CASH WAGGNER & ASSOCIATES, PC
CONSULTING | ENGINEERING | SURVEYING

PROJECT: Goldfinch Cove JOB NO: 5012
SHEET NO: 1 OF: 1
CALCULATED BY: Glen Meritt Jr. DATE: 7-20-22
CHECKED BY: DATE:
SCALE:

Detention Basin #3

P-571 – 12" primary spillway calculations

25-yr. Outlet Rate:

$$Q = \left(1.49/n\right) A \left(R_h^{2/3}\right) S^{1/2}$$

$n = 0.011$; $A = 0.2934$; $R_h = 0.2142$; $S = 0.0032$

$$Q = \left(\frac{1.49}{0.011}\right) 0.2934 \left(0.2142\right)^{2/3} \left(0.0032\right)^{1/2}$$

$Q = 0.80$ cfs for 25-yr.

100-yr. Outlet Rate:

$$Q = \left(1.49/n\right) A \left(R_h^{2/3}\right) S^{1/2}$$

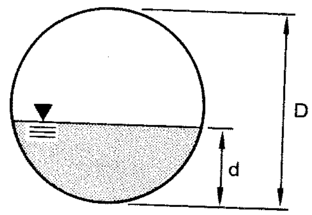
$n = 0.011$; $A = 0.4227$; $R_h = 0.2591$; $S = 0.0032$

$$Q = 1.49/0.011 \; 0.4227 \left(0.2591\right)^{2/3} \left(0.0032\right)^{1/2}$$

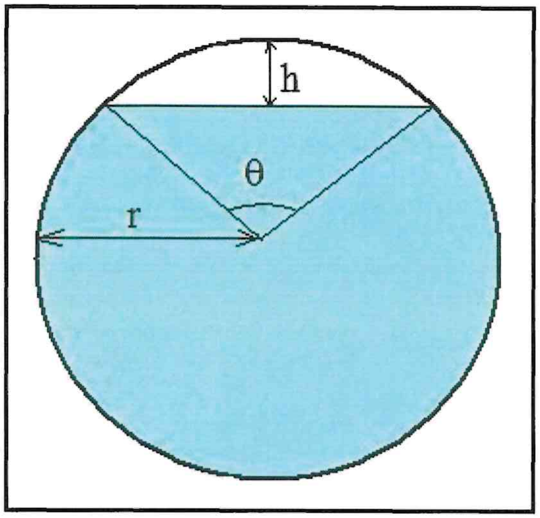
$Q = 1.31$ cfs for 100-yr

APPENDIX 16.C

Area, Wetted Perimeter, and Hydraulic Radius of Partially Filled Circular Pipes



$\frac{d}{D}$	$\frac{\text{area}}{D^2}$	$\frac{\text{wetted perimeter}}{D}$	$\frac{r_h}{D}$	$\frac{d}{D}$	$\frac{\text{area}}{D^2}$	$\frac{\text{wetted perimeter}}{D}$	$\frac{r_h}{D}$
0.01	0.0013	0.2003	0.0066	0.51	0.4027	1.5908	0.2531
0.02	0.0037	0.2838	0.0132	0.52	0.4127	1.6108	0.2561
0.03	0.0069	0.3482	0.0197	0.53	0.4227	1.6308	0.2591
0.04	0.0105	0.4027	0.0262	0.54	0.4327	1.6509	0.2620
0.05	0.0147	0.4510	0.0326	0.55	0.4426	1.6710	0.2649
0.06	0.0192	0.4949	0.0389	0.56	0.4526	1.6911	0.2676
0.07	0.0242	0.5355	0.0451	0.57	0.4625	1.7113	0.2703
0.08	0.0294	0.5735	0.0513	0.58	0.4723	1.7315	0.2728
0.09	0.0350	0.6094	0.0574	0.59	0.4822	1.7518	0.2753
0.10	0.0409	0.6435	0.0635	0.60	0.4920	1.7722	0.2776
0.11	0.0470	0.6761	0.0695	0.61	0.5018	1.7926	0.2797
0.12	0.0534	0.7075	0.0754	0.62	0.5115	1.8132	0.2818
0.13	0.0600	0.7377	0.0813	0.63	0.5212	1.8338	0.2839
0.14	0.0688	0.7670	0.0871	0.64	0.5308	1.8546	0.2860
0.15	0.0739	0.7954	0.0929	0.65	0.5404	1.8755	0.2881
0.16	0.0811	0.8230	0.0986	0.66	0.5499	1.8965	0.2899
0.17	0.0885	0.8500	0.1042	0.67	0.5594	1.9177	0.2917
0.18	0.0961	0.8763	0.1097	0.68	0.5687	1.9391	0.2935
0.19	0.1039	0.9020	0.1152	0.69	0.5780	1.9606	0.2950
0.20	0.1118	0.9273	0.1206	0.70	0.5872	1.9823	0.2962
0.21	0.1199	0.9521	0.1259	0.71	0.5964	2.0042	0.2973
0.22	0.1281	0.9764	0.1312	0.72	0.6054	2.0264	0.2984
0.23	0.1365	1.0003	0.1364	0.73	0.6143	2.0488	0.2995
0.24	0.1449	1.0239	0.1416	0.74	0.6231	2.0714	0.3006
0.25	0.1535	1.0472	0.1466	0.75	0.6318	2.0944	0.3017
0.26	0.1623	1.0701	0.1516	0.76	0.6404	2.1176	0.3025
0.27	0.1711	1.0928	0.1566	0.77	0.6489	2.1412	0.3032
0.28	0.1800	1.1152	0.1614	0.78	0.6573	2.1652	0.3037
0.29	0.1890	1.1373	0.1662	0.79	0.6655	2.1895	0.3040
0.30	0.1982	1.1593	0.1709	0.80	0.6736	2.2143	0.3042
0.31	0.2074	1.1810	0.1755	0.81	0.6815	2.2395	0.3044
0.32	0.2167	1.2025	0.1801	0.82	0.6893	2.2653	0.3043
0.33	0.2260	1.2239	0.1848	0.83	0.6969	2.2916	0.3041
0.34	0.2355	1.2451	0.1891	0.84	0.7043	2.3186	0.3038
0.35	0.2450	1.2661	0.1935	0.85	0.7115	2.3462	0.3033
0.36	0.2546	1.2870	0.1978	0.86	0.7186	2.3746	0.3026
0.37	0.2642	1.3078	0.2020	0.87	0.7254	2.4038	0.3017
0.38	0.2739	1.3284	0.2061	0.88	0.7320	2.4341	0.3008
0.39	0.2836	1.3490	0.2102	0.89	0.7384	2.4655	0.2995
0.40	0.2934	1.3694	0.2142	0.90	0.7445	2.4981	0.2980
0.41	0.3032	1.3898	0.2181	0.91	0.7504	2.5322	0.2963
0.42	0.3130	1.4101	0.2220	0.92	0.7560	2.5681	0.2944
0.43	0.3229	1.4303	0.2257	0.93	0.7612	2.6061	0.2922
0.44	0.3328	1.4505	0.2294	0.94	0.7662	2.6467	0.2896
0.45	0.3428	1.4706	0.2331	0.95	0.7707	2.6906	0.2864
0.46	0.3527	1.4907	0.2366	0.96	0.7749	2.7389	0.2830
0.47	0.3627	1.5108	0.2400	0.97	0.7785	2.7934	0.2787
0.48	0.3727	1.5308	0.2434	0.98	0.7816	2.8578	0.2735
0.49	0.3827	1.5508	0.2467	0.99	0.7841	2.9412	0.2665
0.50	0.3927	1.5708	0.2500	1.00	0.7854	3.1416	0.2500



$$r = D/2 \qquad h = 2r - y$$

$$\theta = 2 \arccos \left(\frac{r - h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r\theta$$

$$R_h = A/P$$

Figure 2. Partially Full Pipe Flow Parameters (more than half full)

Example #3: Calculate the hydraulic radius for water flowing 3.4 ft deep in a 48-inch diameter storm sewer.

Solution: $r = 48/2 = 24$ inches $= 2$ ft; $h = 2*2 - 3.4 = 0.6$ ft

$$\theta = 2 \arccos [(2 - 0.6)/2)] = 1.59 \text{ radians}$$

$$A = \pi (2^2) - [2^2 (1.59 - \sin (1.59))] / 2 = 11.38 \text{ ft}^2$$

$$P = 2 \pi (2) - (2)(1.59) = 9.4 \text{ f5}$$

$$\mathbf{R_h} = 11.38/9.4 = \underline{\mathbf{1.21 \text{ ft}}}$$

This example can also be solved with the course spreadsheet as illustrated in the screenshot below, which is from the "Q_more than half full" tab in the course spreadsheet. As you can see, the values for A, P, and R_h are the same as in the calculations above.

$$Q = (1.49/n)\ A\ (R_h^{2/3})\ S^{1/2}$$