

**Modified Rational Method for Stormwater Detention Pond (Underground)**

Methodist Hospital for Surgery Expansion, Town of Addison

Design Frequency: 100 - year storm

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 Rational Method to determine maximum rate of runoff

$Q = C * I * A$  Where: C = Runoff Coefficient  
I = Rainfall Intensity (in/hr)  
A = Drainage Area (acres)

Assumptions: Rainfall intensity determined using the IDF curve provided by the Town of Addison

For Existing Conditions: C = 0.30, T<sub>c</sub> = 10 min, i = 8.74 in

For Proposed Conditions: C = 0.90, T<sub>c</sub> = 10 min, i = 8.74 in/hr

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

Total site area	1.98 acres
Time of concentration	10 minutes
Rainfall intensity	8.74 in/hr
Existing runoff coefficient	0.30
Existing site runoff	5.19 cfs

Area of site draining through detention pond	1.93 acres
Area of site draining undetained	0.04 acres
Undetained time of concentration	10 minutes
Rainfall intensity for one-hundred year storm	8.74 in/hr
Proposed runoff coefficient	0.90
Runoff from undetained area	0.31 cfs

Allowable release rate from detention pond = 4.88 cfs

Allowable release rate = Existing site runoff - Runoff from undetained area

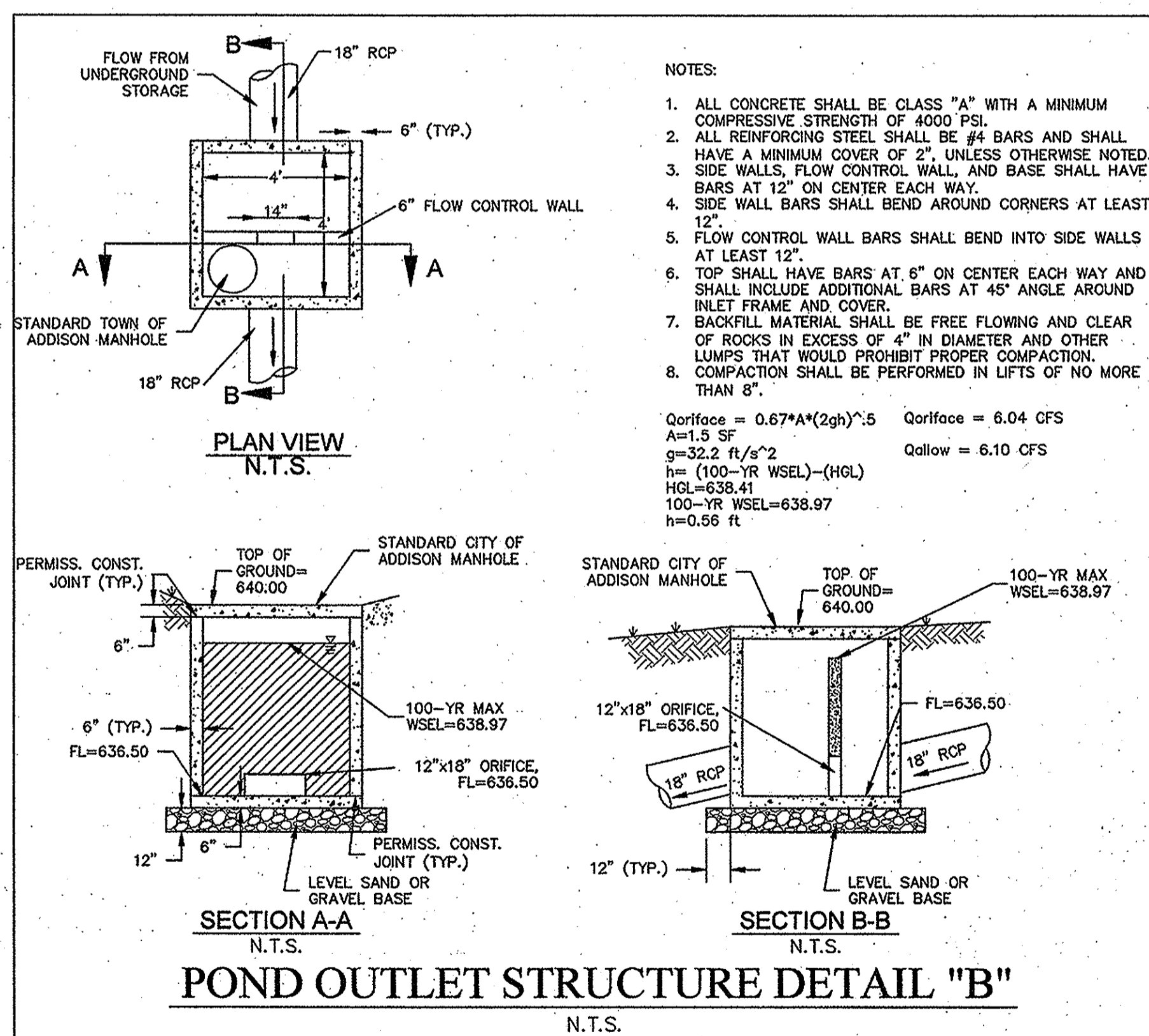
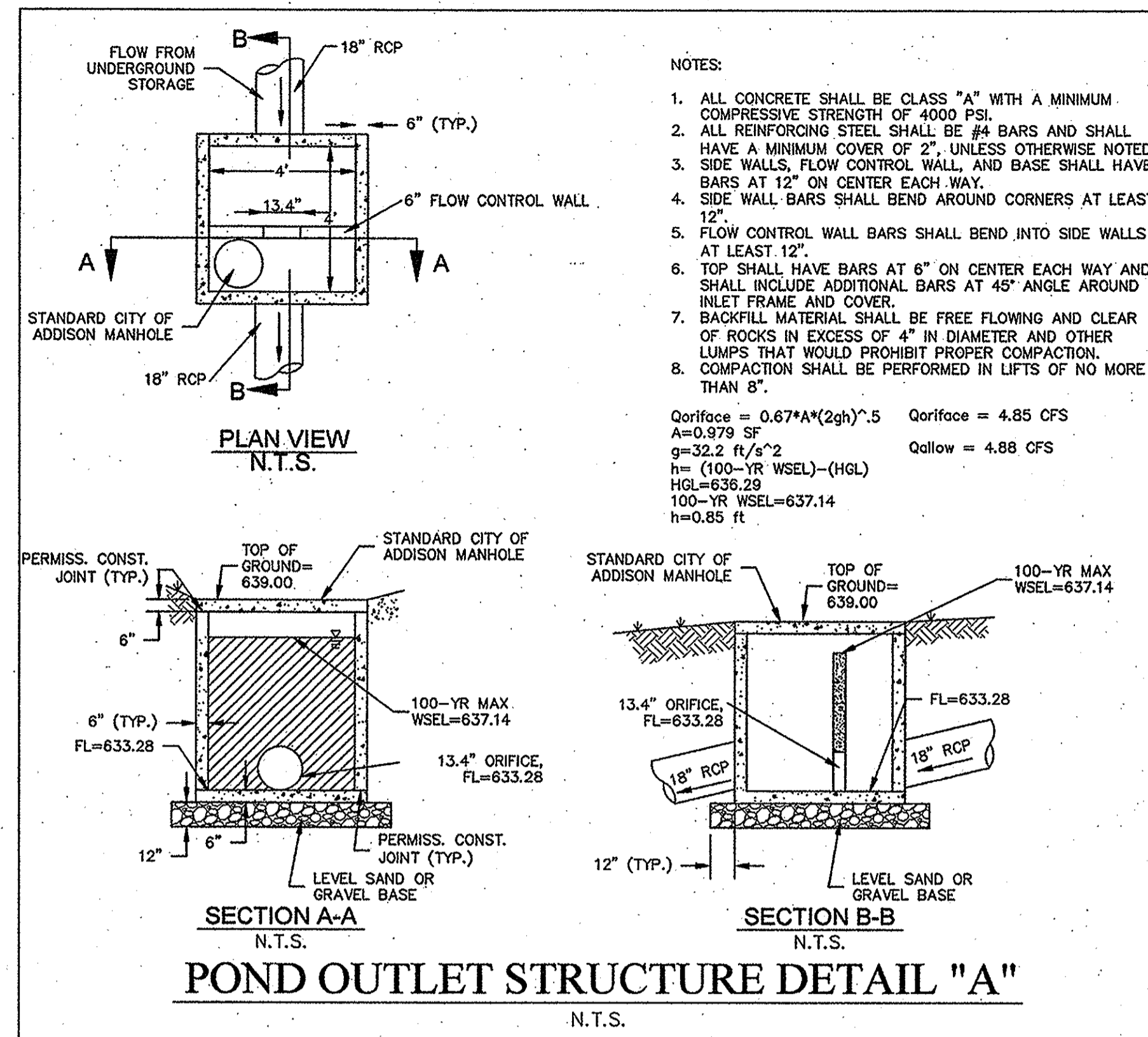
**II. Required Storage Calculations**

Duration (min)	Rainfall Intensity (in/hr)	Inflow Rate (cfs)	Inflow Volume (cf)	Outflow Rate (cfs)	Outflow Volume (cf)	Inflow-Outflow Volume (cf)
10	8.74	15.2	9,109	4.88	2,926	6,183
15	7.52	13.1	11,756	4.88	3,658	8,098
20	6.80	11.8	14,174	4.88	4,389	9,785
30	5.75	10.0	17,978	4.88	5,852	12,126
40	5.00	8.7	20,844	4.88	7,315	13,529
50	4.45	7.7	23,189	4.88	8,778	14,410
60	3.91	6.8	24,450	4.88	10,242	14,208
70	3.63	6.3	26,482	4.88	11,705	14,778
80	3.33	5.8	27,764	4.88	13,168	14,597
90	3.08	5.3	28,890	4.88	14,631	14,259
100	2.87	5.0	29,911	4.88	16,094	13,817
110	2.68	4.7	30,724	4.88	17,557	13,167
120	2.52	4.4	31,516	4.88	19,020	12,496

Underground Detention Stage-Storage Table

Elevation (ft)	Sectional Volume (cf)						Storage (cf)
633.35	0.00	0.00	0.00	0.00	0.00	0.00	0
633.50	33.69	33.69	34.00	34.00	0.00	0.00	135
634.00	459.58	459.58	336.03	336.03	152.25	141.75	1,885
634.50	923.80	923.80	644.31	644.31	414.75	404.25	3,955
635.00	1388.02	1388.02	952.59	952.59	677.25	666.75	6,025
635.50	1852.24	1852.24	1260.87	1260.87	939.75	929.25	8,095
636.00	2316.46	2316.46	1569.15	1569.15	1202.25	1191.75	10,165
636.50	2780.68	2780.68	1877.43	1877.43	1464.75	1454.25	12,235
637.00	3244.90	3244.90	2185.71	2185.71	1727.25	1716.75	14,305
637.14	3350.48	3350.48	2245.16	2245.16	1800.75	1790.25	14,782

Required Storage 100-Year WSEL 14,778 c.f.  
637.14



**DETECTION SYSTEM CALCULATIONS (ABOVE GROUND)**  
**MODIFIED RATIONAL METHOD**

DESIGN FREQUENCY =	100	YEAR STORM
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**ALLOWABLE RELEASE RATE (EXISTING CONDITIONS):**

DRAINAGE AREA (A)	2.44 AC	ANTEC. PREC. COEFF. (K)	1.00
TIME OF CONC. (T <sub>c</sub> )	10 MIN	Q = K * C * I * A	
RAINFALL INTENSITY (I)	8.74 IN/HR		
RUNOFF COEFFICIENT (C)	0.30		
ALLOW. SITE DISCHARGE	6.4 CFS		

**PROPOSED CONDITIONS:**

ON-SITE DETAINED RUNOFF:		OFF-SITE PASS THROUGH FLOW:	
DRAINAGE AREA (A)	2.20 AC	DRAINAGE AREA (A)	0.04 AC
TIME OF CONC. (T <sub>c</sub> )	10 MIN	TIME OF CONC. (T <sub>c</sub> )	10 MIN
RAINFALL INTENSITY (I)	8.74 IN/HR	RAINFALL INTENSITY (I)	8.74 IN/HR
RUNOFF COEFFICIENT (C)	0.90	RUNOFF COEFFICIENT (C)	0.90
DETAINED RUNOFF	17.3 CFS	OFF-SITE PASS THROUGH FLOW:	0.3 CFS

**ON-SITE UNDETAINED RUNOFF:**

DRAINAGE AREA (A)	0.24 AC
TIME OF CONC. (T <sub>c</sub> )	10 MIN
RAINFALL INTENSITY (I)	8.74 IN/HR
RUNOFF COEFFICIENT (C)	0.30
UNDETAINED RUNOFF	0.6 CFS

**ALLOWABLE POND DISCHARGE:** 6.1 CFS

**STORAGE CALCULATIONS:**

DURATION (MIN)	RAINFALL INTENSITY (IN/HR)	INFLOW RATE (CFS)	INFLOW VOLUME (CF)	OUTFLOW RATE (CFS)	OUTFLOW VOLUME (CF)	REQUIRED STORAGE (INFLOW - OUTFLOW) (CF)	(AC-FT)	
10	0.17	9.20	18.5	11,123	6.1	3,650	7,473	0.17
15	0.25	7.86	16.8	14,254	6.1	4,562	9,692	0.22
20	0.33	6.90	13.8	16,694	6.1	5,475	11,219	0.26
30	0.50	5.62	11.3	20,379	6.1	7,300	13,079	0.30
40	0.67	4.78	9.6	23,134	6.1	9,125	14,010	0.32
50	0.83	4.19	8.4	25,343	6.1	10,949	14,393	0.33
60	1.00	3.75	7.6	27,192	6.1	12,774	14,418	0.33
70	1.17	3.40	6.9	28,788	6.1	14,599	14,189	0.33
80	1.33	3.12	6.3	30,196	6.1	16,424	13,771	0.32
90	1.50	2.89	5.8	31,457	6.1	18,249	13,208	0.30
100	1.67	2.70	5.4	32,603	6.1	20,074	12,529	0.29
110	1.83	2.53	5.1	33,655	6.1	21,899	11,756	0.27
120	2.00	2.39	4.8	34,627	6.1	23,724	10,903	0.25
130	2.17	2.26	4.6	35,533	6.1	25,549	9,984	0.23
140	2.33	2.15	4.3	36,382	6.1	27,374	9,008	0.21
150	2.50	2.05	4.1	37,181	6.1	29,199	7,983	0.18
160	2.67	1.96	4.0	37,937	6.1	31,024	6,914	0.16
170	2.83	1.88	3.8	38,655	6.1	32,848	5,806	0.13
180	3.00	1.81	3.6	39,338	6.1	34,673	4,665	0.11
190	3.17	1.74	3.5	39,991	6.1	36,498	3,492	0.08
200	3.33	1.68	3.4	40,616	6.1	38,323	2,292	0.05
210	3.50	1.62	3.3	41,216	6.1	40,148	1,068	0.02
220	3.67	1.57	3.2	41,793	6.1	41,973	-180	0.00
230	3.83	1.52	3.1	42,349	6.1	43,798	-1,449	-0.03
240	4.00	1.48	3.0	42,885	6.1	45,623	-2,737	-0.06

**MAXIMUM REQUIRED STORAGE = 14,418 0.33**

**Pond Volume Calculations**

**Method:** Use the average-end area method to determine volume of storage of the pond and determine the 100-year storm high water level

**Where:** Volume = (1/2) \* (Area of top contour + Area of bottom contour) \* depth increment

High Water Elevation	639.00	feet
High Water Elevation + 1' freeboard	640.00	feet
Invert elevation of outlet structure	636.50	feet

**Goal:** Calculated 100-yr storage 14,418 cubic feet

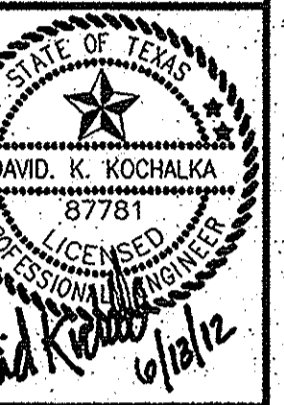
**Calculations:**

Elevation (feet)	Area (sq. ft.)	Incremental Volume (cubic ft.)	Total Volume (ac. ft.)	Total Volume (cubic ft.)
636.50	0.0			
637.00	2,804.6	701.2	0.016	701
638.00	9,794.4	6,299.5	0.145	7,001
639.00	12,687.7	11,241.1	0.258	18,242
640.00	12,250.6	12,469.1	0.286	30,711

RECORD DRAWINGS  
(July 2013)  
INFORMATION PROVIDED BY:  
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and Associates, Inc.**

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Firm No. 05-004  
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METHODIST PAVILION ONE

DETECTION CALCULATIONS

Scale: AS SHOWN  
Designed by: DRK  
Drawn by: DRK  
Checked by: DRK  
Date: 06/27/2012  
Project No. 6930200

SHEET  
C-08