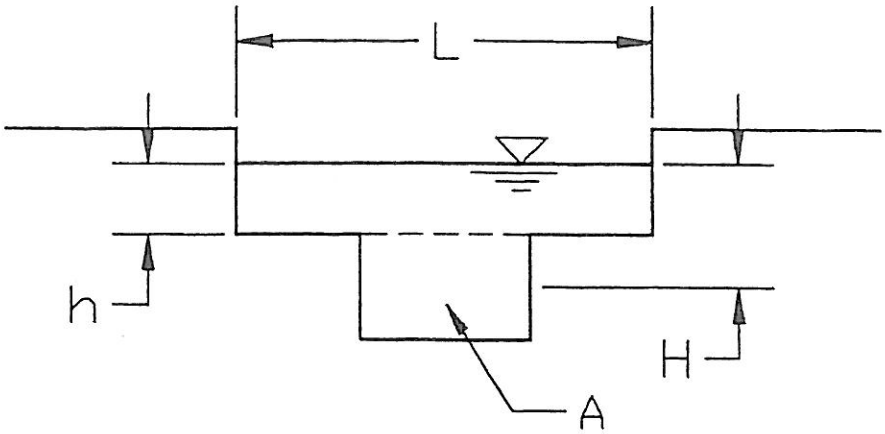
APPENDIX 5

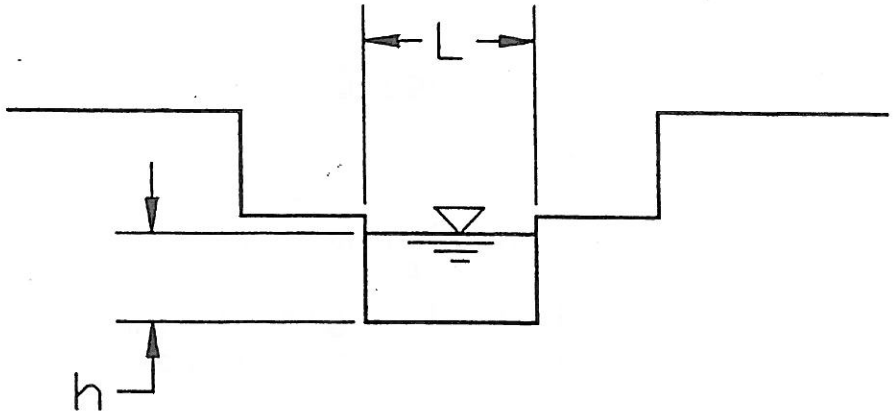


Rectangular Weir and Orifice Flow

$$Q_w = C_w L h^{3/2}$$
$$Q_o = C_o A (2gH)^{1/2}$$

where

Q_w = Weir discharge in CFS
Q_o = Orifice discharge in CFS
C_w = Weir coefficient
C_o = Orifice Coefficient
L = Horizontal length of the weir on feet
h = Head on the weir in feet
H = Head on the orifice in feet



Rectangular Weir Flow Only

$$Q_w = C_w L h^{3/2}$$

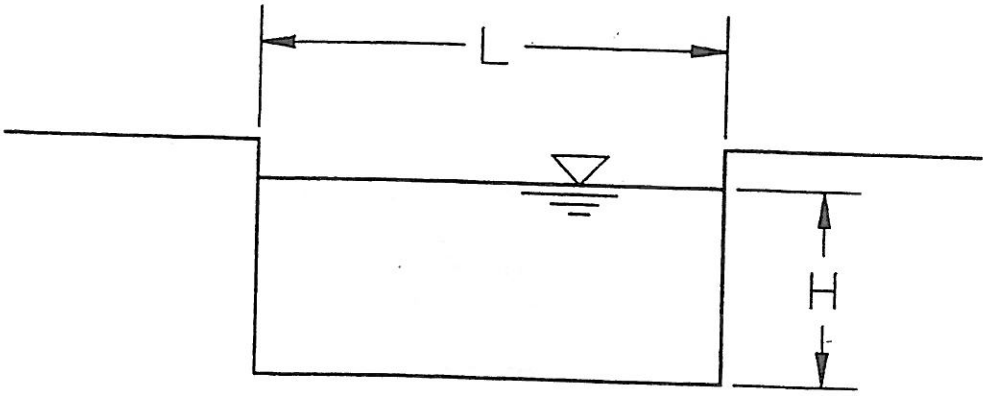
where

Q_w = Weir discharge in CFS
C_w = Weir coefficient
L = Horizontal length of the weir on feet
h = Head on the weir in feet

MULTISTAGE RELEASE STRUCTURES

City of
SPRINGDALE
Arkansas

Figure 5.10



Rectangular Weir Flow Equation

$$Q = CLH^{3/2}$$

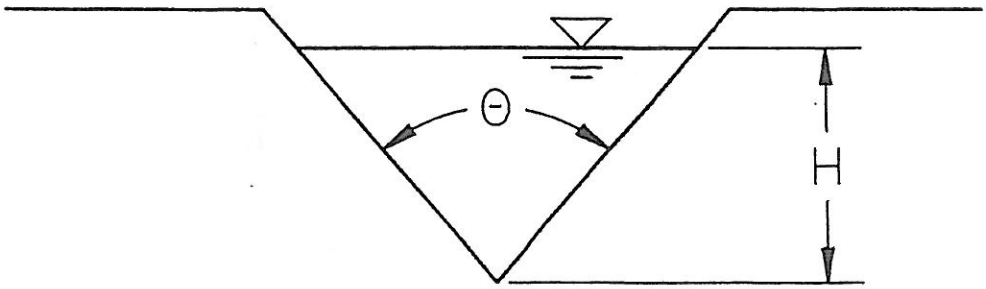
where

Q = Weir discharge in CFS
C = Weir coefficient
L = Horizontal length of the weir on feet
H = Head on the weir in feet .

RECTANGULAR WEIR

City of
SPRINGDALE
Arkansas

Figure 5.9



V-Notch Weir Flow Equation

$$Q = C \tan(\Theta/2) H^{5/2}$$

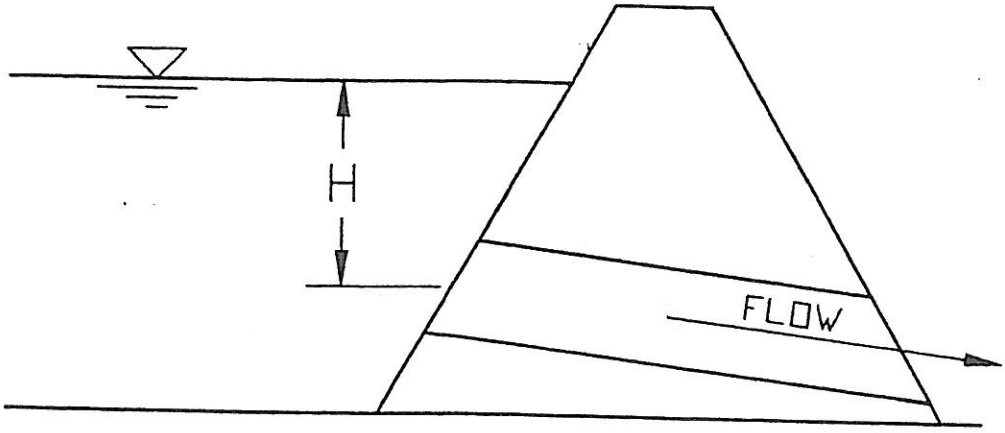
where

Q = Weir discharge in CFS
C = Weir coefficient
Θ = Angle of the weir notch in degrees
H = Head on the weir in feet

V-NOTCH WEIR

City of
SPRINGDALE
Arkansas

Figure 5.8



Orifice Flow Equation

$$Q = CA(2gH)^{1/2}$$

where

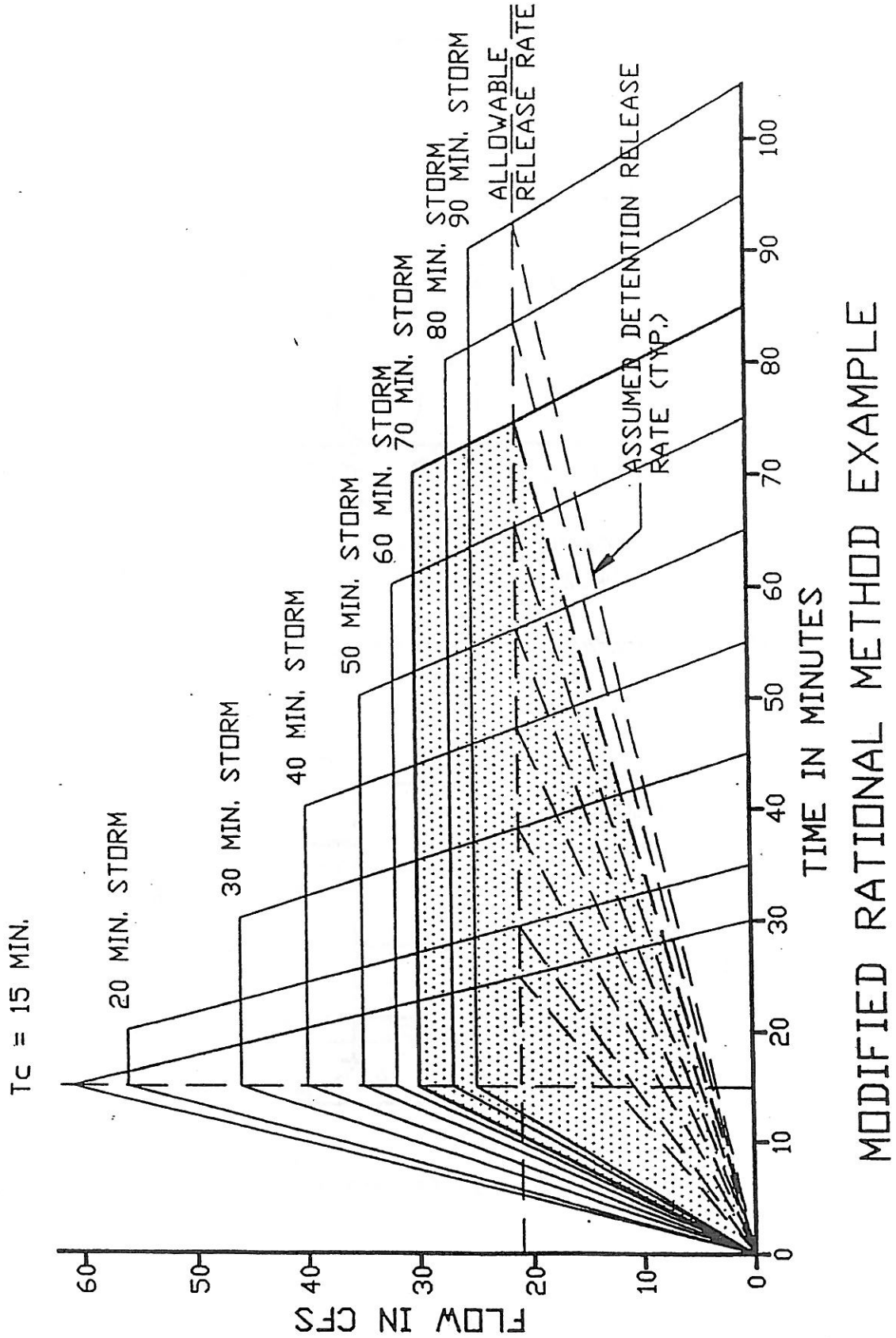
Q = Orifice discharge in CFS
C = Orifice Coefficient
A = Area of orifice in square feet
g = Gravitational constant (32.2 FT/S²)
H = Head on the orifice measured from the centerline in feet

ORIFICE DESIGN

Add A TABLE orifice Coefficients

City of
SPRINGDALE
Arkansas

Figure 5.7

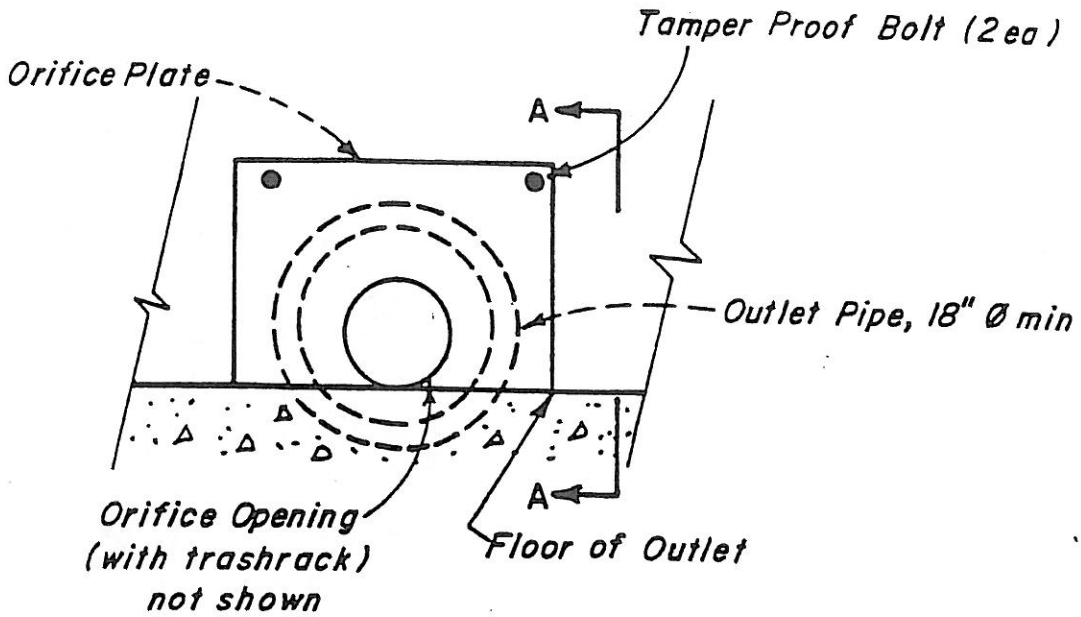


City of
SPRINGDALE
Arkansas

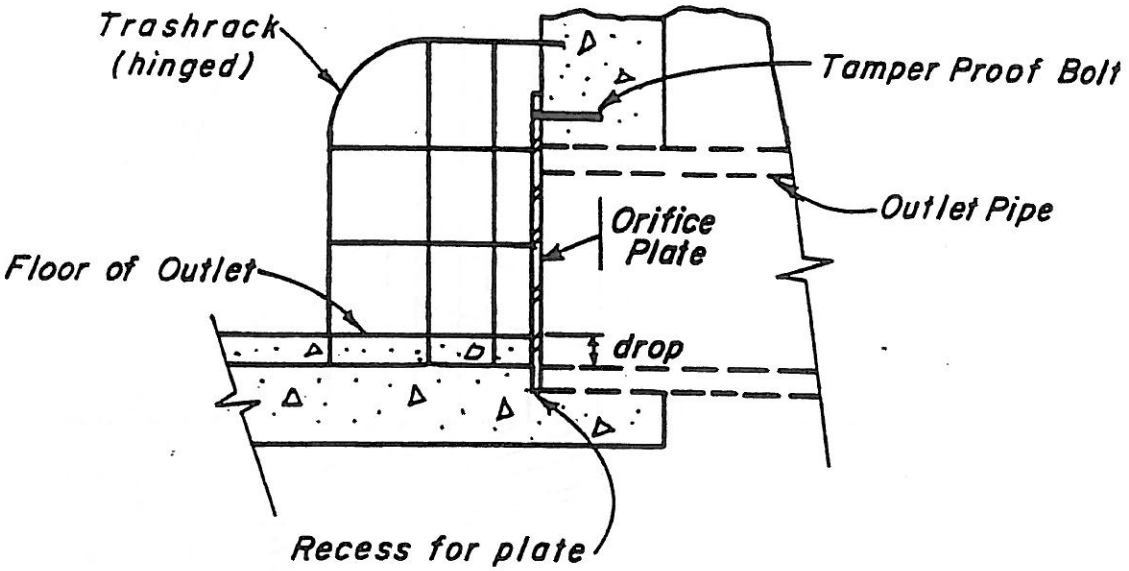
EXAMPLE OF
MODIFIED RATIONAL METHOD

Figure 5.6

ORIFICE PLATE DETAILS



NOTE: Trashrack clear area to be 10 times orifice opening area.

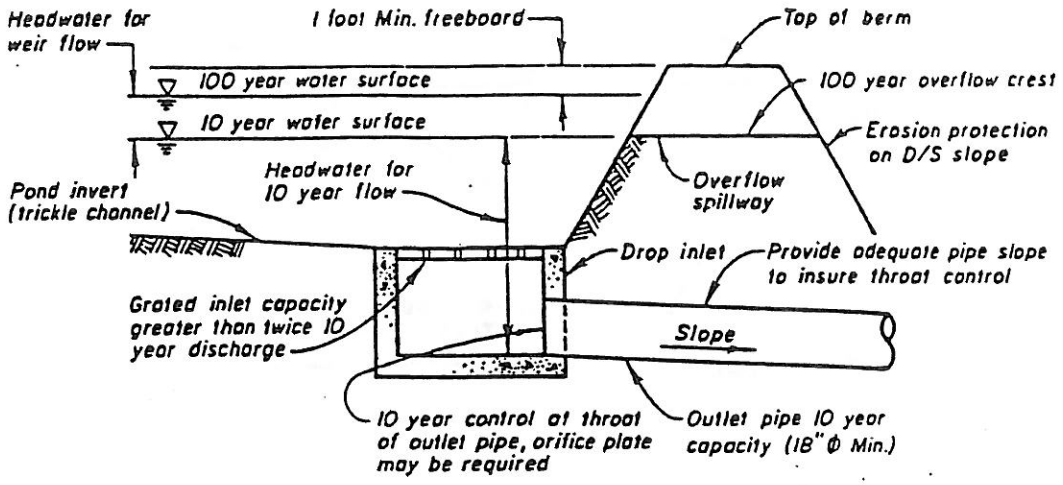


SOURCE: CITY OF TULSA, STORMWATER MANAGEMENT CRITERIA MANUAL

City of
SPRINGDALE
Arkansas

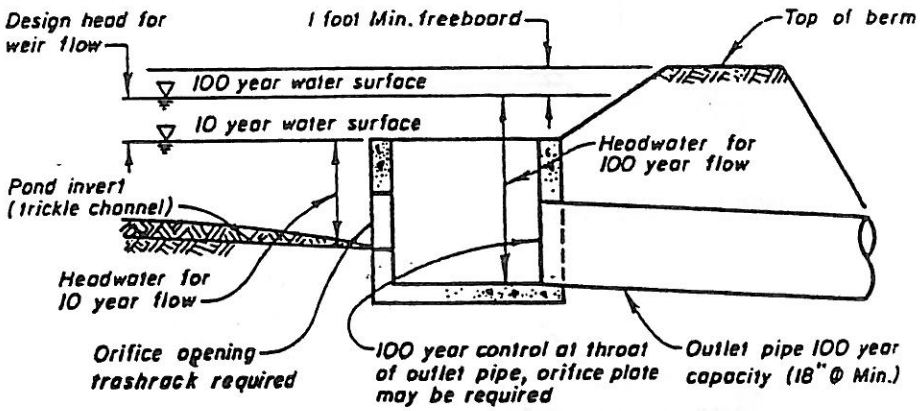
Figure 5.5

DETENTION POND OUTLET CONFIGURATIONS



TYPE 1 OUTLET

No Scale



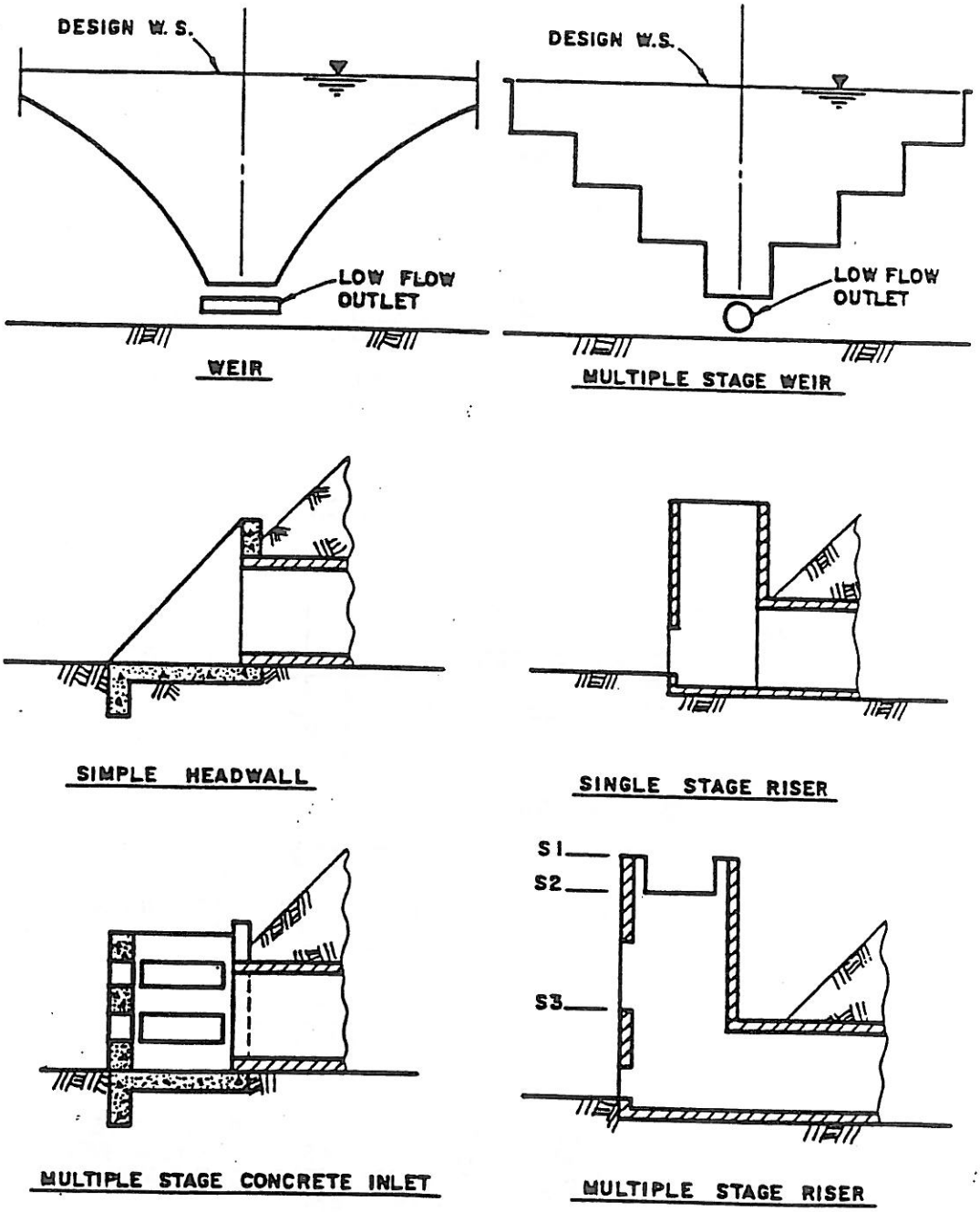
TYPE 2 OUTLET

No Scale

NOTE: OUTLET DESIGN FREQUENCY IN THE 2-YEAR THROUGH THE 100-YEAR. THE 10-YEAR INTERMEDIATE FREQUENCY IS PRESENTED AS THE MINIMUM CONTROLLING FREQUENCY.

SOURCE: CITY OF TULSA, STORMWATER MANAGEMENT CRITERIA MANUAL

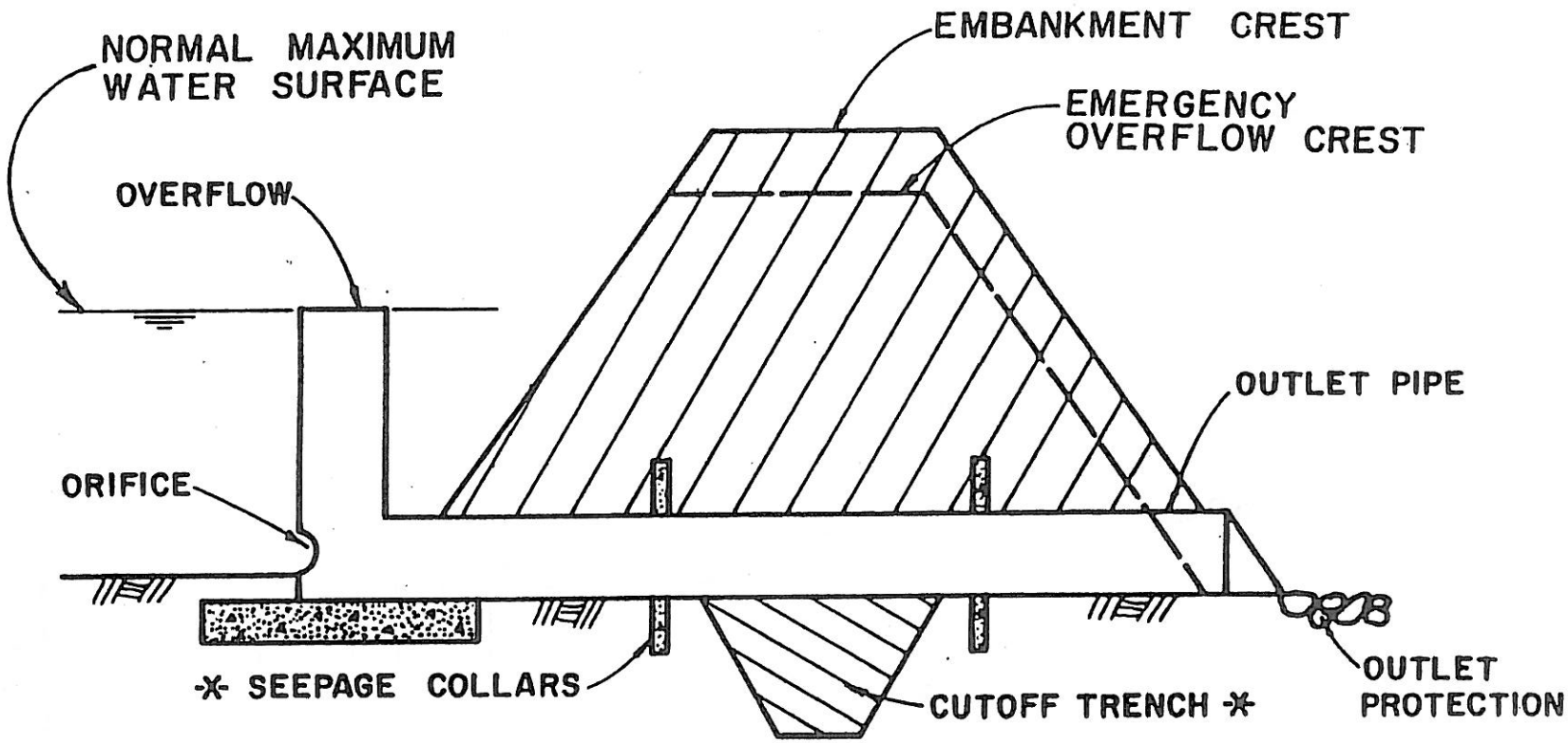
EXAMPLES OF OUTLET STRUCTURES



SOURCE: CITY OF TULSA, STORMWATER MANAGEMENT CRITERIA MANUAL

City of
SPRINGDALE
Arkansas

Figure 5.3

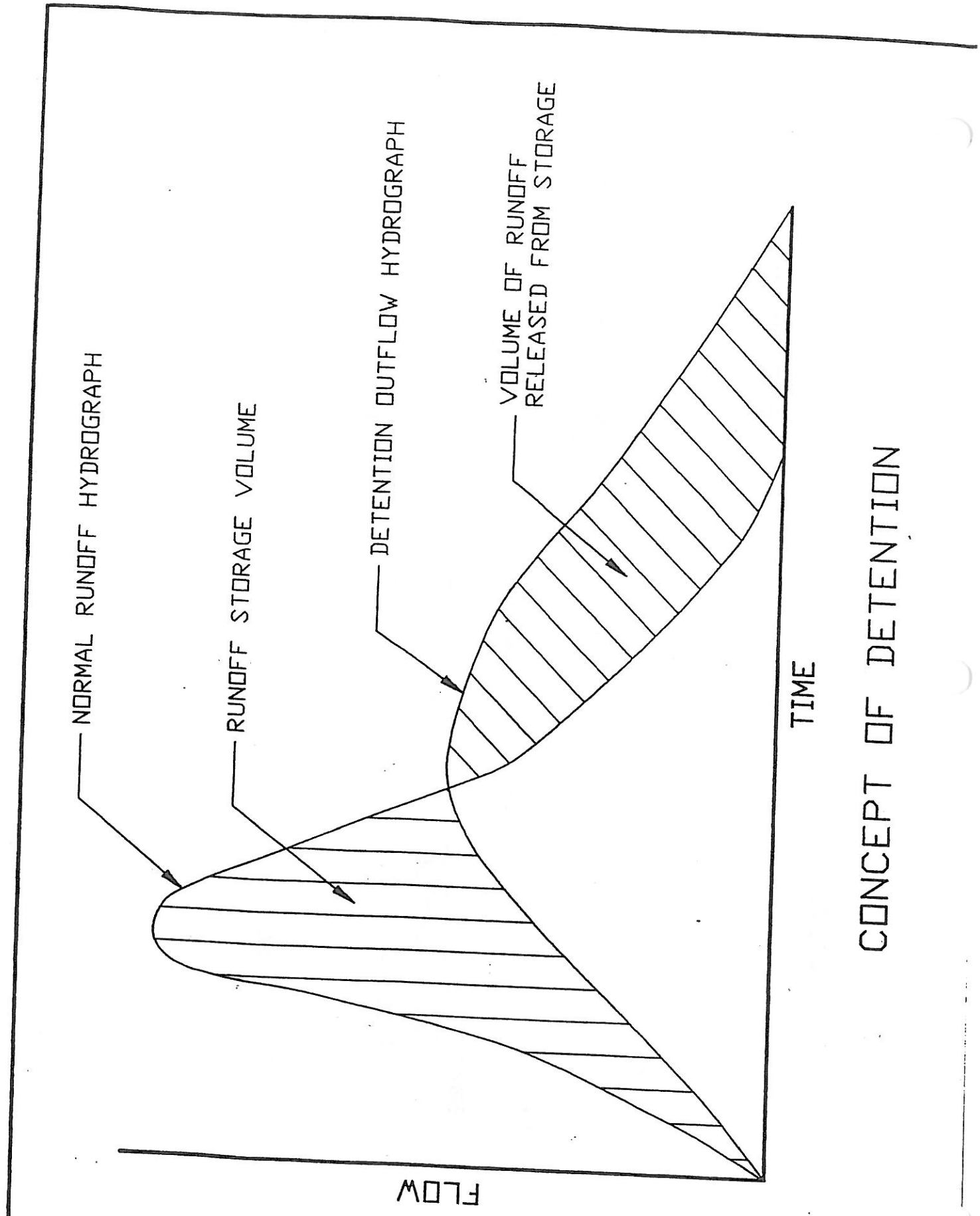


-* FOR VERY LOW HYDRAULIC HEAD THESE ITEMS MAY NOT BE NECESSARY.

SCHEMATIC OF OUTLET WORKS

SOURCE: CITY OF TULSA, STORMWATER MANAGEMENT CRITERIA MANUAL

Figure 5.2



City of
SPRINGDALE
Arkansas

CONCEPT OF DETENTION POND

Figure 5.1

```
*****************************************
*                                       *
*          EXAMPLE PROBLEM No. 1        *
*  Crested Peak Ski Resort Detention Pond *
*                                       *
*                                       *
*                                       *
*****************************************
```

EXECUTED 12-14-1987 23:20:20
Disk Files: C:POND1 .PND ; C:POND1-IN.HYD

INITIAL CONDITIONS
Elevation = 56.80 ft
Outflow = 0.0 cfs

GIVEN POND DATA

ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)
56.80	0.0	0.00
58.00	5.0	0.60
60.00	10.0	2.00
62.00	24.0	3.90
63.50	44.0	5.70
64.00	74.0	7.20
66.00	125.0	8.80

COMPUTATIONS

2S/t (cfs)	2S/t + O (cfs)
0.0	0.0
72.6	77.6
242.0	252.0
471.9	495.9
689.7	733.7
871.2	945.2
1064.8	1189.8

Time increment (t) = 0.200 hrs.

POND-2 Version: 3.03 S/N: 87020497

Pond File: C:POND1 .PND
Inflow Hydrograph: C:POND1-IN.HYD
Outflow Hydrograph: C:POND1OUT.HYD

EXECUTED: 12-14-1987
23:20:20

Peak Inflow = 76.0 cfs
Peak Outflow = 41.0 cfs
Peak Elevation = 63.28 ft

(hrs) * Inflow Hydrograph ---> C:POND2-IN.HYD Qmax = 624.3 cfs
× Estimated Discharge Hydrograph Qmax = 385.0 cfs

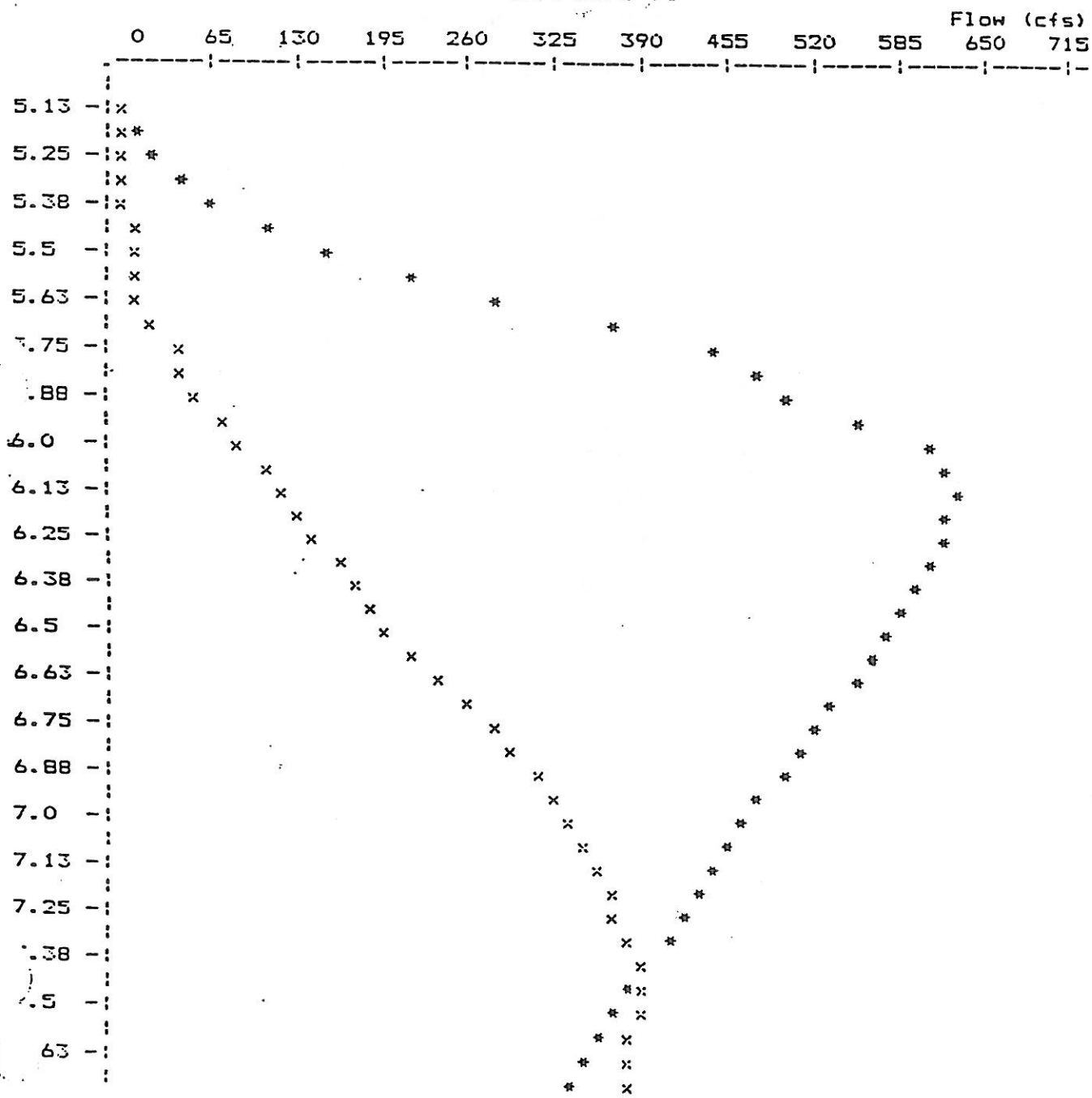
POND-2 Version: S/N:

>>>>> HYDROGRAPH OVERLAY OPTION <<<<<

12-14-1987 23:58:56
Inflow Hydrograph: C:POND2-IN.HYD Qpeak = 624.3 cfs
Overlay Hydrograph: C:ESTM-OUT.HYD Qpeak = 385.0 cfs

Approximate Storage Volume
(computed from t= 5.13 to 7.43 hrs)

47.9 acre-ft



```
*********************************
*                               *
*     EXAMPLE PROBLEM No. 2     *
*  Snowy Pines Detention Pond   *
*                               *
*                               *
*                               *
*********************************
```

EXECUTED 12-15-1987 00:07:22
Disk Files: C:POND2 .PND ; C:POND2-IN.HYD

INITIAL CONDITIONS
Elevation = 59.00 ft
Outflow = 0.0 cfs

GIVEN POND DATA

ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)
59.00	0.0	0.00
60.00	8.0	0.37
61.00	18.0	1.95
61.50	25.0	3.14
62.00	38.0	4.64
63.00	64.0	8.62
64.00	96.0	14.03
65.00	135.0	20.69
66.00	172.0	28.34
66.50	194.0	32.53
67.00	256.0	36.94
68.00	391.0	46.44
69.00	505.0	56.93
69.50	580.0	62.58

COMPUTATIONS

2S/t (cfs)	2S/t + O (cfs)
0.0	0.0
71.6	79.6
377.5	395.5
607.9	632.9
898.3	936.3
1668.8	1732.8
2716.2	2812.2
4005.6	4140.6
5486.6	5658.6
6297.8	6491.8
7151.6	7407.6
8990.8	9381.8
11021.6	11526.6
12115.5	12695.5

Time increment (t) = 0.125 hrs.

POND-2 Version: 3.03 S/N: 87020497

Pond File: C:POND2 .PND
Inflow Hydrograph: C:POND2-IN.HYD
Outflow Hydrograph: C:POND-OUT.HYD

EXECUTED: 12-15-1987
00:07:22

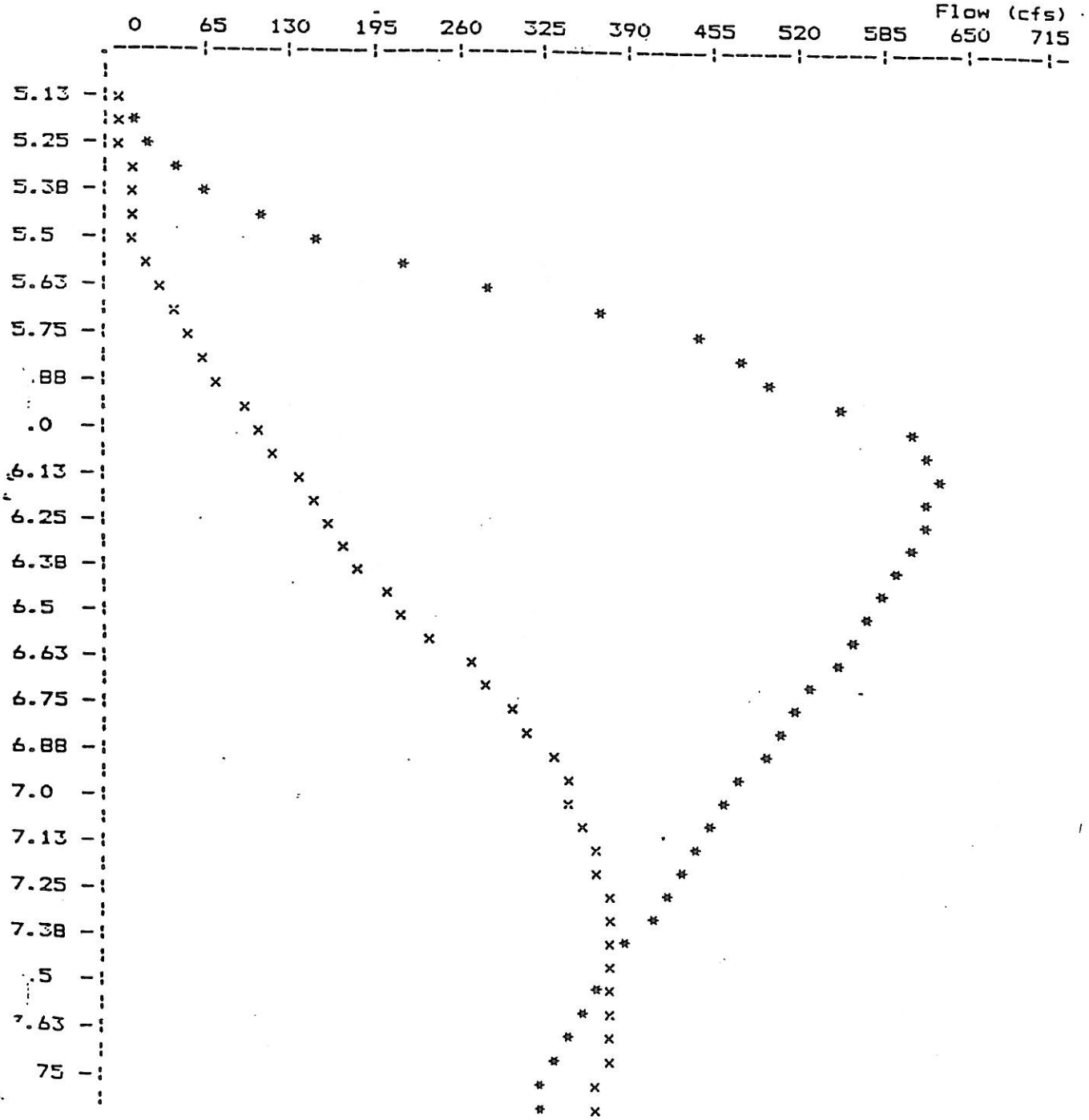
INFLOW HYDROGRAPH

TIME (hrs)	INFLOW (cfs)
10.625	84.3
10.750	79.1
10.875	70.5
11.000	67.9
11.125	65.2
11.250	64.1
11.375	62.5
11.500	61.1
11.625	60.4
11.750	60.3
11.875	58.2
12.000	58.0
12.125	57.2
12.250	56.2
12.375	57.0
12.500	55.3
12.625	55.3
12.750	55.3
12.875	54.3
13.000	54.2
13.125	53.3
13.250	53.2
13.375	52.3
13.500	52.5
13.625	51.3
13.750	51.3
13.875	50.2
14.000	49.3
14.125	48.3
14.250	47.3
14.375	47.0
14.500	45.3
14.625	44.2
14.750	44.3
14.875	43.3
15.000	43.2
15.125	42.2
15.250	40.4
15.375	39.2
15.500	38.3
15.625	36.5
15.750	34.2
15.875	35.7
16.000	30.3
16.125	30.1
16.250	29.3

ROUTING COMPUTATIONS

I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
169.8	4714.2	5027.4	156.6	65.58
163.5	4571.7	4877.6	153.0	65.49
149.7	4423.1	4721.4	149.2	65.38
138.5	4271.0	4561.5	145.3	65.28
133.1	4121.3	4404.1	141.4	65.17
129.4	3975.3	4250.6	137.7	65.07
126.6	3834.2	4101.9	133.9	64.97
123.6	3698.5	3957.8	129.6	64.86
121.5	3568.9	3820.1	125.6	64.76
120.8	3446.1	3689.7	121.8	64.66
118.6	3328.5	3564.7	118.1	64.57
116.2	3215.6	3444.7	114.6	64.48
115.2	3108.3	3330.8	111.2	64.39
113.5	3005.7	3221.8	108.0	64.31
113.2	2908.9	3118.9	105.0	64.23
112.3	2817.0	3021.2	102.1	64.16
110.6	2728.8	2927.6	99.4	64.09
110.6	2645.8	2839.4	96.8	64.02
109.6	2566.9	2755.5	94.3	63.95
108.5	2491.5	2675.4	91.9	63.87
107.5	2419.7	2599.0	89.7	63.80
106.6	2351.2	2526.2	87.5	63.74
105.6	2285.8	2456.8	85.5	63.67
104.9	2223.7	2390.7	83.5	63.61
103.9	2164.3	2327.6	81.6	63.55
102.7	2107.3	2267.0	79.8	63.49
101.6	2052.6	2208.9	78.1	63.44
99.6	1999.3	2152.2	76.4	63.39
97.6	1947.4	2097.0	74.8	63.34
95.6	1896.6	2043.0	73.2	63.29
94.3	1847.6	1990.9	71.7	63.24
92.3	1799.6	1939.9	70.1	63.19
89.6	1751.9	1889.2	68.6	63.14
88.6	1706.1	1840.5	67.2	63.10
87.6	1662.1	1793.7	65.8	63.06
86.5	1619.7	1748.6	64.5	63.01
85.4	1578.9	1705.1	63.1	62.97
82.6	1538.2	1661.6	61.7	62.91
79.6	1497.4	1617.9	60.2	62.86
77.6	1457.2	1574.9	58.8	62.80
74.8	1417.1	1532.0	57.4	62.75
70.7	1375.8	1487.8	56.0	62.69
69.9	1336.4	1445.7	54.6	62.64
66.0	1296.0	1402.4	53.2	62.59
60.4	1253.0	1356.4	51.7	62.53
59.5	1211.9	1312.4	50.3	62.47

Pond File: C:POND2 .PND
Inflow Hydrograph: C:POND2-IN.HYD
Outflow Hydrograph: C:POND-OUT.HYD

EXECUTED: 12-15-1987
00:07:22

Peak Inflow = 624.3 cfs
Peak Outflow = 380.1 cfs
Peak Elevation = 67.92 ft