Section I – Supplemental Calculations

Storm Sewer Calculations

Homestead Developers, LLC
Homesteads at Hillview
Eastview Drive and Upper Shelbyville Road
City of Franklin, Indiana

Submitted:
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By:

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Section 1: Pipe Sizing Calculations

Pipe Sizing Summary

The Rational Method and Manning's Equation were used to size the pipes to convey the peak runoff from the 10-year storm. The TR-55 Method was used to calculate the Times of Concentration. The Inlet Basin Map, pipe sizing calculations, and time of concentration worksheets are included within this section.

Homesteads at Hillview - Phase I
Pipe Sizing Calculations

Structure	Pipe Data						Inlet Watershed Data												Contributing Watershed Data						Pipe Analysis	
	Downstream Structure	Length (ft)	Pipe Diameter (in)	Pipe Material	Invert Slope (%)	Mannings Number n	Catchment Area (ac) Impervious	Runoff Coefficient C Impervious	Catchment Area (ac) Grass	Runoff Coefficient C Grass	Catchment Area (ac) Residence	Runoff Coefficient C Residence	Total Area A (ac)	Composite Coefficient C	Tc (min)	Rainfall Intensity (i) in/hr	Manual Input Flow Q (cfs)	Q=CiA (cfs)	Total Area A (ac)	Runoff Coefficient C	Time in Upstream Pipe (min)	Total Time of Concentration Tc (min)	Intensity I (in/hr)	Total Pipe Flow (cfs)	Pipe Capacity Qmax (cfs)	Pipe Velocity (ft/s)
Str. 1	Str. 2	217	12	RCP	0.27	0.012	0.129	0.850	0.130	0.20	0.000	0.45	0.259	0.52	6.15	6.64	--	0.90	0.259	0.524	N/A	6.15	5.43	0.90	2.01	2.55
Str. 2	Str. 5	300	18	RCP	0.15	0.012	0.000	0.850	0.156	0.20	0.937	0.45	1.093	0.41	9.63	5.59	--	2.53	1.352	0.435	1.42	9.63	5.59	3.29	4.41	2.50
Str. 3	Str. 4	120	15	RCP	0.20	0.012	0.000	0.850	0.000	0.20	0.949	0.45	0.949	0.45	9.88	5.52	--	2.36	0.949	0.450	N/A	9.88	5.52	2.36	3.13	2.55
Str. 4	Str. 5	39	15	RCP	0.20	0.012	No Inlet												0.949	0.450	0.78	10.66	5.39	2.30	3.13	2.55
Str. 5	Str. 6	142	24	RCP	0.13	0.012	0.000	0.850	0.096	0.20	0.627	0.45	0.723	0.42	5.00	6.99	--	2.11	3.024	0.435	1.94	11.57	5.19	6.83	8.84	2.81
Str. 6	Str. 13	26	24	RCP	0.13	0.012	0.046	0.850	0.018	0.20	0.120	0.45	0.184	0.53	5.59	6.18	--	0.60	3.208	0.441	0.78	12.35	5.04	7.12	8.84	2.81
Str. 7	Str. 8	26	12	RCP	0.30	0.012	0.150	0.850	0.055	0.20	0.400	0.45	0.605	0.53	12.42	5.03	--	1.60	0.605	0.526	N/A	12.42	5.03	1.60	2.11	2.69
Str. 8	Str. 9	4	12	RCP	1.00	0.012	0.153	0.850	0.060	0.20	0.172	0.45	0.385	0.57	13.60	4.81	--	1.06	0.990	0.543	0.16	13.60	4.81	2.59	3.86	4.91
Str. 9	Str. 12	150	15	RCP	0.30	0.012	No Inlet												0.990	0.543	0.01	13.61	4.81	2.59	3.83	3.12
Str. 10	Str. 11	26	12	RCP	0.30	0.012	0.066	0.850	0.026	0.20	0.184	0.45	0.276	0.52	12.10	5.09	--	0.73	0.276	0.522	N/A	12.10	5.09	0.73	2.11	2.69
Str. 11	Str. 12	4	12	RCP	1.00	0.012	0.066	0.850	0.026	0.20	0.072	0.45	0.164	0.57	12.10	5.09	--	0.48	0.440	0.540	0.16	12.10	5.09	1.21	3.86	4.91
Str. 12	Str. 14	159	18	RCP	0.23	0.012	No Inlet												1.430	0.542	0.80	14.41	4.66	3.61	5.46	3.09
Str. 13	Str. 14	4	24	RCP	0.25	0.012	0.054	0.850	0.072	0.20	0.047	0.45	0.173	0.47	8.26	6.01	--	0.49	3.381	0.442	0.14	12.49	5.02	7.51	12.25	3.90
Str. 14	Str. 15	89	24	RCP	0.25	0.012	No Inlet												4.811	0.472	0.86	15.27	4.47	10.15	12.25	3.90
Str. 15	Str. 17	150	24	RCP	0.25	0.012	No Inlet												4.811	0.472	0.38	15.65	4.36	9.90	12.25	3.90
Str. 16	Str. 17	90	12	RCP	0.30	0.012	0.000	0.850	0.000	0.20	0.747	0.45	0.747	0.45	12.24	5.06	--	1.70	0.747	0.450	N/A	12.24	5.06	1.70	2.11	2.69
Str. 17	Str. 24	158	24	RCP	0.29	0.012	0.000	0.850	0.093	0.20	0.643	0.45	0.736	0.42	9.09	5.75	--	1.77	6.294	0.463	0.64	16.29	4.17	12.16	13.20	4.20
Str. 18	Str. 20	30	12	RCP	0.30	0.012	0.145	0.850	0.036	0.20	0.136	0.45	0.317	0.60	10.00	5.48	--	1.05	0.317	0.605	N/A	10.00	5.48	1.05	2.11	2.69
Str. 19	Str. 20	62	12	RCP	0.30	0.012	0.169	0.850	0.033	0.20	0.070	0.45	0.272	0.67	10.00	5.48	--	1.00	0.272	0.668	N/A	10.00	5.48	1.00	2.11	2.69
Str. 20	Str. 24	37	12	RCP	0.75	0.012	No Inlet												0.589	0.634	N/A	10.00	5.48	2.05	3.34	4.26
Str. 21	Str. 22	26	12	RCP	0.30	0.012	0.046	0.850	0.015	0.20	0.055	0.45	0.116	0.58	10.76	5.34	--	0.36	0.116	0.576	N/A	10.76	5.34	0.36	2.11	2.69
Str. 22	Str. 23	4	12	RCP	1.00	0.012	0.046	0.850	0.015	0.20	0.055	0.45	0.116	0.58	10.76	5.34	--	0.36	0.232	0.576	0.16	10.92	5.31	0.71	3.86	4.91
Str. 23	Str. 24	148	12	RCP	0.30	0.012	No Inlet												0.232	0.576	0.01	10.93	5.31	0.71	2.11	2.69
Str. 24	Str. 25	127	30	RCP	0.15	0.012	No Inlet												7.115	0.481	0.63	16.92	3.99	13.65	17.21	3.51
Str. 25	Outlet	177	30	RCP	0.15	0.012	No Inlet												7.115	0.481	0.60	17.52	3.81	13.04	17.21	3.51
Str. 26	Str. 27	26	12	RCP	0.30	0.012	0.083	0.850	0.027	0.20	0.253	0.45	0.363	0.52	11.40	5.22	--	0.99	0.363	0.523	N/A	11.40	5.22	0.99	2.11	2.69
Str. 27	Str. 29	4	12	RCP	1.00	0.012	0.088	0.850	0.133	0.20	0.000	0.45	0.221	0.46	11.40	5.22	--	0.53	0.584	0.499	0.16	11.56	5.19	1.51	3.86	4.91
Str. 28	Str. 29	38	12	RCP	2.00	0.012	0.000	0.850	0.151	0.20	1.010	0.45	1.161	0.42	10.35	5.41	--	2.62	1.161	0.417	N/A	10.35	5.41	2.62	5.46	6.95
Str. 29	Str. 32	83	18	RCP	0.21	0.012	No Inlet												1.745	0.445	0.01	11.57	5.19	4.03	5.21	2.95
Str. 30	Str. 31	26	12	RCP	0.30	0.012	0.099	0.850	0.030	0.20	0.322	0.45	0.451	0.52	10.00	5.48	--	1.29	0.451	0.521	N/A	10.00	5.48	1.29	2.11	2.69
Str. 31	Str. 32	4	12	RCP	1.00	0.012	0.099	0.850	0.108	0.20	0.000	0.45	0.207	0.51	10.00	5.48	--	0.58	0.658	0.518	0.16	10.16	5.46	1.86	3.86	4.91
Str. 32	Str. 35	145	18	RCP	0.23	0.012	No Inlet												2.403	0.465	0.49	12.06	5.10	5.70	5.87	3.41
Str. 33	Str. 34	26	12	RCP	0.30	0.012	0.087	0.850	0.018	0.200	0.173	0.450	0.278	0.559	11.990	5.110	--	0.79	0.278	0.559	N/A	11.99	5.11	0.79	2.11	2.69
Str. 34	Str. 35	83	12	RCP	0.30	0.012	0.061	0.850	0.062	0.200	0.000	0.450	0.123	0.522	10.000	5.480	--	0.35	0.401	0.548	0.16	12.15	5.08	1.12	2.11	2.69
Str. 35	Str. 38	25	18	RCP	0.30	0.012	No Inlet												2.804	0.477	0.84	12.90	4.94	6.60	6.02	3.41
Str. 36	Str. 37	26	12	RCP	0.30	0.012	0.092	0.850	0.019	0.200	0.182	0.450	0.293	0.559	11.990	5.110	--	0.84	0.293	0.559	N/A	11.99	5.11	0.84	2.11	2.69
Str. 37	Str. 38	4	12	RCP	1.00	0.012	0.065	0.850	0.066	0.200	0.000	0.450	0.131	0.523	10.000	5.480	--	0.38	0.424	0.548	0.16	12.15	5.08	1.18	3.86	4.91
Str. 38	Str. 41	108	24	RCP	0.15	0.012	No Inlet												3.228	0.486	0.12	13.02	4.92	7.72	9.49	3.02
Str. 39	Str. 40	26	12	RCP	0.30	0.012	0.074	0.850	0.025	0.20	0.291	0.45	0.390	0.51	11.91	5.12	--	1.02	0.390	0.510	N/A	11.91	5.12	1.02	2.11	2.69
Str. 40	Str. 41	4	12	RCP	1.00	0.012	0.010	0.850	0.006	0.20	0.000	0.45	0.016	0.61	5.00	6.99	--	0.07	0.406	0.514	0.16	12.07	5.09	1.06	3.86	4.91
Str. 41	Str. 49	71	24	RCP	0.15	0.012	No Inlet												3.634	0.489	0.42	13.44	4.84	8.60	9.49	3.02
Str. 42	Str. 49	4	12	RCP	1.00	0.012	0.056	0.850	0.019	0.20	0.195	0.45	0.270	0.52	10.00	5.48	--	0.76	0.270	0.515	N/A	10.00	5.48	0.76	3.86	4.91
Str. 43	Str. 44	26	12	RCP	0.30	0.012	0.078	0.850	0.026	0.20	0.090	0.45	0.194	0.58	11.48	5.20	--	0.58	0.194	0.577	N/A	11.48	5.20	0.58	2.11	2.69
Str. 44	Str. 45	4	12	RCP	1.00	0.012	0.078	0.850	0.026	0.20	0.090	0.45	0.194	0.58	11.48	5.20	--	0.58	0.388	0.577	0.16	11.64	5.17	1.16	3.86	4.91
Str. 45	Str. 48	150	12	RCP	0.40	0.012	No Inlet												0.388	0.577	0.01	11.65	5.17	1.16	2.44	3.11
Str. 46	Str. 47	26	12	RCP	0.30	0.012	0.075	0.850	0.026	0.20	0.069	0.45	0.170	0.59	10.30	5.42	--	0.54	0.170	0.588	N/A	10.30	5.42	0.54	2.11	2.69
Str. 47	Str. 48	4	12	RCP	1.00	0.012	0.075	0.850	0.026	0.20	0.069	0.45	0.170	0.59	10.30	5.42	--	0.54	0.340	0.588	0.16	10.46	5.39	1.08	3.86	4.91
Str. 48	Str. 49	27	12	RCP	1.00	0.012	No Inlet												0.728	0.582	0.80	12.45	5.02	2.13	3.86	4.91
Str. 49	Str. 57	107	24	RCP	0.25	0.012	No Inlet												4.632	0.505	0.39	13.83	4.77	11.16	12.25	3.90
Str. 50	Str. 51	26	12	RCP	0.30	0.012	0.123	0.850	0.024	0.20	0.104	0.45	0.251	0.62	13.27	4.87	--	0.76	0.251	0.622	N/A	13.27	4.87	0.76	2.11	2.69
Str. 51	Str. 52	4	12	RCP	1.00	0.012	0.127	0.850	0.023	0.20	0.108	0.45	0.258	0.62	13.27	4.87	--	0.78	0.509	0.623	0.16	13.43	4.84	1.54	3.86	4.91
Str. 52	Str. 57	150	12	RCP	0.60	0.012	No Inlet												0.509	0.623	0.01	13.44	4.84	1.54	2.99	3.81
Str. 53	Str. 54	130	12	RCP	0.50	0.012	0.000	0.850	0.202	0.20	1.271	0.45	1.473	0.42	14.45	4.65	--	2.85	1.473	0.416	N/A	14.45	4.65	2.85	2.93	3.83
Str. 54	Str. 55	30	12	RCP	0.50	0.012	No Inlet												1.473	0.416	0.62	15.07	4.53	2.77	2.93	3.83
Str. 55	Str. 56	26	12	RCP	0.70	0.012	0.062	0.850	0.021	0.20	0.072	0.45	0.155	0.58	11.64	5.17	--	0.46	1.628	0.431	0.14	15.21	4.49	3.15	3.23	4.11
Str. 56	Str. 57	4	12	RCP	1.00	0.012	0.062	0.85	0.021	0.20	0.069	0.45	0.152	0.58	11.64	5.17	--	0.45	1.780	0.444	0.11	15.32	4.46	3.52	3.86	4.91
Str. 57	Str. 58	143	30	RCP	0.20	0.012	No Inlet												6.921	0.498	0.01	15.33	4.45	15.34	19.87	4.05
Str. 58	Outlet	63	30	RCP	0.20	0.012	No Inlet												6.921	0.498	0.59	15.92	4.28	14.75	19.87	4.05
Str. 59	Str. 60	532	30	RCP	0.39	0.012	No Inlet												--	--	--	--	--	15.66	27.75	5.65
Str. 60	Str. 61	25	30	RCP	0.39	0.012	No Inlet												--	--	--	--	--	15.66	27.75	5.65
Str. 61	Str. 62	123	30	RCP	0.39	0.012	No Inlet												--	--	--	--	--	15.66	27.75	5.65
Str. 62	Str. 63	85	30	RCP	0.39	0.012	No Inlet												--	--	--	--	--	15.66	27.75	5.65
Str. 63	Str. 64	146	30	RCP	0.39	0.012	No Inlet												--	--	--	--	--	15.66	27.75	5.65
Str. 64	Outlet	107	30	RCP	0.39	0.012	No Inlet												--	--	--	--	--	15.66	27.75	5.65
Str. 65	Str. 66	177	12	RCP	0.50	0.012	0.000	0.850	0.058	0.20	0.523	0.45	0.581	0.43	10.00	5.48	--	1.35	0.581	0.425	N/A	10.00	5.48	1.35	2.73	3.47
Str. 66	Str. 67	150	12	RCP	0.50	0.012	0.000	0.850	0.000	0.20	0.345	0.45	0.345	0.45	10.00	5.48	--	0.85	0.926	0.434	N/A	10.00	5.48	2.20	2.73	3.47
Str. 67	Outlet	83	12	RCP	0.50	0.012	No Inlet												0.926	0.434	N/A	--	5.48	2.20	2.73	3.47

TIME OF CONCENTRATION or TRAVEL TIME WORKSHEET

Project: Hillview - Village Green

Designer: WFH **Date:** 3/20/2014

Scenario/Structure: Str #1

Sheet Flow

1. Surface Description	grass		pvmt		pvmt	
2. Manning's Roughness Coeff., (n)	0.170		0.011		0.011	
3. Flow Length, (L) **total L<= 300 ft	33.00	ft.	6.00	ft.	0.00	ft.
4. Two-yr 24-hr Rainfall, (P2)	2.64	in.	2.64	in.	2.64	in.
5. Land Slope, (s)	0.0200	ft./ft.	0.0200	ft./ft.	0.0366	ft./ft.
6. Travel Time, (Tt) (Tt = [0.007(nL)^0.8]/[P2^0.5*s^0.4])	0.082	hr +	0.002	hr +	0.000	hr

Shallow Concentrated Flow

7. Surface Description (paved or unpaved)	paved		unpaved		unpaved	
8. Flow Length, (L)	110.00	ft.	0.00	ft.	0.00	ft.
9. Watercourse Slope, (s)	0.0068	ft./ft.	0.0202	ft./ft.	0.0060	ft./ft.
10. Average Velocity, (V) (Vp = 20.3282(s)^0.5) (Vup = 16.1345(s)^0.5)	1.676	ft./s	2.293	ft./s	1.250	ft./s
11. Travel Time, (Tt) (Tt = L/3600V)	0.018	hr +	0.000	hr +	0.000	hr

Watershed or Subarea Tc or Tt =

0.102 hr

or

6.15 min

Channel Flow

12. Cross Sectional Flow Area, (a)	133.48	ft.^2	132.12	ft.^2	174.24	ft.^2
13. Wetted Perimeter, Pw	35.51	ft.	30.71	ft.	43.74	ft.
14. Hydraulic Radius, (r) (r = a/Pw)	3.759	ft.	4.302	ft.	3.984	ft.
15. Channel Slope, (s)	0.0175	ft./ft.	0.0121	ft./ft.	0.0084	ft./ft.
16. Manning's Roughness Coeff., (n)	0.027		0.027		0.027	
17. Velocity, (V) (V = [1.49*r^0.67*s^0.5]/n)	17.727	ft./s	16.136	ft./s	12.769	ft./s
18. Flow Length, (L)	0.00	ft.	0.00	ft.	0.00	ft.
19. Travel Time, (Tt) (Tt = L/3600V)	0.000	hr +	0.000	hr +	0.000	hr

TIME OF CONCENTRATION or TRAVEL TIME WORKSHEET

Project: Hillview - Village Green

Designer: WFH **Date:** 3/20/2014

Scenario/Structure: Str. #2

Sheet Flow

1. Surface Description	grass		pvmt		pvmt	
2. Manning's Roughness Coeff., (n)	0.170		0.011		0.011	
3. Flow Length, (L) **total L<= 300 ft	63.00 ft.		0.00 ft.		0.00 ft.	
4. Two-yr 24-hr Rainfall, (P2)	2.64 in.		2.64 in.		2.64 in.	
5. Land Slope, (s)	0.0200 ft./ft.		0.0200 ft./ft.		0.0366 ft./ft.	
6. Travel Time, (Tt) (Tt = [0.007(nL)^0.8]/[P2^0.5*s^0.4])	0.137 hr	+	0.000 hr	+	0.000 hr	

Shallow Concentrated Flow

7. Surface Description (paved or unpaved)	paved		unpaved		unpaved	
8. Flow Length, (L)	0.00 ft.		190.00 ft.		0.00 ft.	
9. Watercourse Slope, (s)	0.0068 ft./ft.		0.0200 ft./ft.		0.0060 ft./ft.	
10. Average Velocity, (V) (Vp = 20.3282(s)^0.5) (Vup = 16.1345(s)^0.5)	1.676 ft./s		2.282 ft./s		1.250 ft./s	
11. Travel Time, (Tt) (Tt = L/3600V)	0.000 hr	+	0.023 hr	+	0.000 hr	

Watershed or Subarea Tc or Tt =

0.160 hr

or

9.63 min

Channel Flow

12. Cross Sectional Flow Area, (a)	133.48 ft.^2		132.12 ft.^2		174.24 ft.^2	
13. Wetted Perimeter, Pw	35.51 ft.		30.71 ft.		43.74 ft.	
14. Hydraulic Radius, (r) (r = a/Pw)	3.759 ft.		4.302 ft.		3.984 ft.	
15. Channel Slope, (s)	0.0175 ft./ft.		0.0121 ft./ft.		0.0084 ft./ft.	
16. Manning's Roughness Coeff., (n)	0.027		0.027		0.027	
17. Velocity, (V) (V = [1.49*r^0.67*s^0.5]/n)	17.727 ft./s		16.136 ft./s		12.769 ft./s	
18. Flow Length, (L)	0.00 ft.		0.00 ft.		0.00 ft.	
19. Travel Time, (Tt) (Tt = L/3600V)	0.000 hr	+	0.000 hr	+	0.000 hr	

TIME OF CONCENTRATION or TRAVEL TIME WORKSHEET

Project: Hillview - Village Green

Designer: WFH **Date:** 3/20/2014

Scenario/Structure: Str #3

Sheet Flow

1.	Surface Description	grass		pvmt		pvmt
2.	Manning's Roughness Coeff., (n)	0.170		0.011		0.011
3.	Flow Length, (L) **total L<= 300 ft	63.00 ft.		0.00 ft.		0.00 ft.
4.	Two-yr 24-hr Rainfall, (P2)	2.64 in.		2.64 in.		2.64 in.
5.	Land Slope, (s)	0.0200 ft./ft.		0.0200 ft./ft.		0.0366 ft./ft.
6.	Travel Time, (Tt) (Tt = [0.007(nL)^0.8]/[P2^0.5*s^0.4])	0.137 hr	+	0.000 hr	+	0.000 hr

Shallow Concentrated Flow

7.	Surface Description (paved or unpaved)	paved		unpaved		unpaved
8.	Flow Length, (L)	0.00 ft.		225.00 ft.		0.00 ft.
9.	Watercourse Slope, (s)	0.0068 ft./ft.		0.0200 ft./ft.		0.0060 ft./ft.
10.	Average Velocity, (V) (Vp = 20.3282(s)^0.5) (Vup = 16.1345(s)^0.5)	1.676 ft./s		2.282 ft./s		1.250 ft./s
11.	Travel Time, (Tt) (Tt = L/3600V)	0.000 hr	+	0.027 hr	+	0.000 hr

Watershed or Subarea Tc or Tt = 0.165 hr

or

9.88 min

Channel Flow

12.	Cross Sectional Flow Area, (a)	133.48 ft.^2		132.12 ft.^2		174.24 ft.^2
13.	Wetted Perimeter, Pw	35.51 ft.		30.71 ft.		43.74 ft.
14.	Hydraulic Radius, (r) (r = a/Pw)	3.759 ft.		4.302 ft.		3.984 ft.
15.	Channel Slope, (s)	0.0175 ft./ft.		0.0121 ft./ft.		0.0084 ft./ft.
16.	Manning's Roughness Coeff., (n)	0.027		0.027		0.027
17.	Velocity, (V) (V = [1.49*r^0.67*s^0.5]/n)	17.727 ft./s		16.136 ft./s		12.769 ft./s
18.	Flow Length, (L)	0.00 ft.		0.00 ft.		0.00 ft.
19.	Travel Time, (Tt) (Tt = L/3600V)	0.000 hr	+	0.000 hr	+	0.000 hr

TIME OF CONCENTRATION or TRAVEL TIME WORKSHEET

Project: Hillview - Village Green

Designer: WFH **Date:** 3/20/2014

Scenario/Structure: Str. #7

Sheet Flow

1. Surface Description	grass		pvmt		pvmt	
2. Manning's Roughness Coeff., (n)	0.170		0.011		0.011	
3. Flow Length, (L) **total L<= 300 ft	94.50	ft.	6.00	ft.	0.00	ft.
4. Two-yr 24-hr Rainfall, (P2)	2.64	in.	2.64	in.	2.64	in.
5. Land Slope, (s)	0.0200	ft./ft.	0.0200	ft./ft.	0.0366	ft./ft.
6. Travel Time, (Tt) (Tt = [0.007(nL)^0.8]/[P2^0.5*s^0.4])	0.190	hr +	0.002	hr +	0.000	hr

Shallow Concentrated Flow

7. Surface Description (paved or unpaved)	paved		unpaved		unpaved	
8. Flow Length, (L)	91.00	ft.	0.00	ft.	0.00	ft.
9. Watercourse Slope, (s)	0.0072	ft./ft.	0.0200	ft./ft.	0.0060	ft./ft.
10. Average Velocity, (V) (Vp = 20.3282(s)^0.5) (Vup = 16.1345(s)^0.5)	1.725	ft./s	2.282	ft./s	1.250	ft./s
11. Travel Time, (Tt) (Tt = L/3600V)	0.015	hr +	0.000	hr +	0.000	hr

Watershed or Subarea Tc or Tt =

0.207 hr

or

12.42 min

Channel Flow

12. Cross Sectional Flow Area, (a)	133.48	ft.^2	132.12	ft.^2	174.24	ft.^2
13. Wetted Perimeter, Pw	35.51	ft.	30.71	ft.	43.74	ft.
14. Hydraulic Radius, (r) (r = a/Pw)	3.759	ft.	4.302	ft.	3.984	ft.
15. Channel Slope, (s)	0.0175	ft./ft.	0.0121	ft./ft.	0.0084	ft./ft.
16. Manning's Roughness Coeff., (n)	0.027		0.027		0.027	
17. Velocity, (V) (V = [1.49*r^0.67*s^0.5]/n)	17.727	ft./s	16.136	ft./s	12.769	ft./s
18. Flow Length, (L)	0.00	ft.	0.00	ft.	0.00	ft.
19. Travel Time, (Tt) (Tt = L/3600V)	0.000	hr +	0.000	hr +	0.000	hr

TIME OF CONCENTRATION or TRAVEL TIME WORKSHEET

Project: Hillview - Village Green

Designer: WFH **Date:** 3/20/2014

Scenario/Structure: Str #8

Sheet Flow

1. Surface Description	grass		pvmt		pvmt	
2. Manning's Roughness Coeff., (n)	0.170		0.011		0.011	
3. Flow Length, (L) **total L<= 300 ft	94.50	ft.	6.00	ft.	0.00	ft.
4. Two-yr 24-hr Rainfall, (P2)	2.64	in.	2.64	in.	2.64	in.
5. Land Slope, (s)	0.0200	ft./ft.	0.0200	ft./ft.	0.0366	ft./ft.
6. Travel Time, (Tt) (Tt = [0.007(nL)^0.8]/[P2^0.5*s^0.4])	0.190	hr +	0.002	hr +	0.000	hr

Shallow Concentrated Flow

7. Surface Description (paved or unpaved)	paved		unpaved		unpaved	
8. Flow Length, (L)	214.00	ft.	0.00	ft.	0.00	ft.
9. Watercourse Slope, (s)	0.0072	ft./ft.	0.0200	ft./ft.	0.0060	ft./ft.
10. Average Velocity, (V) (Vp = 20.3282(s)^0.5) (Vup = 16.1345(s)^0.5)	1.725	ft./s	2.282	ft./s	1.250	ft./s
11. Travel Time, (Tt) (Tt = L/3600V)	0.034	hr +	0.000	hr +	0.000	hr

Watershed or Subarea Tc or Tt =

0.227 hr

or

13.60 min

Channel Flow

12. Cross Sectional Flow Area, (a)	133.48	ft.^2	132.12	ft.^2	174.24	ft.^2
13. Wetted Perimeter, Pw	35.51	ft.	30.71	ft.	43.74	ft.
14. Hydraulic Radius, (r) (r = a/Pw)	3.759	ft.	4.302	ft.	3.984	ft.
15. Channel Slope, (s)	0.0175	ft./ft.	0.0121	ft./ft.	0.0084	ft./ft.
16. Manning's Roughness Coeff., (n)	0.027		0.027		0.027	
17. Velocity, (V) (V = [1.49*r^0.67*s^0.5]/n)	17.727	ft./s	16.136	ft./s	12.769	ft./s
18. Flow Length, (L)	0.00	ft.	0.00	ft.	0.00	ft.
19. Travel Time, (Tt) (Tt = L/3600V)	0.000	hr +	0.000	hr +	0.000	hr

TIME OF CONCENTRATION or TRAVEL TIME WORKSHEET

Project: Hillview - Village Green

Designer: WFH **Date:** 3/20/2014

Scenario/Structure: Str. #16

Sheet Flow

1. Surface Description	grass		pvmt		pvmt	
2. Manning's Roughness Coeff., (n)	0.170		0.011		0.011	
3. Flow Length, (L) **total L<= 300 ft	90.00 ft.		0.00 ft.		0.00 ft.	
4. Two-yr 24-hr Rainfall, (P2)	2.64 in.		2.64 in.		2.64 in.	
5. Land Slope, (s)	0.0200 ft./ft.		0.0200 ft./ft.		0.0366 ft./ft.	
6. Travel Time, (Tt) (Tt = [0.007(nL)^0.8]/[P2^0.5*s^0.4])	0.183 hr	+	0.000 hr	+	0.000 hr	

Shallow Concentrated Flow

7. Surface Description (paved or unpaved)	paved		unpaved		unpaved	
8. Flow Length, (L)	0.00 ft.		175.00 ft.		0.00 ft.	
9. Watercourse Slope, (s)	0.0072 ft./ft.		0.0200 ft./ft.		0.0060 ft./ft.	
10. Average Velocity, (V) (Vp = 20.3282(s)^0.5) (Vup = 16.1345(s)^0.5)	1.725 ft./s		2.282 ft./s		1.250 ft./s	
11. Travel Time, (Tt) (Tt = L/3600V)	0.000 hr	+	0.021 hr	+	0.000 hr	

Watershed or Subarea Tc or Tt = 0.204 hr

or

12.24 min

Channel Flow

12. Cross Sectional Flow Area, (a)	133.48 ft.^2		132.12 ft.^2		174.24 ft.^2	
13. Wetted Perimeter, Pw	35.51 ft.		30.71 ft.		43.74 ft.	
14. Hydraulic Radius, (r) (r = a/Pw)	3.759 ft.		4.302 ft.		3.984 ft.	
15. Channel Slope, (s)	0.0175 ft./ft.		0.0121 ft./ft.		0.0084 ft./ft.	
16. Manning's Roughness Coeff., (n)	0.027		0.027		0.027	
17. Velocity, (V) (V = [1.49*r^0.67*s^0.5]/n)	17.727 ft./s		16.136 ft./s		12.769 ft./s	
18. Flow Length, (L)	0.00 ft.		0.00 ft.		0.00 ft.	
19. Travel Time, (Tt) (Tt = L/3600V)	0.000 hr	+	0.000 hr	+	0.000 hr	

TIME OF CONCENTRATION or TRAVEL TIME WORKSHEET

Project: Hillview - Village Green

Designer: WFH **Date:** 3/20/2014

Scenario/Structure: Str. #17

Sheet Flow

1.	Surface Description	grass		pvmt		pvmt
2.	Manning's Roughness Coeff., (n)	0.170		0.011		0.011
3.	Flow Length, (L) **total L<= 300 ft	60.00 ft.		0.00 ft.		0.00 ft.
4.	Two-yr 24-hr Rainfall, (P2)	2.64 in.		2.64 in.		2.64 in.
5.	Land Slope, (s)	0.0200 ft./ft.		0.0200 ft./ft.		0.0366 ft./ft.
6.	Travel Time, (Tt) (Tt = [0.007(nL)^0.8]/[P2^0.5*s^0.4])	0.132 hr	+	0.000 hr	+	0.000 hr

Shallow Concentrated Flow

7.	Surface Description (paved or unpaved)	paved		unpaved		unpaved
8.	Flow Length, (L)	0.00 ft.		160.00 ft.		0.00 ft.
9.	Watercourse Slope, (s)	0.0072 ft./ft.		0.0200 ft./ft.		0.0060 ft./ft.
10.	Average Velocity, (V) (Vp = 20.3282(s)^0.5) (Vup = 16.1345(s)^0.5)	1.725 ft./s		2.282 ft./s		1.250 ft./s
11.	Travel Time, (Tt) (Tt = L/3600V)	0.000 hr	+	0.019 hr	+	0.000 hr

Watershed or Subarea Tc or Tt =

0.152 hr

or

9.09 min

Channel Flow

12.	Cross Sectional Flow Area, (a)	133.48 ft.^2		132.12 ft.^2		174.24 ft.^2
13.	Wetted Perimeter, Pw	35.51 ft.		30.71 ft.		43.74 ft.
14.	Hydraulic Radius, (r) (r = a/Pw)	3.759 ft.		4.302 ft.		3.984 ft.
15.	Channel Slope, (s)	0.0175 ft./ft.		0.0121 ft./ft.		0.0084 ft./ft.
16.	Manning's Roughness Coeff., (n)	0.027		0.027		0.027
17.	Velocity, (V) (V = [1.49*r^0.67*s^0.5]/n)	17.727 ft./s		16.136 ft./s		12.769 ft./s
18.	Flow Length, (L)	0.00 ft.		0.00 ft.		0.00 ft.
19.	Travel Time, (Tt) (Tt = L/3600V)	0.000 hr	+	0.000 hr	+	0.000 hr

TIME OF CONCENTRATION or TRAVEL TIME WORKSHEET

Project: Hillview - Village Green

Designer: WFH **Date:** 3/20/2014

Scenario/Structure: Str. #21

Sheet Flow

1. Surface Description	grass		pvmt		pvmt	
2. Manning's Roughness Coeff., (n)	0.170		0.011		0.011	
3. Flow Length, (L) **total L<= 300 ft	77.00 ft.		6.00 ft.		0.00 ft.	
4. Two-yr 24-hr Rainfall, (P2)	2.64 in.		2.64 in.		2.64 in.	
5. Land Slope, (s)	0.0200 ft./ft.		0.0200 ft./ft.		0.0366 ft./ft.	
6. Travel Time, (Tt) (Tt = [0.007(nL)^0.8]/[P2^0.5*s^0.4])	0.161 hr	+	0.002 hr	+	0.000 hr	

Shallow Concentrated Flow

7. Surface Description (paved or unpaved)	paved		unpaved		unpaved	
8. Flow Length, (L)	82.00 ft.		0.00 ft.		0.00 ft.	
9. Watercourse Slope, (s)	0.0050 ft./ft.		0.0200 ft./ft.		0.0060 ft./ft.	
10. Average Velocity, (V) (Vp = 20.3282(s)^0.5) (Vup = 16.1345(s)^0.5)	1.437 ft./s		2.282 ft./s		1.250 ft./s	
11. Travel Time, (Tt) (Tt = L/3600V)	0.016 hr	+	0.000 hr	+	0.000 hr	

Watershed or Subarea Tc or Tt = 0.179 hr

or

10.76 min

Channel Flow

12. Cross Sectional Flow Area, (a)	133.48 ft.^2		132.12 ft.^2		174.24 ft.^2	
13. Wetted Perimeter, Pw	35.51 ft.		30.71 ft.		43.74 ft.	
14. Hydraulic Radius, (r) (r = a/Pw)	3.759 ft.		4.302 ft.		3.984 ft.	
15. Channel Slope, (s)	0.0175 ft./ft.		0.0121 ft./ft.		0.0084 ft./ft.	
16. Manning's Roughness Coeff., (n)	0.027		0.027		0.027	
17. Velocity, (V) (V = [1.49*r^0.67*s^0.5]/n)	17.727 ft./s		16.136 ft./s		12.769 ft./s	
18. Flow Length, (L)	0.00 ft.		0.00 ft.		0.00 ft.	
19. Travel Time, (Tt) (Tt = L/3600V)	0.000 hr	+	0.000 hr	+	0.000 hr	

TIME OF CONCENTRATION or TRAVEL TIME WORKSHEET

Project: Hillview - Village Green

Designer: WFH **Date:** 3/20/2014

Scenario/Structure: Str. #26

Sheet Flow

1.	Surface Description	grass		pvmt		pvmt	
2.	Manning's Roughness Coeff., (n)	0.170		0.011		0.011	
3.	Flow Length, (L) **total L<= 300 ft	82.00	ft.	6.00	ft.	0.00	ft.
4.	Two-yr 24-hr Rainfall, (P2)	2.64	in.	2.64	in.	2.64	in.
5.	Land Slope, (s)	0.0200	ft./ft.	0.0200	ft./ft.	0.0366	ft./ft.
6.	Travel Time, (Tt) (Tt = [0.007(nL)^0.8]/[P2^0.5*s^0.4])	0.170	hr +	0.002	hr +	0.000	hr

Shallow Concentrated Flow

7.	Surface Description (paved or unpaved)	paved		unpaved		unpaved	
8.	Flow Length, (L)	115.00	ft.	0.00	ft.	0.00	ft.
9.	Watercourse Slope, (s)	0.0075	ft./ft.	0.0200	ft./ft.	0.0060	ft./ft.
10.	Average Velocity, (V) (Vp = 20.3282(s)^0.5) (Vup = 16.1345(s)^0.5)	1.760	ft./s	2.282	ft./s	1.250	ft./s
11.	Travel Time, (Tt) (Tt = L/3600V)	0.018	hr +	0.000	hr +	0.000	hr

Watershed or Subarea Tc or Tt =

0.190 hr

or

11.40 min

Channel Flow

12.	Cross Sectional Flow Area, (a)	133.48	ft.^2	132.12	ft.^2	174.24	ft.^2
13.	Wetted Perimeter, Pw	35.51	ft.	30.71	ft.	43.74	ft.
14.	Hydraulic Radius, (r) (r = a/Pw)	3.759	ft.	4.302	ft.	3.984	ft.
15.	Channel Slope, (s)	0.0175	ft./ft.	0.0121	ft./ft.	0.0084	ft./ft.
16.	Manning's Roughness Coeff., (n)	0.027		0.027		0.027	
17.	Velocity, (V) (V = [1.49*r^0.67*s^0.5]/n)	17.727	ft./s	16.136	ft./s	12.769	ft./s
18.	Flow Length, (L)	0.00	ft.	0.00	ft.	0.00	ft.
19.	Travel Time, (Tt) (Tt = L/3600V)	0.000	hr +	0.000	hr +	0.000	hr

TIME OF CONCENTRATION or TRAVEL TIME WORKSHEET

Project: Hillview - Village Green

Designer: WFH **Date:** 3/20/2014

Scenario/Structure: Str. #28

Sheet Flow

1.	Surface Description	grass		pvmt		pvmt
2.	Manning's Roughness Coeff., (n)	0.170		0.011		0.011
3.	Flow Length, (L) **total L<= 300 ft	60.00 ft.		0.00 ft.		0.00 ft.
4.	Two-yr 24-hr Rainfall, (P2)	2.64 in.		2.64 in.		2.64 in.
5.	Land Slope, (s)	0.0200 ft./ft.		0.0200 ft./ft.		0.0366 ft./ft.
6.	Travel Time, (Tt) (Tt = [0.007(nL)^0.8]/[P2^0.5*s^0.4])	0.132 hr	+	0.000 hr	+	0.000 hr

Shallow Concentrated Flow

7.	Surface Description (paved or unpaved)	paved		unpaved		unpaved
8.	Flow Length, (L)	0.00 ft.		235.00 ft.		0.00 ft.
9.	Watercourse Slope, (s)	0.0075 ft./ft.		0.0100 ft./ft.		0.0060 ft./ft.
10.	Average Velocity, (V) (Vp = 20.3282(s)^0.5) (Vup = 16.1345(s)^0.5)	1.760 ft./s		1.613 ft./s		1.250 ft./s
11.	Travel Time, (Tt) (Tt = L/3600V)	0.000 hr	+	0.040 hr	+	0.000 hr

Watershed or Subarea Tc or Tt = 0.173 hr

or 10.35 min

Channel Flow

12.	Cross Sectional Flow Area, (a)	133.48 ft.^2		132.12 ft.^2		174.24 ft.^2
13.	Wetted Perimeter, Pw	35.51 ft.		30.71 ft.		43.74 ft.
14.	Hydraulic Radius, (r) (r = a/Pw)	3.759 ft.		4.302 ft.		3.984 ft.
15.	Channel Slope, (s)	0.0175 ft./ft.		0.0121 ft./ft.		0.0084 ft./ft.
16.	Manning's Roughness Coeff., (n)	0.027		0.027		0.027
17.	Velocity, (V) (V = [1.49*r^0.67*s^0.5]/n)	17.727 ft./s		16.136 ft./s		12.769 ft./s
18.	Flow Length, (L)	0.00 ft.		0.00 ft.		0.00 ft.
19.	Travel Time, (Tt) (Tt = L/3600V)	0.000 hr	+	0.000 hr	+	0.000 hr

TIME OF CONCENTRATION or TRAVEL TIME WORKSHEET

Project: Hillview - Village Green

Designer: WFH **Date:** 3/20/2014

Scenario/Structure: Str. #33

Sheet Flow

1. Surface Description	grass		pvmt		pvmt	
2. Manning's Roughness Coeff., (n)	0.170		0.011		0.011	
3. Flow Length, (L) **total L<= 300 ft	87.00 ft.		6.00 ft.		0.00 ft.	
4. Two-yr 24-hr Rainfall, (P2)	2.64 in.		2.64 in.		2.64 in.	
5. Land Slope, (s)	0.0200 ft./ft.		0.0200 ft./ft.		0.0366 ft./ft.	
6. Travel Time, (Tt) (Tt = [0.007(nL)^0.8]/[P2^0.5*s^0.4])	0.178 hr	+	0.002 hr	+	0.000 hr	

Shallow Concentrated Flow

7. Surface Description (paved or unpaved)	paved		unpaved		unpaved	
8. Flow Length, (L)	102.00 ft.		0.00 ft.		0.00 ft.	
9. Watercourse Slope, (s)	0.0050 ft./ft.		0.0100 ft./ft.		0.0060 ft./ft.	
10. Average Velocity, (V) (Vp = 20.3282(s)^0.5) (Vup = 16.1345(s)^0.5)	1.437 ft./s		1.613 ft./s		1.250 ft./s	
11. Travel Time, (Tt) (Tt = L/3600V)	0.020 hr	+	0.000 hr	+	0.000 hr	

Watershed or Subarea Tc or Tt =

0.200 hr

or

11.99 min

Channel Flow

12. Cross Sectional Flow Area, (a)	133.48 ft.^2		132.12 ft.^2		174.24 ft.^2	
13. Wetted Perimeter, Pw	35.51 ft.		30.71 ft.		43.74 ft.	
14. Hydraulic Radius, (r) (r = a/Pw)	3.759 ft.		4.302 ft.		3.984 ft.	
15. Channel Slope, (s)	0.0175 ft./ft.		0.0121 ft./ft.		0.0084 ft./ft.	
16. Manning's Roughness Coeff., (n)	0.027		0.027		0.027	
17. Velocity, (V) (V = [1.49*r^0.67*s^0.5]/n)	17.727 ft./s		16.136 ft./s		12.769 ft./s	
18. Flow Length, (L)	0.00 ft.		0.00 ft.		0.00 ft.	
19. Travel Time, (Tt) (Tt = L/3600V)	0.000 hr	+	0.000 hr	+	0.000 hr	

TIME OF CONCENTRATION or TRAVEL TIME WORKSHEET

Project: Hillview - Village Green

Designer: WFH **Date:** 3/20/2014

Scenario/Structure: Str. #39

Sheet Flow

1. Surface Description	grass		pvmt		pvmt	
2. Manning's Roughness Coeff., (n)	0.170		0.011		0.011	
3. Flow Length, (L) **total L<= 300 ft	87.00 ft.		6.00 ft.		0.00 ft.	
4. Two-yr 24-hr Rainfall, (P2)	2.64 in.		2.64 in.		2.64 in.	
5. Land Slope, (s)	0.0200 ft./ft.		0.0200 ft./ft.		0.0366 ft./ft.	
6. Travel Time, (Tt) (Tt = [0.007(nL)^0.8]/[P2^0.5*s^0.4])	0.178 hr	+	0.002 hr	+	0.000 hr	

Shallow Concentrated Flow

7. Surface Description (paved or unpaved)	paved		unpaved		unpaved	
8. Flow Length, (L)	117.00 ft.		0.00 ft.		0.00 ft.	
9. Watercourse Slope, (s)	0.0075 ft./ft.		0.0100 ft./ft.		0.0060 ft./ft.	
10. Average Velocity, (V) (Vp = 20.3282(s)^0.5) (Vup = 16.1345(s)^0.5)	1.760 ft./s		1.613 ft./s		1.250 ft./s	
11. Travel Time, (Tt) (Tt = L/3600V)	0.018 hr	+	0.000 hr	+	0.000 hr	

Watershed or Subarea Tc or Tt =

0.199 hr

or

11.91 min

Channel Flow

12. Cross Sectional Flow Area, (a)	133.48 ft.^2		132.12 ft.^2		174.24 ft.^2	
13. Wetted Perimeter, Pw	35.51 ft.		30.71 ft.		43.74 ft.	
14. Hydraulic Radius, (r) (r = a/Pw)	3.759 ft.		4.302 ft.		3.984 ft.	
15. Channel Slope, (s)	0.0175 ft./ft.		0.0121 ft./ft.		0.0084 ft./ft.	
16. Manning's Roughness Coeff., (n)	0.027		0.027		0.027	
17. Velocity, (V) (V = [1.49*r^0.67*s^0.5]/n)	17.727 ft./s		16.136 ft./s		12.769 ft./s	
18. Flow Length, (L)	0.00 ft.		0.00 ft.		0.00 ft.	
19. Travel Time, (Tt) (Tt = L/3600V)	0.000 hr	+	0.000 hr	+	0.000 hr	

TIME OF CONCENTRATION or TRAVEL TIME WORKSHEET

Project: Hillview - Village Green

Designer: WFH **Date:** 3/20/2014

Scenario/Structure: Str #43

Sheet Flow

1.	Surface Description	grass		pvmt		pvmt	
2.	Manning's Roughness Coeff., (n)	0.170		0.011		0.011	
3.	Flow Length, (L) **total L<= 300 ft	77.00	ft.	6.00	ft.	0.00	ft.
4.	Two-yr 24-hr Rainfall, (P2)	2.64	in.	2.64	in.	2.64	in.
5.	Land Slope, (s)	0.0200	ft./ft.	0.0200	ft./ft.	0.0366	ft./ft.
6.	Travel Time, (Tt) (Tt = [0.007(nL)^0.8]/[P2^0.5*s^0.4])	0.161	hr +	0.002	hr +	0.000	hr

Shallow Concentrated Flow

7.	Surface Description (paved or unpaved)	paved		unpaved		unpaved	
8.	Flow Length, (L)	144.00	ft.	0.00	ft.	0.00	ft.
9.	Watercourse Slope, (s)	0.0050	ft./ft.	0.0200	ft./ft.	0.0060	ft./ft.
10.	Average Velocity, (V) (Vp = 20.3282(s)^0.5) (Vup = 16.1345(s)^0.5)	1.437	ft./s	2.282	ft./s	1.250	ft./s
11.	Travel Time, (Tt) (Tt = L/3600V)	0.028	hr +	0.000	hr +	0.000	hr

Watershed or Subarea Tc or Tt =

0.191 hr

or

11.48 min

Channel Flow

12.	Cross Sectional Flow Area, (a)	133.48	ft.^2	132.12	ft.^2	174.24	ft.^2
13.	Wetted Perimeter, Pw	35.51	ft.	30.71	ft.	43.74	ft.
14.	Hydraulic Radius, (r) (r = a/Pw)	3.759	ft.	4.302	ft.	3.984	ft.
15.	Channel Slope, (s)	0.0175	ft./ft.	0.0121	ft./ft.	0.0084	ft./ft.
16.	Manning's Roughness Coeff., (n)	0.027		0.027		0.027	
17.	Velocity, (V) (V = [1.49*r^0.67*s^0.5]/n)	17.727	ft./s	16.136	ft./s	12.769	ft./s
18.	Flow Length, (L)	0.00	ft.	0.00	ft.	0.00	ft.
19.	Travel Time, (Tt) (Tt = L/3600V)	0.000	hr +	0.000	hr +	0.000	hr

TIME OF CONCENTRATION or TRAVEL TIME WORKSHEET

Project: Hillview - Village Green

Designer: WFH **Date:** 3/20/2014

Scenario/Structure: Str #46

Sheet Flow

1. Surface Description	grass		pvmt		pvmt	
2. Manning's Roughness Coeff., (n)	0.170		0.011		0.011	
3. Flow Length, (L) **total L<= 300 ft	77.00	ft.	6.00	ft.	0.00	ft.
4. Two-yr 24-hr Rainfall, (P2)	2.64	in.	2.64	in.	2.64	in.
5. Land Slope, (s)	0.0200	ft./ft.	0.0200	ft./ft.	0.0366	ft./ft.
6. Travel Time, (Tt) (Tt = [0.007(nL)^0.8]/[P2^0.5*s^0.4])	0.161	hr +	0.002	hr +	0.000	hr

Shallow Concentrated Flow

7. Surface Description (paved or unpaved)	paved		unpaved		unpaved	
8. Flow Length, (L)	143.00	ft.	0.00	ft.	0.00	ft.
9. Watercourse Slope, (s)	0.0581	ft./ft.	0.0200	ft./ft.	0.0060	ft./ft.
10. Average Velocity, (V) (Vp = 20.3282(s)^0.5) (Vup = 16.1345(s)^0.5)	4.900	ft./s	2.282	ft./s	1.250	ft./s
11. Travel Time, (Tt) (Tt = L/3600V)	0.008	hr +	0.000	hr +	0.000	hr

Watershed or Subarea Tc or Tt =

0.172 hr

or

10.30 min

Channel Flow

12. Cross Sectional Flow Area, (a)	133.48	ft.^2	132.12	ft.^2	174.24	ft.^2
13. Wetted Perimeter, Pw	35.51	ft.	30.71	ft.	43.74	ft.
14. Hydraulic Radius, (r) (r = a/Pw)	3.759	ft.	4.302	ft.	3.984	ft.
15. Channel Slope, (s)	0.0175	ft./ft.	0.0121	ft./ft.	0.0084	ft./ft.
16. Manning's Roughness Coeff., (n)	0.027		0.027		0.027	
17. Velocity, (V) (V = [1.49*r^0.67*s^0.5]/n)	17.727	ft./s	16.136	ft./s	12.769	ft./s
18. Flow Length, (L)	0.00	ft.	0.00	ft.	0.00	ft.
19. Travel Time, (Tt) (Tt = L/3600V)	0.000	hr +	0.000	hr +	0.000	hr

TIME OF CONCENTRATION or TRAVEL TIME WORKSHEET

Project: Hillview - Village Green

Designer: WFH **Date:** 3/20/2014

Scenario/Structure: Str. #50

Sheet Flow

1. Surface Description	grass		pvmt		pvmt	
2. Manning's Roughness Coeff., (n)	0.170		0.011		0.011	
3. Flow Length, (L) **total L<= 300 ft	88.00	ft.	6.00	ft.	101.00	ft.
4. Two-yr 24-hr Rainfall, (P2)	2.64	in.	2.64	in.	2.64	in.
5. Land Slope, (s)	0.0200	ft./ft.	0.0200	ft./ft.	0.0100	ft./ft.
6. Travel Time, (Tt) (Tt = [0.007(nL)^0.8]/[P2^0.5*s^0.4])	0.179	hr +	0.002	hr +	0.030	hr

Shallow Concentrated Flow

7. Surface Description (paved or unpaved)	paved		unpaved		unpaved	
8. Flow Length, (L)	62.00	ft.	0.00	ft.	0.00	ft.
9. Watercourse Slope, (s)	0.0075	ft./ft.	0.0200	ft./ft.	0.0060	ft./ft.
10. Average Velocity, (V) (Vp = 20.3282(s)^0.5) (Vup = 16.1345(s)^0.5)	1.760	ft./s	2.282	ft./s	1.250	ft./s
11. Travel Time, (Tt) (Tt = L/3600V)	0.010	hr +	0.000	hr +	0.000	hr

Watershed or Subarea Tc or Tt =

0.221 hr

or

13.27 min

Channel Flow

12. Cross Sectional Flow Area, (a)	133.48	ft.^2	132.12	ft.^2	174.24	ft.^2
13. Wetted Perimeter, Pw	35.51	ft.	30.71	ft.	43.74	ft.
14. Hydraulic Radius, (r) (r = a/Pw)	3.759	ft.	4.302	ft.	3.984	ft.
15. Channel Slope, (s)	0.0175	ft./ft.	0.0121	ft./ft.	0.0084	ft./ft.
16. Manning's Roughness Coeff., (n)	0.027		0.027		0.027	
17. Velocity, (V) (V = [1.49*r^0.67*s^0.5]/n)	17.727	ft./s	16.136	ft./s	12.769	ft./s
18. Flow Length, (L)	0.00	ft.	0.00	ft.	0.00	ft.
19. Travel Time, (Tt) (Tt = L/3600V)	0.000	hr +	0.000	hr +	0.000	hr

TIME OF CONCENTRATION or TRAVEL TIME WORKSHEET

Project: Hillview - Village Green

Designer: WFH **Date:** 3/20/2014

Scenario/Structure: Str. #53

Sheet Flow

1. Surface Description	grass		pvmt		pvmt	
2. Manning's Roughness Coeff., (n)	0.170		0.011		0.011	
3. Flow Length, (L) **total L<= 300 ft	94.00	ft.	0.00	ft.	0.00	ft.
4. Two-yr 24-hr Rainfall, (P2)	2.64	in.	2.64	in.	2.64	in.
5. Land Slope, (s)	0.0200	ft./ft.	0.0200	ft./ft.	0.0100	ft./ft.
6. Travel Time, (Tt) (Tt = [0.007(nL)^0.8]/[P2^0.5*s^0.4])	0.189	hr +	0.000	hr +	0.000	hr

Shallow Concentrated Flow

7. Surface Description (paved or unpaved)	paved		unpaved		unpaved	
8. Flow Length, (L)	0.00	ft.	300.00	ft.	0.00	ft.
9. Watercourse Slope, (s)	0.0075	ft./ft.	0.0100	ft./ft.	0.0060	ft./ft.
10. Average Velocity, (V) (Vp = 20.3282(s)^0.5) (Vup = 16.1345(s)^0.5)	1.760	ft./s	1.613	ft./s	1.250	ft./s
11. Travel Time, (Tt) (Tt = L/3600V)	0.000	hr +	0.052	hr +	0.000	hr

Watershed or Subarea Tc or Tt =

0.241 hr

or

14.45 min

Channel Flow

12. Cross Sectional Flow Area, (a)	133.48	ft.^2	132.12	ft.^2	174.24	ft.^2
13. Wetted Perimeter, Pw	35.51	ft.	30.71	ft.	43.74	ft.
14. Hydraulic Radius, (r) (r = a/Pw)	3.759	ft.	4.302	ft.	3.984	ft.
15. Channel Slope, (s)	0.0175	ft./ft.	0.0121	ft./ft.	0.0084	ft./ft.
16. Manning's Roughness Coeff., (n)	0.027		0.027		0.027	
17. Velocity, (V) (V = [1.49*r^0.67*s^0.5]/n)	17.727	ft./s	16.136	ft./s	12.769	ft./s
18. Flow Length, (L)	0.00	ft.	0.00	ft.	0.00	ft.
19. Travel Time, (Tt) (Tt = L/3600V)	0.000	hr +	0.000	hr +	0.000	hr

TIME OF CONCENTRATION or TRAVEL TIME WORKSHEET

Project: Hillview - Village Green

Designer: WFH **Date:** 3/20/2014

Scenario/Structure: Str #55

Sheet Flow

1. Surface Description	grass		pvmt		pvmt	
2. Manning's Roughness Coeff., (n)	0.170		0.011		0.011	
3. Flow Length, (L) **total L<= 300 ft	87.00	ft.	6.00	ft.	0.00	ft.
4. Two-yr 24-hr Rainfall, (P2)	2.64	in.	2.64	in.	2.64	in.
5. Land Slope, (s)	0.0200	ft./ft.	0.0200	ft./ft.	0.0366	ft./ft.
6. Travel Time, (Tt) (Tt = [0.007(nL)^0.8]/[P2^0.5*s^0.4])	0.178	hr +	0.002	hr +	0.000	hr

Shallow Concentrated Flow

7. Surface Description (paved or unpaved)	paved		unpaved		unpaved	
8. Flow Length, (L)	88.00	ft.	0.00	ft.	0.00	ft.
9. Watercourse Slope, (s)	0.0075	ft./ft.	0.0100	ft./ft.	0.0060	ft./ft.
10. Average Velocity, (V) (Vp = 20.3282(s)^0.5) (Vup = 16.1345(s)^0.5)	1.760	ft./s	1.613	ft./s	1.250	ft./s
11. Travel Time, (Tt) (Tt = L/3600V)	0.014	hr +	0.000	hr +	0.000	hr

Watershed or Subarea Tc or Tt =

0.194 hr

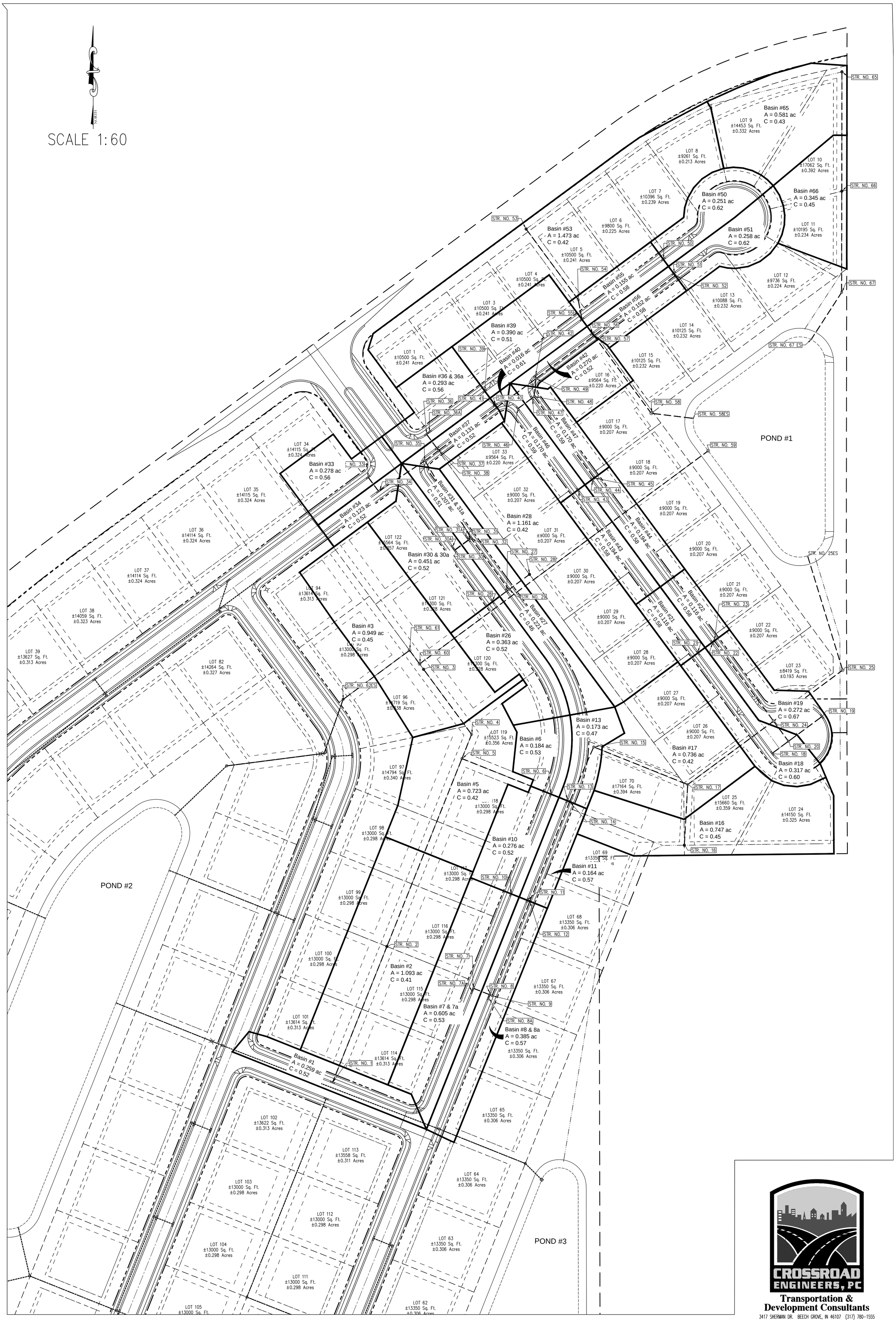
or

11.64 min

Channel Flow

12. Cross Sectional Flow Area, (a)	133.48	ft.^2	132.12	ft.^2	174.24	ft.^2
13. Wetted Perimeter, Pw	35.51	ft.	30.71	ft.	43.74	ft.
14. Hydraulic Radius, (r) (r = a/Pw)	3.759	ft.	4.302	ft.	3.984	ft.
15. Channel Slope, (s)	0.0175	ft./ft.	0.0121	ft./ft.	0.0084	ft./ft.
16. Manning's Roughness Coeff., (n)	0.027		0.027		0.027	
17. Velocity, (V) (V = [1.49*r^0.67*s^0.5]/n)	17.727	ft./s	16.136	ft./s	12.769	ft./s
18. Flow Length, (L)	0.00	ft.	0.00	ft.	0.00	ft.
19. Travel Time, (Tt) (Tt = L/3600V)	0.000	hr +	0.000	hr +	0.000	hr

EXHIBIT 1:
INLET BASIN MAP



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3417 SHERMAN DR. BEECH GROVE, IN 46107 (317) 780-1555

Section 2: Storm Inlet/Grate Calculations

Storm inlets were placed throughout the site to ensure that there will be adequate capacity to pass the design 10-year flow with 50% of the sag inlet clogged with the maximum depth of ponding not exceeding six (6) inches, or maintaining a 10' travel lane in paved areas. The maximum depth of ponding within grass shall not exceed nine (9) inches. The attached charts are a Discharge vs. Depth provided by Neenah Foundry Company. Charts are attached for sag inlets located in grassed areas with 50% of the inlet clogged and for inlets located on grade. The inlets located at sags within the roadway were analyzed using the weir equation. The weir equation is as follows:

$$Q = 3.3P(h)^{1.5}$$

Where: P = perimeter of the grate; h = head above the casting; Q = grate capacity

The casting type used on the attached charts for all road inlets, located in a sag, is a Neenah R-3501-TB, which has a perimeter of 5.7 feet. This length was reduced by 50% to simulate a clogged inlet. Therefore, the perimeter length used in the weir equation is 2.85 feet. The following table indicates the inlets capacity and corresponding roadway spread at each inlet.

Structure No.	Casting Type	Watershed Runoff	Inlet Capacity	Depth Over Grate	Spread	Bypass
1	R-3501-TB	0.90 cfs	0.90 cfs	0.21'	7.38'	0.00 cfs
2	R-4215-C	2.53 cfs	2.60 cfs	0.27'	--	0.00 cfs
3	R-4215-C	2.36 cfs	2.50 cfs	0.26'	--	0.00 cfs
5	R-4215-C	2.11 cfs	2.20 cfs	0.24'	--	0.00 cfs
6	R-3501-TL	0.60 cfs	0.47 cfs	0.136'	3.68'	0.13 cfs
7 & 7a	R-3501-TB	1.60+0.28 = 1.88 cfs	1.90 cfs	0.22'	7.88'	0.00 cfs
8 & 8a	R-3501-TB	1.06 cfs	1.10 cfs	0.15'	4.38'	0.00 cfs
10	R-3501-TL	0.73+0.13 = 0.86 cfs	0.58 cfs	0.155'	4.63'	0.28 cfs
11	R-3501-TR	0.48 cfs	0.55 cfs	0.15'	4.38'	0.00 cfs
13	R-3501-TR	0.49 cfs	0.55 cfs	0.15'	4.38'	0.00 cfs
16	R-4215-C	1.70 cfs	1.70 cfs	0.20'	--	0.00 cfs
17	R-2560-D2	1.77 cfs	1.80 cfs	0.37'	--	0.00 cfs
18	R-3501-TB	1.05+0.05 = 1.10 cfs	1.10 cfs	0.24'	8.88'	0.00 cfs
19	R-3501-TB	1.00+0.05 = 1.05 cfs	1.10 cfs	0.24'	8.88'	0.00 cfs
21	R-3501-TL	0.36 cfs	0.31 cfs	0.091'	1.43'	0.05 cfs
22	R-3501-TR	0.36 cfs	0.31 cfs	0.091'	1.43'	0.05 cfs
26	R-3501-TR	0.99 cfs	0.51 cfs	0.143'	4.03'	0.48 cfs
27	R-3501-TL	0.53 cfs	0.34 cfs	0.113'	2.53'	0.19 cfs
28	R-4215-C	2.62 cfs	2.80 cfs	0.28'	--	0.00 cfs
30 & 30a	R-3501-TB	1.29+0.48 = 1.77 cfs	1.80 cfs	0.21'	7.38'	0.00 cfs
31 & 31a	R-3501-TB	0.58+0.19 = 0.77 cfs	0.80 cfs	0.12'	2.88'	0.00 cfs
33	R-3501-TB	0.79 cfs	0.80 cfs	0.20'	6.88'	0.00 cfs
34	R-3501-TB	0.35 cfs	0.40 cfs	0.12'	2.88'	0.00 cfs
36 & 36a	R-3501-TB	0.84+0.64 = 1.48 cfs	1.60 cfs	0.19'	6.38'	0.00 cfs
37	R-3501-TB	0.87+0.02 = 0.89 cfs	0.90 cfs	0.21'	7.38'	0.00 cfs
39	R-3501-TL	1.02+0.28 = 1.30 cfs	0.66 cfs	0.168'	5.28'	0.64 cfs
40	R-3501-TR	0.07+0.20 = 0.27 cfs	0.25 cfs	0.093'	1.53'	0.02 cfs
42	R-3501-TB	0.76+0.28+0.20=1.24 cfs	1.30 cfs	0.27'	10.38'	0.00 cfs
43	R-3501-TR	0.58 cfs	0.43 cfs	0.092'	1.48'	0.15 cfs
44	R-3501-TL	0.58 cfs	0.43 cfs	0.092'	1.48'	0.15 cfs
46	R-3501-TR	0.54+0.15 = 0.69 cfs	0.49 cfs	0.090'	1.38'	0.20 cfs
47	R-3501-TL	0.54+0.15 = 0.69 cfs	0.49 cfs	0.090'	1.38'	0.20 cfs

50	R-3501-TL	0.76 cfs	0.47 cfs	0.137’	3.73’	0.29 cfs
51	R-3501-TR	0.78 cfs	0.48 cfs	0.139’	3.83’	0.30 cfs
53	R-4215-C	2.85 cfs	2.90 cfs	0.29’	--	0.00 cfs
55	R-3501-TL	0.46+0.29 = 0.75 cfs	0.47 cfs	0.137’	3.73’	0.28 cfs
56	R-3501-TR	0.45+0.30 = 0.75 cfs	0.47 cfs	0.137’	3.73’	0.28 cfs
65	R-4215-C	1.35 cfs	1.40 cfs	0.18’	--	0.00 cfs
66	R-4215-C	0.85 cfs	0.90 cfs	0.13’	--	0.00 cfs

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- Weir and Orifice Calculator
  - Weir Flow
  - Orifice Flow
- Curb Opening Hydraulics Calculator
- R-4999 Vane Trench Grate Hydraulics
- Neenah Grate Information
- Engineering Literature & Videos

WEIR & ORIFICE CALCULATOR

The Weir and Orifice Calculator is used to determine the inlet capacity in sag (ponding) conditions by use of the Weir and Orifice equations. Knowing this information will allow you to select the proper grate type and size for your specific job or project.

Weir Flow Calculations

Weir Equation: $Q = 3.3P(h)^{1.5}$

- **Q** = Capacity in CFS
- **P** = Feet perimeter
- **h** = Head in feet
- Weir Information

Orifice Flow Calculations

Orifice Flow Equation: $Q = 0.6A\sqrt{2gh}$

- **Q** = Capacity in CFS
- **A** = Free open area of grate in sq. ft.
- **g** = 32.2 (feet per sec/sec)
- **h** = Head in feet
- Orifice Information

Instructions:

1. Select a catalog number (will automatically fill in Open Area and Perimeter) or enter your own values
2. Enter head value
3. Click "calculate"

The results will determine automatically if your situation falls into a Weir, Transitional or Orifice flow. Additionally, Neenah grates which fall within the parameters chosen will appear below the calculator.

Catalog Number and Grate Type:

R-3065-L:L

Feet perimeter (P):	Head in feet (h):	Free open area in sq. ft. (A):
2.85	0.21	1.55

Calculate

Weir capacity in cfs:	Transitional flow in cfs:	Orifice capacity in cfs:
0.9		

STR # 1

For additional information regarding Neenah Inlet Grate Capacities, please contact Steven Akkala P.E., at (920) 729.3653 or email at steve.akkala@neenahenterprises.com.

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WEIR & ORIFICE CALCULATOR

The Weir and Orifice Calculator is used to determine the inlet capacity in sag (ponding) conditions by use of the Weir and Orifice equations. Knowing this information will allow you to select the proper grate type and size for your specific job or project.

Weir Flow Calculations

Weir Equation: $Q = 3.3P(h)^{1.5}$

- **Q** = Capacity in CFS
- **P** = Feet perimeter
- **h** = Head in feet
- Weir Information

Orifice Flow Calculations

Orifice Flow Equation: $Q = 0.6A\sqrt{2gh}$

- **Q** = Capacity in CFS
- **A** = Free open area of grate in sq. ft.
- **g** = 32.2 (feet per sec/sec)
- **h** = Head in feet
- Orifice Information

Instructions:

1. Select a catalog number (will automatically fill in Open Area and Perimeter) or enter your own values
2. Enter head value
3. Click "calculate"

The results will determine automatically if your situation falls into a Weir, Transitional or Orifice flow. Additionally, Neenah grates which fall within the parameters chosen will appear below the calculator.

Catalog Number and Grate Type:

R-4215-C:Beehive

Feet perimeter (P):	Head in feet (h):	Free open area in sq. ft. (A):
5.65	0.27	1.65

Calculate

Weir capacity in cfs:	Transitional flow in cfs:	Orifice capacity in cfs:
2.6		

STR #2

For additional information regarding Neenah Inlet Grate Capacities, please contact Steven Akkala P.E., at (920) 729.3653 or email at steve.akkala@neenahenterprises.com.

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WEIR & ORIFICE CALCULATOR

The Weir and Orifice Calculator is used to determine the inlet capacity in sag (ponding) conditions by use of the Weir and Orifice equations. Knowing this information will allow you to select the proper grate type and size for your specific job or project.

Weir Flow Calculations

Weir Equation: $Q = 3.3P(h)^{1.5}$

- **Q** = Capacity in CFS
- **P** = Feet perimeter
- **h** = Head in feet
- Weir Information

Orifice Flow Calculations

Orifice Flow Equation: $Q = 0.6A\sqrt{2gh}$

- **Q** = Capacity in CFS
- **A** = Free open area of grate in sq. ft.
- **g** = 32.2 (feet per sec/sec)
- **h** = Head in feet
- Orifice Information

Instructions:

1. Select a catalog number (will automatically fill in Open Area and Perimeter) or enter your own values
2. Enter head value
3. Click "calculate"

The results will determine automatically if your situation falls into a Weir, Transitional or Orifice flow. Additionally, Neenah grates which fall within the parameters chosen will appear below the calculator.

Catalog Number and Grate Type:

R-4215-C:Beehive

Feet perimeter (P):	Head in feet (h):	Free open area in sq. ft. (A):
5.65	0.26	1.65

Calculate

Weir capacity in cfs:	Transitional flow in cfs:	Orifice capacity in cfs:
2.5		

STR # 3

For additional information regarding Neenah Inlet Grate Capacities, please contact Steven Akkala P.E., at (920) 729.3653 or email at steve.akkala@neenahenterprises.com.

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Modified Manning Calculators

Weir and Orifice Calculator

Weir Flow

Orifice Flow

Curb Opening Hydraulics Calculator

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WEIR & ORIFICE CALCULATOR

The Weir and Orifice Calculator is used to determine the inlet capacity in sag (ponding) conditions by use of the Weir and Orifice equations. Knowing this information will allow you to select the proper grate type and size for your specific job or project.

Weir Flow Calculations

Weir Equation: $Q = 3.3P(h)^{1.5}$

- **Q** = Capacity in CFS
- **P** = Feet perimeter
- **h** = Head in feet
- Weir Information

Orifice Flow Calculations

Orifice Flow Equation: $Q = 0.6A\sqrt{2gh}$

- **Q** = Capacity in CFS
- **A** = Free open area of grate in sq. ft.
- **g** = 32.2 (feet per sec/sec)
- **h** = Head in feet
- Orifice Information

Instructions:

1. Select a catalog number (will automatically fill in Open Area and Perimeter) or enter your own values
2. Enter head value
3. Click "calculate"

The results will determine automatically if your situation falls into a Weir, Transitional or Orifice flow. Additionally, Neenah grates which fall within the parameters chosen will appear below the calculator.

Catalog Number and Grate Type:

R-4215-C:Beehive

Feet perimeter (P):	Head in feet (h):	Free open area in sq. ft. (A):
5.65	0.24	1.65

Calculate

Weir capacity in cfs:	Transitional flow in cfs:	Orifice capacity in cfs:
2.2		

STR #5

For additional information regarding Neenah Inlet Grate Capacities, please contact Steven Akkala P.E., at (920) 729.3653 or email at steve.akkala@neenahenterprises.com.

MUNICIPAL PRODUCT SEARCH

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- Modified Manning Calculators
  - Program Methodology
  - Inlet Spacing
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- Curb Opening Hydraulics Calculator
- R-4999 Vane Trench Grate Hydraulics
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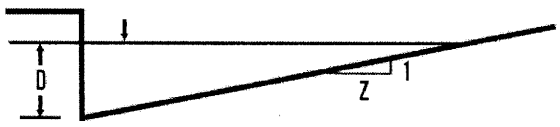
MANNING EQUATION CALCULATOR

The Modified Manning Equation is used to calculate flow velocities and volume (in cubic feet per second or cfs). This information is vitally important when selecting a grate type and size for a given project.



$$Q = \frac{0.56}{N} Z D^{8/3} S^{1/2}$$

Where...

D = Depth of flow in feet

S = Longitudinal slope

Q = Channel flow in cfs (calculated)

N = Roughness coefficient at constant 0.016 (value for concrete and asphalt)

Z = Reciprocal of transverse slope (1/ST)

INSTRUCTIONS

Step 1

Enter the Longitudinal and Transverse Slopes. Enter one of the remaining variables and then press calculate:

- Depth of Flow (D)
- Total flow in cfs (Q)
- Spread of flow in feet

Step 2

To Calculate flow capture of specific Neenah Grates, select a catalog number and grate style from the K Chart drop-down.

1. Select the catalog number for the appropriate "K" chart and from the chart "Determine the "K" value based on the Longitudinal and Transverse slopes entered in Step 1.
2. Derive the Grate Coefficient by plotting the Transverse Slope (ST) and Longitudinal Slope factors onto the K Chart.
3. Enter the "K" value in the space provided.
4. Press Calculate.

Step 1

	Alternate One	Alternate Two	Alternate Three
Depth of flow in feet (D): [?]	0.136		
Transverse Slope in ft./ft. (ST): [?]	0.02		
Longitudinal Slope in ft./ft. (SL): [?]	0.005		
Roughness coefficient (N): (value for concrete or asphalt)	0.016	0.016	0.016
Total flow in cfs (Q): [?]	0.60		
Spread of flow in feet: [?]	6.800		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

STR #6

Step 2

Catalog numbers and grate types that have K-charts: [?]	3065-L		
Grate Coefficient from K-chart (K):	13		
Grate capacity in cfs: [?]	0.47		
Bypass flow in cfs:	0.13		
Percent captured:	78.33		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

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Program Methodology

If your inlet is not capturing enough of the flow, some improvement options include:

Utilizing the improved efficiency of vane style grates Pg 112

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Guards
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Roll & Gutter Inlets
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Drainage Grates
Tree Grates
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LiftMate
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STR # 6

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- Modified Manning Calculators
- Weir and Orifice Calculator
  - Weir Flow
  - Orifice Flow
- Curb Opening Hydraulics Calculator
- R-4999 Vane Trench Grate Hydraulics
- Neenah Grate Information
- Engineering Literature & Videos

WEIR & ORIFICE CALCULATOR

The Weir and Orifice Calculator is used to determine the inlet capacity in sag (ponding) conditions by use of the Weir and Orifice equations. Knowing this information will allow you to select the proper grate type and size for your specific job or project.

Weir Flow Calculations

Weir Equation: $Q = 3.3P(h)^{1.5}$

- **Q** = Capacity in CFS
- **P** = Feet perimeter
- **h** = Head in feet
- Weir Information

Orifice Flow Calculations

Orifice Flow Equation: $Q = 0.6A\sqrt{2gh}$

- **Q** = Capacity in CFS
- **A** = Free open area of grate in sq. ft.
- **g** = 32.2 (feet per sec/sec)
- **h** = Head in feet
- Orifice Information

Instructions:

1. Select a catalog number (will automatically fill in Open Area and Perimeter) or enter your own values
2. Enter head value
3. Click "calculate"

The results will determine automatically if your situation falls into a Weir, Transitional or Orifice flow. Additionally, Neenah grates which fall within the parameters chosen will appear below the calculator.

Catalog Number and Grate Type:

R-3065-L:L

Feet perimeter (P):	Head in feet (h):	Free open area in sq. ft. (A):
5.7	0.22	3.10

Calculate

Weir capacity in cfs:	Transitional flow in cfs:	Orifice capacity in cfs:
1.9		

STR # 7 + 7a Combined

Based on weir flow, the following grates match the criteria you entered.

Catalog Number	Grate Type
R-1878-B1G	A
R-1879-B1G	A
R-1881-E	P
R-2474	A
R-2474	G

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Weir Flow Calculations

Weir Equation: $Q = 3.3P(h)^{1.5}$

- **Q** = Capacity in CFS
- **P** = Feet perimeter
- **h** = Head in feet
- Weir Information

Orifice Flow Calculations

Orifice Flow Equation: $Q = 0.6A\sqrt{2gh}$

- **Q** = Capacity in CFS
- **A** = Free open area of grate in sq. ft.
- **g** = 32.2 (feet per sec/sec)
- **h** = Head in feet
- Orifice Information

Instructions:

1. Select a catalog number (will automatically fill in Open Area and Perimeter) or enter your own values
2. Enter head value
3. Click "calculate"

The results will determine automatically if your situation falls into a Weir, Transitional or Orifice flow. Additionally, Neenah grates which fall within the parameters chosen will appear below the calculator.

Catalog Number and Grate Type:

R-3065-L:L

Feet perimeter (P):	Head in feet (h):	Free open area in sq. ft. (A):
5.7	0.15	3.10

Calculate

Weir capacity in cfs:	Transitional flow in cfs:	Orifice capacity in cfs:
1.1		

Based on weir flow, the following grates match the criteria you entered.

STR #8 & 8a
Combined

Catalog Number	Grate Type
R-1878-B1G	A
R-1879-B1G	A
R-1881-E	P
R-2474	A
R-2474	G

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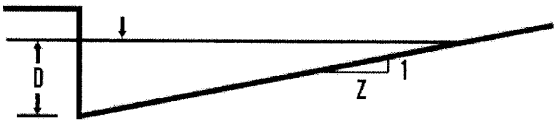

$$Q = \frac{0.56}{N} Z D^{8/3} S^{1/2}$$

Where...

D = Depth of flow in feet

S = Longitudinal slope

Q = Channel flow in cfs (calculated)

N = Roughness coefficient at constant 0.016 (value for concrete and asphalt)

Z = Reciprocal of transverse slope (1/ST)

INSTRUCTIONS

Step 1

Enter the Longitudinal and Transverse Slopes. Enter one of the remaining variables and then press calculate:

- Depth of Flow (D)
- Total flow in cfs (Q)
- Spread of flow in feet

Step 2

To Calculate flow capture of specific Neenah Grates, select a catalog number and grate style from the K Chart drop-down.

1. Select the catalog number for the appropriate "K" chart and from the chart "Determine the "K" value based on the Longitudinal and Transverse slopes entered in Step 1.
2. Derive the Grate Coefficient by plotting the Transverse Slope (ST) and Longitudinal Slope factors onto the K Chart.
3. Enter the "K" value in the space provided.
4. Press Calculate.

Step 1

	Alternate One	Alternate Two	Alternate Three
Depth of flow in feet (D): [?]	0.155		
Transverse Slope in ft./ft. (ST): [?]	0.02		
Longitudinal Slope in ft./ft. (SL): [?]	0.005		
Roughness coefficient (N): (value for concrete or asphalt)	0.016	0.016	0.016
Total flow in cfs (Q): [?]	0.86		
Spread of flow in feet: [?]	7.750		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

STR # 10

Step 2

Catalog numbers and grate types that have K-charts: [?]	3065-L		
Grate Coefficient from K-chart (K):	13		
Grate capacity in cfs: [?]	0.58		
Bypass flow in cfs:	0.28		
Percent captured:	67.44		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

For additional information regarding Neenah Inlet Grate Capacities, please contact Steven Akkala P.E., at (920) 729.3653 or email at steve.akkala@neenahenterprises.com.

Program Methodology

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Trench Castings
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Access & Hatch Covers
Guards
Stop Plates & Grooves
Roll & Gutter Inlets
Bridge Scuppers
Drainage Grates
Tree Grates
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STR #10

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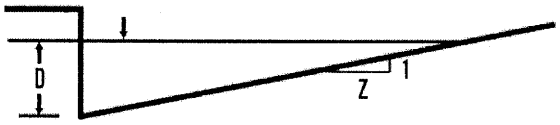
MANNING EQUATION CALCULATOR

The Modified Manning Equation is used to calculate flow velocities and volume (in cubic feet per second or cfs). This information is vitally important when selecting a grate type and size for a given project.



$$Q = \frac{0.56}{N} Z D^{8/3} S^{1/2}$$

Where...

D = Depth of flow in feet

S = Longitudinal slope

Q = Channel flow in cfs (calculated)

N = Roughness coefficient at constant 0.016 (value for concrete and asphalt)

Z = Reciprocal of transverse slope (1/ST)

INSTRUCTIONS

Step 1

Enter the Longitudinal and Transverse Slopes. Enter one of the remaining variables and then press calculate:

- Depth of Flow (D)
- Total flow in cfs (Q)
- Spread of flow in feet

Step 2

To Calculate flow capture of specific Neenah Grates, select a catalog number and grate style from the K Chart drop-down.

1. Select the catalog number for the appropriate "K" chart and from the chart "Determine the "K" value based on the Longitudinal and Transverse slopes entered in Step 1.
2. Derive the Grate Coefficient by plotting the Transverse Slope (ST) and Longitudinal Slope factors onto the K Chart.
3. Enter the "K" value in the space provided.
4. Press Calculate.

Step 1

	Alternate One	Alternate Two	Alternate Three
Depth of flow in feet (D): [?]	0.15		
Transverse Slope in ft./ft. (ST): [?]	0.02		
Longitudinal Slope in ft./ft. (SL): [?]	0.005		
Roughness coefficient (N): (value for concrete or asphalt)	0.016	0.016	0.016
Total flow in cfs (Q): [?]	0.48		
Spread of flow in feet: [?]	7.500		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

STR# 11

Step 2

Catalog numbers and grate types that have K-charts: [?]	3065-L		
Grate Coefficient from K-chart (K):	13		
Grate capacity in cfs: [?]	0.55		
Bypass flow in cfs:	-0.07		
Percent captured:	114.58		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

For additional information regarding Neenah Inlet Grate Capacities, please contact Steven Akkala P.E., at (920) 729.3653 or email at steve.akkala@neenahenterprises.com.

Program Methodology

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Guards
Stop Plates & Grooves
Roll & Gutter Inlets
Bridge Scuppers
Drainage Grates
Tree Grates
LiftMate
LiftMate
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Sign Bases
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Where...

D = Depth of flow in feet

S = Longitudinal slope

Q = Channel flow in cfs (calculated)

N = Roughness coefficient at constant 0.016 (value for concrete and asphalt)

Z = Reciprocal of transverse slope (1/ST)

INSTRUCTIONS

Step 1

Enter the Longitudinal and Transverse Slopes. Enter one of the remaining variables and then press calculate:

- Depth of Flow (D)
- Total flow in cfs (Q)
- Spread of flow in feet

Step 2

To Calculate flow capture of specific Neenah Grates, select a catalog number and grate style from the K Chart drop-down.

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2. Derive the Grate Coefficient by plotting the Transverse Slope (ST) and Longitudinal Slope factors onto the K Chart.
3. Enter the "K" value in the space provided.
4. Press Calculate.

Step 1

	Alternate One	Alternate Two	Alternate Three
Depth of flow in feet (D): [?]	0.15		
Transverse Slope in ft./ft. (ST): [?]	0.02		
Longitudinal Slope in ft./ft. (SL): [?]	0.005		
Roughness coefficient (N): (value for concrete or asphalt)	0.016	0.016	0.016
Total flow in cfs (Q): [?]	0.49		
Spread of flow in feet: [?]	7.500		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

STR # 13

Step 2

Catalog numbers and grate types that have K-charts: [?]	3065-L		
Grate Coefficient from K-chart (K):	13		
Grate capacity in cfs: [?]	0.55		
Bypass flow in cfs:	-0.06		
Percent captured:	112.24		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

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Program Methodology

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STR #13

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Weir Flow Calculations

Weir Equation: $Q = 3.3P(h)^{1.5}$

- **Q** = Capacity in CFS
- **P** = Feet perimeter
- **h** = Head in feet
- Weir Information

Orifice Flow Calculations

Orifice Flow Equation: $Q = 0.6A\sqrt{2gh}$

- **Q** = Capacity in CFS
- **A** = Free open area of grate in sq. ft.
- **g** = 32.2 (feet per sec/sec)
- **h** = Head in feet
- Orifice Information

Instructions:

1. Select a catalog number (will automatically fill in Open Area and Perimeter) or enter your own values
2. Enter head value
3. Click "calculate"

The results will determine automatically if your situation falls into a Weir, Transitional or Orifice flow. Additionally, Neenah grates which fall within the parameters chosen will appear below the calculator.

Catalog Number and Grate Type:

R-4215-C:Beehive

Feet perimeter (P):	Head in feet (h):	Free open area in sq. ft. (A):
5.65	0.20	1.65

Calculate

Weir capacity in cfs:	Transitional flow in cfs:	Orifice capacity in cfs:
1.7		

STR #16

For additional information regarding Neenah Inlet Grate Capacities, please contact Steven Akkala P.E., at (920) 729.3653 or email at steve.akkala@neenahenterprises.com.

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WEIR & ORIFICE CALCULATOR

The Weir and Orifice Calculator is used to determine the inlet capacity in sag (ponding) conditions by use of the Weir and Orifice equations. Knowing this information will allow you to select the proper grate type and size for your specific job or project.

Weir Flow Calculations

Weir Equation: $Q = 3.3P(h)^{1.5}$

- **Q** = Capacity in CFS
- **P** = Feet perimeter
- **h** = Head in feet
- Weir Information

Orifice Flow Calculations

Orifice Flow Equation: $Q = 0.6A\sqrt{2gh}$

- **Q** = Capacity in CFS
- **A** = Free open area of grate in sq. ft.
- **g** = 32.2 (feet per sec/sec)
- **h** = Head in feet
- Orifice Information

Instructions:

1. Select a catalog number (will automatically fill in Open Area and Perimeter) or enter your own values
2. Enter head value
3. Click "calculate"

The results will determine automatically if your situation falls into a Weir, Transitional or Orifice flow. Additionally, Neenah grates which fall within the parameters chosen will appear below the calculator.

Catalog Number and Grate Type:

R-2560-D2:Beehive

Feet perimeter (P):	Head in feet (h):	Free open area in sq. ft. (A):
2.9	0.37	0.6

Calculate

Weir capacity in cfs:	Transitional flow in cfs:	Orifice capacity in cfs:
		1.8

STR#17

Based on orifice flow, the following grates match the criteria you entered.

Catalog Number	Grate Type
R-1878-B1G	A
R-1879-B1G	A
R-2077	F
R-2100	F
R-2112	F

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- **P** = Feet perimeter
- **h** = Head in feet
- Weir Information

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Orifice Flow Equation: $Q = 0.6A\sqrt{2gh}$

- **Q** = Capacity in CFS
- **A** = Free open area of grate in sq. ft.
- **g** = 32.2 (feet per sec/sec)
- **h** = Head in feet
- Orifice Information

Instructions:

1. Select a catalog number (will automatically fill in Open Area and Perimeter) or enter your own values
2. Enter head value
3. Click "calculate"

The results will determine automatically if your situation falls into a Weir, Transitional or Orifice flow. Additionally, Neenah grates which fall within the parameters chosen will appear below the calculator.

Catalog Number and Grate Type:

R-3065-L:L

Feet perimeter (P):	Head in feet (h):	Free open area in sq. ft. (A):
2.85	0.24	1.55

Calculate

Weir capacity in cfs:	Transitional flow in cfs:	Orifice capacity in cfs:
1.1		

STR # 18b19

For additional information regarding Neenah Inlet Grate Capacities, please contact Steven Akkala P.E., at (920) 729.3653 or email at steve.akkala@neenahenterprises.com.

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MANNING EQUATION CALCULATOR

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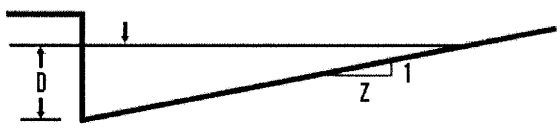

$$Q = \frac{0.56}{N} Z D^{8/3} S^{1/2}$$

Where...

D = Depth of flow in feet

S = Longitudinal slope

Q = Channel flow in cfs (calculated)

N = Roughness coefficient at constant 0.016 (value for concrete and asphalt)

Z = Reciprocal of transverse slope (1/ST)

INSTRUCTIONS

Step 1

Enter the Longitudinal and Transverse Slopes. Enter one of the remaining variables and then press calculate:

- Depth of Flow (D)
- Total flow in cfs (Q)
- Spread of flow in feet

Step 2

To Calculate flow capture of specific Neenah Grates, select a catalog number and grate style from the K Chart drop-down.

1. Select the catalog number for the appropriate "K" chart and from the chart "Determine the "K" value based on the Longitudinal and Transverse slopes entered in Step 1.
2. Derive the Grate Coefficient by plotting the Transverse Slope (ST) and Longitudinal Slope factors onto the K Chart.
3. Enter the "K" value in the space provided.
4. Press Calculate.

STR #21 + 22

Step 1

	Alternate One	Alternate Two	Alternate Three
Depth of flow in feet (D): [?]	0.091		
Transverse Slope in ft./ft. (ST): [?]	0.02		
Longitudinal Slope in ft./ft. (SL): [?]	0.015		
Roughness coefficient (N): (value for concrete or asphalt)	0.016	0.016	0.016
Total flow in cfs (Q): [?]	0.36		
Spread of flow in feet: [?]	4.550		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

Step 2

Catalog numbers and grate types that have K-charts: [?]	3065-L		
Grate Coefficient from K-chart (K):	17		
Grate capacity in cfs: [?]	0.31		
Bypass flow in cfs:	0.05		
Percent captured:	86.11		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

For additional information regarding Neenah Inlet Grate Capacities, please contact Steven Akkala P.E., at (920) 729.3653 or email at steve.akkala@neenahenterprises.com.

Program Methodology

If your inlet is not capturing enough of the flow, some improvement options include:

Utilizing the improved efficiency of vane style grates Pg 112

Improve spread of flow capture utilizing the Neenah R-3599 Slotted Vane Drain System

Remove significant amounts of water utilizing Neenah's R-4999 Vane Style Transverse Drainage Structure Series

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Access & Hatch Covers
Guards
Stop Plates & Grooves
Roll & Gutter Inlets
Bridge Scuppers
Drainage Grates
Tree Grates
LiftMate
LiftMate
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MANNING EQUATION CALCULATOR

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$$Q = \frac{0.56}{N} Z D^{8/3} S^{1/2}$$

Where...

D = Depth of flow in feet

S = Longitudinal slope

Q = Channel flow in cfs (calculated)

N = Roughness coefficient at constant 0.016 (value for concrete and asphalt)

Z = Reciprocal of transverse slope (1/ST)

INSTRUCTIONS

Step 1

Enter the Longitudinal and Transverse Slopes. Enter one of the remaining variables and then press calculate:

- Depth of Flow (D)
- Total flow in cfs (Q)
- Spread of flow in feet

Step 2

To Calculate flow capture of specific Neenah Grates, select a catalog number and grate style from the K Chart drop-down.

1. Select the catalog number for the appropriate "K" chart and from the chart "Determine the "K" value based on the Longitudinal and Transverse slopes entered in Step 1.
2. Derive the Grate Coefficient by plotting the Transverse Slope (ST) and Longitudinal Slope factors onto the K Chart.
3. Enter the "K" value in the space provided.
4. Press Calculate.

Step 1

	Alternate One	Alternate Two	Alternate Three
Depth of flow in feet (D): [?]	0.143		
Transverse Slope in ft./ft. (ST): [?]	0.02		
Longitudinal Slope in ft./ft. (SL): [?]	0.0103		
Roughness coefficient (N): (value for concrete or asphalt)	0.016	0.016	0.016
Total flow in cfs (Q): [?]	0.99		
Spread of flow in feet: [?]	7.150		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

STR #26

Step 2

Catalog numbers and grate types that have K-charts: [?]	3065-L		
Grate Coefficient from K-chart (K):	13		
Grate capacity in cfs: [?]	0.51		
Bypass flow in cfs:	0.48		
Percent captured:	51.52		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

For additional information regarding Neenah Inlet Grate Capacities, please contact Steven Akkala P.E., at (920) 729.3653 or email at steve.akkala@neenahenterprises.com.

Program Methodology

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Trench Castings
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Access & Hatch Covers
Guards
Stop Plates & Grooves
Roll & Gutter Inlets
Bridge Scuppers
Drainage Grates
Tree Grates
LiftMate
LiftMate
Ballast Screens
Sign Bases
Downspout Shoes
Catch Basin Traps
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$$Q = \frac{0.56}{N} Z D^{8/3} S^{1/2}$$

Where...

D = Depth of flow in feet

S = Longitudinal slope

Q = Channel flow in cfs (calculated)

N = Roughness coefficient at constant 0.016 (value for concrete and asphalt)

Z = Reciprocal of transverse slope (1/ST)

INSTRUCTIONS

Step 1

Enter the Longitudinal and Transverse Slopes. Enter one of the remaining variables and then press calculate:

- Depth of Flow (D)
- Total flow in cfs (Q)
- Spread of flow in feet

Step 2

To Calculate flow capture of specific Neenah Grates, select a catalog number and grate style from the K Chart drop-down.

1. Select the catalog number for the appropriate "K" chart and from the chart "Determine the "K" value based on the Longitudinal and Transverse slopes entered in Step 1.
2. Derive the Grate Coefficient by plotting the Transverse Slope (ST) and Longitudinal Slope factors onto the K Chart.
3. Enter the "K" value in the space provided.
4. Press Calculate.

Step 1

	Alternate One	Alternate Two	Alternate Three
Depth of flow in feet (D): [?]	0.113		
Transverse Slope in ft./ft. (ST): [?]	0.02		
Longitudinal Slope in ft./ft. (SL): [?]	0.0103		
Roughness coefficient (N): (value for concrete or asphalt)	0.016	0.016	0.016
Total flow in cfs (Q): [?]	0.53		
Spread of flow in feet: [?]	5.650		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

STR #27

Step 2

Catalog numbers and grate types that have K-charts: [?]	3065-L		
Grate Coefficient from K-chart (K):	13		
Grate capacity in cfs: [?]	0.34		
Bypass flow in cfs:	0.19		
Percent captured:	64.15		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

For additional information regarding Neenah Inlet Grate Capacities, please contact Steven Akkala P.E., at (920) 729.3653 or email at steve.akkala@neenahenterprises.com.

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Weir Flow Calculations

Weir Equation: $Q = 3.3P(h)^{1.5}$

- **Q** = Capacity in CFS
- **P** = Feet perimeter
- **h** = Head in feet
- Weir Information

Orifice Flow Calculations

Orifice Flow Equation: $Q = 0.6A\sqrt{2gh}$

- **Q** = Capacity in CFS
- **A** = Free open area of grate in sq. ft.
- **g** = 32.2 (feet per sec/sec)
- **h** = Head in feet
- Orifice Information

Instructions:

1. Select a catalog number (will automatically fill in Open Area and Perimeter) or enter your own values
2. Enter head value
3. Click "calculate"

The results will determine automatically if your situation falls into a Weir, Transitional or Orifice flow. Additionally, Neenah grates which fall within the parameters chosen will appear below the calculator.

Catalog Number and Grate Type:

R-4215-C:Beehive

Feet perimeter (P):	Head in feet (h):	Free open area in sq. ft. (A):
5.65	0.28	1.65

Calculate

Weir capacity in cfs:	Transitional flow in cfs:	Orifice capacity in cfs:
2.8		

STR#28

For additional information regarding Neenah Inlet Grate Capacities, please contact Steven Akkala P.E., at (920) 729.3653 or email at steve.akkala@neenahenterprises.com.

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- **h** = Head in feet
- Orifice Information

Instructions:

1. Select a catalog number (will automatically fill in Open Area and Perimeter) or enter your own values
2. Enter head value
3. Click "calculate"

The results will determine automatically if your situation falls into a Weir, Transitional or Orifice flow. Additionally, Neenah grates which fall within the parameters chosen will appear below the calculator.

Catalog Number and Grate Type:

R-3065-L:L

Feet perimeter (P):	Head in feet (h):	Free open area in sq. ft. (A):
5.7	0.21	3.10

Calculate

Weir capacity in cfs:	Transitional flow in cfs:	Orifice capacity in cfs:
1.8		

SHR # 30 + 30a Combined

Based on weir flow, the following grates match the criteria you entered.

Catalog Number	Grate Type
R-1878-B1G	A
R-1879-B1G	A
R-1881-E	P
R-2474	A
R-2474	G

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- **h** = Head in feet
- Weir Information

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- **Q** = Capacity in CFS
- **A** = Free open area of grate in sq. ft.
- **g** = 32.2 (feet per sec/sec)
- **h** = Head in feet
- Orifice Information

Instructions:

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2. Enter head value
3. Click "calculate"

The results will determine automatically if your situation falls into a Weir, Transitional or Orifice flow. Additionally, Neenah grates which fall within the parameters chosen will appear below the calculator.

Catalog Number and Grate Type:

R-3065-L:L

Feet perimeter (P):	Head in feet (h):	Free open area in sq. ft. (A):
5.70	0.12	3.10

Calculate

Weir capacity in cfs:	Transitional flow in cfs:	Orifice capacity in cfs:
0.8		

STR# 31+31a

Based on weir flow, the following grates match the criteria you entered.

Catalog Number	Grate Type
R-1878-B1G	A
R-1879-B1G	A
R-1881-E	P
R-2474	A
R-2474	G

MUNICIPAL PRODUCT SEARCH

Enter a product number. Go

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- **P** = Feet perimeter
- **h** = Head in feet
- Weir Information

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- **Q** = Capacity in CFS
- **A** = Free open area of grate in sq. ft.
- **g** = 32.2 (feet per sec/sec)
- **h** = Head in feet
- Orifice Information

Instructions:

1. Select a catalog number (will automatically fill in Open Area and Perimeter) or enter your own values
2. Enter head value
3. Click "calculate"

The results will determine automatically if your situation falls into a Weir, Transitional or Orifice flow. Additionally, Neenah grates which fall within the parameters chosen will appear below the calculator.

Catalog Number and Grate Type:

R-3065-L:L

Feet perimeter (P):	Head in feet (h):	Free open area in sq. ft. (A):
2.85	0.20	1.55

Calculate

Weir capacity in cfs:	Transitional flow in cfs:	Orifice capacity in cfs:
0.8		

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For additional information regarding Neenah Inlet Grate Capacities, please contact Steven Akkala P.E., at (920) 729.3653 or email at steve.akkala@neenahenterprises.com.

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WEIR & ORIFICE CALCULATOR

The Weir and Orifice Calculator is used to determine the inlet capacity in sag (ponding) conditions by use of the Weir and Orifice equations. Knowing this information will allow you to select the proper grate type and size for your specific job or project.

Weir Flow Calculations

Weir Equation: $Q = 3.3P(h)^{1.5}$

- **Q** = Capacity in CFS
- **P** = Feet perimeter
- **h** = Head in feet
- Weir Information

Orifice Flow Calculations

Orifice Flow Equation: $Q = 0.6A\sqrt{2gh}$

- **Q** = Capacity in CFS
- **A** = Free open area of grate in sq. ft.
- **g** = 32.2 (feet per sec/sec)
- **h** = Head in feet
- Orifice Information

Instructions:

1. Select a catalog number (will automatically fill in Open Area and Perimeter) or enter your own values
2. Enter head value
3. Click "calculate"

The results will determine automatically if your situation falls into a Weir, Transitional or Orifice flow. Additionally, Neenah grates which fall within the parameters chosen will appear below the calculator.

Catalog Number and Grate Type:

R-3065-L:L

Feet perimeter (P):	Head in feet (h):	Free open area in sq. ft. (A):
2.85	0.12	1.55

Calculate

Weir capacity in cfs:	Transitional flow in cfs:	Orifice capacity in cfs:
0.4		

STR #34

For additional information regarding Neenah Inlet Grate Capacities, please contact Steven Akkala P.E., at (920) 729.3653 or email at steve.akkala@neenahenterprises.com.

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Instructions:

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2. Enter head value
3. Click "calculate"

The results will determine automatically if your situation falls into a Weir, Transitional or Orifice flow. Additionally, Neenah grates which fall within the parameters chosen will appear below the calculator.

Catalog Number and Grate Type:

R-3065-L:L

Feet perimeter (P):	Head in feet (h):	Free open area in sq. ft. (A):
5.7	0.19	3.10

Calculate

Weir capacity in cfs:	Transitional flow in cfs:	Orifice capacity in cfs:
1.6		

STR# 36-P36a

Based on weir flow, the following grates match the criteria you entered.

Catalog Number	Grate Type
R-1878-B1G	A
R-1879-B1G	A
R-1881-E	P
R-2474	A
R-2474	G

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- **h** = Head in feet
- Weir Information

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- **Q** = Capacity in CFS
- **A** = Free open area of grate in sq. ft.
- **g** = 32.2 (feet per sec/sec)
- **h** = Head in feet
- Orifice Information

Instructions:

1. Select a catalog number (will automatically fill in Open Area and Perimeter) or enter your own values
2. Enter head value
3. Click "calculate"

The results will determine automatically if your situation falls into a Weir, Transitional or Orifice flow. Additionally, Neenah grates which fall within the parameters chosen will appear below the calculator.

Catalog Number and Grate Type:

R-3065-L:L

Feet perimeter (P):	Head in feet (h):	Free open area in sq. ft. (A):
2.85	0.21	1.55

Calculate

Weir capacity in cfs:	Transitional flow in cfs:	Orifice capacity in cfs:
0.9		

STR #37

For additional information regarding Neenah Inlet Grate Capacities, please contact Steven Akkala P.E., at (920) 729.3653 or email at steve.akkala@neenahenterprises.com.

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MANNING EQUATION CALCULATOR

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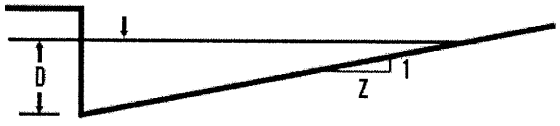

$$Q = \frac{0.56}{N} Z D^{8/3} S^{1/2}$$

Where...

D = Depth of flow in feet

S = Longitudinal slope

Q = Channel flow in cfs (calculated)

N = Roughness coefficient at constant 0.016 (value for concrete and asphalt)

Z = Reciprocal of transverse slope (1/ST)

INSTRUCTIONS

Step 1

Enter the Longitudinal and Transverse Slopes. Enter one of the remaining variables and then press calculate:

- Depth of Flow (D)
- Total flow in cfs (Q)
- Spread of flow in feet

Step 2

To Calculate flow capture of specific Neenah Grates, select a catalog number and grate style from the K Chart drop-down.

1. Select the catalog number for the appropriate "K" chart and from the chart "Determine the "K" value based on the Longitudinal and Transverse slopes entered in Step 1.
2. Derive the Grate Coefficient by plotting the Transverse Slope (ST) and Longitudinal Slope factors onto the K Chart.
3. Enter the "K" value in the space provided.
4. Press Calculate.

Step 1

	Alternate One	Alternate Two	Alternate Three
Depth of flow in feet (D): [?]	0.168		
Transverse Slope in ft./ft. (ST): [?]	0.02		
Longitudinal Slope in ft./ft. (SL): [?]	0.0075		
Roughness coefficient (N): (value for concrete or asphalt)	0.016	0.016	0.016
Total flow in cfs (Q): [?]	1.30		
Spread of flow in feet: [?]	8.400		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

STR #39

Step 2

Catalog numbers and grate types that have K-charts: [?]	Select Product		
Grate Coefficient from K-chart (K):	13		
Grate capacity in cfs: [?]	0.66		
Bypass flow in cfs:	0.64		
Percent captured:	50.77		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

For additional information regarding Neenah Inlet Grate Capacities, please contact Steven Akkala P.E., at (920) 729.3653 or email at steve.akkala@neenahenterprises.com.

Program Methodology

If your inlet is not capturing enough of the flow, some improvement options include:

Utilizing the improved efficiency of vane style grates Pg 112

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Roll & Gutter Inlets
Bridge Scuppers
Drainage Grates
Tree Grates
LiftMate
LiftMate
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Sign Bases
Downspout Shoes
Catch Basin Traps
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MANNING EQUATION CALCULATOR

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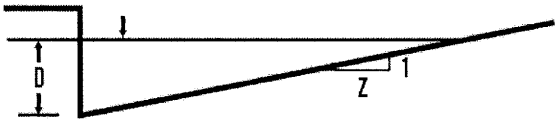

$$Q = \frac{0.56}{N} Z D^{8/3} S^{1/2}$$

Where...

D = Depth of flow in feet

S = Longitudinal slope

Q = Channel flow in cfs (calculated)

N = Roughness coefficient at constant 0.016 (value for concrete and asphalt)

Z = Reciprocal of transverse slope (1/ST)

INSTRUCTIONS

Step 1

Enter the Longitudinal and Transverse Slopes. Enter one of the remaining variables and then press calculate:

- Depth of Flow (D)
- Total flow in cfs (Q)
- Spread of flow in feet

Step 2

To Calculate flow capture of specific Neenah Grates, select a catalog number and grate style from the K Chart drop-down.

1. Select the catalog number for the appropriate "K" chart and from the chart "Determine the "K" value based on the Longitudinal and Transverse slopes entered in Step 1.
2. Derive the Grate Coefficient by plotting the Transverse Slope (ST) and Longitudinal Slope factors onto the K Chart.
3. Enter the "K" value in the space provided.
4. Press Calculate.

STR #40

Step 1

	Alternate One	Alternate Two	Alternate Three
Depth of flow in feet (D): [?]	0.093		
Transverse Slope in ft./ft. (ST): [?]	0.02		
Longitudinal Slope in ft./ft. (SL): [?]	0.0075		
Roughness coefficient (N): (value for concrete or asphalt)	0.016	0.016	0.016
Total flow in cfs (Q): [?]	0.27		
Spread of flow in feet: [?]	4.650		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

Step 2

Catalog numbers and grate types that have K-charts: [?]	Select Product		
Grate Coefficient from K-chart (K):	13		
Grate capacity in cfs: [?]	0.25		
Bypass flow in cfs:	0.02		
Percent captured:	92.59		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

For additional information regarding Neenah Inlet Grate Capacities, please contact Steven Akkala P.E., at (920) 729.3653 or email at steve.akkala@neenahenterprises.com.

Program Methodology

If your inlet is not capturing enough of the flow, some improvement options include:

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Trench Castings
Valves & Gates
Access & Hatch Covers
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Roll & Gutter Inlets
Bridge Scuppers
Drainage Grates
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STR #40

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  - Orifice Flow
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Weir Flow Calculations

Weir Equation: $Q = 3.3P(h)^{1.5}$

- **Q** = Capacity in CFS
- **P** = Feet perimeter
- **h** = Head in feet
- Weir Information

Orifice Flow Calculations

Orifice Flow Equation: $Q = 0.6A\sqrt{2gh}$

- **Q** = Capacity in CFS
- **A** = Free open area of grate in sq. ft.
- **g** = 32.2 (feet per sec/sec)
- **h** = Head in feet
- Orifice Information

Instructions:

1. Select a catalog number (will automatically fill in Open Area and Perimeter) or enter your own values
2. Enter head value
3. Click "calculate"

The results will determine automatically if your situation falls into a Weir, Transitional or Orifice flow. Additionally, Neenah grates which fall within the parameters chosen will appear below the calculator.

Catalog Number and Grate Type:

R-3065-L:L

Feet perimeter (P):	Head in feet (h):	Free open area in sq. ft. (A):
2.85	0.27	1.55

Calculate

Weir capacity in cfs:	Transitional flow in cfs:	Orifice capacity in cfs:
1.3		

STR# 42

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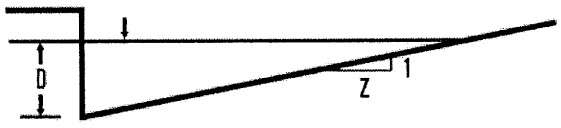

$$Q = \frac{0.56}{N} Z D^{8/3} S^{1/2}$$

Where...

D = Depth of flow in feet

S = Longitudinal slope

Q = Channel flow in cfs (calculated)

N = Roughness coefficient at constant 0.016 (value for concrete and asphalt)

Z = Reciprocal of transverse slope (1/ST)

INSTRUCTIONS

Step 1

Enter the Longitudinal and Transverse Slopes. Enter one of the remaining variables and then press calculate:

- Depth of Flow (D)
- Total flow in cfs (Q)
- Spread of flow in feet

Step 2

To Calculate flow capture of specific Neenah Grates, select a catalog number and grate style from the K Chart drop-down.

1. Select the catalog number for the appropriate "K" chart and from the chart "Determine the "K" value based on the Longitudinal and Transverse slopes entered in Step 1.
2. Derive the Grate Coefficient by plotting the Transverse Slope (ST) and Longitudinal Slope factors onto the K Chart.
3. Enter the "K" value in the space provided.
4. Press Calculate.

STR#43 & 44

Step 1

	Alternate One	Alternate Two	Alternate Three
Depth of flow in feet (D): [?]	0.092		
Transverse Slope in ft./ft. (ST): [?]	0.02		
Longitudinal Slope in ft./ft. (SL): [?]	0.0368		
Roughness coefficient (N): (value for concrete or asphalt)	0.016	0.016	0.016
Total flow in cfs (Q): [?]	0.58		
Spread of flow in feet: [?]	4.600		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

Step 2

Catalog numbers and grate types that have K-charts: [?]	Select Product		
Grate Coefficient from K-chart (K):	23		
Grate capacity in cfs: [?]	0.43		
Bypass flow in cfs:	0.15		
Percent captured:	74.14		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

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Program Methodology

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Trench Castings
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Access & Hatch Covers
Guards
Stop Plates & Grooves
Roll & Gutter Inlets
Bridge Scuppers
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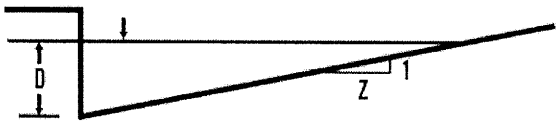

$$Q = \frac{0.56}{N} Z D^{8/3} S^{1/2}$$

Where...

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S = Longitudinal slope

Q = Channel flow in cfs (calculated)

N = Roughness coefficient at constant 0.016 (value for concrete and asphalt)

Z = Reciprocal of transverse slope (1/ST)

INSTRUCTIONS

Step 1

Enter the Longitudinal and Transverse Slopes. Enter one of the remaining variables and then press calculate:

- Depth of Flow (D)
- Total flow in cfs (Q)
- Spread of flow in feet

Step 2

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2. Derive the Grate Coefficient by plotting the Transverse Slope (ST) and Longitudinal Slope factors onto the K Chart.
3. Enter the "K" value in the space provided.
4. Press Calculate.

Step 1

	Alternate One	Alternate Two	Alternate Three
Depth of flow in feet (D): [?]	0.090		
Transverse Slope in ft./ft. (ST): [?]	0.02		
Longitudinal Slope in ft./ft. (SL): [?]	0.0581		
Roughness coefficient (N): (value for concrete or asphalt)	0.016	0.016	0.016
Total flow in cfs (Q): [?]	0.69		
Spread of flow in feet: [?]	4.500		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

STR #46 & 47

Step 2

Catalog numbers and grate types that have K-charts: [?]	3065-L		
Grate Coefficient from K-chart (K):	27		
Grate capacity in cfs: [?]	0.49		
Bypass flow in cfs:	0.20		
Percent captured:	71.01		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

For additional information regarding Neenah Inlet Grate Capacities, please contact Steven Akkala P.E., at (920) 729.3653 or email at steve.akkala@neenahenterprises.com.

Program Methodology

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Airport Castings
Detectable Warning Plates
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Valves & Gates
Access & Hatch Covers
Guards
Stop Plates & Grooves
Roll & Gutter Inlets
Bridge Scuppers
Drainage Grates
Tree Grates
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LiftMate
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MANNING EQUATION CALCULATOR

The Modified Manning Equation is used to calculate flow velocities and volume (in cubic feet per second or cfs). This information is vitally important when selecting a grate type and size for a given project.

$$Q = \frac{0.56}{N} Z D^{8/3} S^{1/2}$$

Where...

D = Depth of flow in feet

S = Longitudinal slope

Q = Channel flow in cfs (calculated)

N = Roughness coefficient at constant 0.016 (value for concrete and asphalt)

Z = Reciprocal of transverse slope (1/ST)

INSTRUCTIONS

Step 1

Enter the Longitudinal and Transverse Slopes. Enter one of the remaining variables and then press calculate:

- Depth of Flow (D)
- Total flow in cfs (Q)
- Spread of flow in feet

Step 2

To Calculate flow capture of specific Neenah Grates, select a catalog number and grate style from the K Chart drop-down.

1. Select the catalog number for the appropriate "K" chart and from the chart "Determine the "K" value based on the Longitudinal and Transverse slopes entered in Step 1.
2. Derive the Grate Coefficient by plotting the Transverse Slope (ST) and Longitudinal Slope factors onto the K Chart.
3. Enter the "K" value in the space provided.
4. Press Calculate.

Step 1

	Alternate One	Alternate Two	Alternate Three
Depth of flow in feet (D): [?]	0.137		
Transverse Slope in ft./ft. (ST): [?]	0.02		
Longitudinal Slope in ft./ft. (SL): [?]	0.0075		
Roughness coefficient (N): (value for concrete or asphalt)	0.016	0.016	0.016
Total flow in cfs (Q): [?]	0.76		
Spread of flow in feet: [?]	6.850		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

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Step 2

Catalog numbers and grate types that have K-charts: [?]	3065-L		
Grate Coefficient from K-chart (K):	13		
Grate capacity in cfs: [?]	0.47		
Bypass flow in cfs:	0.29		
Percent captured:	61.84		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

For additional information regarding Neenah Inlet Grate Capacities, please contact Steven Akkala P.E., at (920) 729.3653 or email at steve.akkala@neenahenterprises.com.

Program Methodology

If your inlet is not capturing enough of the flow, some improvement options include:

Utilizing the improved efficiency of vane style grates Pg 112

Improve spread of flow capture utilizing the Neenah R-3599 Slotted Vane Drain System

Remove significant amounts of water utilizing Neenah's R-4999 Vane Style Transverse Drainage Structure Series

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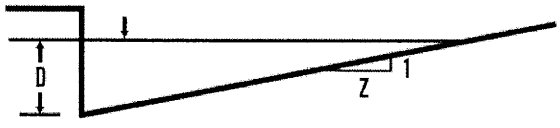

$$Q = \frac{0.56}{N} Z D^{8/3} S^{1/2}$$

Where...

D = Depth of flow in feet

S = Longitudinal slope

Q = Channel flow in cfs (calculated)

N = Roughness coefficient at constant 0.016 (value for concrete and asphalt)

Z = Reciprocal of transverse slope (1/ST)

INSTRUCTIONS

Step 1

Enter the Longitudinal and Transverse Slopes. Enter one of the remaining variables and then press calculate:

- Depth of Flow (D)
- Total flow in cfs (Q)
- Spread of flow in feet

Step 2

To Calculate flow capture of specific Neenah Grates, select a catalog number and grate style from the K Chart drop-down.

1. Select the catalog number for the appropriate "K" chart and from the chart "Determine the "K" value based on the Longitudinal and Transverse slopes entered in Step 1.
2. Derive the Grate Coefficient by plotting the Transverse Slope (ST) and Longitudinal Slope factors onto the K Chart.
3. Enter the "K" value in the space provided.
4. Press Calculate.

Step 1

	Alternate One	Alternate Two	Alternate Three
Depth of flow in feet (D): [?]	0.139		
Transverse Slope in ft./ft. (ST): [?]	0.02		
Longitudinal Slope in ft./ft. (SL): [?]	0.0075		
Roughness coefficient (N): (value for concrete or asphalt)	0.016	0.016	0.016
Total flow in cfs (Q): [?]	0.78		
Spread of flow in feet: [?]	6.950		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

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Step 2

Catalog numbers and grate types that have K-charts: [?]	Select Product		
Grate Coefficient from K-chart (K):	13		
Grate capacity in cfs: [?]	0.48		
Bypass flow in cfs:	0.30		
Percent captured:	61.54		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

For additional information regarding Neenah Inlet Grate Capacities, please contact Steven Akkala P.E., at (920) 729.3653 or email at steve.akkala@neenahenterprises.com.

Program Methodology

If your inlet is not capturing enough of the flow, some improvement options include:

Utilizing the improved efficiency of vane style grates Pg 112

Improve spread of flow capture utilizing the Neenah R-3599 Slotted Vane Drain System

Remove significant amounts of water utilizing Neenah's R-4999 Vane Style Transverse Drainage Structure Series

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- Engineering Literature & Videos

WEIR & ORIFICE CALCULATOR

The Weir and Orifice Calculator is used to determine the inlet capacity in sag (ponding) conditions by use of the Weir and Orifice equations. Knowing this information will allow you to select the proper grate type and size for your specific job or project.

Weir Flow Calculations

Weir Equation: $Q = 3.3P(h)^{1.5}$

- **Q** = Capacity in CFS
- **P** = Feet perimeter
- **h** = Head in feet
- Weir Information

Orifice Flow Calculations

Orifice Flow Equation: $Q = 0.6A\sqrt{2gh}$

- **Q** = Capacity in CFS
- **A** = Free open area of grate in sq. ft.
- **g** = 32.2 (feet per sec/sec)
- **h** = Head in feet
- Orifice Information

Instructions:

1. Select a catalog number (will automatically fill in Open Area and Perimeter) or enter your own values
2. Enter head value
3. Click "calculate"

The results will determine automatically if your situation falls into a Weir, Transitional or Orifice flow. Additionally, Neenah grates which fall within the parameters chosen will appear below the calculator.

Catalog Number and Grate Type:

R-4215-C:Beehive

Feet perimeter (P):	Head in feet (h):	Free open area in sq. ft. (A):
5.65	0.29	1.65

Calculate

Weir capacity in cfs:	Transitional flow in cfs:	Orifice capacity in cfs:
2.9		

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For additional information regarding Neenah Inlet Grate Capacities, please contact Steven Akkala P.E., at (920) 729.3653 or email at steve.akkala@neenahenterprises.com.

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MANNING EQUATION CALCULATOR

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$$Q = \frac{0.56}{N} Z D^{8/3} S^{1/2}$$

Where...

D = Depth of flow in feet

S = Longitudinal slope

Q = Channel flow in cfs (calculated)

N = Roughness coefficient at constant 0.016 (value for concrete and asphalt)

Z = Reciprocal of transverse slope (1/ST)

INSTRUCTIONS

Step 1

Enter the Longitudinal and Transverse Slopes. Enter one of the remaining variables and then press calculate:

- Depth of Flow (D)
- Total flow in cfs (Q)
- Spread of flow in feet

Step 2

To Calculate flow capture of specific Neenah Grates, select a catalog number and grate style from the K Chart drop-down.

1. Select the catalog number for the appropriate "K" chart and from the chart "Determine the "K" value based on the Longitudinal and Transverse slopes entered in Step 1.
2. Derive the Grate Coefficient by plotting the Transverse Slope (ST) and Longitudinal Slope factors onto the K Chart.
3. Enter the "K" value in the space provided.
4. Press Calculate.

Step 1

	Alternate One	Alternate Two	Alternate Three
Depth of flow in feet (D): [?]	0.137		
Transverse Slope in ft./ft. (ST): [?]	0.02		
Longitudinal Slope in ft./ft. (SL): [?]	0.0075		
Roughness coefficient (N): (value for concrete or asphalt)	0.016	0.016	0.016
Total flow in cfs (Q): [?]	0.75		
Spread of flow in feet: [?]	6.850		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

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Step 2

Catalog numbers and grate types that have K-charts: [?]	Select Product		
Grate Coefficient from K-chart (K):	13		
Grate capacity in cfs: [?]	0.47		
Bypass flow in cfs:	0.28		
Percent captured:	62.67		
	Calculate	Calculate	Calculate
	Reset	Reset	Reset

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Program Methodology

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Weir Flow Calculations

Weir Equation: $Q = 3.3P(h)^{1.5}$

- **Q** = Capacity in CFS
- **P** = Feet perimeter
- **h** = Head in feet
- Weir Information

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Orifice Flow Equation: $Q = 0.6A\sqrt{2gh}$

- **Q** = Capacity in CFS
- **A** = Free open area of grate in sq. ft.
- **g** = 32.2 (feet per sec/sec)
- **h** = Head in feet
- Orifice Information

Instructions:

1. Select a catalog number (will automatically fill in Open Area and Perimeter) or enter your own values
2. Enter head value
3. Click "calculate"

The results will determine automatically if your situation falls into a Weir, Transitional or Orifice flow. Additionally, Neenah grates which fall within the parameters chosen will appear below the calculator.

Catalog Number and Grate Type:

R-4215-C:Beehive

Feet perimeter (P):	Head in feet (h):	Free open area in sq. ft. (A):
5.65	0.18	1.65

Calculate

Weir capacity in cfs:	Transitional flow in cfs:	Orifice capacity in cfs:
1.4		

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For additional information regarding Neenah Inlet Grate Capacities, please contact Steven Akkala P.E., at (920) 729.3653 or email at steve.akkala@neenahenterprises.com.

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- Weir Information

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- **Q** = Capacity in CFS
- **A** = Free open area of grate in sq. ft.
- **g** = 32.2 (feet per sec/sec)
- **h** = Head in feet
- Orifice Information

Instructions:

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2. Enter head value
3. Click "calculate"

The results will determine automatically if your situation falls into a Weir, Transitional or Orifice flow. Additionally, Neenah grates which fall within the parameters chosen will appear below the calculator.

Catalog Number and Grate Type:

R-4215-C:Beehive

Feet perimeter (P):	Head in feet (h):	Free open area in sq. ft. (A):
5.65	0.13	1.65

Calculate

Weir capacity in cfs:	Transitional flow in cfs:	Orifice capacity in cfs:
0.9		

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For additional information regarding Neenah Inlet Grate Capacities, please contact Steven Akkala P.E., at (920) 729.3653 or email at steve.akkala@neenahenterprises.com.

Section 3: Emergency Spillway Calculations (Pond #1)

Emergency Spillway

An emergency spillway shall be constructed on each detention basin and shall be designed to pass 1.25 times the Q_{100} of contributing watersheds in the event the detention outlet structure becomes plugged and/or overwhelmed. The peak 100-year inflow flood hydrograph is included within this section. All emergency elevations are below the maximum allowed head provided below, and a minimum of two (2) feet of freeboard is provided.

$L = 1.25 \times Q_{100\ INFLOW} / (CDH^{1.5})$
$L = 108.38$ cfs x 1.25)] / $(3.3*0.30^{1.5}) = 249.84'$ use **250'**

Peak Flowrate = 108.38 cfs
Length of Weir, L = 250 ft.
Spillway Crest Elevation = 739.90
Max. Head, H = 740.20 – 739.90 = 0.30 ft.
Top of Bank = 742.20
Freeboard = 742.20 – 740.20 = **2.0 ft.**

The emergency spillway has the capacity to discharge the necessary flowrate in the event the Detention Outlet Structure becomes completely plugged.