

Stormwater Calculations

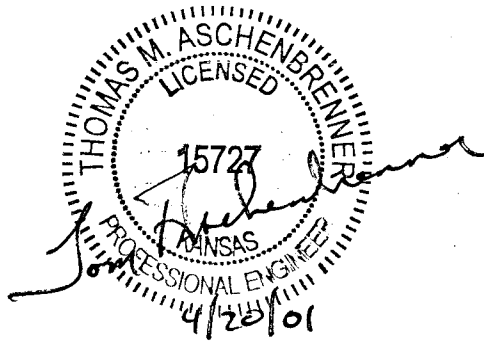
**Via Christi Property Services, Inc.
(Job #D4945)**

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Storm Sewer Calculations:

Sewer Location:		Tributary Area:				Flow Rate:	
From	To	Inc. (Ac)	Total (Ac)	Intensity	C value	In Section	Total
A	B	0.31	0.31	7.41	0.95	2.182245	2.182245
B	D	0.27	0.58	7.41	0.95	1.900665	4.08291
Roof	C	0.12	0.12	7.41	0.95	0.84474	0.84474
C	D	0.12	0.24	7.41	0.95	0.84474	1.68948
D	Existing	0.07	0.82	7.41	0.95	0.492765	6.265155

Sewer Location:		Sewer Design:				Profiles:				
From	To	Length (feet)	Slope (%)	Diameter (inches)	Qdesign (cfs)	Velocity (ft/sec)	Capacity (cfs)	Upper	Lower	Rim Elev.
A	B	125	1.5%	10	2.182245	4.5	2.19	140.47	138.59	144
B	D	60	1.5%	12	4.08291	6.1	4.22	138.49	137.6	144.75
Roof	C	47	1.4%	8	0.84474	3.7	1.21	140.26	139.59	-
C	D	126	1.5%	10	1.68948	4.4	2.19	139.49	137.6	144.75
D	Existing	33	0.2%	24	6.265155	3.1	11	136.24	136.18	144.75

Inlet Sizing:

Inlet:	Grate:	Inlet Capacity (cfs)	Max Flow (10 year event) (cfs)
A	Neenah R-2580 Type A inlet	6.5	2.182245
B	Neenah R-2580 Type A inlet	6.5	1.900665
C	Neenah R-2580 Type A inlet	6.5	0.84474
D	Neenah R-2580 Type A inlet	6.5	0.492765

APPENDIX

April 15, 1986

ATTACHMENT A
DRAINAGE CRITERIA MANUAL

CITY OF WICHITA, KANSAS

RAINFALL INTENSITY TABLE FOR SEDGWICK COUNTY, KANSAS

The following tabulation contains rainfall intensity in inches per hour as derived from ESSA Weather Bureau Technical Paper 40 Modified to NWS Hydro-35, 1977 During First Hour

DURATION IN MINUTES	RETURN PERIODS OF						
	1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
5	4.18	5.57	6.53	7.41	8.52	9.48	10.32
6	3.99	5.32	6.25	7.09	8.16	9.09	9.89
7	3.81	5.09	5.99	6.81	7.84	8.74	9.50
8	3.66	4.89	5.75	6.55	7.55	8.42	9.15
9	3.52	4.70	5.54	6.31	7.28	8.13	8.83
10	3.39	4.52	5.34	6.09	7.04	7.86	8.54
11	3.27	4.36	5.16	5.89	6.81	7.61	8.27
12	3.18	4.21	4.99	5.71	6.60	7.38	8.02
13	3.05	4.08	4.84	5.53	6.41	7.17	7.79
14	2.96	3.95	4.69	5.37	6.23	6.97	7.57
15	2.87	3.83	4.56	5.22	6.06	6.78	7.37
16	2.78	3.72	4.43	5.08	5.90	6.60	7.18
17	2.71	3.61	4.31	4.95	5.75	6.44	7.00
18	2.63	3.51	4.20	4.83	5.61	6.29	6.84
19	2.56	3.42	4.10	4.71	5.47	6.14	6.68
20	2.50	3.33	4.00	4.60	5.35	6.00	6.53
21	2.44	3.25	3.90	4.50	5.23	5.87	6.39
22	2.38	3.17	3.81	4.40	5.12	5.75	6.26
23	2.32	3.10	3.73	4.31	5.01	5.63	6.13
24	2.27	3.03	3.65	4.22	4.91	5.52	6.01
25	2.22	2.96	3.57	4.13	4.81	5.41	5.90
26	2.20	2.90	3.50	4.05	4.72	5.31	5.79
27	2.16	2.84	3.43	3.98	4.63	5.21	5.69
28	2.14	2.78	3.37	3.90	4.55	5.12	5.59
29	2.11	2.72	3.30	3.83	4.47	5.03	5.49
30	2.08	2.67	3.24	3.76	4.39	4.94	5.40
31	2.05	2.62	3.19	3.70	4.32	4.86	5.32
32	2.02	2.57	3.10	3.63	4.25	4.79	5.22
33	1.99	2.52	3.05	3.57	4.18	4.71	5.14
34	1.96	2.48	3.01	3.51	4.11	4.63	5.07
35	1.93	2.44	2.98	3.46	4.05	4.56	5.00
36	1.91	2.39	2.93	3.41	3.99	4.50	4.93
37	1.89	2.35	2.88	3.36	3.93	4.43	4.86
38	1.87	2.32	2.84	3.31	3.87	4.37	4.79
39	1.85	2.28	2.80	3.26	3.82	4.31	4.73
40	1.83	2.24	2.76	3.22	3.76	4.25	4.66
41	1.81	2.21	2.72	3.17	3.71	4.19	4.60
42	1.79	2.18	2.68	3.13	3.66	4.13	4.54
43	1.77	2.14	2.64	3.09	3.61	4.08	4.49
44	1.75	2.11	2.61	3.05	3.57	4.03	4.43
45	1.73	2.08	2.57	3.01	3.52	3.98	4.38

Table 8.03a
Value of Runoff Coefficient
(C) for Rational Formula

Land Use	C	Land Use	C
Business:		Lawns:	
Downtown areas	0.70-0.95	Sandy soil, flat, 2%	0.05-0.10
Neighborhood areas	0.50-0.70	Sandy soil, ave., 2-7%	0.10-0.15
		Sandy soil, steep, 7%	0.15-0.20
Residential:		Heavy soil, flat, 2%	0.13-0.17
Single-family areas	0.30-0.50	Heavy soil, ave., 2-7%	0.18-0.22
Multi units, detached	0.40-0.60	Heavy soil, steep, 7%	0.25-0.35
Multi units, attached	0.60-0.75		
Suburban	0.25-0.40	Agricultural land:	
		Bare packed soil	
Industrial:		Smooth	0.30-0.60
Light areas	0.50-0.80	Rough	0.20-0.50
Heavy areas	0.60-0.90	Cultivated rows	
		Heavy soil no crop	0.30-0.60
Parks, cemeteries	0.10-0.25	Heavy soil with crop	0.20-0.50
		Sandy soil no crop	0.20-0.40
Playgrounds	0.20-0.35	Sandy soil with crop	0.10-0.25
		Pasture	
Railroad yard areas	0.20-0.40	Heavy soil	0.15-0.45
		Sandy soil	0.05-0.25
Unimproved areas	0.10-0.30	Woodlands	0.05-0.25
Streets:			
Asphalt	0.70-0.95		
Concrete	0.80-0.95		
Brick	0.70-0.85		
Drives and walks	0.75-0.85		
Roofs	0.75-0.85		

NOTE: The designer must use judgment to select the appropriate C value within the range for the appropriate land use. Generally, larger areas with permeable soils, flat slopes, and dense vegetation should have lowest C values. Smaller areas with slowly permeable soils, steep slopes, and sparse vegetation should be assigned highest C values.

Source: American Society of Civil Engineers

The overland flow portion of flow time may be determined from Figure 8.03a. The flow time (in minutes) in the channel can be estimated by calculating the average velocity in feet per minute and dividing the length (in feet) by the average velocity.

Step 4. Determine the rainfall intensity, frequency, and duration (Figures 8.03b through 8.03g—source: North Carolina State Highway Commission; Jan. 1973). Select the chart for the locality closest to your location. Enter the "duration" axis of the chart with the calculated time of concentration, T_c . Move vertically until you intersect the curve of the appropriate design storm, then move horizontally to read the rainfall intensity factor, i , in inches per hour.

Step 5. Determine peak discharge, Q (ft^3/sec), by multiplying the previously determined factors using the rational formula (Sample Problem 8.03a).

Simplified Detention Routing (Basins less than 10 acres tributary)

Equations

Total Tributary Area

4.660

acres

$S = (1000/CN) - 10.0$ where:
 SN = SCS Curve Number from Table C
 $Q = (P \cdot 0.2S)^2 / (P + 0.8S)$ where:
 Q = Runoff in Inches
 P = 24 hour rainoff in inches from Table B
 $VR = (Q/12) \cdot A \cdot 43,560$ where:
 VR = Cu. Ft. Inflow to detention
 A = Acres of tributary to detention

Qi = Peak Flow to detention
 Calculated by either:
 * Rational Method ($Qi = CiA$)
 * Hydrograph routing
 Qr = Peak CFS discharge from detention
 Criteria Max. (CFS/Trib. Acre)
 Qr(allowable) = Peak Pre-Construction Flow

Rainfall	P	I
2 yr	3.60	3.80
10 yr	5.28	5.19
100 yr	7.68	7.36

Given Conditions			
Storm Event	100	Year	P (in) = 7.68
			i (in) = 7.36
		Tc =	15 min

Pre-Construction Runoff and Detention Calculations

	CN	C
Impervious	98	0.90
Developed Parks	79	0.46
Open Space	76	0.40

Area 1 Parking Area North of Doctor's Building

Given Information

Calculated Data

A = 17,864.39 ft²
 PK Disch. 0 CFS
 CN = 76
 C = 0.4
 P = 7.68 inches
 Tc = 15 min
 i = 7.36 from Table A

A = 0.410 Acres
 S = 3.158
 Q = 4.868 inches (24 hour runoff)
 Qi = 1.207 CFS
 Qr = 1.207 CFS
 VR = 7,246.39 ft³
 Qr/Qi = 1.000

Area 2 Doctors Clinic Building

Given Information

Calculated Data

A = 20,227.83 ft²
 PK Disch. 0 CFS
 CN = 76
 C = 0.4
 P = 7.68 inches
 Tc = 15 min
 i = 7.36 from Table A

A = 0.464 Acres
 S = 3.158
 Q = 4.868 inches (24 hour runoff)
 Qi = 1.367 CFS
 Qr = 1.367 CFS
 VR = 8,205.08 ft³
 Qr/Qi = 1.000

Area 3 Paved Area just south of Doctors Building

Given Information

A = 7,855.11 ft²
PK Disch. 0 CFS
CN = 76
C = 0.4
P = 7.68 inches
Tc = 15 min
i = 7.36 from Table A

Calculated Data

A = 0.180 Acres
S = 3.158
Q = 4.868 inches (24 hour runoff)
Qi = 0.531 CFS
Qr = 0.531 CFS
VR = 3,186.29 ft³
Qr/Qi = 1.000

Area 4 Building to far east

Given Information

A = 12,850.29 ft²
PK Disch. 0 CFS
CN = 98
C = 0.9
P = 7.68 inches
Tc = 15 min
i = 7.36 from Table A

Calculated Data

A = 0.295 Acres
S = 0.204
Q = 7.440 inches (24 hour runoff)
Qi = 1.954 CFS
Qr = 1.954 CFS
VR = 7,967.62 ft³
Qr/Qi = 1.000

Area 5 Grassed Area west of Doctors Building w/o Building Site

Given Information

A = 37,526.43 ft²
PK Disch. 0 CFS
CN = 79
C = 0.46
P = 7.68 inches
Tc = 15 min
i = 7.36 from Table A

Calculated Data

A = 0.861 Acres
S = 2.658
Q = 5.211 inches (24 hour runoff)
Qi = 2.917 CFS
Qr = 2.917 CFS
VR = 16,294.85 ft³
Qr/Qi = 1.000

Area 6 East Roof Top of Parking Lot Building

Given Information

A = 2,465.19 ft²
 PK Disch. 0 CFS
 CN = 98
 C = 0.9
 P = 7.68 inches
 Tc = 15 min
 i = 7.36 from Table A

Calculated Data

A = 0.057 Acres
 S = 0.204
 Q = 7.440 inches (24 hour runoff)
 Qi = 0.375 CFS
 Qr = 0.375 CFS
 VR = 1,528.50 ft³
 Qr/Qi = 1.000

Area 7 Proposed Detention Pond Area

Given Information

A = 22,147.03 ft²
 PK Disch. 0 CFS
 CN = 76
 C = 0.4
 P = 7.68 inches
 Tc = 15 min
 i = 7.36 from Table A

Calculated Data

A = 0.508 Acres
 S = 3.158
 Q = 4.868 inches (24 hour runoff)
 Qi = 1.497 CFS
 Qr = 1.497 CFS
 VR = 8,983.57 ft³
 Qr/Qi = 1.000

Area 8 Transformer Pad Area

Given Information

A = ft²
 PK Disch. 0 CFS
 CN = 79
 C = 0.46
 P = 7.68 inches
 Tc = 15 min
 i = 7.36 from Table A

Calculated Data

A = 0.000 Acres
 S = 2.658
 Q = 5.211 inches (24 hour runoff)
 Qi = 0.000 CFS
 Qr = 0.000 CFS
 VR = 0.00 ft³
 Qr/Qi = #DIV/0!

Area 9 Runoff Area west of new sidewalk

Given Information

A = ft²
PK Disch. 0 CFS
CN = 79
C = 0.46
P = 7.68 inches
T_c = 15 min
i = 7.36 from Table A

Calculated Data

A = 0.000 Acres
S = 2.658
Q = 5.211 inches (24 hour runoff)
Q_i = 0.000 CFS
Q_r = 0.000 CFS
VR = 0.00 ft³
Q_r/Q_i = #DIV/0!

Area 10 C shaped building

Given Information

A = 16,827.23 ft²
PK Disch. 0 CFS
CN = 98
C = 0.9
P = 7.68 inches
T_c = 15 min
i = 7.36 from Table A

Calculated Data

A = 0.386 Acres
S = 0.204
Q = 7.440 inches (24 hour runoff)
Q_i = 2.559 CFS
Q_r = 2.559 CFS
VR = 10,433.46 ft³
Q_r/Q_i = 1.000

Area 11 Paved area around C building

Given Information

A = 19,328.79 ft²
PK Disch. 0 CFS
CN = 98
C = 0.9
P = 7.68 inches
T_c = 15 min
i = 7.36 from Table A

Calculated Data

A = 0.444 Acres
S = 0.204
Q = 7.440 inches (24 hour runoff)
Q_i = 2.939 CFS
Q_r = 2.939 CFS
VR = 11,984.51 ft³
Q_r/Q_i = 1.000

Area 12 & 15 Paved Parking east of Doctors Building

Given Information

A = 17,100.40 ft²
PK Disch. 0 CFS
CN = 98
C = 0.9
P = 7.68 inches
Tc = 15 min
i = 7.36 from Table A

Calculated Data

A = 0.393 Acres
S = 0.204
Q = 7.440 inches (24 hour runoff)
Qi = 2.600 CFS
Qr = 2.600 CFS
VR = 10,602.84 ft³
Qr/Qi = 1.000

Area 13 East portion of east parking area

Given Information

A = 13,781.75 ft²
PK Disch. 0 CFS
CN = 98
C = 0.9
P = 7.68 inches
Tc = 15 min
i = 7.36 from Table A

Calculated Data

A = 0.316 Acres
S = 0.204
Q = 7.440 inches (24 hour runoff)
Qi = 2.096 CFS
Qr = 2.096 CFS
VR = 8,545.16 ft³
Qr/Qi = 1.000

Area 5B Potential Building Site in Area 5

Given Information

A = 15,000.00 ft²
PK Disch. 0 CFS
CN = 79
C = 0.46
P = 7.68 inches
Tc = 15 min
i = 7.36 from Table A

Calculated Data

A = 0.344 Acres
S = 2.658
Q = 5.211 inches (24 hour runoff)
Qi = 1.166 CFS
Qr = 1.166 CFS
VR = 6,513.35 ft³
Qr/Qi = 1.000

Post-Construction Building, Parking Lot and Paved Area

Area 1 Parking Area North of Doctor's Building

Given Information

A = 17,864.39 ft²
 PK Disch. 0 CFS
 CN = 98
 C = 0.9
 P = 7.68 inches
 Tc = 15 min
 i = 7.36 from Table A

Calculated Data

A = 0.410 Acres
 S = 0.204
 Q = 7.440 inches (24 hour runoff)
 Qi = 2.717 CFS
 Qr = 1.207 CFS
 VR = 11,076.54 ft³
 Qr/Qi = 0.444

VS/VR* = 0.295

* From Graph Type II Storm

VS = 3,267.58 ft³
 0.075 acre feet

Area 2 Doctors Clinic Building

Given Information

A = 20,227.83 ft²
 PK Disch. 0 CFS
 CN = 98
 C = 0.9
 P = 7.68 inches
 Tc = 15 min
 i = 7.36 from Table A

Calculated Data

A = 0.464 Acres
 S = 0.204
 Q = 7.440 inches (24 hour runoff)
 Qi = 3.076 CFS
 Qr = 1.367 CFS
 VR = 12,541.95 ft³
 Qr/Qi = 0.444

VS/VR* = 0.295

* From Graph Type II Storm

VS = 3,699.88 ft³
 0.085 acre feet

Area 3 Paved Area just south of Doctors Building

Given Information

A = 7,855.11 ft²
 PK Disch. 0 CFS
 CN = 98
 C = 0.9
 P = 7.68 inches
 Tc = 15 min
 i = 7.36 from Table A

Calculated Data

A = 0.180 Acres
 S = 0.204
 Q = 7.440 inches (24 hour runoff)
 Qi = 1.194 CFS
 Qr = 0.531 CFS
 VR = 4,870.44 ft³
 Qr/Qi = 0.444

VS/VR* = 0.295

* From Graph Type II Storm

VS = 1,436.78 ft³
 0.033 acre feet

Area 5B Potential Building Site in Area 5

Given Information

A = 15,000.00 ft²
 PK Disch. = 0 CFS
 CN = 98
 C = 0.9
 P = 7.68 inches
 Tc = 15 min
 i = 7.36 from Table A

Calculated Data

A = 0.344 Acres
 S = 0.204
 Q = 7.440 inches (24 hour runoff)
 Qi = 2.281 CFS
 Qr = 1.166 CFS
 VR = 9,300.52 ft³
 Qr/Qi = 0.511

VS/VR* = 0.268

* From Graph Type II Storm

VS = 2,492.54 ft³
 0.057 acre feet

Estimated Stormwater Volume

100 year Storm Event

Area	Pre-Const.		Post Const.		Detention Storage Required	
	Peak Flow CFS	Runoff Volume ft ³	Peak Flow CFS	Runoff Volume ft ³	ft ³	acre feet
1	1.207	7,246.39	2.717	11,076.54	3,267.58	0.075
2	1.367	8,205.08	3.076	12,541.95	3,699.88	0.085
3	0.531	3,186.29	1.194	4,870.44	1,436.78	0.033
4	1.954	7,967.62	1.954	7,967.62		
5	2.917	16,294.85	2.917	16,294.85		
6	0.375	1,528.50	0.375	1,528.50		
7	1.497	8,983.57	1.497	8,983.57		
8	0.000	0.000	0.000	0.000		
9	0.000	0.00	0.000	0.00		
10	2.559	10,433.46	2.559	10,433.46		
11	2.939	11,984.51	2.939	11,984.51		
12	2.600	10,602.84	2.600	10,602.84		
13	2.096	8,545.16	2.096	8,545.16		
5B	1.166	6,513.35	2.281	6,513.35	2,492.538	0.057

21.208 101,491.6 26.205 111,342.8 10,896.77 0.250

Increase in Peak Flow = 4.997 CFS

Increase in Runoff Volume 9,851.16 ft³

Simplified Detention Routing (Basins less than 10 acres tributary)

Equations

Total Tributary Area

4.660

acres

S = (1000/CN) - 10.0 where:
 SN = SCS Curve Number from Table C
 Q = (P 0.2S)^2/(P+0.8S) where:
 Q = Runoff in Inches
 P = 24 hour rainoff in inches from Table B
 VR = (Q/12)*A*43,560 where:
 VR = Cu. Ft. Inflow to detention
 A = Acres of tributary to detention

Qi = Peak Flow to detention
 Calculated by either:
 * Rational Method (Qi = CiA)
 * Hydrograph routing

Rainfall	P	I
2 yr	3.60	3.80
10 yr	5.28	5.19
100 yr	7.68	7.36

Qr = Peak CFS discharge from detention
 Criteria Max. (CFS/Trib. Acre)
 Qr(allowable) = Peak Pre-Construction Flow

Given Conditions				Tc =	15	min
Storm Event	10	Year	P (in) = 5.28	i (in) = 5.19		

Pre-Construction Runoff and Detention Calculations

Impervious	CN	98	C	0.90
Developed Parks		79		0.46
Open Space		76		0.40

Area 1 Parking Area North of Doctor's Building

Given Information

Calculated Data

A = 17,864.39 ft²
 PK Disch. 0 CFS
 CN = 76
 C = 0.4
 P = 5.28 inches
 Tc = 15 min
 i = 5.19 from Table A

A = 0.410 Acres
 S = 3.158
 Q = 2.768 inches (24 hour runoff)
 Qi = 0.851 CFS
 Qr = 0.851 CFS
 VR = 4,120.71 ft³
 Qr/Qi = 1.000

Area 2 Doctors Clinic Building

Given Information

Calculated Data

A = 20,227.83 ft²
 PK Disch. 0 CFS
 CN = 76
 C = 0.4
 P = 5.28 inches
 Tc = 15 min
 i = 5.19 from Table A

A = 0.464 Acres
 S = 3.158
 Q = 2.768 inches (24 hour runoff)
 Qi = 0.964 CFS
 Qr = 0.964 CFS
 VR = 4,665.87 ft³
 Qr/Qi = 1.000

Area 3 Paved Area just south of Doctors Building

Given Information

A = 7,855.11 ft²
PK Disch. 0 CFS
CN = 76
C = 0.4
P = 5.28 inches
Tc = 15 min
i = 5.18 from Table A

Calculated Data

A = 0.180 Acres
S = 3.158
Q = 2.768 inches (24 hour runoff)
Qi = 0.374 CFS
Qr = 0.374 CFS
VR = 1,811.91 ft³
Qr/Qi = 1.000

Area 4 Building to far east

Given Information

A = 12,850.29 ft²
PK Disch. 0 CFS
CN = 98
C = 0.9
P = 5.28 inches
Tc = 15 min
i = 5.18 from Table A

Calculated Data

A = 0.295 Acres
S = 0.204
Q = 5.043 inches (24 hour runoff)
Qi = 1.375 CFS
Qr = 1.375 CFS
VR = 5,400.07 ft³
Qr/Qi = 1.000

Area 5 Grassed Area west of Doctors Building w/o Building Site

Given Information

A = 37,526.43 ft²
PK Disch. 0 CFS
CN = 79
C = 0.46
P = 5.28 inches
Tc = 15 min
i = 5.18 from Table A

Calculated Data

A = 0.861 Acres
S = 2.658
Q = 3.044 inches (24 hour runoff)
Qi = 2.053 CFS
Qr = 2.053 CFS
VR = 9,519.73 ft³
Qr/Qi = 1.000

Area 6 East Roof Top of Parking Lot Building

Given Information

A = 2,465.19 ft²
 PK Disch. 0 CFS
 CN = 98
 C = 0.9
 P = 5.28 inches
 Tc = 15 min
 i = 5.18 from Table A

Calculated Data

A = 0.057 Acres
 S = 0.204
 Q = 5.043 inches (24 hour runoff)
 Qi = 0.264 CFS
 Qr = 0.264 CFS
 VR = 1,035.95 ft³
 Qr/Qi = 1.000

Area 7 Proposed Detention Pond Area

Given Information

A = 22,147.03 ft²
 PK Disch. 0 CFS
 CN = 76
 C = 0.4
 P = 5.28 inches
 Tc = 15 min
 i = 5.18 from Table A

Calculated Data

A = 0.508 Acres
 S = 3.158
 Q = 2.768 inches (24 hour runoff)
 Qi = 1.053 CFS
 Qr = 1.053 CFS
 VR = 5,108.57 ft³
 Qr/Qi = 1.000

Area 8 Transformer Pad Area

Given Information

A = ft²
 PK Disch. 0 CFS
 CN = 79
 C = 0.46
 P = 5.28 inches
 Tc = 15 min
 i = 5.18 from Table A

Calculated Data

A = 0.000 Acres
 S = 2.658
 Q = 3.044 inches (24 hour runoff)
 Qi = 0.000 CFS
 Qr = 0.000 CFS
 VR = 0.00 ft³
 Qr/Qi = #DIV/0!

Area 9 Runoff Area west of new sidewalk

Given Information

A = ft²
PK Disch. 0 CFS
CN = 79
C = 0.46
P = 5.28 inches
Tc = 15 min
i = 5.18 from Table A

Calculated Data

A = 0.000 Acres
S = 2.658
Q = 3.044 inches (24 hour runoff)
Qi = 0.000 CFS
Qr = 0.000 CFS
VR = 0.00 ft³
Qr/Qi = #DIV/0!

Area 10 C shaped building

Given Information

A = 16,827.23 ft²
PK Disch. 0 CFS
CN = 98
C = 0.9
P = 5.28 inches
Tc = 15 min
i = 5.18 from Table A

Calculated Data

A = 0.386 Acres
S = 0.204
Q = 5.043 inches (24 hour runoff)
Qi = 1.801 CFS
Qr = 1.801 CFS
VR = 7,071.30 ft³
Qr/Qi = 1.000

Area 11 Paved area around C building

Given Information

A = 19,328.79 ft²
PK Disch. 0 CFS
CN = 98
C = 0.9
P = 5.28 inches
Tc = 15 min
i = 5.18 from Table A

Calculated Data

A = 0.444 Acres
S = 0.204
Q = 5.043 inches (24 hour runoff)
Qi = 2.069 CFS
Qr = 2.069 CFS
VR = 8,122.53 ft³
Qr/Qi = 1.000

Area 12 & 15 Paved Parking east of Doctors Building

Given Information

A = 17,100.40 ft²
PK Disch. 0 CFS
CN = 98
C = 0.9
P = 5.28 inches
Tc = 15 min
i = 5.18 from Table A

Calculated Data

A = 0.393 Acres
S = 0.204
Q = 5.043 inches (24 hour runoff)
Qi = 1.830 CFS
Qr = 1.830 CFS
VR = 7,186.09 ft³
Qr/Qi = 1.000

Area 13 East portion of east parking area

Given Information

A = 13,781.75 ft²
PK Disch. 0 CFS
CN = 98
C = 0.9
P = 5.28 inches
Tc = 15 min
i = 5.18 from Table A

Calculated Data

A = 0.316 Acres
S = 0.204
Q = 5.043 inches (24 hour runoff)
Qi = 1.475 CFS
Qr = 1.475 CFS
VR = 5,791.50 ft³
Qr/Qi = 1.000

Area 5B Potential Building Site in Area 5

Given Information

A = 15,000.00 ft²
PK Disch. 0 CFS
CN = 79
C = 0.46
P = 5.28 inches
Tc = 15 min
i = 5.18 from Table A

Calculated Data

A = 0.344 Acres
S = 2.658
Q = 3.044 inches (24 hour runoff)
Qi = 0.821 CFS
Qr = 0.821 CFS
VR = 3,805.21 ft³
Qr/Qi = 1.000

Post-Construction Building, Parking Lot and Paved Area

Area 1 Parking Area North of Doctor's Building

Given Information

A = 17,864.39 ft²
 PK Disch. 0 CFS
 CN = 98
 C = 0.9
 P = 5.28 inches
 Tc = 15 min
 i = 5.18 from Table A

VS/VR* =
 * From Graph Type II Storm

Calculated Data

A = 0.410 Acres
 S = 0.204
 Q = 5.043 inches (24 hour runoff)
 Qi = 1.912 CFS
 Qr = 0.850 CFS
 VR = 7,507.14 ft³
 Qr/Qi = 0.444

VS = 2,214.61 ft³
 0.051 acre feet

Area 2 Doctors Clinic Building

Given Information

A = 20,227.83 ft²
 PK Disch. 0 CFS
 CN = 98
 C = 0.9
 P = 5.28 inches
 Tc = 15 min
 i = 5.18 from Table A

VS/VR* =
 * From Graph Type II Storm

Calculated Data

A = 0.464 Acres
 S = 0.204
 Q = 5.043 inches (24 hour runoff)
 Qi = 2.165 CFS
 Qr = 0.962 CFS
 VR = 8,500.33 ft³
 Qr/Qi = 0.444

VS = 2,507.60 ft³
 0.058 acre feet

Area 3 Paved Area just south of Doctors Building

Given Information

A = 7,855.11 ft²
 PK Disch. 0 CFS
 CN = 98
 C = 0.9
 P = 5.28 inches
 Tc = 15 min
 i = 5.18 from Table A

VS/VR* =
 * From Graph Type II Storm

Calculated Data

A = 0.180 Acres
 S = 0.204
 Q = 5.043 inches (24 hour runoff)
 Qi = 0.841 CFS
 Qr = 0.374 CFS
 VR = 3,300.95 ft³
 Qr/Qi = 0.444

VS = 973.78 ft³
 0.022 acre feet

Area 5B Potential Building Site in Area 5

Given Information

A = 15,000.00 ft²
 PK Disch. 0 CFS
 CN = 98
 C = 0.9
 P = 5.28 inches
 Tc = 15 min
 i = 5.18 from Table A

Calculated Data

A = 0.344 Acres
 S = 0.204
 Q = 5.043 inches (24 hour runoff)
 Qi = 1.605 CFS
 Qr = 0.821 CFS
 VR = 6,303.44 ft³
 Qr/Qi = 0.511

VS/VR* = 0.268

VS = 1,689.32 ft³
 0.039 acre feet

* From Graph Type II Storm

Estimated Stormwater Volume

10 year Storm Event

Area	Pre-Const.		Post Const.		Detention Storage Required	
	Peak Flow CFS	Runoff Volume ft ³	Peak Flow CFS	Runoff Volume ft ³	ft ³	acre feet
1	0.850	4,120.71	1.912	7,507.14	2,214.61	0.051
2	0.962	4,665.87	2.165	8,500.33	2,507.60	0.058
3	0.374	1,811.91	0.841	3,300.95	973.78	0.022
4	1.375	5,400.07	1.375	5,400.07		
5	2.053	9,519.73	2.053	9,519.73		
6	0.264	1,035.95	0.264	1,035.95		
7	1.053	5,108.57	1.053	5,108.57		
8	0.000	0.000	0.000	0.000		
9	0.000	0.00	0.000	0.00		
10	1.801	7,071.30	1.801	7,071.30		
11	2.069	8,122.53	2.069	8,122.53		
12	1.830	7,186.09	1.830	7,186.09		
13	1.475	5,791.50	1.475	5,791.50		
5B	0.821	3,805.21	1.605	3,805.21	1,689.322	0.039
	14.926	63,639.4	18.443	72,349.4	7,385.31	0.170

Increase in Peak Flow = 3.517 CFS

Increase in Runoff Volume 8,709.94 ft³

Simplified Detention Routing (Basins less than 10 acres tributary)

Equations

Total Tributary Area

4.660

acres

$S = (1000/CN) - 10.0$ where:

SN = SCS Curve Number from Table C

$Q = (P \cdot 0.2S)^2 / (P + 0.8S)$ where:

Q = Runoff in Inches

P = 24 hour rainoff in inches from Table B

$VR = (Q/12) \cdot A \cdot 43,560$ where:

VR = Cu. Ft. Inflow to detention

A = Acres of tributary to detention

Qi = Peak Flow to detention

Calculated by either:

* Rational Method (Qi = CiA)

* Hydrograph routing

Qr = Peak CFS discharge from detention

Criteria Max. (CFS/Trib. Acre)

Qr(allowable) = Peak Pre-Construction Flow

Rainfall	P	I
2 yr	3.60	3.80
10 yr	5.28	5.19
100 yr	7.68	7.36

Given Conditions				Tc =	15	min
Storm Event	2	Year	P (in) = 3.60	i (in) = 3.80		

Pre-Construction Runoff and Detention Calculations

Area 1 Parking Area North of Doctor's Building

Impervious	98	0.90
Developed Parks	79	0.46
Open Space	76	0.40

Given Information

Calculated Data

A = 17,864.39 ft²
 PK Disch. 0 CFS
 CN = 76
 C = 0.4
 P = 3.6 inches
 Tc = 15 min
 i = 3.8 from Table A

A = 0.410 Acres
 S = 3.158
 Q = 1.438 inches (24 hour runoff)
 Qi = 0.623 CFS
 Qr = 0.623 CFS
 VR = 2,141.21 ft³
 Qr/Qi = 1.000

Area 2 Doctors Clinic Building

Given Information

Calculated Data

A = 20,227.83 ft²
 PK Disch. 0 CFS
 CN = 76
 C = 0.4
 P = 3.6 inches
 Tc = 15 min
 i = 3.8 from Table A

A = 0.464 Acres
 S = 3.158
 Q = 1.438 inches (24 hour runoff)
 Qi = 0.706 CFS
 Qr = 0.706 CFS
 VR = 2,424.49 ft³
 Qr/Qi = 1.000

Area 3 Paved Area just south of Doctors Building

Given Information

A = 7,855.11 ft²
PK Disch. 0 CFS
CN = 76
C = 0.4
P = 3.6 inches
Tc = 15 min
i = 3.8 from Table A

Calculated Data

A = 0.180 Acres
S = 3.158
Q = 1.438 inches (24 hour runoff)
Qi = 0.274 CFS
Qr = 0.274 CFS
VR = 941.51 ft³
Qr/Qi = 1.000

Area 4 Building to far east

Given Information

A = 12,850.29 ft²
PK Disch. 0 CFS
CN = 98
C = 0.9
P = 3.6 inches
Tc = 15 min
i = 3.8 from Table A

Calculated Data

A = 0.295 Acres
S = 0.204
Q = 3.366 inches (24 hour runoff)
Qi = 1.009 CFS
Qr = 1.009 CFS
VR = 3,604.69 ft³
Qr/Qi = 1.000

Area 5 Grassed Area west of Doctors Building w/o Building Site

Given Information

A = 37,526.43 ft²
PK Disch. 0 CFS
CN = 79
C = 0.46
P = 3.6 inches
Tc = 15 min
i = 3.8 from Table A

Calculated Data

A = 0.861 Acres
S = 2.658
Q = 1.644 inches (24 hour runoff)
Qi = 1.506 CFS
Qr = 1.506 CFS
VR = 5,141.28 ft³
Qr/Qi = 1.000

Area 6 East Roof Top of Parking Lot Building

Given Information

A = 2,465.19 ft²
 PK Disch. 0 CFS
 CN = 98
 C = 0.9
 P = 3.6 inches
 Tc = 15 min
 i = 3.8 from Table A

Calculated Data

A = 0.057 Acres
 S = 0.204
 Q = 3.366 inches (24 hour runoff)
 Qi = 0.194 CFS
 Qr = 0.194 CFS
 VR = 691.52 ft³
 Qr/Qi = 1.000

Area 7 Proposed Detention Pond Area

Given Information

A = 22,147.03 ft²
 PK Disch. 0 CFS
 CN = 76
 C = 0.4
 P = 3.6 inches
 Tc = 15 min
 i = 3.8 from Table A

Calculated Data

A = 0.508 Acres
 S = 3.158
 Q = 1.438 inches (24 hour runoff)
 Qi = 0.773 CFS
 Qr = 0.773 CFS
 VR = 2,654.52 ft³
 Qr/Qi = 1.000

Area 8 Transformer Pad Area

Given Information

A = ft²
 PK Disch. 0 CFS
 CN = 79
 C = 0.46
 P = 3.6 inches
 Tc = 15 min
 i = 3.8 from Table A

Calculated Data

A = 0.000 Acres
 S = 2.658
 Q = 1.644 inches (24 hour runoff)
 Qi = 0.000 CFS
 Qr = 0.000 CFS
 VR = 0.00 ft³
 Qr/Qi = #DIV/0!

Area 9 Runoff Area west of new sidewalk

Given Information

A = ft²
PK Disch. = 0 CFS
CN = 79
C = 0.46
P = 3.6 inches
Tc = 15 min
i = 3.8 from Table A

Calculated Data

A = 0.000 Acres
S = 2.658
Q = 1.644 inches (24 hour runoff)
Qi = 0.000 CFS
Qr = 0.000 CFS
VR = 0.00 ft³
Qr/Qi = #DIV/0!

Area 10 C shaped building

Given Information

A = 16,827.23 ft²
PK Disch. = 0 CFS
CN = 98
C = 0.9
P = 3.6 inches
Tc = 15 min
i = 3.8 from Table A

Calculated Data

A = 0.386 Acres
S = 0.204
Q = 3.366 inches (24 hour runoff)
Qi = 1.321 CFS
Qr = 1.321 CFS
VR = 4,720.28 ft³
Qr/Qi = 1.000

Area 11 Paved area around C building

Given Information

A = 19,328.79 ft²
PK Disch. = 0 CFS
CN = 98
C = 0.9
P = 3.6 inches
Tc = 15 min
i = 3.8 from Table A

Calculated Data

A = 0.444 Acres
S = 0.204
Q = 3.366 inches (24 hour runoff)
Qi = 1.518 CFS
Qr = 1.518 CFS
VR = 5,422.00 ft³
Qr/Qi = 1.000

Area 12 & 15 Paved Parking east of Doctors Building

Given Information

A = 17,100.40 ft²
PK Disch. 0 CFS
CN = 98
C = 0.9
P = 3.6 inches
Tc = 15 min
i = 3.8 from Table A

Calculated Data

A = 0.393 Acres
S = 0.204
Q = 3.366 inches (24 hour runoff)
Qi = 1.343 CFS
Qr = 1.343 CFS
VR = 4,796.90 ft³
Qr/Qi = 1.000

Area 13 East portion of east parking area

Given Information

A = 13,781.75 ft²
PK Disch. 0 CFS
CN = 98
C = 0.9
P = 3.6 inches
Tc = 15 min
i = 3.8 from Table A

Calculated Data

A = 0.316 Acres
S = 0.204
Q = 3.366 inches (24 hour runoff)
Qi = 1.082 CFS
Qr = 1.082 CFS
VR = 3,865.98 ft³
Qr/Qi = 1.000

Area 5B Potential Building Site in Area 5

Given Information

A = 15,000.00 ft²
PK Disch. 0 CFS
CN = 79
C = 0.46
P = 3.6 inches
Tc = 15 min
i = 3.8 from Table A

Calculated Data

A = 0.344 Acres
S = 2.658
Q = 1.644 inches (24 hour runoff)
Qi = 0.602 CFS
Qr = 0.000 CFS
VR = 2,055.06 ft³
Qr/Qi = 0.000

Post-Construction Building, Parking Lot and Paved Area

Area 1 Parking Area North of Doctor's Building

Given Information

A = 17,864.39 ft²
 PK Disch. 0 CFS
 CN = 98
 C = 0.9
 P = 3.6 inches
 Tc = 15 min
 i = 3.8 from Table A

VS/VR* =

* From Graph Type II Storm

Calculated Data

A = 0.410 Acres
 S = 0.204
 Q = 3.366 inches (24 hour runoff)
 Qi = 1.403 CFS
 Qr = 0.623 CFS
 VR = 5,011.21 ft³
 Qr/Qi = 0.444

VS = 1,478.31 ft³
 0.034 acre feet

Area 2 Doctors Clinic Building

Given Information

A = 20,227.83 ft²
 PK Disch. 0 CFS
 CN = 98
 C = 0.9
 P = 3.6 inches
 Tc = 15 min
 i = 3.8 from Table A

VS/VR* =

* From Graph Type II Storm

Calculated Data

A = 0.464 Acres
 S = 0.204
 Q = 3.366 inches (24 hour runoff)
 Qi = 1.588 CFS
 Qr = 0.706 CFS
 VR = 5,674.19 ft³
 Qr/Qi = 0.444

VS = 1,673.89 ft³
 0.038 acre feet

Area 3 Paved Area just south of Doctors Building

Given Information

A = 7,855.11 ft²
 PK Disch. 0 CFS
 CN = 98
 C = 0.9
 P = 3.6 inches
 Tc = 15 min
 i = 3.8 from Table A

VS/VR* =

* From Graph Type II Storm

Calculated Data

A = 0.180 Acres
 S = 0.204
 Q = 3.366 inches (24 hour runoff)
 Qi = 0.617 CFS
 Qr = 0.274 CFS
 VR = 2,203.47 ft³
 Qr/Qi = 0.444

VS = 650.02 ft³
 0.015 acre feet

Area 5B Potential Building Site in Area 5

Given Information

A = 15,000.00 ft²
 PK Disch. 0 CFS
 CN = 98
 C = 0.9
 P = 3.6 inches
 T_c = 15 min
 i = 3.8 from Table A

Calculated Data

A = 0.344 Acres
 S = 0.204
 Q = 3.366 inches (24. hour runoff)
 Q_i = 1.178 CFS
 Q_r = 0.602 CFS
 VR = 4,207.71 ft³
 Q_r/Q_i = 0.511

VS/VR* = 0.268

VS = 1,127.67 ft³
 0.026 acre feet

* From Graph Type II Storm

Estimated Stormwater Volume

2 year Storm Event

Area	Pre-Const.		Post Const.		Detention Storage Required	
	Peak Flow CFS	Runoff Volume ft ³	Peak Flow CFS	Runoff Volume ft ³	ft ³	acre feet
1	0.623	2,141.21	1.403	5,011.21	1,478.31	0.034
2	0.706	2,424.49	1.588	5,674.19	1,673.89	0.038
3	0.274	941.51	0.617	2,203.47	650.02	0.015
4	1.009	3,604.69	1.009	3,604.69		
5	1.506	5,141.28	1.506	5,141.28		
6	0.194	691.52	0.194	691.52		
7	0.773	2,654.52	0.773	2,654.52		
8	0.000	0.000	0.000	0.000		
9	0.000	0.00	0.000	0.00		
10	1.321	4,720.28	1.321	4,720.28		
11	1.518	5,422.00	1.518	5,422.00		
12	1.343	4,796.90	1.343	4,796.90		
13	1.082	3,865.98	1.082	3,865.98		
5B	0.602	2,055.06	1.178	2,055.06	1,127.667	0.026
	10.950	38,459.4	13.530	45,841.1	4,929.88	0.113

Increase in Peak Flow = 2.580 CFS

Increase in Runoff Volume 7,381.68 ft³

2147.03 44'
1.487 65'

CN C
79 46

① CN C
76 .90 17867.39 44'
98 .90

CN C
98 .90 16526.4

⑫

⑬

52526.43 44'

100x150' bu. plus
S.H. (65,000 sq ft)

CN C
94 90

CN C
79 .46

⑬
CN C
98 .90
246515

②

CN C
76 .90
98 .90

20227.83 44'

⑤

CN C
76 .90
98 .90

7855.11 44'

⑨
CN C
79 .90
98 .90

⑭
CN C
98 .90

⑩

CN C
98 .90

⑮

16827.23 44'

④

CN C
98 .90

12850.29 44'

CN C
99 .90

19387.79 44'

BUILDING
F.E. - 1340
CITY OF LOS ANGELES

BUILDING
F.E. - 1340
CITY OF LOS ANGELES

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CITY OF LOS ANGELES

BUILDING
F.E. - 1340
CITY OF LOS ANGELES



Professional Engineering Consultants, P.A.

January 17, 2002

City of Wichita
Public Works Department, 7th Floor
455 N. Main Street
Wichita, KS 67202

Attention: Ms. Vicki Huang
Subdivision Design

Reference: Via Christi Storm Sewer Extension
PEC Project No. 34-01554-0299

Dear Ms. Huang:

Thank you for taking the time to meet with Rod Young and myself on Tuesday, January 15, 2002, concerning the proposed stormwater detention and drainage improvements for the Via Christi Medical Facilities located in the vicinity of Zimmerly Street and Clifton Avenue.

As discussed, the purpose of this meeting was to review preliminary plans for addressing the increased runoff created by construction of the Family Practice Building and adjacent newly constructed parking area. Significant aspects of the proposed drainage improvements include the following:

1. Storm sewer and inlets will be installed in the east side of the Family Practice building to collect runoff and route it the proposed 0.25 acre-foot detention cell. (Copies of stormwater calculations and sketches were provided to the City during meeting).
2. The grassed area adjacent to Zimmerly Street and north of the main parking lot will be regraded to provide the stormwater detention cell for the additional runoff generated by the New Family Practice building and new parking area.
3. The proposed detention cell is large enough to accommodate the additional runoff from a future building of approximately 15,000 square feet.
4. It is understood that the proposed improvements are intended to provide detention and improve stormwater drainage generally related to the new Family Practice facilities.
5. Stormwater accumulated in the detention cell will be discharged directly into the existing City stormwater sewer. The proposed discharge inlet and piping configuration which will connect to the City SWS will be included in the design plans and submitted to the City for review and approval.

DIRECTORS:

D.E. MALTBIE, P.E.
M.D. SCHOMAKER, P.E.
G.D. SCHOCK, P.E.
J.H. BAILEY, P.E., Ph.D.
D.I. NORTON, P.E.
B.E. REMSBERG, P.E.
G.K. GREENWOOD, P.E.
D.E. HAGER, P.E.
M.W. BERRY, P.E.
J.B. GEORGE, P.E.

ASSOCIATE

DIRECTORS:

R.A. SCHLITT, P.E.
K.L. ROOD, P.E.
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Ms. Vicki Huang
January 17, 2002
Page 2

6. During large storm events, the detention cell will overflow to the southwest into the existing Via Christi parking lot. A portion of this overflow may discharge into the existing SWS inlet in the parking lot with the excess flowing to the street to the north and west.
7. The project will be a private stormwater sewer extension project completed through Via Christi. Construction plans will be completed and submitted to the City for review and approval. The appropriate permit review fee will be paid the Owner.
8. Per City requirements, specific language will be included in the project plans and specifications which will require the use of qualified and/or certified surveying, construction staking, and inspection services and personnel.
9. The Owner will provide the City a set of record drawings of the completed project.

PEC will proceed with final design of the proposed improvements as outlined in this letter unless notified otherwise.

Please notify if there are comments or questions.

Very truly yours,

PROFESSIONAL ENGINEERING CONSULTANTS P.A.



Ted T. Johnson, I.E.
Design Engineer

TTJ/tac

cc: Mike Spangler, Via Christi Medical Facilities

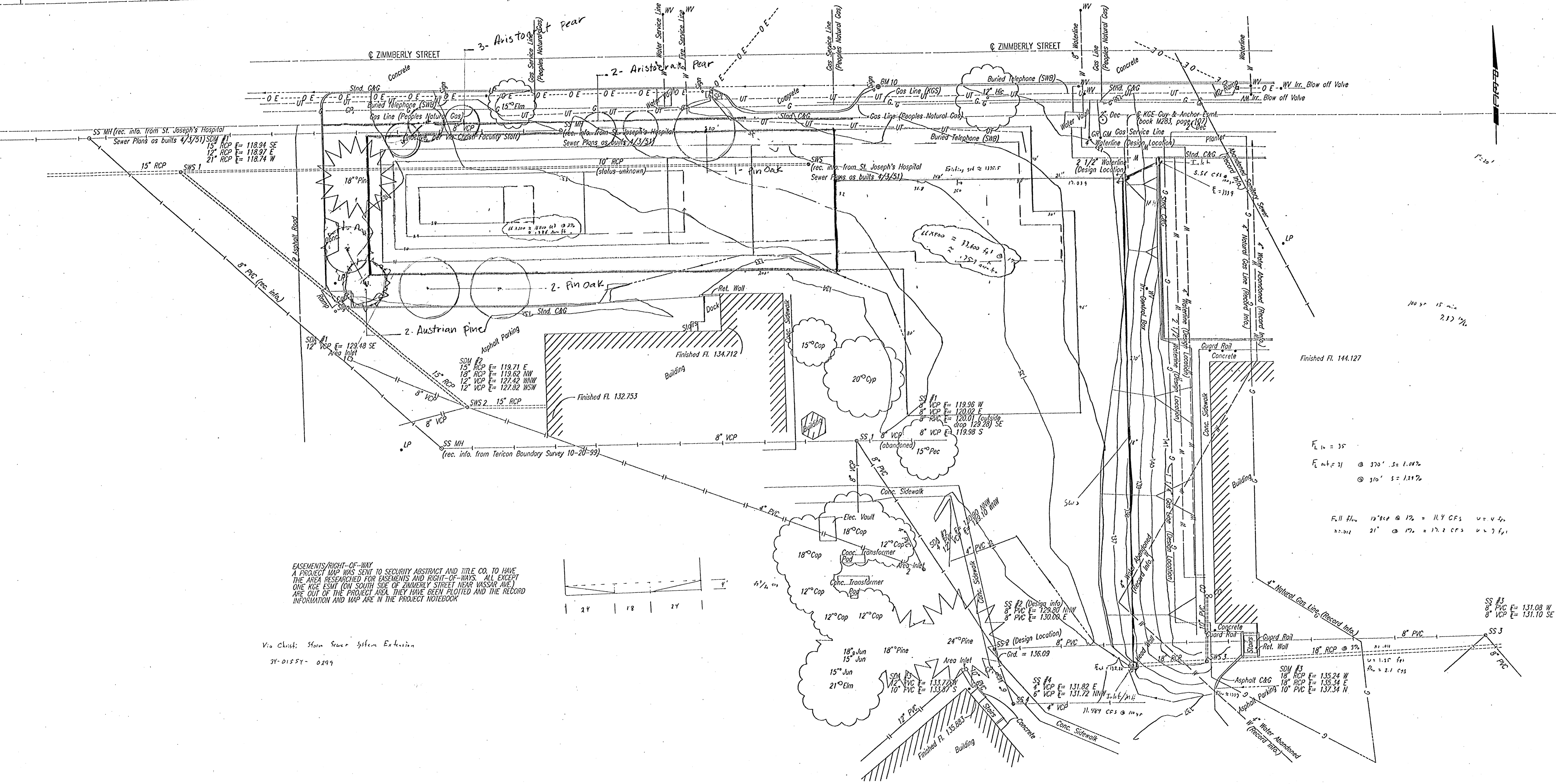
PAUL'S ADDITION ①

SAVAGE ADDITION

VASSAR AVENUE

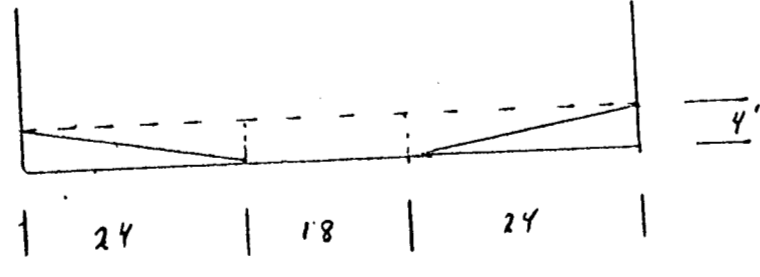
ZIMMERLY STREET

ZIMMERLY STREET



EASEMENTS/RIGHT-OF-WAY
 A PROJECT MAP WAS SENT TO SECURITY ABSTRACT AND TITLE CO. TO HAVE
 THE AREA RESEARCHED FOR EASEMENTS AND RIGHT-OF-WAYS. ALL EXCEPT
 ONE RGE ESMT (ON SOUTH SIDE OF ZIMMERLY STREET NEAR VASSAR AVE.)
 ARE OUT OF THE PROJECT AREA. THEY HAVE BEEN PLOTTED AND THE RECORD
 INFORMATION AND MAP ARE IN THE PROJECT NOTEBOOK

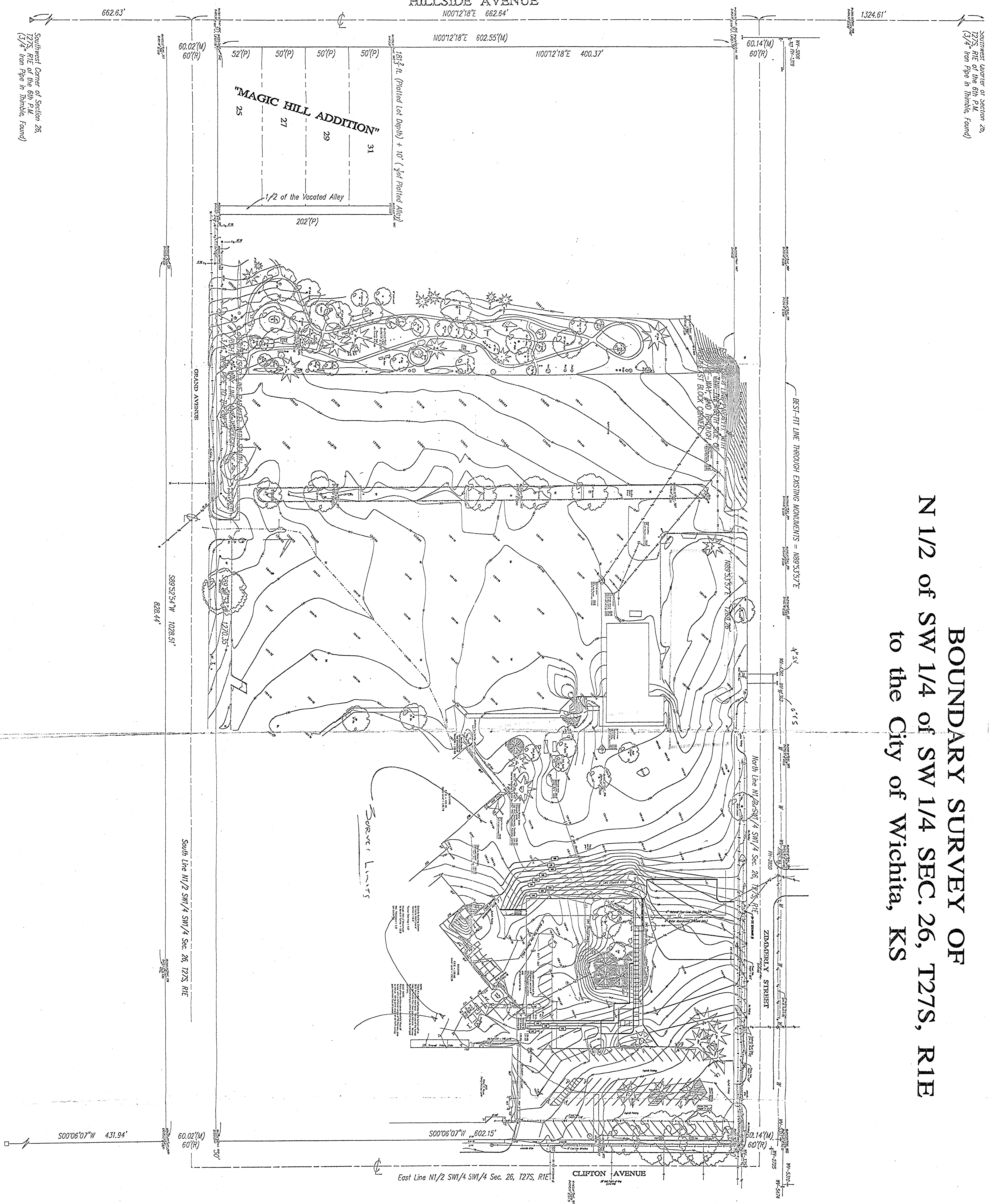
Via Christi Storm Sewer System Extension
 34-01554-0299



$F_L 14 = 35$
 $F_L 24 = 31$ @ 370' S = 1.082
 @ 310' S = 1.212
 $F_L 14 = 12^{\circ} RCP @ 12' = 11.4 CFS \quad v = 4.5$
 $n = 0.14 \quad 21' @ 17' = 17.2 CFS \quad v = 7.1$

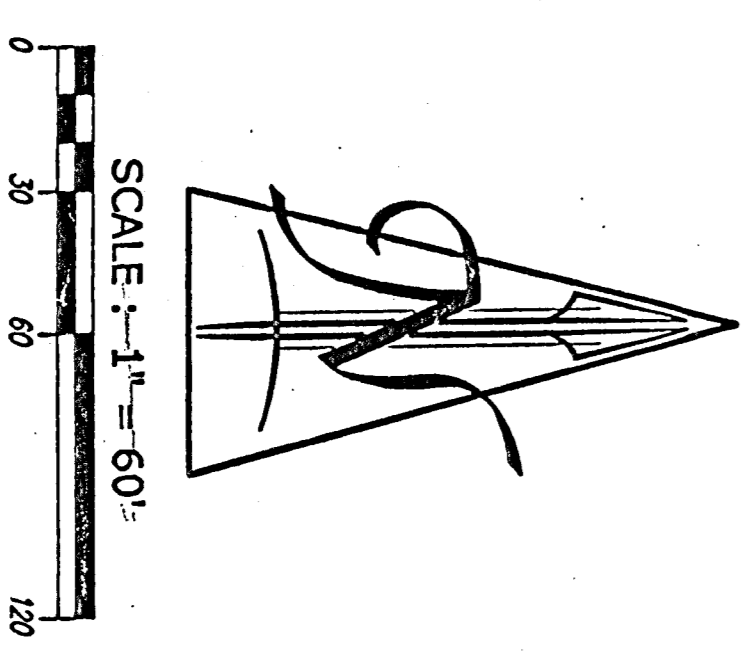
SS #3
 8" PVC E = 131.08 W
 8" VCP E = 131.10 SE

**BOUNDARY SURVEY OF
N 1/2 of SW 1/4 of SW 1/4 SEC. 26, T27S, R1E
to the City of Wichita, KS**



Southwest Corner of Section 26,
T27S, R1E of the 6th P.M.
(3/4\"/>

Southeast Quarter of Section 26,
T27S, R1E of the 6th P.M.
(3/4\"/>



- Legend:**
- (P) = Pinned Measurement
 - (D) = Described in Record
 - (M) = Measured
 - Beating Boss Assumed
 - File #890045
 - Date of Preparation: October 26, 1991
 - ▲ = Section Corner Found as Marked
 - = 1\"/>
 - = 1/2\"/>
 - = 3/4\"/>
 - = #12 Rebar with 12 Cap. Set
 - = #12S Q.527
 - ⊙ = #4 Rebar Found, No 12
 - X = Observed Pins Found
 - * = Observed Pins Set