83	22.5067	26.33	33.3975	45.67	0.0369
7.00	26.7529	26.50	31.3075	45.83	0.0348
7.17	31.9023	26.67	29.3657	46.00	0.0328
7.33	37.9567	26.83	27.5591	46.17	0.0310
7.50	44.1484	27.00	25.8764	46.33	0.0292
7.67	60.6570	27.17	24.3073	46.50	0.0276
7.83	88.2593	27.33	22.8428	46.67	0.0260
8.00	117.2416	27.50	21.4745	46.83	0.0246
8.17	135.7247	27.67	20.1951	47.00	0.0232
8.33	143.2762	27.83	18.9978	47.17	0.0219
8.50	151.0186	28.00	17.8765	47.33	0.0206
8.67	155.8423	28.17	16.8257	47.50	0.0195
8.83	157.8513	28.33	15.8404	47.67	0.0184
9.00	160.1944	28.50	14.9159	47.83	0.0173
9.17	160.6723	28.67	14.0481	48.00	0.0164
9.33	159.3779	28.83	13.2331	48.17	0.0154
9.50	158.5350	29.00	12.4674	48.33	0.0146
9.67	157.4123	29.17	11.7476	48.50	0.0137
9.83	156.0026	29.33	11.0709	48.67	0.0130
10.00	154.9654	29.50	10.4343	48.83	0.0122
10.17	153.5637	29.67	9.8355	49.00	0.0115
10.33	151.8060	29.83	9.2718	49.17	0.0109
10.50	150.3854	30.00	8.7413	49.33	0.0103
10.67	148.7894	30.17	8.2418	49.50	0.0097
10.83	147.0171	30.33	7.7713	49.67	0.0092
11.00	145.5358	30.50	7.3282	49.83	0.0086
11.17	144.0695	30.67	6.9108	50.00	0.0081
11.33	142.6058	30.83	6.5175	50.17	0.0077
11.50	141.3727	31.00	6.1469	50.33	0.0073
11.67	140.0987	31.17	5.7976	50.50	0.0068
11.83	138.7797	31.33	5.4684	50.67	0.0065
12.00	137.6551	31.50	5.1581	50.83	0.0061
12.17	136.4548	31.67	4.8655	51.00	0.0057
12.33	135.1799	31.83	4.5896	51.17	0.0054
12.50	134.0785	32.00	4.3296	51.33	0.0051
12.67	132.8798	32.17	4.0843	51.50	0.0048
12.83	131.5885	32.33	3.8530	51.67	0.0046
13.00	130.4589	32.50	3.6349	51.83	0.0043
13.17	129.4728	32.67	3.4292	52.00	0.0041
13.33	128.6145	32.83	3.2352	52.17	0.0038
13.50	127.8698	33.00	3.0522	52.33	0.0036
13.67	126.9699	33.17	2.8796	52.50	0.0034
13.83	125.9269	33.33	2.7168	52.67	0.0032
14.00	125.0083	33.50	2.5633	52.83	0.0030
14.17	124.2007	33.67	2.4184	53.00	0.0029
14.33	123.4924	33.83	2.2817	53.17	0.0027
14.50	122.8733	34.00	2.1528	53.33	0.0025
14.67	122.0717	34.17	2.0312	53.50	0.0024
14.83	121.1033	34.33	1.9164	53.67	0.0023
15.00	120.2443	34.50	1.8082	53.83	0.0021
15.17	119.4831	34.67	1.7061	54.00	0.0020
15.33	118.8098	34.83	1.6097	54.17	0.0019
15.50	118.2155	35.00	1.5188	54.33	0.0018
15.67	117.4250	35.17	1.4331	54.50	0.0017
15.83	116.4556	35.33	1.3522	54.67	0.0016
16.00	115.5899	35.50	1.2758	54.83	0.0015
16.17	114.8172	35.67	1.2037	55.00	0.0014
16.33	114.1280	35.83	1.1357	55.17	0.0013
16.50	113.5140	36.00	1.0716	55.33	0.0013
16.67	112.9678	36.17	1.0111	55.50	0.0012

16.83	112.4830	36.33	0.9541	55.67	0.0011
17.00	112.0536	36.50	0.9001	55.83	0.0011
17.17	111.4010	36.67	0.8493	56.00	0.0010
17.33	110.5454	36.83	0.8014	56.17	0.0009
17.50	109.7787	37.00	0.7562	56.33	0.0009
17.67	109.0918	37.17	0.7135	56.50	0.0008
17.83	108.4766	37.33	0.6732	56.67	0.0008
18.00	107.9259	37.50	0.6353	56.83	0.0008
18.17	107.1563	37.67	0.5994	57.00	0.0007
18.33	106.1875	37.83	0.5656	57.17	0.0007
18.50	105.3147	38.00	0.5337	57.33	0.0006
18.67	104.5278	38.17	0.5036	57.50	0.0006
18.83	103.8182	38.33	0.4751	57.67	0.0006
19.00	103.1781	38.50	0.4483	57.83	0.0005
19.17	102.3201	38.67	0.4230	58.00	0.0005
19.33	101.2641	38.83	0.3992	58.17	0.0005
19.50	100.3085	39.00	0.3766	58.33	0.0004
19.67	99.4427	39.17	0.3554	58.50	0.0004
19.83	98.6576	39.33	0.3353	58.67	0.0004
20.00	97.9452	39.50	0.3164	58.83	0.0004
20.17	97.2986	39.67	0.2985	59.00	0.0004
20.33	96.7113	39.83	0.2817	59.17	0.0003
20.50	96.1779	40.00	0.2658	59.33	0.0003
20.67	95.6934	40.17	0.2508	59.50	0.0003
20.83	95.2535	40.33	0.2367	59.67	0.0003
21.00	94.8543	40.50	0.2233	59.83	0.0003
21.17	94.4923	40.67	0.2107	60.00	0.0002
21.33	94.1645	40.83	0.1988	60.17	0.0002
21.50	93.8679	41.00	0.1876	60.33	0.0002
21.67	93.6001	41.17	0.1770	60.50	0.0002
21.83	93.3587	41.33	0.1670	60.67	0.0002
22.00	93.1417	41.50	0.1576	60.83	0.0002
22.17	92.6585	41.67	0.1487	61.00	0.0002
22.33	91.9342	41.83	0.1403	61.17	0.0002
22.50	91.2798	42.00	0.1324	61.33	0.0002
22.67	90.6881	42.17	0.1249	61.50	0.0001
22.83	90.1526	42.33	0.1179	61.67	0.0001
23.00	89.6676	42.50	0.1112	61.83	0.0001
23.17	89.2283	42.67	0.1049	62.00	0.0001
23.33	88.8302	42.83	0.0990	62.17	0.0001
23.50	88.4696	43.00	0.0934	62.33	0.0001
23.67	88.1428	43.17	0.0882	62.50	0.0001

Hydrograph ID: CULV. INLET - 100 yr

Area:	1209.0000 ac	Hyd Int:	10.00 min	Base Flow:	
Pending tt translation:	0.00 min				
Peak Flow:	203.6969 cfs	Peak Time:	9.17 hrs	Hyd Vol:	221.6530 acft

Hydrograph ID: CULV. INLET - 100 yr

Area:	1209.0000 ac	Hyd Int:	10.00 min	Base Flow:	
Pending tt translation:	0.00 min				
Peak Flow:	203.6969 cfs	Peak Time:	9.17 hrs	Hyd Vol:	221.6530 acft

Time	Flow	Time	Flow	Time	Flow
hr	cfs	hr	cfs	hr	cfs
4.00	0.0111	23.83	103.2271	43.33	0.0980
4.17	0.1019	24.00	102.8851	43.50	0.0925
4.33	0.3207	24.17	98.8115	43.67	0.0873
4.50	0.6470	24.33	91.3596	43.83	0.0823
4.67	1.0945	24.50	84.6035	44.00	0.0777
4.83	1.7309	24.67	78.4634	44.17	0.0733
5.00	2.6083	24.83	72.8702	44.33	0.0692
5.17	3.8072	25.00	67.7637	44.50	0.0653
5.33	5.3206	25.17	63.0912	44.67	0.0616
5.50	7.0552	25.33	58.8069	44.83	0.0581
5.67	9.1180	25.50	54.8706	45.00	0.0548
5.83	11.5002	25.67	51.2470	45.17	0.0517

6.00	14.0568	25.83	47.9053	45.33	0.0488
6.17	17.1329	26.00	44.8181	45.50	0.0461
6.33	20.7305	26.17	41.9615	45.67	0.0435
6.50	24.4792	26.33	39.3142	45.83	0.0410
6.67	29.0626	26.50	36.8572	46.00	0.0387
6.83	34.4837	26.67	34.5738	46.17	0.0365
7.00	40.0316	26.83	32.4492	46.33	0.0345
7.17	46.6951	27.00	30.4699	46.50	0.0325
7.33	54.4647	27.17	28.6241	46.67	0.0307
7.50	62.3080	27.33	26.9010	46.83	0.0289
7.67	83.3084	27.50	25.2909	47.00	0.0273
7.83	118.1502	27.67	23.7852	47.17	0.0258
8.00	154.1002	27.83	22.3760	47.33	0.0243
8.17	176.5839	28.00	21.0561	47.50	0.0229
8.33	185.3177	28.17	19.8191	47.67	0.0216
8.50	194.2401	28.33	18.6591	47.83	0.0204
8.67	199.5533	28.50	17.5706	48.00	0.0193
8.83	201.4095	28.67	16.5488	48.17	0.0182
9.00	203.6821	28.83	15.5891	48.33	0.0172
9.17	203.6969	29.00	14.6873	48.50	0.0162
9.33	201.5744	29.17	13.8397	48.67	0.0153
9.50	200.0240	29.33	13.0426	48.83	0.0144
9.67	198.1578	29.50	12.2929	49.00	0.0136
9.83	195.9665	29.67	11.5875	49.17	0.0128
10.00	194.2478	29.83	10.9236	49.33	0.0121
10.17	192.1106	30.00	10.2987	49.50	0.0114
10.33	189.5647	30.17	9.7103	49.67	0.0108
10.50	187.4451	30.33	9.1561	49.83	0.0102
10.67	185.1339	30.50	8.6341	50.00	0.0096
10.83	182.6291	30.67	8.1424	50.17	0.0091
11.00	180.4913	30.83	7.6791	50.33	0.0085
11.17	178.3882	31.00	7.2424	50.50	0.0081
11.33	176.3039	31.17	6.8309	50.67	0.0076
11.50	174.5106	31.33	6.4431	50.83	0.0072
11.67	172.6824	31.50	6.0775	51.00	0.0068
11.83	170.8136	31.67	5.7328	51.17	0.0064
12.00	169.1897	31.83	5.4078	51.33	0.0060
12.17	167.4876	32.00	5.1013	51.50	0.0057
12.33	165.7078	32.17	4.8124	51.67	0.0054
12.50	164.1457	32.33	4.5399	51.83	0.0051
12.67	162.4783	32.50	4.2829	52.00	0.0048
12.83	160.7103	32.67	4.0406	52.17	0.0045
13.00	159.1444	32.83	3.8120	52.33	0.0043
13.17	157.7583	33.00	3.5964	52.50	0.0040
13.33	156.5326	33.17	3.3930	52.67	0.0038
13.50	155.4501	33.33	3.2012	52.83	0.0036
13.67	154.1909	33.50	3.0202	53.00	0.0034
13.83	152.7690	33.67	2.8496	53.17	0.0032
14.00	151.5019	33.83	2.6885	53.33	0.0030
14.17	150.3734	34.00	2.5366	53.50	0.0028
14.33	149.3690	34.17	2.3933	53.67	0.0027
14.50	148.4763	34.33	2.2581	53.83	0.0025
14.67	147.3735	34.50	2.1306	54.00	0.0024
14.83	146.0786	34.67	2.0103	54.17	0.0022
15.00	144.9187	34.83	1.8967	54.33	0.0021
15.17	143.8800	35.00	1.7896	54.50	0.0020
15.33	142.9501	35.17	1.6886	54.67	0.0019
15.50	142.1185	35.33	1.5932	54.83	0.0018
15.67	141.0595	35.50	1.5033	55.00	0.0017
15.83	139.7937	35.67	1.4184	55.17	0.0016
16.00	138.6548	35.83	1.3382	55.33	0.0015
16.17	137.6297	36.00	1.2627	55.50	0.0014
16.33	136.7072	36.17	1.1914	55.67	0.0013
16.50	135.8772	36.33	1.1242	55.83	0.0013
16.67	135.1308	36.50	1.0607	56.00	0.0012
16.83	134.4600	36.67	1.0008	56.17	0.0011
17.00	133.8580	36.83	0.9443	56.33	0.0011
17.17	132.9962	37.00	0.8910	56.50	0.0010
17.33	131.8985	37.17	0.8407	56.67	0.0009
17.50	130.9085	37.33	0.7933	56.83	0.0009

17.67	130.0154	37.50	0.7485	57.00	0.0008
17.83	129.2094	37.67	0.7063	57.17	0.0008
18.00	128.4820	37.83	0.6664	57.33	0.0007
18.17	127.4998	38.00	0.6288	57.50	0.0007
18.33	126.2860	38.17	0.5933	57.67	0.0007
18.50	125.1875	38.33	0.5599	57.83	0.0006
18.67	124.1925	38.50	0.5283	58.00	0.0006
18.83	123.2906	38.67	0.4985	58.17	0.0006
19.00	122.4725	38.83	0.4703	58.33	0.0005
19.17	121.4009	39.00	0.4438	58.50	0.0005
19.33	120.0989	39.17	0.4187	58.67	0.0005
19.50	118.9168	39.33	0.3951	58.83	0.0004
19.67	117.8422	39.50	0.3728	59.00	0.0004
19.83	116.8642	39.67	0.3518	59.17	0.0004
20.00	115.9734	39.83	0.3319	59.33	0.0004
20.17	115.1614	40.00	0.3132	59.50	0.0004
20.33	114.4209	40.17	0.2955	59.67	0.0003
20.50	113.7449	40.33	0.2788	59.83	0.0003
20.67	113.1279	40.50	0.2631	60.00	0.0003
20.83	112.5648	40.67	0.2483	60.17	0.0003
21.00	112.0506	40.83	0.2343	60.33	0.0003
21.17	111.5814	41.00	0.2210	60.50	0.0002
21.33	111.1535	41.17	0.2086	60.67	0.0002
21.50	110.7635	41.33	0.1968	60.83	0.0002
21.67	110.4083	41.50	0.1857	61.00	0.0002
21.83	110.0851	41.67	0.1752	61.17	0.0002
22.00	109.7918	41.83	0.1653	61.33	0.0002
22.17	109.1881	42.00	0.1560	61.50	0.0002
22.33	108.3035	42.17	0.1472	61.67	0.0002
22.50	107.5017	42.33	0.1389	61.83	0.0002
22.67	106.7741	42.50	0.1310	62.00	0.0001
22.83	106.1132	42.67	0.1237	62.17	0.0001
23.00	105.5124	42.83	0.1167	62.33	0.0001
23.17	104.9658	43.00	0.1101	62.50	0.0001
23.33	104.4683	43.17	0.1039	62.67	0.0001
23.50	104.0153	43.33	0.0980	62.83	0.0001
23.67	103.6027	43.50	0.0925	63.00	0.0001

Open Channel Flow Based on The Mannings Equation
For Trapezoidal Cross Section

Design:

Z=	1.00	H:V	
S=	0.0070	FT/FT	
n=	0.0700		Sluggish reaches, weedy, deep pools

Variables:

Y=	6.500	FT
B_w=	2.00	FT

Gives:

A=	55.25	SF
R=	2.71	FT
B=	15.00	FT

Check:

V=	3.45	FPS

Set:

Q=	190.7596	CFS

Trapezoidal - Downstream

Open Channel Flow Based on The Mannings Equation
For Trapezoidal Cross Section

Design:

Z=	2.00	H:V	
S=	0.0043	FT/FT	
n=	0.0700		Sluggish reaches, weedy, deep pools

Variables:

Y=	3.500	FT
B_w=	28.00	FT

Gives:

A=	122.50	SF
R=	2.81	FT
B=	42.00	FT

Check:

V=	2.77	FPS

Set:

Q=	339.2677	CFS

Open Channel Flow Based on The Mannings Equation
For Circular Cross Section

Design:

d_o=	10	IN	Diameter
S=	0.02	FT/FT	
n=	0.012		

Variables:

Y=	0.83	FT	Flow Depth

Gives:

θ=	360.00	Degrees	
	or		
θ=	6.28	Radians	
A=	0.55	SF	Flow Area
P=	2.62	FT	
R=	0.21	FT	
B=	0.00	FT	
	or		
B=	0.00	FT	

Check:

V=	6.15	FPS	

Set:

Q=	3.3568	CFS	

Open Channel Flow Based on The Mannings Equation
For Circular Cross Section

Design:

d_o=	48	IN	Diameter
S=	0.005	FT/FT	
n=	0.03		

Variables:

Y=	4.00	FT	Flow Depth

Gives:

θ=	360.00	Degrees	
	or		
θ=	6.28	Radians	
A=	12.57	SF	Flow Area
P=	12.57	FT	
R=	1.00	FT	
B=	0.00	FT	
	or		
B=	0.00	FT	

Check:

V=	3.50	FPS

Set:

Q=	44.0142	CFS