STORMWATER DETENTION POND CALCULATIONS

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STORM DATA REFERENCE : CITY STANDARD RAINFALL INTENSITY-FIGURE 1 FOR 100 YEAR STORM FREQUENCY

ALLOWABLE RELEASE RATE EQUAL TO THE 100-YEAR PEAK RUNOFF RATE PRIOR TO SITE DEVELOPMENT
WHEN C=0.35, I=6.13 @ Tc=20 MINS
TOTAL SITE AREA: 6.13 Acres
BY PASS RUNOFF AREA "B"= 1.68 CFS
ALLOWABLE RUNOFF FROM SITE : 0.35 X 8.30 X 6.13 = 17.81 CFS
ALLOWABLE RELEASE FROM DETENTION POND :17.81-1.68=16.13CFS **16.13**
TOTAL DETAINED AREA= 5.94ACRES

STORM DURATION DATA & DETENTION POND SYSTEM CALCULATION :

TIME	C x Cf	I10	TOTAL AREA	Q	INFLOW	OUTFLOW	STORAGE
(Min)	Full Dev.	(10-Year)	(Acres)	(CFS)	(CF)	(CF)	(CF)
10	0.90	9.80	5.94	52.39	31,434	9,678	21,756
20	0.90	8.30	5.94	44.37	53,246	14,517	38,729
30	0.90	6.90	5.94	36.89	66,397	19,356	47,041
40	0.90	5.80	5.94	31.01	74,416	24,195	50,221
50	0.90	5.00	5.94	26.73	80,190	29,034	51,156
60	0.90	4.50	5.94	24.06	86,605	33,873	52,732
70	0.90	4.20	5.94	22.45	94,303	38,712	55,591
80	0.90	3.90	5.94	20.85	100,077	43,551	56,526
90	0.90	3.50	5.94	18.71	101,039	48,390	52,649

REQUIRE STORAGE VOLUME CALCULATION SUMMARY:

REQUIRED STORAGE VOLUME = INFLOW - OUTFLOW
INFLOW = STORM DURATION X RESPECTIVE PEAK DISCHARGE X 60 SEC./MIN.
OUTFLOW = HALF OF THE RESPECTIVE INFLOW DURATION X CONTROL RELEASE DISCHARGE X 60 SEC./MIN.

100 YEAR STORM EVENT @ 70 MIN.
INFLOW = 0.90 X3.90 X5.94 X80 X 60 = 100,077
OUTFLOW = 0.5 X16.13X 90 X 60 =43,551

REQUIRED DETENTION SYSTEM STORAGE CAPACITY = INFLOW - OUTFLOW =100,077-43,551= 56,526 CF
PROVIDED DETENTION VOULME = 62,999 CF

VOLUME CALCULATION					
ELEVATION (ft)	AREA (sf)	AV.AREA (sf)	INCR DEPTH (ft)	INCR VOL. (cf)	CUMM. VOL. (cf)
22					
23	14443	7221	1	7221	7221
24	17116	15779	1	15779	23000
25	19960	18538	1	18538	41538
26	22962	21461	1	21461	62999

DISCHARGE TABLE			
Storm	Q Allowable	Q Actual	Water Surface Elevation
5 yrs	10.4	10.4	524.46
25 yrs	14.14	14.14	525.09
50 yrs	15.59	15.59	525.39
100 yrs	16.13	16.13	525.69

25 YRS ORIFICE CALCULATIONS

From the orifice equation
$Q = C * A * (2*g*H)^{1/2}$

Where
Q = rate of discharge (ft^3/s)
A = orifice area (ft^2)
C = orifice coefficient (usually about 0.60)
g = gravitational constant (32.2 ft/s^2)
H = depth of water above the centroid of the orifice (ft)

When
Q = allowable release from detention pond
= 14.14 CFS
H = average depth of water in detention system = 3.5ft

So
$A = Q / (C * (2*g*H)^{1/2})$
$=14.14/ (0.6 * (2*32.2*3.5)^{1/2})$
$= 1.57ft^2$

Area Provided=1.57 S.F.

50 YRS ORIFICE CALCULATIONS

From the orifice equation
$Q = C * A * (2*g*H)^{1/2}$

Where
Q = rate of discharge (ft^3/s)
A = orifice area (ft^2)
C = orifice coefficient (usually about 0.60)
g = gravitational constant (32.2 ft/s^2)
H = depth of water above the centroid of the orifice (ft)

When
Q = allowable release from detention pond
= 15.59CFS
H = average depth of water in detention system = 3.5ft

So
$A = Q / (C * (2*g*H)^{1/2})$
$=15.59/ (0.6 * (2*32.2*3.5)^{1/2})$
$= 1.73ft^2$

Area Provided= 1.73 S.F.

100 YRS ORIFICE CALCULATIONS

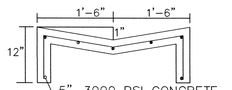
From the orifice equation
$Q = C * A * (2*g*H)^{1/2}$

Where
Q = rate of discharge (ft^3/s)
A = orifice area (ft^2)
C = orifice coefficient (usually about 0.60)
g = gravitational constant (32.2 ft/s^2)
H = depth of water above the centroid of the orifice (ft)

When
Q = allowable release from detention pond
= 16.13CFS
H = average depth of water in detention system = 3.5ft

So
$A = Q / (C * (2*g*H)^{1/2})$
$=16.13/ (0.6 * (2*32.2*3.5)^{1/2})$
$= 1.79ft^2$

Area Provided=1.79 S.F.



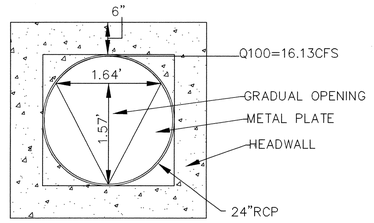
FLUME DETAIL
N.T.S.

CHANNEL 'A' (TRAPEZOIDAL SECTION)
SLOVE FOR NORMAL DEPTH
PROVIDED:
Q100=23.00 CFS
LEFT SIDE SLOPE= 3:1
RIGHT SIDE SLOPE= 3:1
BOTTOM WIDTH= 0.50FT
MANNING'S COEFFICIENT =0.030

RESULT:
NORMAL DEPTH(Q100)= 2.50 FT

LINE "B" CURB INLET CAPACITY
$Q=CwLH^{3/2}$
Q100= 2.02 CFS
H=CURB OPENING HT.(0.5 FT)
$2.02=3XLX0.5^{3/2}$
L = 1.90 FT.
THEREFORE 5 FT. CURB INLET.

LINE "E" CURB INLET CAPACITY
$Q=CwLH^{3/2}$
Q100= 4.85 CFS
H=CURB OPENING HT.(0.5 FT)
$4.85=3XLX0.5^{3/2}$
L = 4.57 FT.
THEREFORE 5 FT. CURB INLET.



GRADUAL OUTFALL DETAILS.

5 YRS ORIFICE CALCULATIONS

From the orifice equation
$Q = C * A * (2*g*H)^{1/2}$

Where
Q = rate of discharge (ft^3/s)
A = orifice area (ft^2)
C = orifice coefficient (usually about 0.60)
g = gravitational constant (32.2 ft/s^2)
H = depth of water above the centroid of the orifice (ft)

When
Q = allowable release from detention pond
= 10.40 CFS
H = average depth of water in detention system = 3.5ft

So
$A = Q / (C * (2*g*H)^{1/2})$
$=10.40/ (0.6 * (2*32.2*3.5)^{1/2})$
$= 1.15ft^2$

Area Provided = 1.15 S.F.

Culvert Summary Table: Culvert "A"

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	36.60	0.000	0.0*	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
0.57	0.20	36.73	0.234	0.0*	1-S2n	0.069	0.162	0.071	0.061	3.092	1.664
1.13	0.42	36.81	0.309	0.0*	1-S2n	0.140	0.227	0.140	0.091	4.541	2.096
1.70	0.68	36.87	0.369	0.0*	1-S2n	0.184	0.276	0.166	0.114	5.336	2.414
2.26	0.72	36.92	0.420	0.0*	1-S2n	0.179	0.313	0.209	0.135	4.886	2.638
2.83	0.86	36.96	0.462	0.0*	1-S2n	0.193	0.339	0.229	0.153	4.876	2.833
3.39	1.02	37.00	0.498	0.0*	1-S2n	0.211	0.370	0.219	0.169	6.171	2.991
3.96	1.18	37.03	0.532	0.0*	1-S2n	0.225	0.396	0.226	0.184	6.701	3.153
4.52	1.28	37.06	0.563	0.0*	1-S2n	0.238	0.420	0.240	0.198	6.834	3.277
5.09	1.41	37.09	0.593	0.0*	1-S2n	0.251	0.444	0.268	0.211	6.810	3.396
5.65	1.53	37.12	0.621	0.0*	1-S2n	0.264	0.468	0.272	0.223	6.914	3.514

* theoretical depth is impractical. Depth reported is corrected.

Inlet Elevation (invert): 36.59 ft, Outlet Elevation (invert): 33.20 ft
Culvert Length: 80.09 ft, Culvert Slope: 0.0412

Culvert Summary Table: Culvert "F"

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	22.00	0.000	0.0*	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
1.61	1.61	22.60	0.604	0.0*	1-S2n	0.402	0.434	0.403	0.170	3.577	1.622
3.23	3.23	22.86	0.863	0.003	1-S2n	0.566	0.624	0.573	0.253	4.320	2.033
4.84	4.84	23.00	1.003	0.066	1-S2n	0.700	0.771	0.705	0.316	4.870	2.327
6.45	6.45	23.30	1.298	0.122	1-S2n	0.822	0.895	0.824	0.372	5.295	2.530
8.06	8.06	23.49	1.488	0.168	1-S2n	0.931	1.010	0.934	0.418	5.601	2.718
9.68	9.68	23.67	1.665	0.212	1-S2n	1.038	1.108	1.038	0.462	5.878	2.867
11.29	11.29	23.84	1.838	0.252	1-S2n	1.141	1.205	1.144	0.502	6.080	2.994
12.90	12.90	24.01	2.012	0.288	5-S2n	1.246	1.288	1.246	0.538	6.263	3.123
14.52	14.52	24.20	2.195	0.323	5-S2n	1.354	1.371	1.356	0.573	6.411	3.222
16.13	16.13	24.46	2.392	2.462	2-MCc	1.472	1.444	1.448	0.605	6.623	3.321

* theoretical depth is impractical. Depth reported is corrected.

Inlet Elevation (invert): 22.00 ft, Outlet Elevation (invert): 21.75 ft
Culvert Length: 98.92 ft, Culvert Slope: 0.0084

HYDRAULIC GRADE COMPUTATION FOR LINE "C"

MANHOLE OR INLET FROM	MANHOLE OR INLET TO	PIPE LENGTH DISTANCE BETWEEN COLLECTION POINTS	STORM WATER RUNOFF "Q" 100YR (c.f.s.)	PIPE FLOW "Q" (c.f.s.)	SIZE OF PIPE (in)	FRICTION GRADIENT SLOPE (ft/ft)	HYDRAULIC GRADIENT ELEVATION UP-STREAM (ft MSL)	HYDRAULIC GRADIENT ELEVATION DOWN-STREAM (ft MSL)	HEAD LOSS AT CHANGE IN SECTION INFLOW VEL. V1 (fps)	OUTFLOW VELOCITY V2 (fps)	V1^2 2g (ft)	V2^2 2g (ft)	Kj	Hj	HGL
STA 0+00								33.60							
	STA 1+15.85	115.85	11.7	12.9	18	0.0124	35.04		3.86	6.63	0.23	0.68	0.75	0.28	35.32
STA 1+15.85															
	STA 1+42.10	26.25	6.83	12.9	18	0.0042	35.43		2.47	3.86	0.09	0.23	0.75	0.08	35.51
STA 1+42.10															
	STA 2+35.80	93.70	4.36	12.86	18	0.0017	35.67		0.00	2.47	0.00	0.09	1.25	0.11	35.78

HYDRAULIC GRADE COMPUTATION FOR LINE "B"

MANHOLE OR INLET FROM	MANHOLE OR INLET TO	PIPE LENGTH DISTANCE BETWEEN COLLECTION POINTS	STORM WATER RUNOFF "Q" 100YR (c.f.s.)	PIPE FLOW "Q" (c.f.s.)	SIZE OF PIPE (in)	FRICTION GRADIENT SLOPE (ft/ft)	HYDRAULIC GRADIENT ELEVATION UP-STREAM (ft MSL)	HYDRAULIC GRADIENT ELEVATION DOWN-STREAM (ft MSL)	HEAD LOSS AT CHANGE IN SECTION INFLOW VEL. V1 (fps)	OUTFLOW VELOCITY V2 (fps)	V1^2 2g (ft)	V2^2 2g (ft)	Kj	Hj	HGL
STA 0+00								38.50							
	STA 0+98.54	112.07	2.0	10.5	18	0.0004	38.54		0.00	1.14	0.00	0.02	1.25	0.03	38.57

ALL RESPONSIBILITY FOR ADEQUACY OF DESIGN REMAINS WITH THE DESIGN ENGINEER. THE CITY OF ROCKWALL, IN REVIEWING AND RELEASING PLANS FOR CONSTRUCTION, ASSUMES NO RESPONSIBILITY FOR ADEQUACY OR ACCURACY OF DESIGN.

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DRAINAGE CALCS

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SCALE: N.T.S. | DATE: 5/18/10

DRAWN BY: CS | DWG NO. 7.1

7.1 | –

SHEET NO. | REV.