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STANDARD RIGHT-TO-KNOW REQUEST FORM

DATE REQUESTED: 11/09/2020

REQUEST SUBMITTED BY: ☑ E-MAIL ☐ U.S. MAIL ☐ FAX ☐ IN-PERSON

REQUEST SUBMITTED TO (Agency name & address): Caln Township
253 Municipal Drive, Thorndale, PA 19372

NAME OF REQUESTER : Robert E. Blue Consulting Engineers, P.C. (Sean McGranahan)

STREET ADDRESS: 1149 Skippack Pike

CITY/STATE/COUNTY/ZIP(Required): Blue Bell, PA 19422 (Montgomery County)

TELEPHONE (Optional):______________________ **EMAIL (optional):**______________________________

RECORDS REQUESTED: **Provide as much specific detail as possible so the agency can identify the information.* ***Please use additional sheets if necessary***

Stormwater Managment Reports, As-Built Plans and Land Development Plans for Caln Plaza (1847-1855 E. Lincoln Highway, Coatesville, PA 19320). Please email copies if possible, thank you.

DO YOU WANT COPIES? ☑ YES ☐ NO
DO YOU WANT TO INSPECT THE RECORDS? ☐ YES ☑ NO
DO YOU WANT CERTIFIED COPIES OF RECORDS? ☐ YES ☑ NO
DO YOU WANT TO BE NOTIFIED IN ADVANCE IF THE COST EXCEEDS $100? ☑ YES ☐ NO

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**** IT IS A REQUIRED DOCUMENT IF YOU WOULD NEED TO FILE AN APPEAL ****

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OPEN-RECORDS OFFICER:

☐ I have provided notice to appropriate third parties and given them an opportunity to object to this request

DATE RECEIVED BY THE AGENCY:

AGENCY FIVE (5) BUSINESS DAY RESPONSE DUE:

***Public bodies may fill anonymous verbal or written requests. If the requestor wishes to pursue the relief and remedies provided for in this Act, the request must be in writing. (Section 702.) Written requests need not include an explanation why information is sought or the intended use of the information unless otherwise required by law. (Section 703.)*

STORM WATER MANAGEMENT

for

CALN PLAZA

Land Development Plan

Project Number B30060

Caln Township, Chester County, PA.

September 23, 2003

9-24-03

Prepared by:

Lake Roeder Hillard and Associates
313 W. Liberty Street, Suite 1
Lancaster, PA 17603
eln

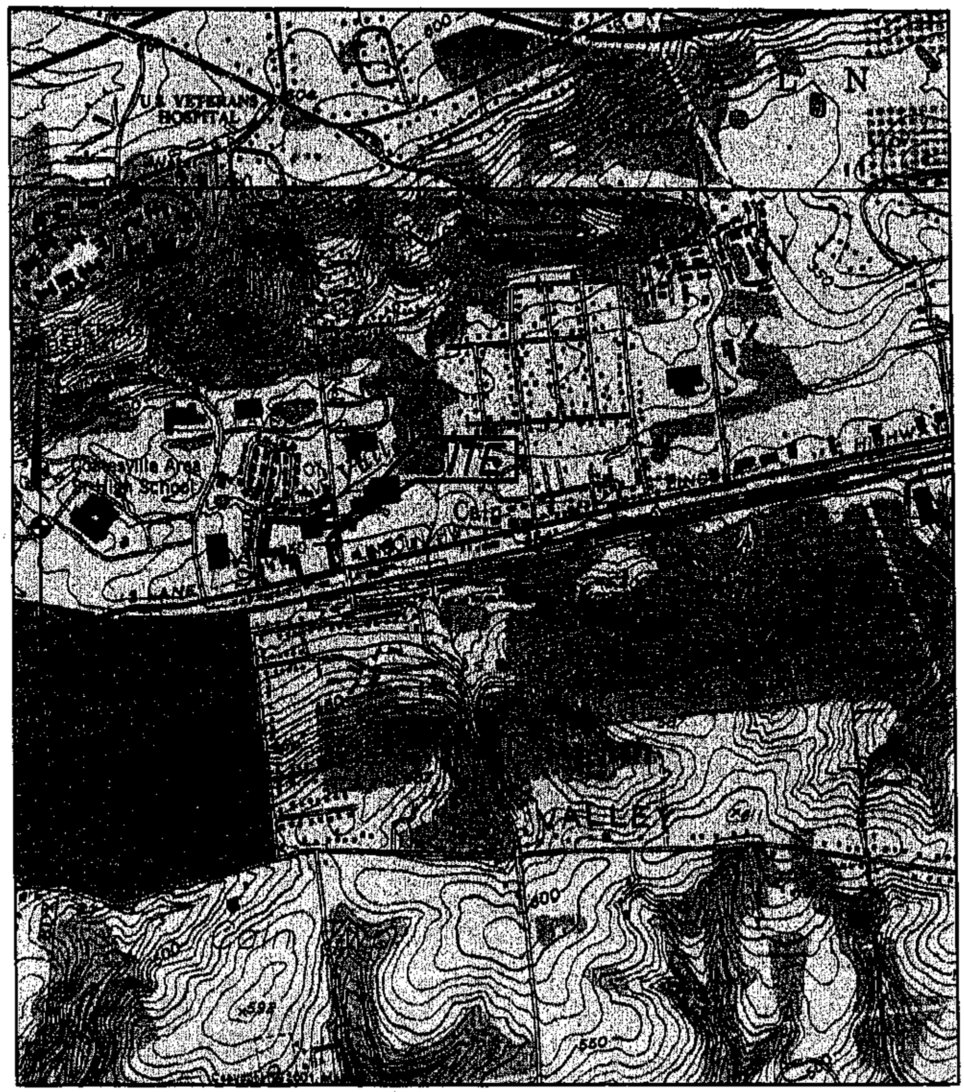

Figure 1. Site Location
USGS Coatesville Quadrangle - Scale: 1"=2000'

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Caln Plaza
Land Development Plan
Project Number B30060

I. NARRATIVE OF THE PROJECT

The owners of Caln Plaza are proposing to add 3 retail buildings to their existing five store shopping center. The existing shopping center is situated on a 8.26 acre tract of land located on the north side of Lincoln Highway (SR 3070), between North Caln Road (SR 4005) and Toth Avenue (T-155) in Caln Township, Chester County, PA. The existing shopping center has access from Lincoln Highway (SR 3070) and North Caln Road (SR 4005).

The existing tract contains an existing shopping center, parking for 261 cars and an existing detention basin. A stream known as Valley Run (Chapter 93 designation: TSF, MF) traverses the tract along the northern property line. The FEMA Map (Map #42029C03606 D) identifies the tract within Zone X – Areas determined to be outside 500-year floodplain. See Appendix C for FEMA Map.

The tract is divided into two watersheds; Watershed 1 and Watershed 2. The watershed divide approximately follows the main entrance to the site off of Lincoln Highway (SR 3070). Watershed 1 contains the area on the west side of the main entrance and less than half of the existing building. Watershed 1 contains the existing detention basin located on the west side of the existing building. Runoff from Watershed 1 is routed through the existing detention basin and discharges into Valley Run. Watershed 2 contains the area on the east side of the main entrance and greater than half of the existing building. Runoff from Watershed 2 discharges into Valley Run. See Appendix D for Watershed Map.

The improvements to the tract will consist of the following:

1. A 6,400 sq. ft. addition to the east side of the existing shopping center. This addition will be located on what is currently an existing parking area. Seven parking spaces will be added on the north side of the proposed addition. This addition and parking spaces are located within Watershed 2.
2. A 3,000 sq. ft. building known as "Building A" located near the southeast corner of the tract. This building will be located on what is currently an existing parking area. Six parking spaces will be added on the south side of the proposed building. This building and parking spaces are located within Watershed 2.
3. A 3,000 sq. ft. building known as "Building B" located near the southwest corner of the tract. This building will be located on what is currently a vacant area of the tract. Ten parking spaces and an access drive will be located around the proposed building. This building, parking spaces and access drive are located within Watershed 1. This building, access drive and parking spaces were part of the original Land Development Plan for Caln Plaza and included in the design of the detention basin. No additional impervious area is proposed with this plan, beyond what was included on the original Land Development Plan.

Although no additional impervious area is proposed within Watershed 1, modifications to the outlet structure will be required to reduce peak discharges from the site to below predevelopment levels as originally designed.

Storm water management for Watershed 2 is not proposed due to the insignificant increase in peak discharges. See Summary of Predevelopment & Post Development Peak Flows below. The only additional impervious area in Watershed 2 is the proposed parking spaces provided around the proposed addition and proposed "Building A". The proposed addition and proposed "Building A" are located on existing impervious area.

The following table summarizes the pre and post development peak flows: *(Taken from Hydrologic Study for Caln Plaza – Phase Two, dated February 22, 1993).*

<u>Summary of Predevelopment & Post Development Peak Flows</u>

Watershed 1

	2 Yr	**5 Yr**	**10 Yr**	**25 Yr**	**50 Yr**	**100 Yr**
Pre Development	2.8	3.3	3.8	4.4	5.2	5.9
Post Development (Bypass)	0.8	0.9	1.1	1.2	1.3	1.4
Allowable Basin Outflow	2.0	2.4	2.7	3.2	3.9	4.5

<u>Actual Peak Outflow from Modified As-Built Basin</u>

```
  2 Year  - The basin peak is   1.32 at El.  344.59
  5 Year  - The basin peak is   1.48 at El.  344.81
 10 Year  - The basin peak is   1.63 at El.  345.03
 25 Year  - The basin peak is   1.77 at El.  345.30
 50 Year  - The basin peak is   2.13 at El.  346.04
100 Year  - The basin peak is   3.14 at El.  346.46
```

Watershed 2

	2 Yr	**5 Yr**	**10 Yr**	**25 Yr**	**50 Yr**	**100 Yr**
Pre Development	14.9	17.5	19.5	21.7	24.3	26.6
Post Development	15.1	17.7	19.8	22.0	24.7	26.9

The addition to the east side of the existing shopping center will be located over an existing storm sewer with carries runoff from the parking lot on the north and east sides of the existing shopping center to a discharge point on the south side of the existing shopping center. The existing 12" CMP will be abandoned and replaced with a 15" SLCPP (smooth lined corrugated polyethylene pipe) and will be rerouted around the proposed addition to the same discharge point. The existing 12" CMP was calculated for capacity and the proposed 15" SLCPP was calculated using the same flow. See Appendix E for calculations.

II. AREA AND C FACTOR CALCULATIONS

Areas & C Factors - The areas shown in the table below are listed in acres for each type of ground cover and hydrologic soil group. The C Factors were taken from taken from Hydrologic Study for Caln Plaza – Phase Two, dated February 22, 1993.

Cover Description	Imperv.	Natural	Landscaped		
Soils	B	B	B	**Total**	**Composite**
C Factor	0.95	0.20	0.25	**Area**	**C Factor**
Watershed					
PRE 1	0.76	3.03	0.03	**3.82**	**0.35**
PRE 2	3.18	0.82	0.27	**4.27**	**0.76**
POST 1 (BASIN)	2.58	0.00	0.71	**3.29**	**0.80**
POST 1 (BYPASS)	0.06	0.00	0.47	**0.53**	**0.33**
POST 2	3.24	0.79	0.24	**4.27**	**0.77**

III. PEAK FLOW CALCULATIONS

Watershed			Time of Concentration		Peak Flow		
Name	Area	C Factor	Tc	Comments	Storm	I	Q
Pre 1	3.82	0.35	30.0	Taken from Hydrologic Study For Cain Plaza – Phase Two Dated February 22, 1993	2 Yr	2.09	2.8
					5 Yr	2.50	3.3
					10 Yr	2.82	3.8
					25 Yr	3.27	4.4
					50 Yr	3.92	5.2
					100 Yr	4.41	5.9
Pre 2	4.27	0.76	5.0	Assumed Tc due to 75% of Drainage area is impervious	2 Yr	4.60	14.9
					5 Yr	5.39	17.5
					10 Yr	6.02	19.5
					25 Yr	6.70	21.7
					50 Yr	7.50	24.4
					100 Yr	8.19	26.6
Post 1 (Basin)	3.29	0.80	12.2	Taken from Hydrologic Study For Cain Plaza – Phase Two Dated February 22, 1993	2 Yr	3.30	8.7
					5 Yr	3.94	10.4
					10 Yr	4.38	11.5
					25 Yr	5.01	13.2
					50 Yr	5.85	15.4
					100 Yr	6.47	17.0
Post 1 (Bypass)	0.53	0.33	5.0	Taken from Hydrologic Study For Cain Plaza – Phase Two Dated February 22, 1993	2 Yr	4.60	0.8
					5 Yr	5.39	0.9
					10 Yr	6.02	1.1
					25 Yr	6.70	1.2
					50 Yr	7.50	1.3
					100 Yr	8.19	1.4
Post 2	4.27	0.77	5.0	Assumed Tc due to 75% of Drainage area is impervious	2 Yr	4.60	15.1
					5 Yr	5.39	17.7
					10 Yr	6.02	19.8
					25 Yr	6.70	22.0
					50 Yr	7.50	24.7
					100 Yr	8.19	26.9

IV. MODIFIED AS-BUILT DETENTION BASIN CALCULATIONS

The as-built detention basin has the following outlet configuration:

1. 4.75" wide Rectangular weir at elevation 343.36 and extending to near the top of inlet box.
2. 2'x 4' Type M inlet at elevation 346.38.
3. 15'± wide Rip-rap spillway at approximate elevation 347.00.

The as-built detention basin will require a minor modification in order reduce the peak flows below the pre development discharge levels. The existing 4.75" wide rectangular weir will be converted to a 4.75" wide x 9" tall rectangular orifice. A metal plate will be placed over the rectangular weir, covering the upper part of the weir, leaving a 4.75" wide x 9" tall opening. See Appendix A for outlet structure modification.

The original design included a storage trench located under the existing parking lot. The design invert elevation of this trench was 342.5 and the top elevation was 345.0. See the Hydrologic Study for Caln Plaza - Phase Two, dated February 22, 1993. The storage area for this trench was included in the calculated basin storage area shown below.

The calculated 2, 5, 10, 25, 50 and 100 year storm events are routed through the modified as-built detention basin using the Modified Rational Method. Rainfall intensities are taken from the Field Manual for PDT-IDF Curves for Region 5 prepared by Penn State University. Hydrographs are computed assuming with time to peak occurring at three (3) times the Tc of the controlled watershed, and with the time to the end of storm event at ten (10) times the Tc.

The Stage-Storage-Outflow Table calculations were developed using a program written by LAKE ROEDER HILLARD & ASSOCIATES. See Appendix B for description of methodologies used in this detention basin program.

A. Modified As-Built Basin

1) Basin Outflows

```
  2 Year  - The basin peak is   1.32 at El.  344.59
  5 Year  - The basin peak is   1.48 at El.  344.81
 10 Year  - The basin peak is   1.63 at El.  345.03
 25 Year  - The basin peak is   1.77 at El.  345.30
 50 Year  - The basin peak is   2.13 at El.  346.04
100 Year  - The basin peak is   3.14 at El.  346.46
```

2) Detention Basin Storage Volumes

Elevation (ft)	Trench Area (sf)	Basin Area (sf)	Total Area (sf)	Avg. Area (sf)	Depth (ft)	Volume (cf)	Sum Volume (cf)
343.36	7394	0	7394				0
				7502	0.14	1050	
343.50	7394	216	7610				1050
				7995.5	0.5	3998	
344.00	7394	987	8381				5048
				8766	0.5	4383	
344.50	7394	1757	9151				9431
				9536.5	0.5	4768	
345.00	7394	2528	9922				14199
				7105.5	0.5	3553	
345.50		4289	4289				17752
				5169.5	0.5	2585	
346.00		6050	6050				20337
				6621	0.5	3311	
346.50		7192	7192				23647
				7762.5	0.5	3881	
347.00		8333	8333				27529

3) Detention Basin Stage Storage Outflow table

Number of Outlets	Min Elev	Max Elev	Interval			
3	343.50	346.90	0.10			
Rectangular Orifice	Invert	Width	Height	Cd		
1	343.36	4.75	9.00	0.60		
Grate Inlet	Top	Perimeter	Area	Cd		
	346.38	12.00	5.10	3.00		
Emergency Spillway	Crest	Length		Cd		
	347.00	15.00		3.00		
Basin Outlet Pipe						
Round Pipe	Invert	Length	Diameter	Slope	n	Entrance
1	343.17	31	24	0.50	0.013	SqEdgeHeadwall
Constant TW Elev						
0.00						

					Outlet No 1		Outlet No 2		Outlet No 3	
Stage (1)	Storage (2)	Qt (3)	HW (4)	Qpipe (5)	H (6)	Q (7)	H (8)	Q (9)	H (10)	Q (11)
343.36	0	0.00	0.00	0.00	-	-	-	-	-	-
343.60	1850	0.13	0.27	0.13	0.16	0.13	-	-	-	-
343.70	2650	0.23	0.29	0.23	0.24	0.23	-	-	-	-
343.80	3450	0.34	0.31	0.34	0.32	0.34	-	-	-	-
343.90	4250	0.46	0.34	0.46	0.39	0.46	-	-	-	-
344.00	5050	0.59	0.37	0.59	0.46	0.59	-	-	-	-
344.10	5928	0.73	0.40	0.73	0.53	0.73	-	-	-	-
344.20	6798	0.97	0.45	0.97	0.47	0.97	-	-	-	-
344.30	7678	1.07	0.47	1.07	0.56	1.07	-	-	-	-
344.40	8558	1.17	0.48	1.17	0.67	1.17	-	-	-	-
344.50	9428	1.25	0.50	1.25	0.77	1.25	-	-	-	-
344.60	10381	1.33	0.51	1.33	0.86	1.33	-	-	-	-
344.70	11341	1.40	0.53	1.40	0.96	1.40	-	-	-	-
344.80	12291	1.48	0.54	1.48	1.06	1.48	-	-	-	-
344.90	13241	1.54	0.55	1.54	1.17	1.54	-	-	-	-
345.00	14201	1.61	0.57	1.61	1.26	1.61	-	-	-	-
345.10	14909	1.66	0.58	1.66	1.35	1.66	-	-	-	-
345.20	15619	1.72	0.59	1.72	1.44	1.72	-	-	-	-
345.30	16329	1.77	0.60	1.77	1.53	1.77	-	-	-	-
345.40	17039	1.82	0.61	1.82	1.62	1.82	-	-	-	-
345.50	17749	1.87	0.61	1.87	1.72	1.87	-	-	-	-
345.60	18272	1.92	0.62	1.92	1.81	1.92	-	-	-	-
345.70	18782	1.97	0.63	1.97	1.90	1.97	-	-	-	-
345.80	19302	2.02	0.64	2.02	1.99	2.02	-	-	-	-
345.90	19822	2.06	0.65	2.06	2.08	2.06	-	-	-	-
346.00	20332	2.11	0.66	2.11	2.17	2.11	-	-	-	-
346.10	20997	2.15	0.66	2.15	2.27	2.15	-	-	-	-
346.20	21657	2.20	0.67	2.20	2.36	2.20	-	-	-	-
346.30	22327	2.24	0.68	2.24	2.45	2.24	-	-	-	-
346.40	22987	2.37	0.70	2.37	2.53	2.27	0.02	0.10	-	-
346.50	23647	3.72	0.91	3.72	2.42	2.22	0.12	1.50	-	-
346.60	24427	5.85	1.20	5.85	2.23	2.14	0.22	3.71	-	-
346.70	25197	8.55	1.50	8.55	2.03	2.04	0.32	6.52	-	-
346.80	25977	11.72	1.83	11.72	1.80	1.92	0.42	9.80	-	-
346.90	26757	15.22	2.27	15.22	1.46	1.73	0.52	13.50	-	-

Notes:
- (1) Water Surface Elevation
- (2) Storage in cu. ft.
- (3) Total Flow from basin in cfs
- (4) Headwater required for outlet culvert
- (5) Flow in outlet culvert in cfs
- (6) Head for 4.8"x 9.0" rectangular orifice
- (7) Flow for rectangular orifice in cfs
- (8) Head for grate inlet
- (9) Flow for grate inlet in cfs
- (10) Head for 15.0' emergency spillway
- (11) Flow for emergency spillway in cfs

4) Detention Basin Routings

Using the Storage Indication Method from Introduction to Hydrology by Viesman, Knapp, Lewis, et al, Page 240.
I = Inflow (cfs)
O and O1 = Outflow (cfs)
S = Storage (cf)
T = Routing Interval = 2 min
Stage = Water Surface Elevation

Area = 3.29 acres
C = 0.80
Tc = 12.2 min.
Pa DOT Region 5 Intensities

2 Year, 122.0 Minute Storm

Time	I1	I1+I2	2S/T-O	2S/T+O	O1	Stage
0.0	0.00	0.21	0.00	0.00	0.00	343.36
2.0	0.21	0.63	0.21	0.21	0.00	343.36
4.0	0.42	1.04	0.83	0.83	0.00	343.37
6.0	0.63	1.46	1.85	1.87	0.01	343.37
8.0	0.83	1.88	3.28	3.31	0.01	343.39
10.0	1.04	2.29	5.12	5.16	0.02	343.40
12.0	1.25	2.68	7.35	7.41	0.03	343.42
14.0	1.43	3.02	9.94	10.03	0.04	343.44
16.0	1.60	3.37	12.86	12.97	0.05	343.46
18.0	1.77	3.71	16.09	16.22	0.07	343.49
20.0	1.94	4.05	19.63	19.79	0.08	343.51
22.0	2.11	4.39	23.48	23.68	0.10	343.54
24.0	2.28	5.43	27.64	27.87	0.12	343.58
26.0	3.15	7.34	32.78	33.07	0.15	343.62
28.0	4.19	9.43	39.73	40.12	0.20	343.67
30.0	5.24	11.51	48.62	49.15	0.27	343.74
32.0	6.28	13.60	59.41	60.13	0.36	343.82
34.0	7.32	15.68	72.06	73.01	0.48	343.91
36.0	8.36	16.46	86.50	87.74	0.62	344.02
38.0	8.10	15.38	101.40	102.97	0.79	344.12
40.0	7.28	13.73	114.80	116.77	0.99	344.22
42.0	6.45	12.08	126.40	128.53	1.07	344.30
44.0	5.63	10.44	136.21	138.48	1.13	344.36
46.0	4.81	8.79	144.27	146.65	1.19	344.42
48.0	3.98	7.44	150.62	153.06	1.22	344.46
50.0	3.46	6.59	155.56	158.06	1.25	344.50
52.0	3.13	5.93	159.61	162.15	1.27	344.52
54.0	2.80	5.28	162.97	165.54	1.29	344.54
56.0	2.48	4.62	165.65	168.25	1.30	344.56
58.0	2.15	3.97	167.66	170.27	1.31	344.57
60.0	1.82	3.42	168.99	171.62	1.32	344.58
62.0	1.60	3.09	169.77	172.41	1.32	344.59
64.0	1.49	2.87	170.22	172.87	1.32	344.59
66.0	1.38	2.65	170.45	173.09	1.32	344.59
68.0	1.27	2.43	170.45	173.10	1.32	344.59
70.0	1.16	2.21	170.23	172.88	1.32	344.59
72.0	1.05	2.03	169.80	172.44	1.32	344.59
74.0	0.98	1.93	169.19	171.83	1.32	344.58
76.0	0.96	1.90	168.50	171.13	1.31	344.58
78.0	0.94	1.86	167.77	170.39	1.31	344.58

80.0	0.92	1.82	167.02	169.63	1.31	344.57
82.0	0.90	1.78	166.24	168.84	1.30	344.57
84.0	0.88	1.75	165.42	168.02	1.30	344.56
86.0	0.87	1.72	164.59	167.17	1.29	344.56
88.0	0.85	1.69	163.72	166.30	1.29	344.55
90.0	0.84	1.66	162.84	165.41	1.29	344.54
92.0	0.82	1.63	161.94	164.50	1.28	344.54
94.0	0.81	1.60	161.02	163.57	1.28	344.53
96.0	0.79	1.58	160.08	162.63	1.27	344.53
98.0	0.78	1.55	159.13	161.66	1.27	344.52
100.0	0.77	1.53	158.15	160.68	1.26	344.51
102.0	0.76	1.51	157.17	159.68	1.26	344.51
104.0	0.75	1.48	156.17	158.68	1.25	344.50
106.0	0.74	1.46	155.16	157.66	1.25	344.50
108.0	0.72	1.44	154.14	156.63	1.24	344.49
110.0	0.71	1.42	153.11	155.58	1.23	344.48
112.0	0.70	1.40	152.08	154.53	1.23	344.47
114.0	0.70	1.38	151.03	153.48	1.22	344.47
116.0	0.69	1.36	149.98	152.41	1.22	344.46
118.0	0.68	1.35	148.92	151.34	1.21	344.45
120.0	0.67	1.33	147.85	150.26	1.21	344.44
122.0	0.66	1.21	146.78	149.18	1.20	344.44
124.0	0.55	0.99	145.60	147.99	1.19	344.43
126.0	0.44	0.78	144.23	146.60	1.19	344.42
128.0	0.33	0.56	142.65	145.00	1.18	344.41
130.0	0.23	0.35	140.88	143.21	1.17	344.40
132.0	0.12	0.13	138.92	141.22	1.15	344.38
134.0	0.01	0.01	136.77	139.05	1.14	344.37
136.0	0.00	0.00	134.54	136.78	1.12	344.35
138.0	0.00	0.00	132.33	134.54	1.11	344.34
140.0	0.00	0.00	130.14	132.33	1.09	344.32
142.0	0.00	0.00	127.99	130.14	1.08	344.31
144.0	0.00	0.00	125.86	127.99	1.06	344.29
146.0	0.00	0.00	123.76	125.86	1.05	344.28
148.0	0.00	0.00	121.69	123.76	1.03	344.26
150.0	0.00	0.00	119.65	121.69	1.02	344.25

5 Year, 122.0 Minute Storm

Time	I1	I1+I2	2S/T-O	2S/T+O	O1	Stage
0.0	0.00	0.23	0.00	0.00	0.00	343.36
2.0	0.23	0.70	0.23	0.23	0.00	343.36
4.0	0.46	1.16	0.92	0.93	0.00	343.37
6.0	0.70	1.62	2.06	2.08	0.01	343.38
8.0	0.93	2.09	3.65	3.68	0.02	343.39
10.0	1.16	2.55	5.69	5.74	0.02	343.40
12.0	1.39	3.00	8.17	8.24	0.03	343.42
14.0	1.61	3.43	11.08	11.17	0.05	343.45
16.0	1.82	3.86	14.39	14.51	0.06	343.47
18.0	2.04	4.29	18.09	18.25	0.08	343.50
20.0	2.25	4.71	22.19	22.38	0.09	343.53
22.0	2.46	5.14	26.68	26.91	0.11	343.57
24.0	2.68	6.41	31.55	31.82	0.14	343.61
26.0	3.73	8.71	37.59	37.96	0.18	343.65
28.0	4.98	11.22	45.81	46.30	0.25	343.71
30.0	6.24	13.73	56.36	57.03	0.33	343.79
32.0	7.49	16.24	69.19	70.09	0.45	343.89
34.0	8.75	18.75	84.24	85.44	0.60	344.00
36.0	10.00	19.70	101.42	103.00	0.79	344.12

38.0	9.70	18.42	119.09	121.12	1.02	344.25
40.0	8.72	16.46	135.25	137.51	1.13	344.36
42.0	7.74	14.51	149.29	151.72	1.21	344.45
44.0	6.77	12.56	161.25	163.80	1.28	344.53
46.0	5.79	10.60	171.15	173.80	1.33	344.60
48.0	4.81	8.98	179.02	181.75	1.36	344.65
50.0	4.17	7.93	185.23	188.01	1.39	344.69
52.0	3.76	7.10	190.33	193.16	1.41	344.72
54.0	3.34	6.27	194.56	197.43	1.44	344.74
56.0	2.93	5.44	197.92	200.83	1.45	344.77
58.0	2.51	4.61	200.43	203.36	1.47	344.78
60.0	2.10	3.94	202.10	205.04	1.47	344.79
62.0	1.84	3.58	203.08	206.03	1.48	344.80
64.0	1.74	3.39	203.70	206.66	1.48	344.80
66.0	1.65	3.19	204.12	207.09	1.48	344.80
68.0	1.55	3.00	204.35	207.31	1.48	344.81
70.0	1.45	2.80	204.37	207.34	1.48	344.81
72.0	1.35	2.63	204.21	207.17	1.48	344.81
74.0	1.28	2.54	203.88	206.84	1.48	344.80
76.0	1.26	2.49	203.46	206.42	1.48	344.80
78.0	1.23	2.44	203.00	205.95	1.48	344.80
80.0	1.21	2.40	202.49	205.44	1.48	344.79
82.0	1.19	2.35	201.94	204.89	1.47	344.79
84.0	1.16	2.30	201.35	204.29	1.47	344.79
86.0	1.14	2.26	200.72	203.65	1.47	344.78
88.0	1.12	2.22	200.05	202.98	1.46	344.78
90.0	1.10	2.18	199.35	202.27	1.46	344.77
92.0	1.08	2.15	198.62	201.54	1.46	344.77
94.0	1.06	2.11	197.87	200.77	1.45	344.77
96.0	1.05	2.07	197.08	199.98	1.45	344.76
98.0	1.03	2.04	196.27	199.16	1.44	344.75
100.0	1.01	2.01	195.43	198.31	1.44	344.75
102.0	1.00	1.98	194.57	197.44	1.44	344.74
104.0	0.98	1.95	193.69	196.55	1.43	344.74
106.0	0.97	1.92	192.79	195.64	1.43	344.73
108.0	0.95	1.89	191.87	194.71	1.42	344.73
110.0	0.94	1.87	190.93	193.76	1.42	344.72
112.0	0.93	1.84	189.97	192.79	1.41	344.71
114.0	0.91	1.82	189.00	191.81	1.41	344.71
116.0	0.90	1.79	188.01	190.81	1.40	344.70
118.0	0.89	1.77	187.01	189.80	1.40	344.70
120.0	0.88	1.74	185.99	188.78	1.39	344.69
122.0	0.87	1.59	184.96	187.74	1.39	344.68
124.0	0.72	1.31	183.79	186.55	1.38	344.68
126.0	0.58	1.02	182.34	185.09	1.38	344.67
128.0	0.44	0.74	180.62	183.36	1.37	344.66
130.0	0.30	0.45	178.64	181.36	1.36	344.64
132.0	0.16	0.17	176.39	179.09	1.35	344.63
134.0	0.01	0.01	173.88	176.56	1.34	344.61
136.0	0.00	0.00	171.24	173.90	1.33	344.60
138.0	0.00	0.00	168.61	171.24	1.31	344.58
140.0	0.00	0.00	166.01	168.61	1.30	344.56
142.0	0.00	0.00	163.44	166.01	1.29	344.55
144.0	0.00	0.00	160.88	163.44	1.28	344.53
146.0	0.00	0.00	158.36	160.88	1.26	344.52
148.0	0.00	0.00	155.86	158.36	1.25	344.50
150.0	0.00	0.00	153.39	155.86	1.24	344.48

10 Year, 122.0 Minute Storm

Time	I1	I1+I2	2S/T-O	2S/T+O	O1	Stage
0.0	0.00	0.31	0.00	0.00	0.00	343.36
2.0	0.31	0.92	0.30	0.31	0.00	343.36
4.0	0.61	1.53	1.21	1.22	0.01	343.37
6.0	0.92	2.14	2.72	2.74	0.01	343.38
8.0	1.22	2.76	4.82	4.86	0.02	343.40
10.0	1.53	3.37	7.51	7.58	0.03	343.42
12.0	1.84	3.91	10.79	10.88	0.05	343.44
14.0	2.07	4.38	14.58	14.70	0.06	343.47
16.0	2.31	4.84	18.80	18.96	0.08	343.51
18.0	2.54	5.30	23.44	23.64	0.10	343.54
20.0	2.77	5.76	28.50	28.74	0.12	343.58
22.0	3.00	6.22	33.96	34.26	0.15	343.62
24.0	3.23	7.58	39.78	40.18	0.20	343.67
26.0	4.36	10.07	46.85	47.36	0.25	343.72
28.0	5.71	12.78	56.26	56.92	0.33	343.79
30.0	7.06	15.48	68.15	69.03	0.44	343.88
32.0	8.42	18.19	82.48	83.64	0.58	343.99
34.0	9.77	20.90	99.17	100.67	0.75	344.11
36.0	11.13	21.92	118.06	120.08	1.01	344.24
38.0	10.79	20.53	137.69	139.98	1.14	344.37
40.0	9.73	18.41	155.72	158.22	1.25	344.50
42.0	8.67	16.29	171.47	174.13	1.33	344.60
44.0	7.62	14.17	184.98	187.76	1.39	344.68
46.0	6.56	12.05	196.27	199.16	1.44	344.75
48.0	5.50	10.31	205.35	208.32	1.49	344.81
50.0	4.81	9.17	212.62	215.65	1.52	344.86
52.0	4.36	8.29	218.72	221.80	1.54	344.90
54.0	3.92	7.40	223.88	227.01	1.56	344.93
56.0	3.48	6.51	228.13	231.28	1.58	344.96
58.0	3.04	5.63	231.45	234.64	1.59	344.98
60.0	2.59	4.89	233.87	237.08	1.60	344.99
62.0	2.30	4.47	235.54	238.76	1.61	345.00
64.0	2.17	4.19	236.77	240.01	1.62	345.01
66.0	2.03	3.92	237.72	240.97	1.62	345.02
68.0	1.89	3.65	238.39	241.64	1.62	345.03
70.0	1.75	3.37	238.79	242.04	1.63	345.03
72.0	1.62	3.14	238.91	242.16	1.63	345.03
74.0	1.52	3.02	238.80	242.05	1.63	345.03
76.0	1.50	2.97	238.57	241.82	1.62	345.03
78.0	1.47	2.91	238.29	241.54	1.62	345.03
80.0	1.44	2.86	237.96	241.21	1.62	345.02
82.0	1.42	2.80	237.58	240.82	1.62	345.02
84.0	1.39	2.75	237.14	240.38	1.62	345.02
86.0	1.36	2.70	236.66	239.89	1.62	345.01
88.0	1.34	2.66	236.14	239.36	1.61	345.01
90.0	1.32	2.62	235.57	238.80	1.61	345.00
92.0	1.30	2.58	234.97	238.19	1.61	345.00
94.0	1.28	2.54	234.34	237.55	1.61	345.00
96.0	1.26	2.49	233.67	236.87	1.60	344.99
98.0	1.24	2.46	232.96	236.16	1.60	344.99
100.0	1.22	2.42	232.22	235.42	1.60	344.98
102.0	1.20	2.39	231.46	234.64	1.59	344.98
104.0	1.19	2.36	230.66	233.85	1.59	344.97
106.0	1.17	2.32	229.85	233.02	1.59	344.97
108.0	1.15	2.29	229.00	232.17	1.58	344.96
110.0	1.14	2.26	228.13	231.29	1.58	344.96
112.0	1.12	2.23	227.24	230.39	1.58	344.95
114.0	1.11	2.20	226.33	229.47	1.57	344.95

116.0	1.09	2.18	225.40	228.53	1.57	344.94
118.0	1.08	2.15	224.45	227.57	1.56	344.93
120.0	1.07	2.12	223.48	226.60	1.56	344.93
122.0	1.05	1.93	222.49	225.60	1.55	344.92
124.0	0.88	1.59	221.32	224.42	1.55	344.91
126.0	0.71	1.24	219.83	222.91	1.54	344.90
128.0	0.54	0.90	218.00	221.07	1.54	344.89
130.0	0.36	0.55	215.84	218.90	1.53	344.88
132.0	0.19	0.21	213.36	216.40	1.52	344.86
134.0	0.02	0.02	210.55	213.57	1.51	344.85
136.0	0.00	0.00	207.58	210.57	1.50	344.83
138.0	0.00	0.00	204.61	207.58	1.48	344.81
140.0	0.00	0.00	201.67	204.61	1.47	344.79
142.0	0.00	0.00	198.75	201.67	1.46	344.77
144.0	0.00	0.00	195.87	198.75	1.44	344.75
146.0	0.00	0.00	193.01	195.87	1.43	344.73
148.0	0.00	0.00	190.19	193.01	1.41	344.72
150.0	0.00	0.00	187.39	190.19	1.40	344.70

25 Year, 122.0 Minute Storm

Time	I1	I1+I2	2S/T-O	2S/T+O	O1	Stage
0.0	0.00	0.16	0.00	0.00	0.00	343.36
2.0	0.16	0.49	0.16	0.16	0.00	343.36
4.0	0.33	0.82	0.65	0.65	0.00	343.37
6.0	0.49	1.14	1.45	1.46	0.01	343.37
8.0	0.65	1.47	2.57	2.59	0.01	343.38
10.0	0.82	1.80	4.01	4.04	0.02	343.39
12.0	0.98	2.40	5.75	5.80	0.02	343.40
14.0	1.42	3.31	8.08	8.15	0.03	343.42
16.0	1.89	4.25	11.30	11.39	0.05	343.45
18.0	2.36	5.19	15.41	15.54	0.07	343.48
20.0	2.83	6.13	20.43	20.60	0.09	343.52
22.0	3.30	7.07	26.34	26.56	0.11	343.57
24.0	3.77	8.86	33.11	33.41	0.15	343.62
26.0	5.09	11.70	41.54	41.97	0.21	343.68
28.0	6.62	14.76	52.64	53.25	0.30	343.77
30.0	8.15	17.82	66.56	67.41	0.43	343.87
32.0	9.68	20.88	83.21	84.38	0.59	344.00
34.0	11.21	23.94	102.48	104.09	0.80	344.13
36.0	12.74	25.11	124.32	126.42	1.05	344.28
38.0	12.37	23.57	147.03	149.43	1.20	344.44
40.0	11.20	21.22	167.97	170.60	1.31	344.58
42.0	10.02	18.87	186.41	189.20	1.39	344.69
44.0	8.85	16.52	202.33	205.28	1.47	344.79
46.0	7.67	14.17	215.80	218.85	1.53	344.88
48.0	6.50	12.21	226.82	229.97	1.57	344.95
50.0	5.71	10.88	235.80	239.03	1.61	345.01
52.0	5.17	9.82	243.39	246.68	1.65	345.07
54.0	4.64	8.75	249.86	253.21	1.68	345.13
56.0	4.11	7.68	255.20	258.60	1.70	345.17
58.0	3.57	6.61	259.43	262.88	1.72	345.21
60.0	3.04	5.73	262.57	266.04	1.74	345.23
62.0	2.69	5.22	264.81	268.30	1.75	345.25
64.0	2.53	4.90	266.52	270.03	1.75	345.27
66.0	2.37	4.58	267.91	271.43	1.76	345.28
68.0	2.21	4.26	268.96	272.49	1.76	345.29
70.0	2.05	3.94	269.68	273.22	1.77	345.29
72.0	1.89	3.67	270.08	273.62	1.77	345.30

74.0	1.78	3.53	270.21	273.75	1.77	345.30
76.0	1.75	3.47	270.20	273.74	1.77	345.30
78.0	1.72	3.41	270.13	273.67	1.77	345.30
80.0	1.69	3.34	270.00	273.54	1.77	345.30
82.0	1.66	3.28	269.81	273.35	1.77	345.30
84.0	1.63	3.22	269.56	273.10	1.77	345.29
86.0	1.60	3.17	269.26	272.79	1.77	345.29
88.0	1.57	3.12	268.90	272.43	1.76	345.29
90.0	1.55	3.08	268.50	272.02	1.76	345.28
92.0	1.53	3.03	268.06	271.58	1.76	345.28
94.0	1.50	2.98	267.57	271.09	1.76	345.28
96.0	1.48	2.94	267.04	270.55	1.76	345.27
98.0	1.46	2.89	266.47	269.98	1.75	345.27
100.0	1.44	2.86	265.86	269.36	1.75	345.26
102.0	1.42	2.82	265.22	268.72	1.75	345.26
104.0	1.40	2.78	264.55	268.04	1.75	345.25
106.0	1.38	2.74	263.85	267.33	1.74	345.24
108.0	1.36	2.70	263.11	266.59	1.74	345.24
110.0	1.34	2.67	262.34	265.81	1.74	345.23
112.0	1.33	2.64	261.55	265.01	1.73	345.23
114.0	1.31	2.61	260.73	264.19	1.73	345.22
116.0	1.30	2.58	259.89	263.34	1.73	345.21
118.0	1.28	2.55	259.02	262.46	1.72	345.20
120.0	1.26	2.51	258.13	261.56	1.72	345.20
122.0	1.25	2.29	257.22	260.64	1.71	345.19
124.0	1.04	1.88	256.10	259.51	1.71	345.18
126.0	0.84	1.47	254.58	257.98	1.70	345.17
128.0	0.63	1.06	252.68	256.06	1.69	345.15
130.0	0.43	0.66	250.38	253.74	1.68	345.13
132.0	0.23	0.25	247.71	251.04	1.66	345.11
134.0	0.02	0.02	244.66	247.96	1.65	345.08
136.0	0.00	0.00	241.40	244.68	1.64	345.05
138.0	0.00	0.00	238.16	241.40	1.62	345.03
140.0	0.00	0.00	234.94	238.16	1.61	345.00
142.0	0.00	0.00	231.75	234.94	1.60	344.98
144.0	0.00	0.00	228.58	231.75	1.58	344.96
146.0	0.00	0.00	225.45	228.58	1.57	344.94
148.0	0.00	0.00	222.34	225.45	1.55	344.92
150.0	0.00	0.00	219.26	222.34	1.54	344.90

50 Year, 122.0 Minute Storm

Time	I1	I1+I2	2S/T-O	2S/T+O	O1	Stage
0.0	0.00	0.44	0.00	0.00	0.00	343.36
2.0	0.44	1.31	0.43	0.44	0.00	343.36
4.0	0.87	2.18	1.72	1.74	0.01	343.37
6.0	1.31	3.05	3.87	3.90	0.02	343.39
8.0	1.74	3.92	6.85	6.91	0.03	343.41
10.0	2.18	4.79	10.68	10.77	0.05	343.44
12.0	2.61	5.59	15.34	15.47	0.06	343.48
14.0	2.98	6.32	20.75	20.93	0.09	343.52
16.0	3.34	7.03	26.84	27.07	0.11	343.57
18.0	3.70	7.75	33.57	33.87	0.15	343.62
20.0	4.06	8.47	40.91	41.32	0.21	343.68
22.0	4.42	9.19	48.84	49.38	0.27	343.74
24.0	4.78	11.00	57.35	58.03	0.34	343.80
26.0	6.23	14.19	67.48	68.35	0.43	343.88
28.0	7.96	17.64	80.55	81.67	0.56	343.98
30.0	9.69	21.10	96.76	98.20	0.72	344.09

32.0	11.41	24.56	115.87	117.86	0.99	344.22
34.0	13.14	28.01	138.14	140.43	1.15	344.38
36.0	14.87	29.36	163.57	166.15	1.29	344.55
38.0	14.49	27.68	190.10	192.93	1.41	344.72
40.0	13.20	25.11	214.74	217.79	1.52	344.87
42.0	11.91	22.53	236.61	239.85	1.62	345.01
44.0	10.62	19.95	255.73	259.14	1.71	345.18
46.0	9.33	17.37	272.12	275.68	1.78	345.31
48.0	8.04	15.17	285.82	289.49	1.84	345.43
50.0	7.13	13.59	297.21	300.99	1.89	345.54
52.0	6.46	12.26	306.91	310.80	1.95	345.65
54.0	5.80	10.93	315.18	319.17	1.99	345.75
56.0	5.13	9.60	322.05	326.11	2.03	345.83
58.0	4.47	8.27	327.53	331.65	2.06	345.89
60.0	3.80	7.16	331.65	335.81	2.08	345.94
62.0	3.35	6.47	334.61	338.80	2.10	345.97
64.0	3.12	6.00	336.86	341.08	2.11	346.00
66.0	2.88	5.53	338.62	342.86	2.12	346.02
68.0	2.65	5.06	339.91	344.15	2.12	346.03
70.0	2.41	4.59	340.72	344.97	2.12	346.04
72.0	2.18	4.20	341.06	345.31	2.13	346.04
74.0	2.02	4.01	341.01	345.26	2.13	346.04
76.0	1.99	3.94	340.77	345.02	2.12	346.04
78.0	1.95	3.86	340.45	344.70	2.12	346.03
80.0	1.91	3.79	340.07	344.32	2.12	346.03
82.0	1.88	3.72	339.62	343.86	2.12	346.03
84.0	1.84	3.65	339.11	343.34	2.12	346.02
86.0	1.81	3.59	338.52	342.76	2.12	346.02
88.0	1.78	3.53	337.88	342.11	2.11	346.01
90.0	1.75	3.48	337.19	341.42	2.11	346.00
92.0	1.73	3.42	336.45	340.67	2.11	346.00
94.0	1.70	3.37	335.67	339.88	2.10	345.99
96.0	1.67	3.31	334.84	339.04	2.10	345.98
98.0	1.64	3.26	333.97	338.15	2.09	345.97
100.0	1.62	3.22	333.05	337.23	2.09	345.96
102.0	1.60	3.18	332.11	336.27	2.08	345.94
104.0	1.58	3.13	331.13	335.28	2.08	345.93
106.0	1.55	3.09	330.12	334.26	2.07	345.92
108.0	1.53	3.04	329.08	333.21	2.06	345.91
110.0	1.51	3.00	328.01	332.12	2.06	345.90
112.0	1.49	2.97	326.90	331.01	2.05	345.88
114.0	1.47	2.93	325.77	329.87	2.05	345.87
116.0	1.46	2.90	324.62	328.71	2.04	345.86
118.0	1.44	2.86	323.44	327.52	2.04	345.84
120.0	1.42	2.82	322.24	326.30	2.03	345.83
122.0	1.40	2.57	321.01	325.06	2.03	345.82
124.0	1.17	2.12	319.54	323.58	2.02	345.80
126.0	0.94	1.66	317.64	321.66	2.01	345.78
128.0	0.71	1.20	315.31	319.30	1.99	345.75
130.0	0.48	0.74	312.55	316.50	1.98	345.72
132.0	0.25	0.28	309.36	313.28	1.96	345.68
134.0	0.02	0.02	305.76	309.64	1.94	345.64
136.0	0.00	0.00	301.95	305.78	1.92	345.59
138.0	0.00	0.00	298.16	301.95	1.89	345.55
140.0	0.00	0.00	294.42	298.16	1.87	345.51
142.0	0.00	0.00	290.70	294.42	1.86	345.47
144.0	0.00	0.00	287.02	290.70	1.84	345.44
146.0	0.00	0.00	283.37	287.02	1.83	345.41
148.0	0.00	0.00	279.75	283.37	1.81	345.38
150.0	0.00	0.00	276.16	279.75	1.79	345.35

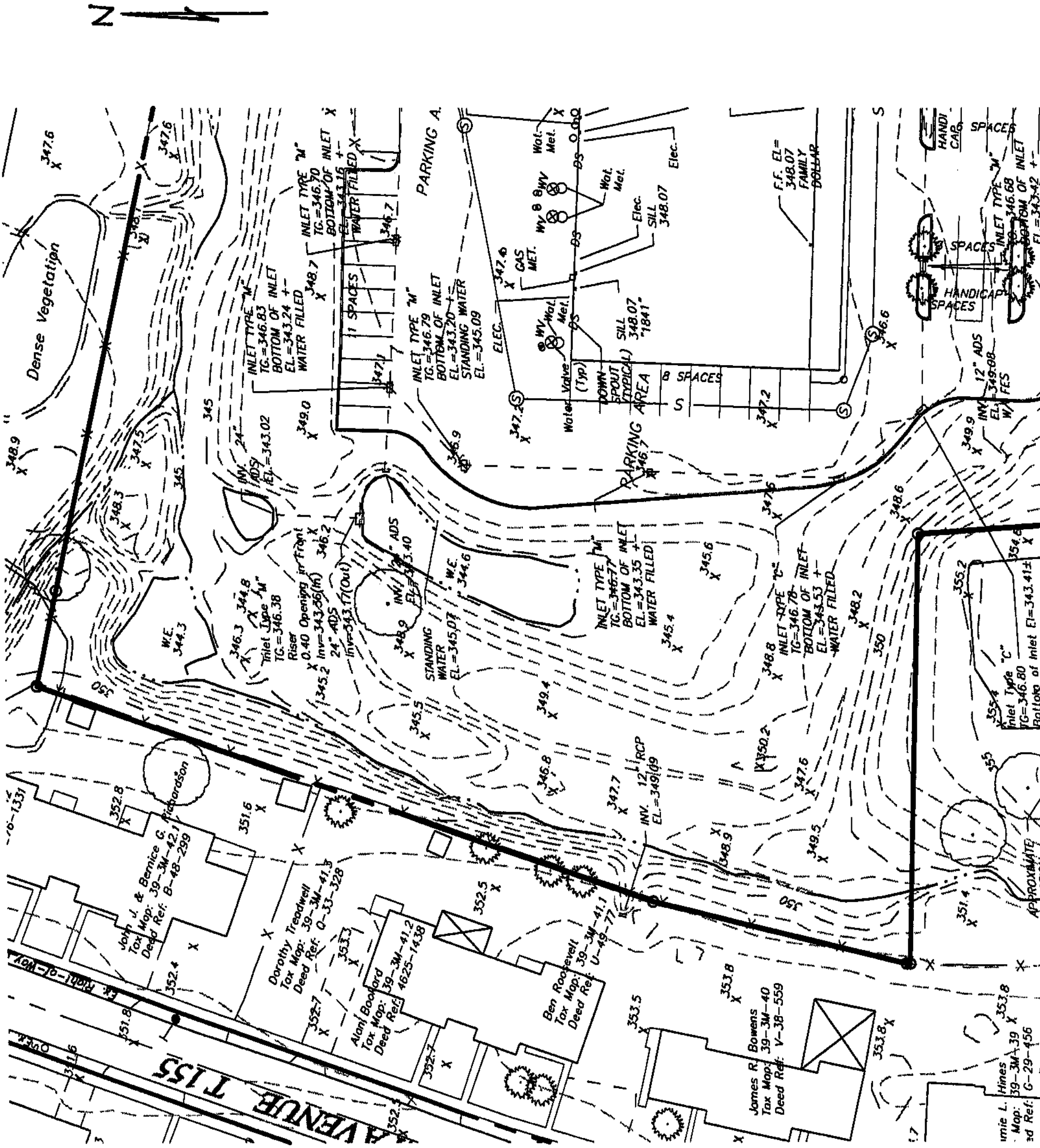
100 Year, 122.0 Minute Storm

Time	I1	I1+I2	2S/T-O	2S/T+O	O1	Stage
0.0	0.00	0.53	0.00	0.00	0.00	343.36
2.0	0.53	1.59	0.53	0.53	0.00	343.36
4.0	1.06	2.66	2.10	2.12	0.01	343.38
6.0	1.59	3.72	4.72	4.76	0.02	343.40
8.0	2.13	4.78	8.37	8.44	0.04	343.43
10.0	2.66	5.85	13.04	13.15	0.06	343.46
12.0	3.19	6.80	18.73	18.89	0.08	343.51
14.0	3.61	7.62	25.31	25.52	0.11	343.56
16.0	4.01	8.44	32.64	32.93	0.14	343.61
18.0	4.42	9.25	40.67	41.08	0.21	343.68
20.0	4.83	10.06	49.37	49.92	0.28	343.74
22.0	5.23	10.88	58.72	59.43	0.35	343.81
24.0	5.64	12.84	68.71	69.60	0.44	343.89
26.0	7.20	16.26	80.43	81.55	0.56	343.98
28.0	9.06	19.96	95.29	96.69	0.70	344.08
30.0	10.91	23.67	113.29	115.25	0.98	344.21
32.0	12.76	27.37	134.71	136.96	1.12	344.35
34.0	14.61	31.07	159.55	162.08	1.27	344.52
36.0	16.46	32.52	187.82	190.62	1.40	344.70
38.0	16.06	30.75	217.27	220.34	1.53	344.89
40.0	14.69	28.01	244.72	248.02	1.65	345.08
42.0	13.32	25.27	269.20	272.73	1.77	345.29
44.0	11.95	22.54	290.76	294.48	1.86	345.47
46.0	10.58	19.80	309.38	313.30	1.96	345.68
48.0	9.21	17.44	325.09	329.18	2.05	345.86
50.0	8.23	15.72	338.30	342.53	2.12	346.01
52.0	7.49	14.24	349.69	354.01	2.16	346.12
54.0	6.75	12.77	359.53	363.94	2.20	346.21
56.0	6.02	11.30	367.84	372.31	2.23	346.28
58.0	5.28	9.83	374.55	379.14	2.30	346.34
60.0	4.55	8.59	379.67	384.38	2.36	346.39
62.0	4.04	7.80	382.91	388.26	2.67	346.42
64.0	3.76	7.24	384.83	390.71	2.94	346.44
66.0	3.48	6.67	385.89	392.06	3.09	346.45
68.0	3.20	6.11	386.27	392.56	3.14	346.46
70.0	2.91	5.55	386.14	392.38	3.12	346.46
72.0	2.63	5.08	385.59	391.68	3.05	346.45
74.0	2.45	4.85	384.80	390.67	2.94	346.44
76.0	2.40	4.76	384.00	389.65	2.82	346.43
78.0	2.36	4.67	383.30	388.76	2.73	346.43
80.0	2.32	4.59	382.69	387.98	2.64	346.42
82.0	2.27	4.50	382.15	387.28	2.57	346.41
84.0	2.23	4.41	381.65	386.65	2.50	346.41
86.0	2.19	4.34	381.20	386.07	2.43	346.40
88.0	2.15	4.27	380.79	385.54	2.38	346.40
90.0	2.12	4.20	380.33	385.06	2.37	346.40
92.0	2.08	4.14	379.82	384.53	2.36	346.39
94.0	2.05	4.07	379.25	383.95	2.35	346.39
96.0	2.02	4.00	378.63	383.32	2.34	346.38
98.0	1.98	3.94	377.95	382.63	2.34	346.37
100.0	1.96	3.89	377.24	381.90	2.33	346.37
102.0	1.93	3.83	376.49	381.13	2.32	346.36
104.0	1.90	3.78	375.71	380.32	2.31	346.35
106.0	1.88	3.73	374.89	379.49	2.30	346.35
108.0	1.85	3.67	374.03	378.61	2.29	346.34

110.0	1.82	3.62	373.15	377.70	2.28	346.33
112.0	1.80	3.58	372.23	376.77	2.27	346.32
114.0	1.78	3.54	371.30	375.81	2.26	346.31
116.0	1.76	3.49	370.34	374.83	2.25	346.30
118.0	1.73	3.45	369.36	373.83	2.24	346.30
120.0	1.71	3.40	368.34	372.80	2.23	346.29
122.0	1.69	3.10	367.28	371.74	2.23	346.28
124.0	1.41	2.55	365.93	370.38	2.23	346.26
126.0	1.14	1.99	364.04	368.48	2.22	346.25
128.0	0.86	1.44	361.61	366.03	2.21	346.23
130.0	0.58	0.89	358.65	363.05	2.20	346.20
132.0	0.30	0.33	355.17	359.54	2.18	346.17
134.0	0.03	0.03	351.18	355.51	2.17	346.13
136.0	0.00	0.00	346.91	351.20	2.15	346.09
138.0	0.00	0.00	342.65	346.91	2.13	346.05
140.0	0.00	0.00	338.41	342.65	2.12	346.02
142.0	0.00	0.00	334.22	338.41	2.10	345.97
144.0	0.00	0.00	330.08	334.22	2.07	345.92
146.0	0.00	0.00	325.99	330.08	2.05	345.87
148.0	0.00	0.00	321.92	325.99	2.03	345.83
150.0	0.00	0.00	317.91	321.92	2.01	345.78

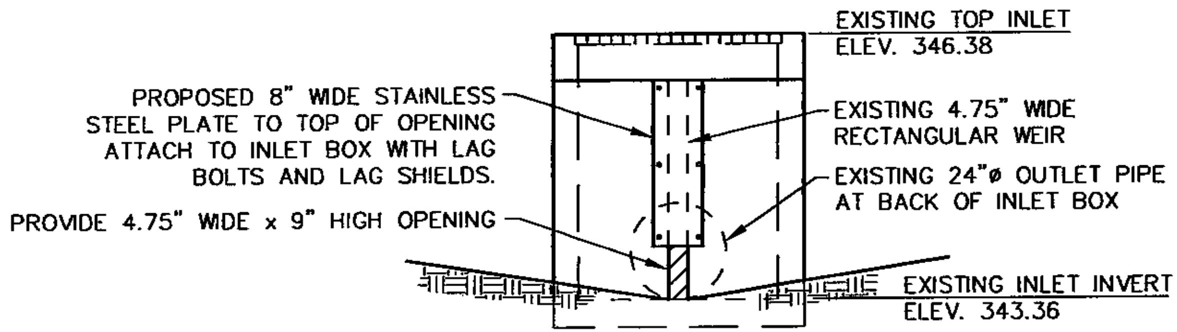
APPENDIX A

As-Built Detention Basin Plan, Modified Outlet Structure Detail



AS-BUILT DETENTION BASIN PLAN

SCALE: 1" = 50'



MODIFIED OUTLET STRUCTURE DETAIL

NOT TO SCALE

APPENDIX B

Tri-Tech Resources, Inc.

Detention Basin Outlet Program

Methods of Calculation

GENERAL INFORMATION

The Tri-Tech Resources, Inc. Detention Basin Outlet Program will calculate *the* outflow from a detention basin with multiple openings that let water into a concrete box or riser pipe that discharge into a primary outlet culvert. The basin may have an emergency spillway that bypasses the primary out let culvert. The following seven outlet structures are supported by the program: Circular Orifice, Rectangular Orifice, Rectangular Weir Grate Topped Inlet, Riser Pipe, Discharge Pipe (short pipe that leads to the riser box) and an Emergency Spillway. The user controls the discharge coefficients for each structure.

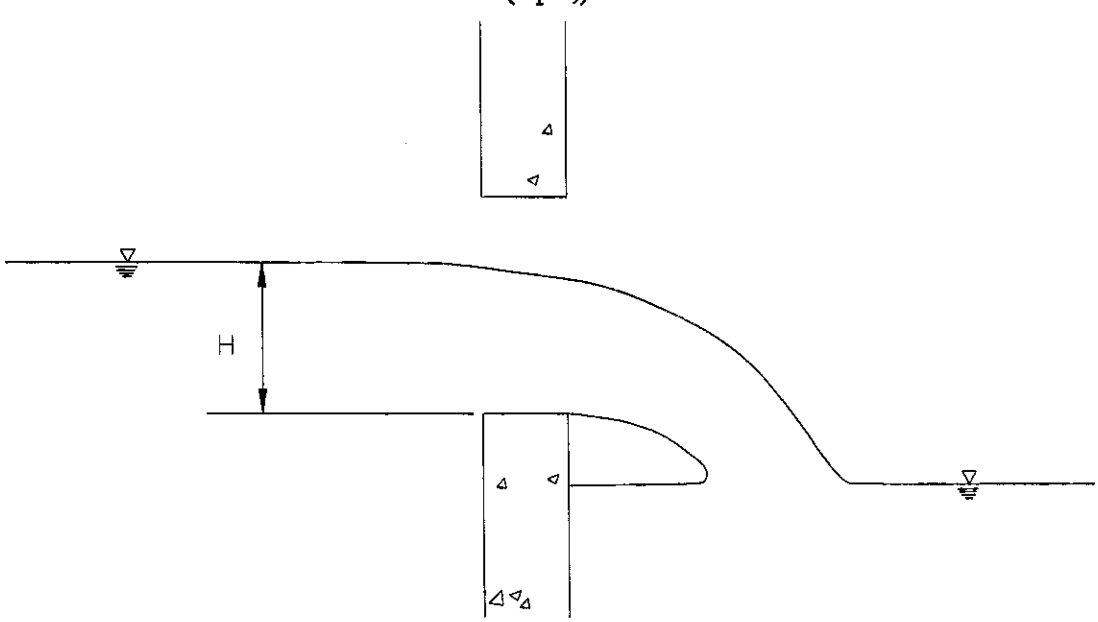
The program will calculate the outflow from the basin from start elevation to the end elevation given by the user at a user-specified interval. For each stage in the detention basin, the program will calculate the Headwater Elevation required by the total flow from each outflow structure through the outlet culvert. It then calculates the flow through each structure based on the Stage in the basin and the Riser Box Elevation. The program does these calculations iteratively until the sum of the flow through the outlet structures equals the flow through the out let culvert. The hydraulic calculation for flow through each type of outlet structure is given below.

CIRCULAR ORIFICE

Two different types of flow conditions may occur for circular orifices. The Riser Box Stage may effect the flow in each of these conditions. The first condition is when the Basin Stage is below the top of the orifice. The orifice acts as a circular weir similar to low flow through a culvert under inlet control. The calculations are taken from Tables 8 & 9 of "Hydraulic Design of Highway Culverts" (HDS—5) by the U.S. DOT. The equation for this flow is:

$$HWi/D = Hc/D + K\,(Q/AD^{.5})^2$$ where

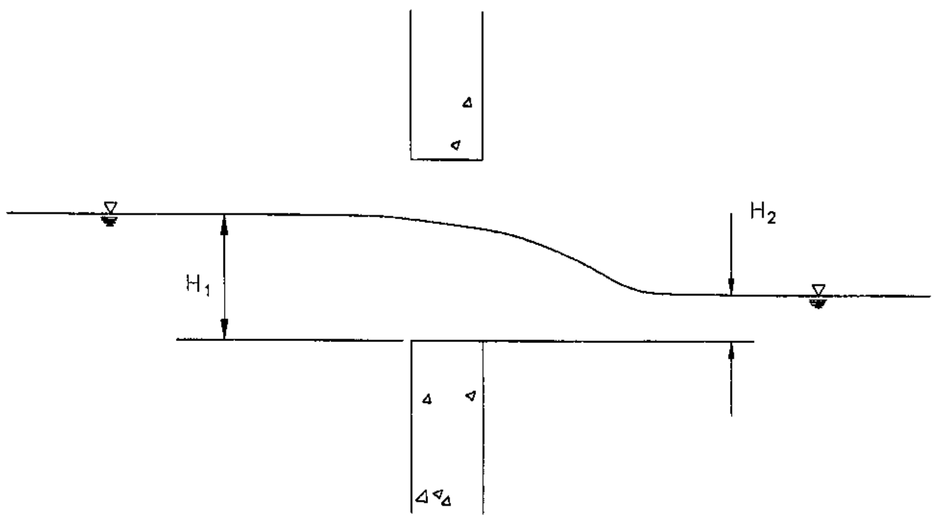
HWi = Head (ft.)
D = Diameter of orifice (ft.)
Hc = Specific Head at Critical Depth (ft.)
K = 0.0098 (from Table 9)
Q = Flow (cfs)
A = Full cross sectional area (sq.ft,)



If the Riser Box Elevation is above the invert of the circular orifice, the flow is reduced. The method for calculating flow through submerged sharp crested weirs is taken from page 5--19 of "Handbook of Hydraulics" by Brater & King. The equation is:

$$Q = Q_1(1 - (H_2/H_1)^{1.5})^{0.385}$$ where

Q = Actual Flow (cfs)
Q_1 = Flow through unsubmerged weir (cfs) — see above section
H_2 = Submergence Depth (it)
H_1 = Unsubmerged Head

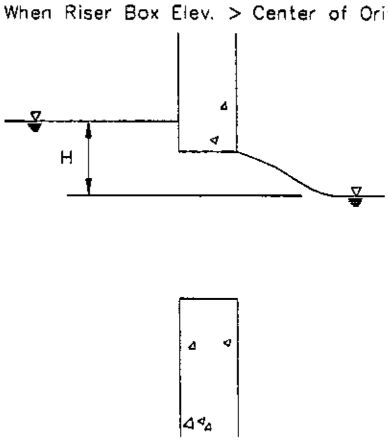


The second flow condition is when the Stage is above the top of the orifice. This flow is calculated using the orifice equation:

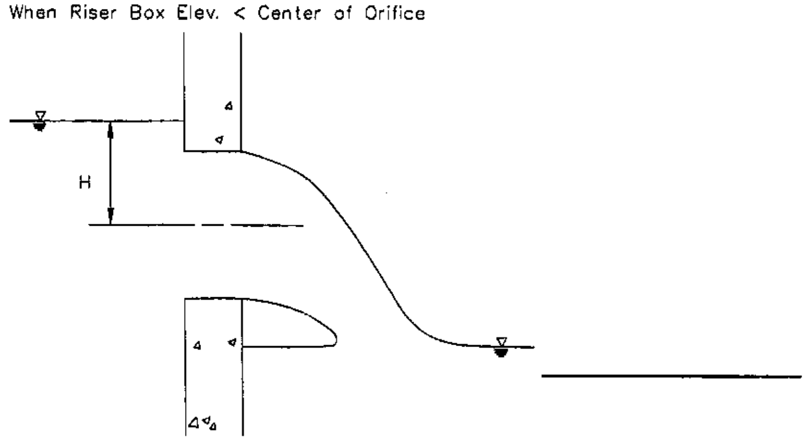
$$Q = Cd \times A \times (64.4 \times H)^{0.5}$$

Cd = Coefficient of Discharge
A = Full Flow Area (sq.ft,)
H = Head (ft)
Q = Flow through orifice (cfs)

When Riser Box Elev. > Center of Orifice



When Riser Box Elev. < Center of Orifice



RECTANGULAR ORIFICE

Rectangular or if ices also have two flow conditions. If the Stage is below the top of the orifice the orifice acts like a rectangular weir. See the next section for details of the calculations. If the Stage is above the top of the orifice, the calculations are the same as those for a circular orifice. Substitute the correct Cd and A in the equation given for the second flew condition for a circular orifice (see the previous section).

RECTANGULAR WEIR

The flow over a rectangular weir can not he restricted by a top. Treat the structure as a rectangular orifice if the weir has a top. Two flow conditions occur with rectangular weirs. The first is used when the Riser Box Elevation is below the crest of the weir. The equation used is:

$Q = Cd \times L \times H^{1.5}$ where

Cd = Coefficient of Discharge
L = Length of Wier (ft)
H = Head (ft.)
Q = Flow over Heir (cfs)

When the Riser Box Elevation is above the crest of the weir the flow is treated as a submerged weir. The method for calculating flow through submerged sharp crested weirs is taken from page 5—19 of "Handbook of Hydraulics" by Brater & King. The equation is:

$Q = Q_1 (1 - (H_2 / H_1)^{1.5})^{0.385}$ where

Q = Actual Flow (cfs)
Q_1 = Flow through unsubmerged weir (cfs) — see above section
H_2 = Submergence Depth (ft)
H_1 = Unsubmerged Head

H_1 & H_2 are measured in the same manner as shown on the sketch for a circular orifice acting as a submerged weir.

GRATE TOPPED INLET & CIRCULAR RISER PIPE

The flow over a grate topped inlet and over a circular riser pipe is similar and both calculations are done by the program using the same routine. The flow may be controlled by the weir equation (for lower flows) *or* by the orifice equation (for higher flows). The program computes the flow over each and uses the smaller flow for the structure. The weir flow is computed in the same way as shown in the section on rectangular weirs. The orifice flow is calculated as shown in the rectangular orifice section.

EMERGENCY SPILLWAY

The flow over an emergency spillway is treated as a broad crested trapezoidal weir. The trapezoidal weir is modeled in two parts. The first part is a rectangular weir. The second part is a triangular weir. The Coefficient of Discharge is 3,0 for the rectangular weir. The program assumes flow from the emergency spillway can not be submerged. The flow over the emergency spillway does not go into the riser box.

Rectangular Heir:

$Qs = 3 \times L \times H^{1.5}$ where

Qs = Flow over spillway (cfs)
L = Length of the spillway (ft.)
H = Head = Stage -Crest Elev. (ft.)

Triangular Weir:

$Q = 2.5 \times Tan(O / 2) \times H^{2.5}$

H = Head (same as the equation for the rectangular weir)
The Equation is taken from "Handbook of Hydraulics" by Brater & King.
page 5—16, Eq. 5—45. The side slope of 3 to 1

DISCHARGE PIPE

The discharge pipe is section of pipe that connects for the riser box. It is treated a culvert and calculated in the same manner as the outlet culvert shown in the next section.

OUTLET CULVERT

The head calculations for a culvert are done as shown in "Hydraulic Design of Highway Culverts" (HDS—5) by the U.S. DOT. One correction has been made to the method shown in this book. When the outlet controls the book says assume the depth of flow at the outlet of the culvert will be (D + Dc)/2. This assumption is incorrect for low flows through culverts. The outlet depth has been computed according to the method shown in "Open Channel Hydraulics" by Richard H. French, Pages 365 - 390. For HW/D ratios below 1.5 the outlet depth for the culvert will be the critical depth. For HW/D ratios above 1.5 the culvert will flow full and the outlet depth is the diameter of the culvert.

Perforated Risers

The outlet program will accept perforated riser pipes if the vertical spacing of each hole is constant. The computer computes the flow from each hole as an orifice (see previous section for a detailed description). The chart below shows the calculations for a perforated riser with 1" diameter holes spaced 0.18' apart vertically. The invert of the bottom hole is 490.04 in the example. The outlet pipe is 215'-24" CMP @ 0.29%. The BoxEl shows the elevation of the water inside the riser pipe. The Stage shows the elevation of the water surface in the Detention Basin.

Stage	BoxEl	HoleEl	H	Q1	Cum. Q
493.50	489.12	490.08	3.42	0.05	0.05
493.50	489.12	490.26	3.24	0.05	0.10
493.50	489.12	490.44	3.06	0.05	0.14
493.50	489.12	490.62	2.88	0.04	0.19
493.50	489.12	490.80	2.70	0.04	0.23
493.50	489.12	490.98	2.52	0.04	0.27
493.50	489.12	491.16	2.34	0.04	0.31
493.50	489.12	491.34	2.16	0.04	0.35
493.50	489.12	491.52	1.98	0.04	0.39
493.50	489.12	491.70	1.80	0.04	0.42
493.50	489.12	491.88	1.62	0.03	0.46
493.50	489.12	492.06	1.44	0.03	0.49
493.50	489.12	492.24	1.26	0.03	0.52
493.50	489.12	492.42	1.08	0.03	0.54
493.50	489.12	492.60	0.90	0.02	0.57
493.50	489.12	492.78	0.72	0.02	0.59
493.50	489.12	492.96	0.54	0.02	0.61
493.50	489.12	493.14	0.36	0.02	0.63
493.50	489.12	493.32	0.18	0.01	0.64

APPENDIX C

FEMA Map

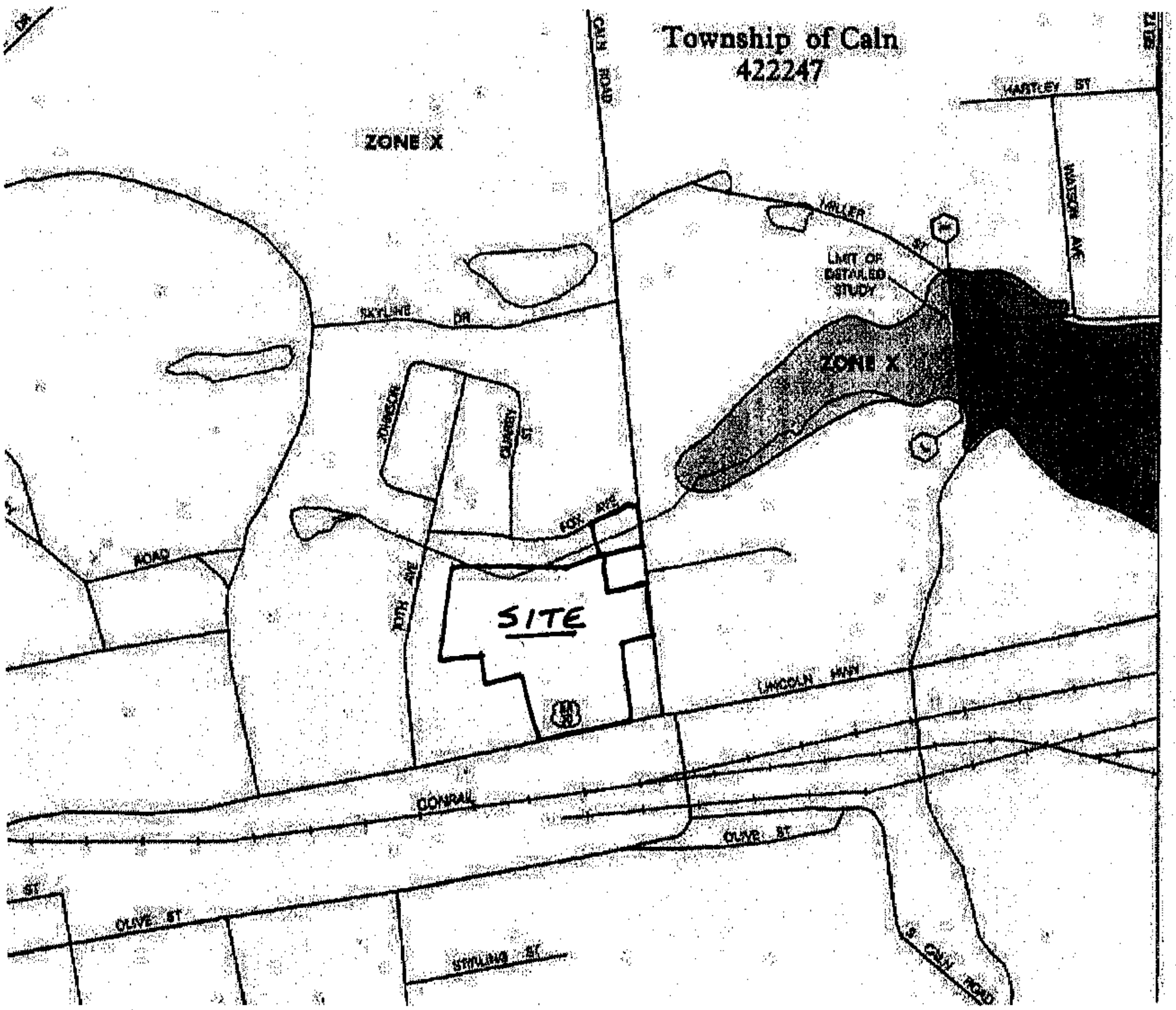
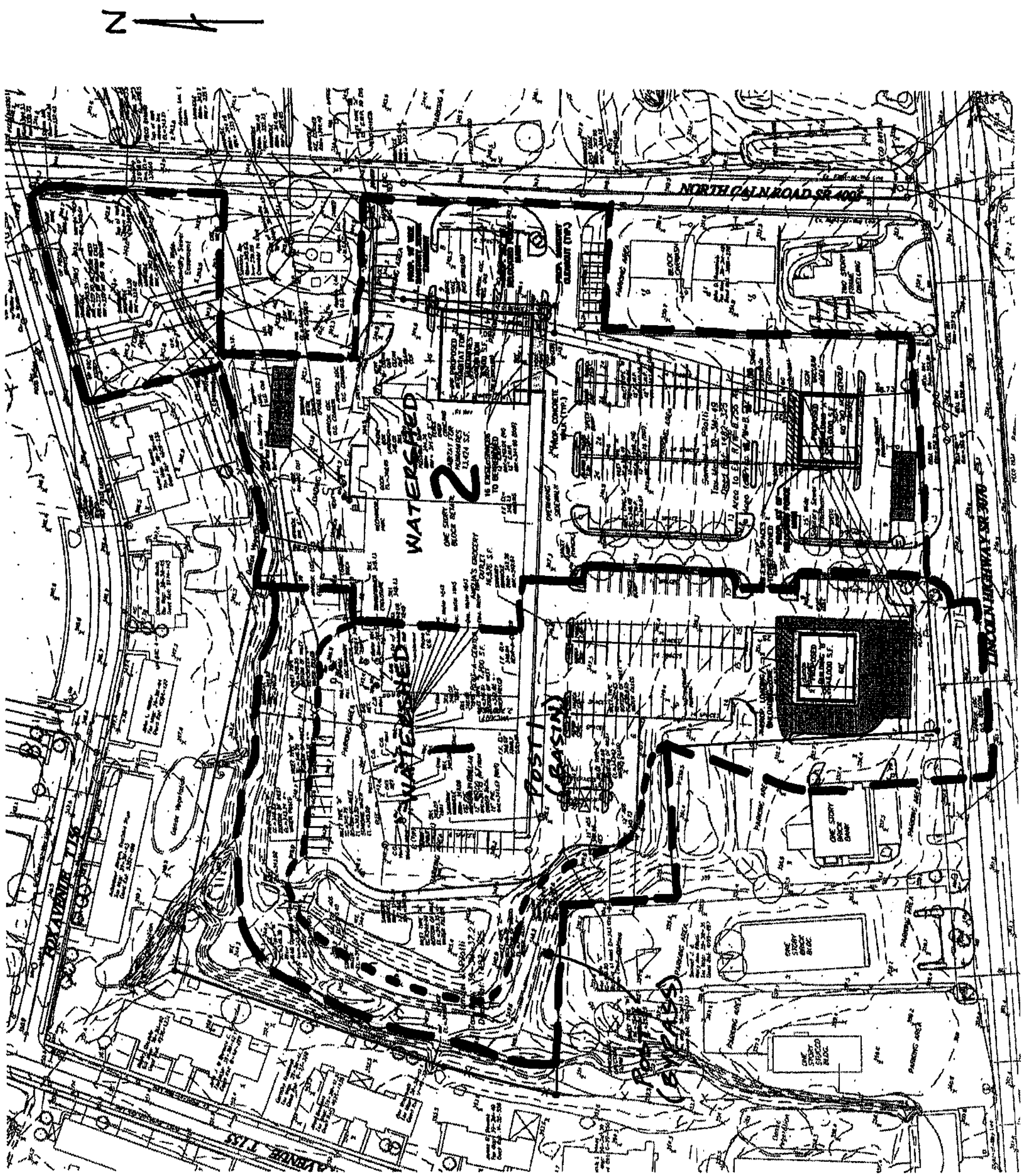


Figure 2. FEMA Map
Map Number 42029C0306 D – Scale: 1" = 650'

APPENDIX D

Watershed Map



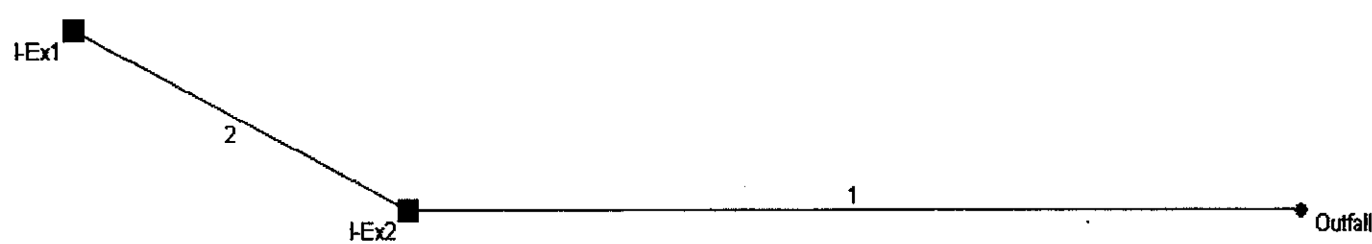
WATERSHED MAP

NOT TO SCALE

APPENDIX E

Existing 12" CMP Calculations
Proposed 15" SLCPP Calculations

Hydraflow Plan View



Project file: Ex Run.stm	No. Lines: 2	10-03-2003

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line type	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
1	End	203.0	-180.0	MH	0.00	0.00	0.00	0.0	341.13	0.42	341.98	12	Cir	0.013	0.45	346.13	EW-Ex2 I-Ex2
2	1	84.0	26.0	Grate	4.00	0.00	0.00	0.0	342.04	1.33	343.16	12	Cir	0.013	1.00	346.25	I-Ex2 I-Ex1

Project File: Ex Run.stm | Number of lines: 2 | Date: 10-03-2003

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Up	Dn	Up	Dn	Up	Dn	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	203.0	0.00	0.00	0.00	0.00	0.00	0.0	0.3	0.0	4.00	2.30	5.19	12	0.42	341.98	341.13	344.47	342.05	346.13	342.20	EW-Ex2 I-Ex2
2	1	84.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	4.00	4.11	5.09	12	1.33	343.16	342.04	345.72	344.66	346.25	346.13	I-Ex2 I-Ex1

Project File: Ex Run.stm | Number of lines: 2 | Run Date: 10-03-2003

NOTES: Intensity = 84.09 / (Inlet time + 15.40) ^ 0.77; Return period = 100 Yrs.

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)		Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)		
	(in)	(cfs)									(ft)											(K)	(ft)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
1	12	4.00	341.13	342.05	0.92	0.76	5.29	0.44	342.49	1.095	203	341.98	344.47	1.00	0.79	5.09	0.40	344.88	1.262	1.178	2.392	0.45	0.18
2	12	4.00	342.04	344.66	1.00	0.79	5.09	0.40	345.06	1.262	84.0	343.16	345.72	1.00	0.79	5.09	0.40	346.12	1.262	1.262	1.060	1.00	0.40

Project File: Ex Run.stm | Number of lines: 2 | Run Date: 10-03-2003

NOTES: * Normal depth assumed., ** Critical depth assumed.

Hydraflow HGL Computation Procedure

General Procedure: Hydraflow computes the HGL using the Bernoulli energy equation. Manning's equation is used to determine energy losses due to pipe friction. In a standard step, iterative procedure, Hydraflow assumes upstream HGLs until the energy equation balances. If the energy equation cannot balance, supercritical flow exists and critical depth is assumed at the upstream end.

Col. 1 The line number being computed. Calculations begin at Line 1 and proceed upstream.

Col. 2 The line size. In the case of non-circular pipes, the line rise is printed above the span.

Col. 3 Total flow rate in the line.

Col. 4 The elevation of the downstream invert.

Col. 5 Elevation of the hydraulic grade line at the downstream end. This is computed as the upstream HGL + Minor loss of this line's downstream line.

Col. 6 The downstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

Col. 7 Cross-sectional area of the flow at the downstream end.

Col. 8 The velocity of the flow at the downstream end, (Col. 3 / Col. 7).

Col. 9 Velocity head (Velocity squared / 2g).

Col. 10 The elevation of the energy grade line at the downstream end, HGL + Velocity head, (Col. 5 + Col. 9).

Col. 11 The friction slope at the downstream end (the S or Slope term in Manning's equation).

Col. 12 The line length.

Col. 13 The elevation of the upstream invert.

Col. 14 Elevation of the hydraulic grade line at the upstream end.

Col. 15 The upstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

Col. 16 Cross-sectional area of the flow at the upstream end.

Col. 17 The velocity of the flow at the upstream end, (Col. 3 / Col. 16).

Col. 18 Velocity head (Velocity squared / 2g).

Col. 19 The elevation of the energy grade line at the upstream end, HGL + Velocity head, (Col. 14 + Col. 18) .

Col. 20 The friction slope at the upstream end (the S or Slope term in Manning's equation).

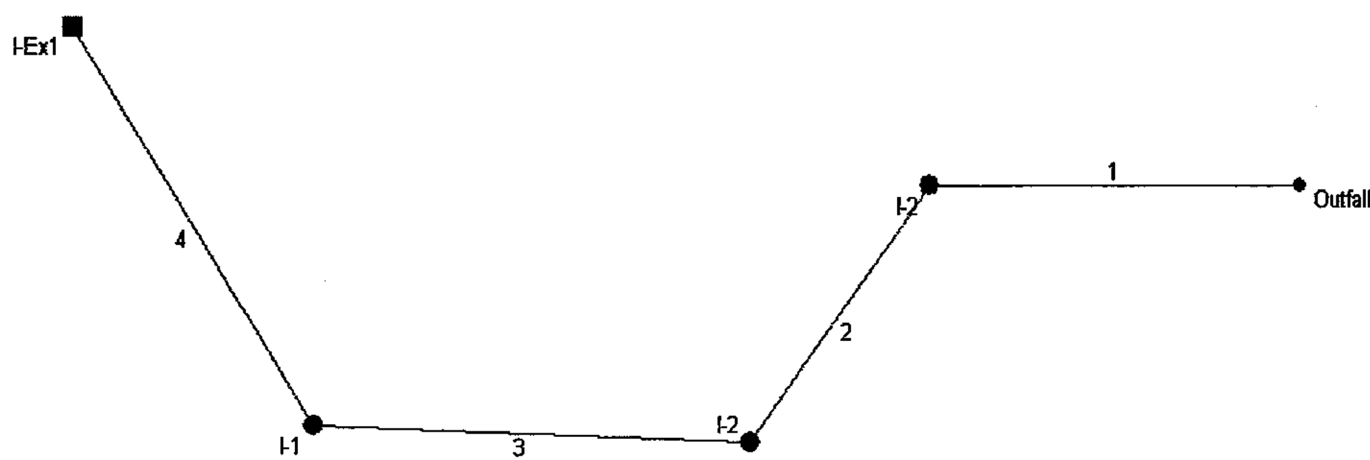
Col. 21 The average of the downstream and upstream friction slopes.

Col. 22 Energy loss. Average Sf/100 x Line Length (Col. 21/100 x Col. 12). Equals (EGL upstream - EGL downstream) +/- tolerance.

Col. 23 The junction loss coefficient (K).

Col. 24 Minor loss. (Col. 23 x Col. 18). Is added to upstream HGL and used as the starting HGL for the next upstream line(s).

Hydraflow Plan View



Project file: Prop Run.stm	No. Lines: 4	10-03-2003

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line type	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
1	End	84.0	-180.0	MH	0.00	0.00	0.00	0.0	341.13	0.56	341.60	15	Cir	0.013	0.75	346.90	EW-2 I-2
2	1	66.0	-52.0	MH	0.00	0.00	0.00	0.0	341.60	0.56	341.97	15	Cir	0.013	0.85	345.10	I-2 I-2
3	2	100.0	54.0	MH	0.00	0.00	0.00	0.0	341.97	0.57	342.54	15	Cir	0.013	0.85	346.90	I-2 I-1
4	3	98.0	54.0	Grate	4.00	0.00	0.00	0.0	342.54	0.63	343.16	15	Cir	0.013	1.00	346.25	I-1 I-Ex1

Project File: Prop Run.stm | Number of lines: 4 | Date: 10-03-2003

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Up	Dn	Up	Dn	Up	Dn	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	84.0	0.00	0.00	0.00	0.00	0.00	0.0	1.1	0.0	4.00	4.83	4.47	15	0.56	341.60	341.13	342.52	341.93	346.90	343.38	EW-2 I-2
2	1	66.0	0.00	0.00	0.00	0.00	0.00	0.0	0.9	0.0	4.00	4.83	3.73	15	0.56	341.97	341.60	342.92	342.72	345.10	346.90	I-2 I-2
3	2	100.0	0.00	0.00	0.00	0.00	0.00	0.0	0.4	0.0	4.00	4.88	3.78	15	0.57	342.54	341.97	343.45	343.13	346.90	345.10	I-2 I-1
4	3	98.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	4.00	5.14	3.99	15	0.63	343.16	342.54	344.00	343.68	346.25	346.90	I-1 I-Ex1

Project File: Prop Run.stm | Number of lines: 4 | Run Date: 10-03-2003

NOTES: Intensity = 84.09 / (Inlet time + 15.40) ^ 0.77; Return period = 100 Yrs.

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
1	15	4.00	341.13	341.93	0.80	0.83	4.82	0.36	342.29	0.700	84.0	341.60	342.52	0.92	0.97	4.11	0.26	342.79	0.477	0.589	0.494	0.75	0.20
2	15	4.00	341.60	342.72	1.12	1.16	3.45	0.18	342.91	0.339	66.0	341.97	342.92	0.95	1.00	4.01	0.25	343.17	0.452	0.395	0.261	0.85	0.21
3	15	4.00	341.97	343.13	1.16	1.19	3.37	0.18	343.31	0.332	100	342.54	343.45	0.91	0.95	4.19	0.27	343.72	0.498	0.415	0.415	0.85	0.23
4	15	4.00	342.54	343.68	1.14	1.17	3.41	0.18	343.86	0.335	98.0	343.16	344.00	0.84	0.88	4.57	0.32	344.32	0.613	0.474	0.464	1.00	0.32

Project File: Prop Run.stm | Number of lines: 4 | Run Date: 10-03-2003

NOTES: * Normal depth assumed., ** Critical depth assumed.

Hydraflow HGL Computation Procedure

General Procedure: Hydraflow computes the HGL using the Bernoulli energy equation. Manning's equation is used to determine energy losses due to pipe friction. In a standard step, iterative procedure, Hydraflow assumes upstream HGLs until the energy equation balances. If the energy equation cannot balance, supercritical flow exists and critical depth is assumed at the upstream end.

Col. 1 The line number being computed. Calculations begin at Line 1 and proceed upstream.

Col. 2 The line size. In the case of non-circular pipes, the line rise is printed above the span.

Col. 3 Total flow rate in the line.

Col. 4 The elevation of the downstream invert.

Col. 5 Elevation of the hydraulic grade line at the downstream end. This is computed as the upstream HGL + Minor loss of this line's downstream line.

Col. 6 The downstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

Col. 7 Cross-sectional area of the flow at the downstream end.

Col. 8 The velocity of the flow at the downstream end, (Col. 3 / Col. 7).

Col. 9 Velocity head (Velocity squared / 2g).

Col. 10 The elevation of the energy grade line at the downstream end, HGL + Velocity head, (Col. 5 + Col. 9).

Col. 11 The friction slope at the downstream end (the S or Slope term in Manning's equation).

Col. 12 The line length.

Col. 13 The elevation of the upstream invert.

Col. 14 Elevation of the hydraulic grade line at the upstream end.

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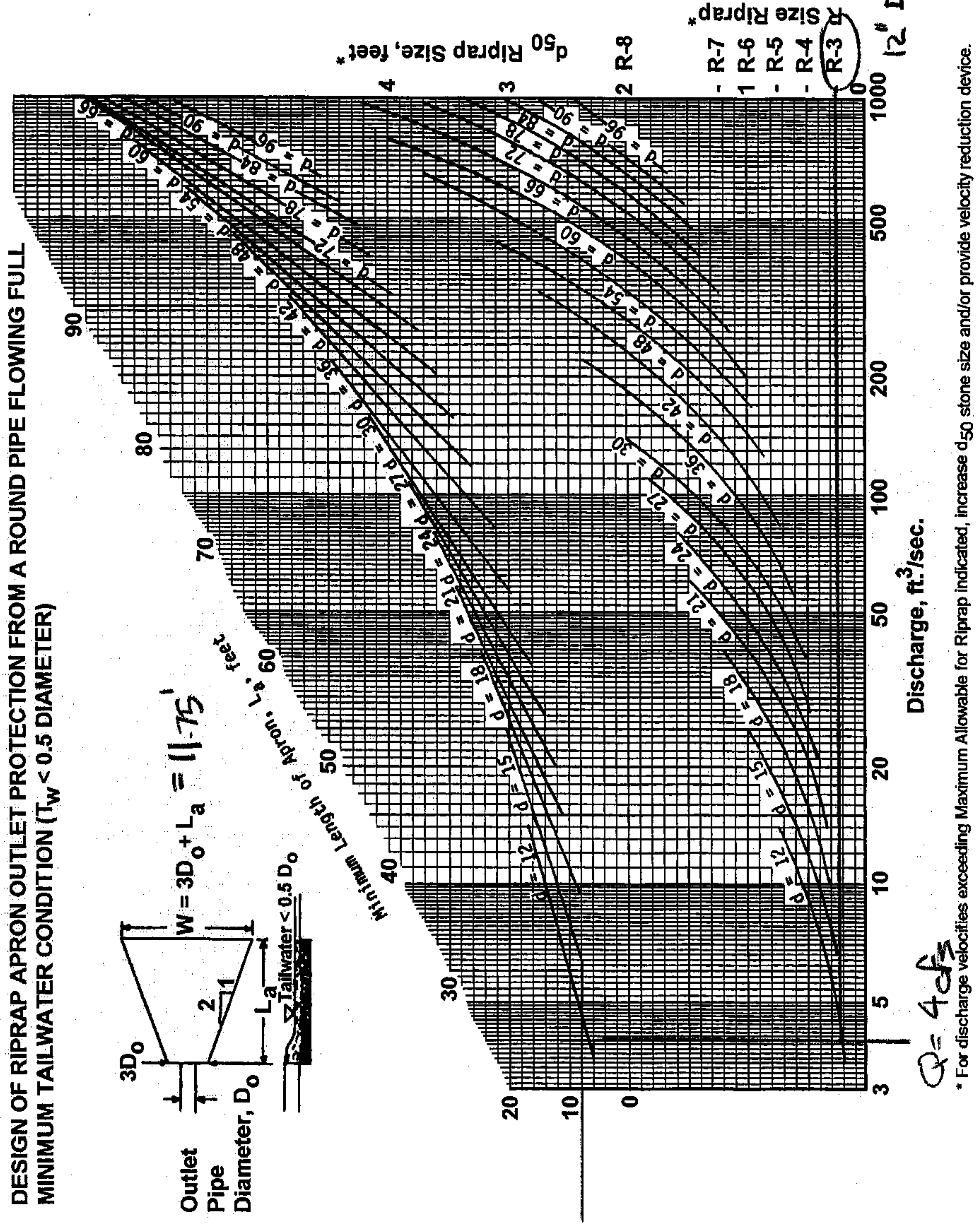
Col. 21 The average of the downstream and upstream friction slopes.

Col. 22 Energy loss. Average Sf/100 x Line Length (Col. 21/100 x Col. 12). Equals (EGL upstream - EGL downstream) +/- tolerance.

Col. 23 The junction loss coefficient (K).

Col. 24 Minor loss. (Col. 23 x Col. 18). Is added to upstream HGL and used as the starting HGL for the next upstream line(s).

FIGURE 21
Riprap Apron Design, Minimum Tailwater Condition



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.