

**Modified Rational Method for Stormwater Detention**  
**Rockwall Imaging Center - Rockwall, Texas**  
**1.15 Acre Site - 100 Year Storm Event**

**Purpose:** Use the modified rational method to determine the volume of stormwater storage needed to compensate for increased runoff due to development.  
**Method:** Use the Modified Rational Method to determine maximum rate of runoff,  $Q = c \cdot I \cdot A$   
 Where:  $c$  = Runoff Coefficient  
 $I$  = Rainfall Intensity (in/hr)  
 $A$  = Drainage Area (acres)  
**Assumptions:** Rainfall intensity determined from City of Rockwall ToRainfall Intensity graph given Time of Concentration (Tc)  
 For undeveloped conditions: Use  $c = 0.35$ , Tc=20 min, I=8.10 in/hr.  
 For developed conditions: Use  $c = 0.50$ , Tc=10 min, I=8.10 in/hr.

**I. Determination of Allowable Release Rate - Undeveloped Site**

Total area of site draining to storage facility	0.97	acres
Total area of site allowed to bypass through the storage facility (Self-Detained)	1.15	acres
Total area of site bypassing the storage facility required to be detained	0.18	acres
Total time of concentration for undeveloped conditions	20	minutes
Runoff coefficient for undeveloped conditions	0.35	
Rainfall intensity for one-hundred year storm (undeveloped)	8.10	inches/hr
Total time of concentration for developed conditions	10	minutes
Runoff coefficient for developed conditions	0.50	
Rainfall intensity for ten year storm (developed)	8.10	inches/hr
Release rate of undeveloped site draining to the storage	2.58	cfs
Release rate of undeveloped site allowed to bypass but required to be detained	0.47	cfs
Release rate of undeveloped site allowed to bypass through the storage (Self-Detained)	3.33	cfs
Release rate of developed site bypassing the storage	1.42	cfs
Allowable release rate	3.20	cfs

**II. Required Storage Calculations, Return Period = 100 years**

Duration (hours)	Duration (min)	Rainfall Intensity (in/hr)	Inflow Rate (cfs)	Inflow Volume (cf)	Allowable Release Rate (cfs)	Outflow Volume (cf)	Inflow - Outflow Volume (cf)	Required Storage (ac-ft)
0.17	10	9.80	12.40	7.85	5.20	3.118	4.377	0.160
0.25	15	9.80	11.47	10.325	5.20	3.898	6.428	0.148
0.33	20	8.30	10.58	12.088	5.20	4.677	8.019	0.184
0.50	30	6.80	8.80	15.832	5.20	6.236	9.596	0.220
0.67	40	5.80	7.30	17.744	5.20	7.795	9.949	0.228
0.83	50	5.00	6.00	19.121	5.20	9.354	9.766	0.224
1.00	60	4.40	5.01	20.192	5.20	10.914	9.278	0.213
1.17	70	3.70	4.72	19.809	5.20	12.473	7.337	0.188
1.33	80	3.40	4.53	20.004	5.20	14.032	6.772	0.155
1.50	90	3.20	4.08	22.027	5.20	15.591	6.437	0.148
2.00	120	2.80	3.31	23.863	5.20	20.268	3.595	0.083

Capacity Required: **9.941** cubic feet **0.228** acre-feet  
 Capacity Provided: **10.205** cubic feet **0.234** acre-feet AT ELEVATION = 543.70

**Orifice Discharge Calculations**  
**Rockwall Imaging Center - Rockwall, Texas**

Orifice Data			
Orifice #1	Orifice #2	Orifice #3	
Diameter (in):	3.00	6.00	8.00
Area (sq ft):	0.05	0.35	0.35
Elevation (ft.):	540.30	541.60	542.70
Coefficient:	0.80	0.60	0.60

  

Site and Stormwater Detention Data			
Site Draining to Pond:	0.97	acres	
Time of Concentration:	10	minutes	
Runoff Coefficient:	0.30		
Storm Duration:	40.0	minutes	
Rainfall Intensity:	5.80	inches/hr	
Inflow Rate:	7.30	cfs	
Inflow Volume:	17.744	cf	
Allowable Release Rate:	5.20	cfs	
Existing Time of Concentration:	20	minutes	
Existing Runoff Coefficient:	0.35		

Orifice equation used for calculation:  $Q = (\text{Orifice coefficient}) \cdot (\text{Area of Orifice}) \cdot (2 \cdot g \cdot \text{Elev. Orifice Elev.})^{0.5}$

Elevation (feet)	Orifice 1 Discharge (cfs)	Orifice 2 Discharge (cfs)	Orifice 3 Discharge (cfs)	Outflow Rate (cfs)	Outflow Volume (cf)	Required Storage (cf)	Provided Storage (cf)	Difference (cf)	Incr. Volume (cf)	Contour Area (sq. ft.)
540.10	0.00	0.00	0.00	0.00	0	17.744	0	17.744	0	0
540.80	0.19	0.00	0.00	0.19	289	17.455	105	(17.350)	105	300
541.30	0.29	0.00	0.00	0.29	442	17.362	533	(16.789)	428	1,414
541.80	0.37	0.17	0.00	0.54	805	16.939	1,519	(15,420)	985	2,558
542.30	0.43	1.02	0.00	1.45	2,174	15,670	3,082	(12,476)	1,573	3,764
542.80	0.49	1.56	0.04	2.09	3,138	14,608	5,283	(6,324)	2,191	5,000
543.23	0.53	1.91	0.23	3.27	4,368	12,837	6,437	(6,389)	491	5,517
543.33	0.54	1.99	0.22	3.44	4,505	12,581	6,982	(5,588)	277	5,894
543.43	0.55	2.06	1.06	3.66	5,492	12,283	7,558	(4,695)	521	6,891
543.53	0.56	2.12	1.18	3.86	5,795	11,949	8,131	(3,617)	530	5,778
543.63	0.56	2.19	1.30	4.05	6,070	11,587	8,714	(2,553)	288	5,985
543.68	0.57	2.22	1.35	4.14	6,212	11,532	9,008	(2,520)	2,540	5,900
543.70	0.57	2.23	1.37	4.18	6,265	10,503	10,205	(298)	2,676	5,909
544.20	0.61	2.53	1.82	4.98	7,457	10,105	15,294	4,987	3,396	7,194
544.70	0.65	2.80	2.17	5.52	8,426	9,319	19,092	9,774	3,799	8,000
545.20	0.69	3.04	2.47	6.20	9,301	8,444	26,863	17,419	6,771	19,083
545.70	0.72	3.26	2.74	6.73	10,096	7,849	38,175	30,526	12,312	30,185

**Modified Rational Method for Stormwater Detention**  
**Rockwall Imaging Center - Rockwall, Texas**  
**1.15 Acre Site - 50 Year Storm Event**

**Purpose:** Use the modified rational method to determine the volume of stormwater storage needed to compensate for increased runoff due to development.  
**Method:** Use the Modified Rational Method to determine maximum rate of runoff,  $Q = c \cdot I \cdot A$   
 Where:  $c$  = Runoff Coefficient  
 $I$  = Rainfall Intensity (in/hr)  
 $A$  = Drainage Area (acres)  
**Assumptions:** Rainfall intensity determined from City of Rockwall ToRainfall Intensity graph given Time of Concentration (Tc)  
 For undeveloped conditions: Use  $c = 0.35$ , Tc=20 min.  
 For developed conditions: Use  $c = 0.50$ , Tc=10 min.

**I. Determination of Allowable Release Rate - Undeveloped Site**

Total area of site draining to storage facility	0.97	acres
Total area of site allowed to bypass through the storage facility	1.15	acres
Total area of site bypassing the storage facility required to be detained	0.18	acres
Total time of concentration for undeveloped conditions	20	minutes
Runoff coefficient for undeveloped conditions	0.35	
Rainfall intensity for fifty year storm (undeveloped)	7.68	inches/hr
Total time of concentration for developed conditions	10	minutes
Runoff coefficient for developed conditions	0.50	
Rainfall intensity for fifty year storm (developed)	9.00	inches/hr
Release rate of undeveloped site draining to the storage	2.58	cfs
Release rate of undeveloped site allowed to bypass through the storage	3.05	cfs
Release rate of developed site bypassing the storage	1.31	cfs
Allowable release rate	4.33	cfs

**II. Required Storage Calculations, Return Period = 50 years**

Duration (hours)	Duration (min)	Rainfall Intensity (in/hr)	Inflow Rate (cfs)	Inflow Volume (cf)	Allowable Release Rate (cfs)	Outflow Volume (cf)	Inflow - Outflow Volume (cf)	Required Storage (ac-ft)
0.17	10	9.80	11.47	6,884	4.33	2,595	4,289	0.085
0.25	15	8.10	10.33	9,263	4.33	3,244	6,019	0.139
0.33	20	7.40	9.69	11,628	4.33	3,893	7,735	0.178
0.50	30	6.00	7.85	13,767	4.33	5,190	8,577	0.197
0.67	40	5.00	6.37	15,297	4.33	6,488	8,809	0.202
0.83	50	4.40	5.61	16,826	4.33	7,785	9,041	0.208
1.00	60	3.90	4.97	17,887	4.33	9,083	8,804	0.202
1.17	70	3.50	4.46	18,739	4.33	10,380	8,358	0.192
1.33	80	3.20	4.08	19,580	4.33	11,678	7,902	0.181
1.50	90	2.90	3.70	19,962	4.33	12,976	6,987	0.160
2.00	120	2.40	3.05	22,027	4.33	16,808	5,159	0.118

Capacity Required: **9.841** cubic feet **0.208** acre-feet

**Orifice Discharge Calculations**  
**Rockwall Imaging Center - Rockwall, Texas**

Orifice Data			
Orifice #1	Orifice #2	Orifice #3	
Diameter (in):	3.00	6.00	8.00
Area (sq ft):	0.05	0.35	0.35
Elevation (ft.):	540.30	541.60	542.70
Coefficient:	0.80	0.60	0.60

  

Site and Stormwater Detention Data			
Site Draining to Pond:	0.97	acres	
Time of Concentration:	10	minutes	
Runoff Coefficient:	0.30		
Storm Duration:	50.0	minutes	
Rainfall Intensity:	4.40	inches/hr	
Inflow Rate:	5.61	cfs	
Inflow Volume:	16,826	cf	
Allowable Release Rate:	4.33	cfs	
Existing Time of Concentration:	20	minutes	
Existing Runoff Coefficient:	0.35		

Orifice equation used for calculation:  $Q = (\text{Orifice coefficient}) \cdot (\text{Area of Orifice}) \cdot (2 \cdot g \cdot \text{Elev. Orifice Elev.})^{0.5}$

Elevation (feet)	Orifice 1 Discharge (cfs)	Orifice 2 Discharge (cfs)	Orifice 3 Discharge (cfs)	Outflow Rate (cfs)	Outflow Volume (cf)	Required Storage (cf)	Provided Storage (cf)	Difference (cf)	Incr. Volume (cf)	Contour Area (sq. ft.)
540.30	0.00	0.00	0.00	0.00	0	16,826	0	16,826	0	0
541.00	0.24	0.00	0.00	0.24	430	16,396.3	385	(16,011)	385	1,101
541.50	0.33	0.00	0.00	0.33	588	16,238.3	1,190	(15,048)	805	2,119
542.00	0.40	0.57	0.00	0.97	1,745	15,081.2	2,504	(12,577)	1,314	3,137
542.50	0.45	1.27	0.00	1.72	3,095	13,711.9	4,237	(10,615)	2,129	3,795
543.00	0.51	1.74	0.36	2.60	4,675	12,151.0	6,299	(8,520)	2,982	4,482
543.07	0.51	1.79	0.51	2.81	5,082	11,764.3	6,627	(5,137)	329	4,942
543.17	0.52	1.87	0.72	3.11	5,694	11,222.6	7,124	(4,099)	497	4,891
543.21	0.53	1.90	0.80	3.23	5,820	11,006.3	7,345	(3,651)	221	4,949
543.27	0.53	1.94	0.88	3.36	6,046	10,780.2	7,626	(3,155)	502	5,040
543.37	0.54	2.01	0.98	3.53	6,355	10,471.4	8,132	(2,339)	566	5,089
543.47	0.55	2.08	1.11	3.74	6,739	10,087.1	8,843	(1,444)	511	5,138
543.57	0.56	2.15	1.23	3.94	7,093	9,723.8	9,224	(619)	2,893	5,432
544.07	0.60	2.46	1.71	4.77	8,586	8,240.9	12,008	3,767	2,787	5,716
544.57	0.64	2.73	2.08	5.45	9,818	7,008.8	14,937	7,928	2,929	6,000

**Modified Rational Method for Stormwater Detention**  
**Rockwall Imaging Center - Rockwall, Texas**  
**1.15 Acre Site - 25 Year Storm Event**

**Purpose:** Use the modified rational method to determine the volume of stormwater storage needed to compensate for increased runoff due to development.  
**Method:** Use the Modified Rational Method to determine maximum rate of runoff,  $Q = c \cdot I \cdot A$   
 Where:  $c$  = Runoff Coefficient  
 $I$  = Rainfall Intensity (in/hr)  
 $A$  = Drainage Area (acres)  
**Assumptions:** Rainfall intensity determined from City of Rockwall ToRainfall Intensity graph given Time of Concentration (Tc)  
 For undeveloped conditions: Use  $c = 0.35$ , Tc=20 min.  
 For developed conditions: Use  $c = 0.50$ , Tc=10 min.

**I. Determination of Allowable Release Rate - Undeveloped Site**

Total area of site draining to storage facility	0.97	acres
Total area of site allowed to bypass through the storage facility	1.15	acres
Total area of site bypassing the storage facility required to be detained	0.18	acres
Total time of concentration for undeveloped conditions	20	minutes
Runoff coefficient for undeveloped conditions	0.35	
Rainfall intensity for twenty-five year storm (undeveloped)	6.70	inches/hr
Total time of concentration for developed conditions	10	minutes
Runoff coefficient for developed conditions	0.50	
Rainfall intensity for twenty-five year storm (developed)	8.10	inches/hr
Release rate of undeveloped site draining to the storage	2.27	cfs
Release rate of undeveloped site allowed to bypass through the storage	2.80	cfs
Release rate of developed site bypassing the storage	1.10	cfs
Allowable release rate	3.70	cfs

**II. Required Storage Calculations, Return Period = 25 years**

Duration (hours)	Duration (min)	Rainfall Intensity (in/hr)	Inflow Rate (cfs)	Inflow Volume (cf)	Allowable Release Rate (cfs)	Outflow Volume (cf)	Inflow - Outflow Volume (cf)	Required Storage (ac-ft)
0.17	10	8.10	10.33	6,195	3.70	2,273	3,922	0.080
0.25	15	7.30	9.31	6,375	3.70	2,842	5,533	0.127
0.33	20	6.70	8.54	10,249	3.70	3,410	6,839	0.157
0.50	30	5.30	6.70	12,161	3.70	4,547	7,614	0.175
0.67	40	4.50	5.74	13,767	3.70	5,683	8,084	0.188
0.83	50	3.90	4.97	14,914	3.70	6,820	8,094	0.186
1.00	60	3.40	4.33	15,603	3.70	7,957	7,646	0.176
1.17	70	3.10	3.95	15,597	3.70	9,093	7,504	0.172
1.33	80	2.80	3.57	17,132	3.70	10,230	6,902	0.158
1.50	90	2.50	3.19	17,209	3.70	11,367	5,842	0.134
2.00	120	2.10	2.68	19,274	3.70	14,777	4,497	0.103

Capacity Required: **8.894** cubic feet **0.198** acre-feet

**Orifice Discharge Calculations**  
**Rockwall Imaging Center - Rockwall, Texas**

Orifice Data			
Orifice #1	Orifice #2	Orifice #3	
Diameter (in):	3.00	6.00	8.00
Area (sq ft):	0.05	0.35	