PRELIMINARY DRAINAGE STUDY

COMOTARA POWER CENTER
36th and North Rock Road
Wichita, Kansas

Return Frequency of
10-year, 100-year Design Storm

Program Methods:
Texas Hydraulic System (Rational Method)
Pond2 and PondPak (Haested)

Reference:
Calculation & Drainage Information for Upstream Condition
by Mid-Kansas Engineering Consultants
Design of Urban Highway Design Manual 1
Drainage of Highway Pavements Manual 2
Interim Drainage and Storm Sewer Policy
for Design Criteria and Documentation

Prepared by

KAW VALLEY ENGINEERING
April 1992

KAW VALLEY ENGINEERING

• ENGINEERING • ARCHITECTURE • PLANNING • SURVEYING • INSPECTION • TESTING •

2319 N. Jackson • P. O. Box 1304 • Junction City, Kansas 66441 • 913/762-5040

GRANT OF STORM DRAINAGE EASEMENT

STATE OF KANSAS, COUNTY OF SEDGWICK:

For and in consideration of One Dollar ($1.00) and other good and valuable consideration to the undersigned owner paid, the receipt of which is hereby acknowledged; the undersigned hereby grants to the CITY OF WICHITA, KANSAS, a municipal corporation located in Sedgwick County, Kansas, and its successors and assigns, a permanent and perpetual easement and right-of-way to construct, maintain, repair and replace storm drainage channel and underground pipelines and appurtenances within, on and under the following described tract of real estate located in Sedgwick County, Kansas, and described as follows, to-wit:

See attached legal description.

together with the right of ingress and egress for all purposes incident to said grant.

The said Grantor, its successors and assigns, hereby agrees that no building, buildings or other structures shall be erected on or over the above described easement, but are otherwise to fully use and enjoy said premises except for the purposes hereinbefore granted to said grantee.

This Grant of Easement shall run with the land and is binding upon the heirs, representatives, successors and assigns of the respective parties hereto.

IN WITNESS WHEREOF:

Northrock Realty Partners, the Grantor herein, has caused to execute this instrument this _____ day of _____, 19___.

ATTEST:

_____

BY:

_____

David C Nesbitt, Partner
Northrock Realty Partners

STATE OF KANSAS, COUNTY OF SEDGWICK ss:

The foregoing Grant of Easement and right-of-way was acknowledged before me this __ day of _____, 19___.

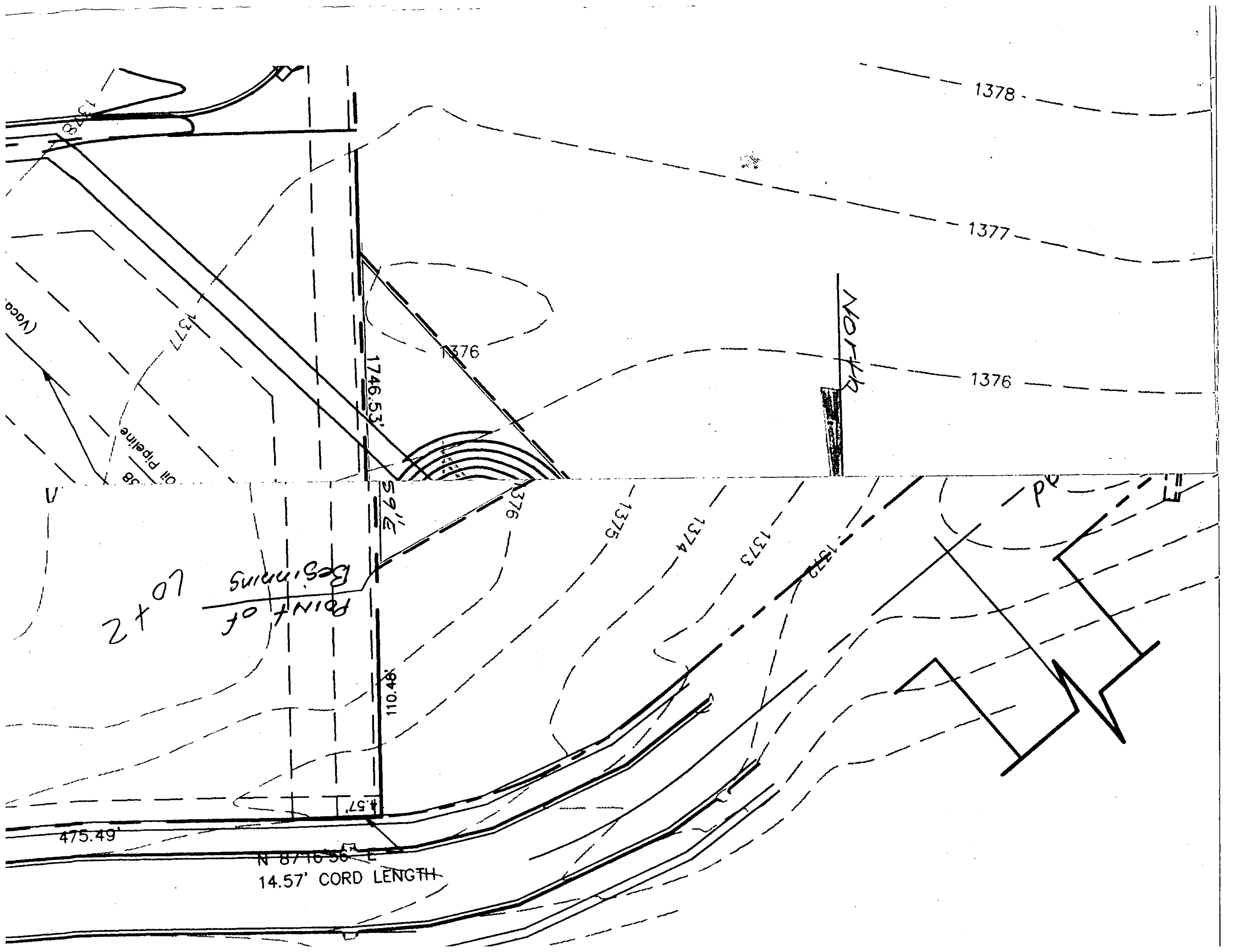
_____

Notary Public

July 10, 1992
92-1399

DESCRIPTION FOR STORM DRAINAGE EASEMENT

A tract of land for storm drainage easement located in the Northeast Quarter of Section 31, Township 26 South, Range 2 East of the 6th Principal Meridian, Sedgwick County, Kansas and being a portion of Killarney Plaza Second Addition more particularly described as follows:
Commencing at the Northwest corner of Lot 2, Block 1 Comotara Power Center; thence S 01°04'59" E on the West line of said Comotara Power Center a distance of 110.48 feet to the POINT OF BEGINNING of tract to be described:
thence continuing on said West line S 01°04'59" E a distance of 563.05 feet;
thence N 42°04'31" W a distance of 556.67 feet to the South Right-of-Way line of Inwood;
thence N 49°00'00" E on said South Right-of-Way line a distance of 110.00 feet;
thence S 42°04'31" E a distance of 74.69 feet;
thence N 59°52'45" E a distance of 265.19 feet to the Point of Beginning.
Contains 2.29 acres, more or less.
END OF DESCRIPTION


1378
1377
1376
1376
1746.53'
59'E
1376
1375
1374
1373
1372
North
Point of Beginning
Lot 2
110.48'
4.57'
475.49'
N 87°16'56" E
14.57' CORD LENGTH
Oil Pipeline
1377

KAW VALLEY ENGINEERING & DEVELOPMENT, INC.

2319 NORTH JACKSON
P.O. BOX 1304
JUNCTION CITY, KANSAS 66441
TEL: (913) 762-5040
FAX: (913) 762-7744

122 NW PARKWAY
RIVERSIDE, MISSOURI 64150
TEL: (816) 587-5033
FAX: (816) 587-0129

June 5, 1992
92-1399

City of Wichita
Engineering Department
455 N Main, 7th Floor
Wichita, KS 67202

ATTN Vicky Huang, P E

RE Commercial Development Site at 36th and North Rock Road, Wichita, Kansas

Dear Vicky

As you discussed with Leon Osbourn of this office we have reexamined the storm drainage study originally provided you on the above referenced project to estimate the effects of detaining the storm water from the proposed development of this 45-acre site. Although it is possible as we originally stated, that continuing to add detention storage for each site in the development may result in a higher maximum discharge at some specific given point somewhere downstream, we believe it is still necessary to provide some detention to store the increased runoff from this site.

An analysis of the watershed to determine water surface elevations at specific points in time and specific locations downstream would require a large amount of data and study, which we believe is far beyond the scope of an individual development. We have therefore, completed a preliminary design to size detention storage to retain the additional runoff from a storm of 100-year frequency that would occur after this 45-acre site is fully developed.

The runoff from the existing condition of the site is estimated at 158 cfs, and when fully developed with all paving, streets, and buildings in place, it is estimated that this could increase to 382 cfs from a storm of 100-year frequency. To detain that difference requires a detention storage of 8.1 acre/feet. This can be achieved by constructing a dry detention basin immediately upstream from the box bridge on Inwood. As stated in the original report, the water discharging from the existing detention basins East of Rock Road would be passed through without further detention, and only the increased runoff from this site would be detained in a normally dry detention basin.

The above quantities are preliminary estimates and are conservative, based on preliminary storm drainage and site development plans. It is believed that the final design of the detention storage will result in somewhat less volume, and construction of that facility will provide the downstream protection, which leaves the greatest flexibility for other storm water management decisions in the watershed.

We sincerely appreciate your assistance in this project; and please allow us the opportunity to respond to any questions or comments you may have.

Sincerely

Bruce V Collins, P E
Project Engineer

BVC/js

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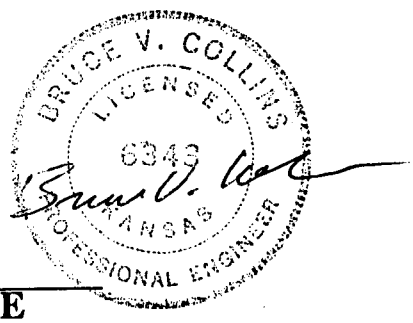


Bruce V Collins, P E

PRELIMINARY DRAINAGE STUDY

Project: **Proposed Commercial Site**
36th and Rock Road, Wichita, Kansas

Subject: **Storm Drainage Improvements and Runoff Calculations**

South Tract

This proposed site is a 27.8-acre tract undeveloped and currently covered with grass, brush and some wheat. There has been prior installation of water and sewer lines across portions of the tract, which is otherwise vacant. The proposed improvement of the tract contemplates construction of retail stores and parking, which will essentially result in some 95% of the area becoming impermeable to storm water. Existing ditches and portions of an existing pond will be filled and replaced with storm drainage facilities and relocated detention areas.

In the investigation of the effect of storm water runoff of this proposed development, the following was assumed.

1. A detention pond currently exists upstream from this site on the East side of Rock Road. Per calculations and information furnished by Mid-Kansas Engineering Consultants, the design discharge through the 8 x 3 reinforced concrete box culvert on to this site is 130 cfs. Since it is assumed that this is the effluent from a properly designed and sized detention pond, this storm water runoff discharge will be passed through the subject site without further detention.

2. The time of concentration on the aforementioned storm water runoff was given as 26 minutes.

3. No other off site storm runoff discharge was considered.

4. Attempts to obtain storm water drainage reports for the developments East of Rock Road were unsuccessful.

Although the City of Wichita requires storm drainage to be designed for 5-year storm frequencies, the proposed developer of this tract requires a 10-year design in storm sewers, and the higher frequencies passed (without damage to any buildings) overland. Therefore, storm sewers were located and sized as per the attached drawing labeled as a grading plan and the attached calculations. These calculations indicate a maximum discharge from the site as improved, of 143 cfs for the storm of 10-year frequency, and 200 cfs for the storm of 100-year frequency.

As per the "Interim Drainage and Storm Sewer Policy for Design Criteria and Documentation for the City of Wichita," herinafter referred to as "the Policy," the runoff from the unimproved site was analyzed by SCS TR 55 methods, to provide quick estimates of probable size of detention ponds. This method yielded a 10-year storm discharge of 60 cfs and a 100-yr storm discharge of 99 cfs. With the proposed discharge of 143 cfs from the 10-year storm, this would require a 3.8-acre/feet of storage volume, and the calculated discharge from the proposed condition of 200 cfs for the 100-year storm would require a 5.0-acre/feet of detention storage volume.

North Tract

The north portion of this proposed development is a currently vacant tract of 18.54 acres. Existing ground cover is primarily grass with some brush. The projected improvement of the tract contemplates construction of commercial buildings and parking. The existing ditches and small pond would be replaced with storm sewers and storm runoff presently entering the site from detention structures east of Rock Road will be passed through the site in a large RCB structure.

The same assumptions stated previously apply to the North tract except the runoff entering from East of Rock Road has a listed discharge (Q100) of 350 cfs at a Tc of 35 minutes.

Again for estimate purposes, runoff from the existing and the improved site was analyzed by SCS TR55 methods, indicating the discharges stated on the attached summary. Calculations are also enclosed herewith.

Total Tract

Total development of this tract of land routes stormwater runoff from East of Rock Road through the site as previously mentioned adding the additional runoff of the improved site, and passing this water downstream to the West to a new structure being designed across Inwood Road. Detention structures were sized to retain the differential runoff of the site.

The estimates of required volume are:

	South	North	Total
10 yr freq.	3.8 af	1.5 af	5.3 af
100 yr freq.	5.0 af	2.2 af	7.2 af

There is, however, with substantial storm water runoff entering the site from the East, the importance of the consideration of times of concentration. Because of the detention East of Rock Road, the Tc has been reported as 26 to 35 minutes. Calculations from the storm sewer design reports attached herewith for the proposed site indicate that the Tc for the site is only 6.5 minutes. It is therefore probable that storm water runoff from this proposed site if detained, results in matching peak runoff from the area East of Rock Road as the storm water passes through the existing detention ponds there.

Because of the relative Tc of each area, it is therefore recommended that the storm water runoff from the proposed site be allowed to pass downstream undetained to clear downstream channels of this runoff, prior to the runoff from already detained storm water to the East.

Summary

In summary, although it is relatively easy to construct detention ponds to retain some of the peak runoff from this site, it would appear that this would defeat the long-term goals of spreading out the peak storm water discharges downstream. Should storm drainage detention be required, the discharge from the two sites can be combined in that detention storage.

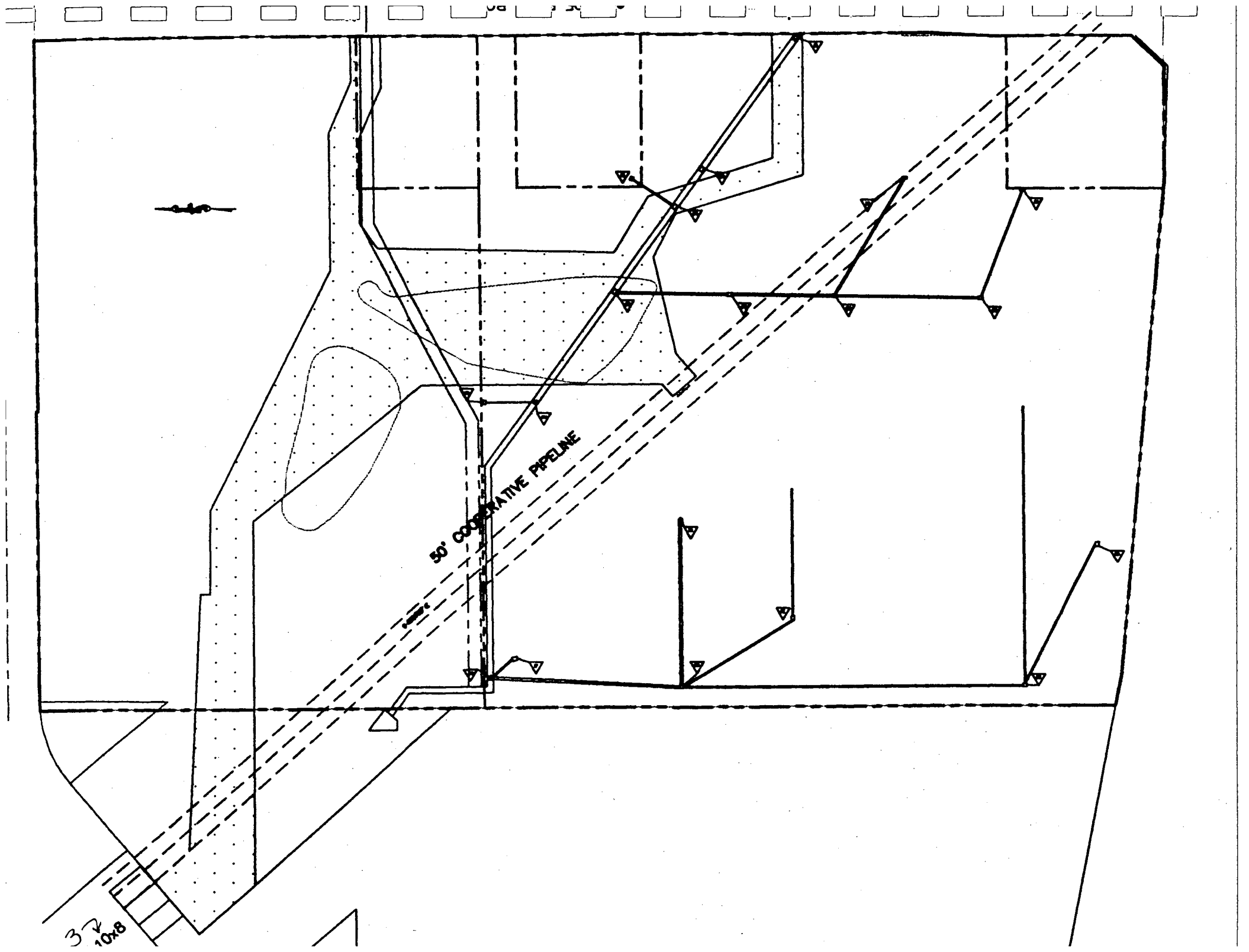
We would be pleased to respond to any questions, comments, or requests for additional information.

BRUCE V COLLINS
Professional Engineer

STORM RUNOFF SUMMARY

		Q 10 cfs	Q 100 cfs	T c min
A. NORTH TRACT				
1. From East of Rock Road per MKEC calculations		220*	350	35
2. From North tract devel.	Detained	54	67	
	Undetained	137	165	6
3. Total Peak Q	W/ detention	274	417	
	W/O detention	220	350	
B. SOUTH TRACT				
1. From East of Rock Road per MKEC calculations		81*	130	26
2. From South tract devel.	Detained	60	99	
	Undetained	143	200	6.5
3. Total Peak Q	W/ detention	141	229	
	W/O detention	143	200	
C. TOTAL DOWNSTREAM PEAK DISCHARGE				
With Detention		415	646	
Without Detention		363	550	

NOTE; Exact amounts will change with final designs, but the differential proportions are expected to be similar.


50' COOPERATIVE PIPELINE
3
10x8

South Tract Calculations

Quick TR-55 Version: 5.46 S/N: 1315400181

>>>>> DETENTION STORAGE ESTIMATE <<<<<

DETENTION POND SIZE ESTIMATES BVC 4-17-92 1399

CALCULATED
DISK FILE: A:399 .DET

South Tract

Drainage Area (acres) 27.8 0.0434 sq.mi.
Rainfall Distribution (Type) II

	Storm #1	Storm #2	Storm #3
Frequency (years)	5	10	100
Peak Inflow, qi (cfs)	130	143	200
Inflow Runoff, Q (in)	0.79	5.26	7.76
Peak Outflow, qo (cfs)	49	60	99
qo/qi Ratio	0.377	0.420	0.495
* Vs/Vr Ratio	0.333	0.311	0.278
Inflow Volume, Vr (ac-ft)	1.8	12.2	18.0
STORAGE VOLUME, Vs (ac-ft)	0.6	3.8	5.0

Summary of Volume Computations

C0	0.682	0.682	0.682
C1	-1.430	-1.430	-1.430
C2	1.640	1.640	1.640
C3	-0.804	-0.804	-0.804
* Vs/Vr	0.333	0.311	0.278

$$* \quad Vs/Vr = C0 + (C1*(qo/qi)) + (C2*(qo/qi)^2) + (C3*(qo/qi)^3)$$

Storm Sewer size
Rational Formula
South Tract

1/4

```
**********************************************************************
*                                  * THYSYS S/N   : 1393300036       *
*                                  * HMVersion    :  3.31            *
*                                  * Date         :  4/17/92         *
*   KAW VALLEY ENGINEERING         * Time         : 17:03:36         *
*                                  * Input file   : A:399-10.DA1     *
*                                  * Output file  : A:399-10.RP2     *
```

```
$Storm Drainage, SAMS     Site, WICHITA, KS              10 yr Freq.    91-1399
$PROPOSED LINE A, E,B,D VALUES FROMTPNO. 40 CALC                              20
$Kaw Valley Engineering, MAR 20,1992     BVC                                  30
SEWER     DESIGN              RUNOFF    INLET     SEWER     FREQUENCY=10 YR   40
COEF DESC A=ROOF    B=PVMT    C=TURF    D=RES     E=GRVL                      50
RAT COEF  0.98 0.95 0.30 0.40 0.70      MIN TC =    5.00.721 54.7 11.0        60
DA A  1                         2.41    L   V   T  5     12       3          70
DA A  2         2.06                    L   V   T  5                         80
DA A  3         1.29                    L   V   T  5                         85
DA A  4         1.24                    L   V   T  5                         90
DA A  6         1.86                    L   V   T  5                         91
DA A  7         0.81                    L   V   T  5                         92
DA B  1                         1.61    L   V   T  5                         93
DA L  1                                 L   V   T  5                185.0    94
DA L  2                         2.12    L   V   T  5                         95
DA F  1                         1.67    L   V   T  5                         96
DA G  1         0.51                    L   V   T  5                         97
DA C  1         0.67      1.80          L   V   T  5                         98
DA C  2   1.83                          L   V   T  5                         99
DA C  3         0.95      0.20          L   V   T  5                        100
DA D  1   1.83                          L   V   T  5                        101
DA E  1         1.06                    L   V   T  5                        102
DA E  2         0.10      0.85          L   V   T  5                        110
DA J  1                       2.20      L   V   T  5                        130
JUNC A  1 TYPE=GSAG                                 12.0                    140
JUNC A  2 TYPE=GSAG                                 12.0                    150
JUNC A  3 TYPE=GSAG                                 12.0                    155
JUNC A  4 TYPE=GSAG                           0.6    9.0                    156
JUNC A  5 TYPE=JUNCT                                                        157
JUNC A  6 TYPE=CSAG                           0.6    7.0                    158
JUNC A  7 TYPE=CSAG                           0.6    7.0                    159
JUNC A  8 TYPE=JUNCT                                                        160
JUNC B  1 TYPE=CSAG                           0.6   12.0                    161
JUNC L  1 TYPE=GSAG                                 36.0                    162
JUNC L  2 TYPE=GSAG                                 12.0                    163
JUNC L  3 TYPE=JUNCT                                                        164
JUNC F  1 TYPE=GSAG                                 12.0                    165
JUNC G  1 TYPE=CURB 10.0 1.00 30.0 15.0     0.0150.6                        166
JUNC J  1 TYPE=CSAG                           0.6    9.0                    167
JUNC C  1 TYPE=CSAG                           0.6   12.0                    168
JUNC C  2 TYPE=GSAG                                 20.0                    169
JUNC D  1 TYPE=GSAG                                 20.0                    171
JUNC C  3 TYPE=CSAG                           0.6   12.0                    172
JUNC E  1 TYPE=CSAG                           0.6   12.0                    173
JUNC E  2 TYPE=CSAG                           0.6   12.0                    180
OUTLET    STATIONING  1000.00 T.W. ELEV   378.00   A  8                     195
DSGN   1  A  1 A  2 US 384.1  DS 383.5   190          0.010      24 CIRC     200
DSGN   2  A  2 A  3 US 383.5  DS 382.5   235          0.010      30 CIRC     202
DSGN   3  A  3 A  4 US 382.5  DS 381.7   170          0.010      30 CIRC     205
DSGN   4  A  4 A  5 US 381.7  DS 380.8   180          0.013      36 CIRC     205
DSGN   5  L  1 L  2 US 383.6  DS 382.0   290          0.013       3  BOX     210
DSGN   6  L  2 L  3 US 382.0  DS 381.66   70          0.013       3  BOX     215
```

- Passthru from Q East of Kwik Rd. Estimated @ Max. capacity of existing RCB.

Station Q from MKEC report = 180 cfs

2/4

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DS6N   7  L  3 A  5 US 381.66 DS 380.79  170          0.013       3  BOX   217
DS6N   8  F  1 L  3 US 382.0  DS 381.66   80          0.010      24 CIRC   219
DS6N   9  A  5 A  6 US 380.8  DS 379.7   205          0.013       4  BOX   222
DS6N  10  G  1 A  6 US 380.5  DS 379.7    85          0.010      24 CIRC   223
DS6N  11  B  1 A  3 US 383.5  DS 382.5   225          0.010      24 CIRC   224
D36N  12  A  6 A  7 US 379.7  DS 377.1   475          0.013       4  BOX   225
DS6N  13  J  1 A  7 US 377.3  DS 377.1    45          0.010      24 CIRC   227
DS6N  14  C  1 C  2 US 382.5  DS 381.4   260          0.010      24 CIRC   228
DS6N  15  C  2 C  3 US 381.4  DS 378.6   555          0.010      30 CIRC   230
DS6N  16  D  1 E  2 US 381.0  DS 379.0   200          0.010      24 CIRC   235
DS6N  18  E  1 E  2 US 379.9  DS 379.0   205          0.010      24 CIRC   242
DS6N  19  E  2 C  3 US 379.0  DS 378.6    35          0.010      30 CIRC   245
DS6N  20  C  3 A  7 US 378.6  DS 377.1   305          0.013      42 CIRC   255
DS6N  21  A  7 A  8 US 377.3  DS 376.7   100          0.013       4  BOX   267
ENDATA
```

SURFACE DESCRIPTION OF RATIONAL COEFFICIENTS

A	B	C	D	E	F
ROOF	PVMT	TURF	RES	GRVL	
.9800	.9500	.3000	.4000	.7000	.0000

MINIMUM TIME OF CONCENTRATION = 5.0 MINUTES

E = .721 B = 55. D = 11.0

I.D.	CA	TC	SUPPLY Q	INTENSITY	TOTAL FLOW
A 1	1.69	5.00	.0	7.41	12.5
A 2	1.96	5.00	.0	7.41	14.5
A 3	1.23	5.00	.0	7.41	9.1
A 4	1.18	5.00	.0	7.41	8.7
A 6	1.77	5.00	.0	7.41	13.1
A 7	.77	5.00	.0	7.41	5.7
B 1	1.13	5.00	.0	7.41	8.4
L 1	.00	5.00	185.0	.00	185.0
L 2	1.48	5.00	.0	7.41	11.0
F 1	1.17	5.00	.0	7.41	8.7
G 1	.48	5.00	.0	7.41	3.6
C 1	1.36	5.00	.0	7.41	10.1
C 2	1.79	5.00	.0	7.41	13.3
C 3	.98	5.00	.0	7.41	7.3
D 1	1.79	5.00	.0	7.41	13.3
E 1	1.01	5.00	.0	7.41	7.5
E 2	.44	5.00	.0	7.41	3.2
J 1	1.54	5.00	.0	7.41	11.4
A 5	.00	.00	.0	.00	.0
A 8	.00	.00	.0	.00	.0
L 3	.00	.00	.0	.00	.0

INLET DESIGN

INLET I.D.	INLET TYPE	FLOW (CFS)	MINIMUM COMPUTED LENGTH REQUIRED (FT)	MINIMUM STANDARD LENGTH REQUIRED (FT)	STANDARD INLET OPENING (FT)	GRATE WIDTH (FT)	CARRYOVER (CFS)	CARRYOVER ASSIGNMENT INLET I.D.	MINIMUM AREA REQUIRED (SQ.FT.)	CALCULATED POND WIDTH (FT)
A 1	GSAG	12.5	.00	.0	.0	.0	.0	- --	4.45	.00
A 2	GSAG	14.5	.00	.0	.0	.0	.0	- --	5.16	.00
A 3	GSAG	9.1	.00	.0	.0	.0	.0	- --	3.23	.00
A 4	GSAG	8.7	.00	.0	.0	.0	.0	- --	3.59	.00
A 6	CSAG	13.1	3.30	.0	.0	.0	.0	- --	.00	.00

A	7	CSA6	5.7	1.43	.0	.0	.0	.0	- --	.00	.00
B	1	CSA6	8.4	1.34	.0	.0	.0	.0	- --	.00	.00
L	1	6SA6	185.0	.00	.0	.0	.0	.0	- --	38.03	.00
L	2	6SA6	11.0	.00	.0	.0	.0	.0	- --	3.91	.00
F	1	6SA6	8.7	.00	.0	.0	.0	.0	- --	3.08	.00
6	1	CURB	3.6	3.22	5.0	5.0	.0	.0	- --	.00	8.26
C	1	CSA6	10.1	1.61	.0	.0	.0	.0	- --	.00	.00
C	2	6SA6	13.3	.00	.0	.0	.0	.0	- --	3.66	.00
C	3	CSA6	7.3	1.17	.0	.0	.0	.0	- --	.00	.00
D	1	6SA6	13.3	.00	.0	.0	.0	.0	- --	3.66	.00
E	1	CSA6	7.5	1.19	.0	.0	.0	.0	- --	.00	.00
E	2	CSA6	3.2	.52	.0	.0	.0	.0	- --	.00	.00
J	1	CSA6	11.4	2.36	.0	.0	.0	.0	- --	.00	.00

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SEWER DESIGN

CONFIGURATION DATA

RUN	U.S. ID	D.S. ID	U.S. F.L. ELEV	D.S. F.L. ELEV	LENGTH FEET	SLOPE	BBLS	RISE	SPAN	SHAPE
1	A 1	A 2	382.10	381.50	190	.00316	1	24	24	CIRC
2	A 2	A 3	381.00	380.00	235	.00426	1	30	30	CIRC
3	A 3	A 4	380.00	379.20	170	.00471	2	30	30	CIRC
4	A 4	A 5	379.20	378.30	180	.00500	2	30	30	CIRC
5	L 1	L 2	380.60	379.00	290	.00552	2	3	5	BOX
6	L 2	L 3	379.00	378.66	70	.00486	2	3	5	BOX
7	L 3	A 5	378.66	377.79	170	.00512	2	3	5	BOX
8	F 1	L 3	380.50	380.16	80	.00425	1	18	18	CIRC
9	A 5	A 6	376.80	375.70	205	.00537	1	4	7	BOX
10	6 1	A 6	379.50	378.70	85	.00941	1	12	12	CIRC
11	B 1	A 3	382.00	381.00	225	.00444	1	18	18	CIRC
12	A 6	A 7	375.70	373.10	475	.00547	1	4	7	BOX
13	J 1	A 7	375.55	375.35	45	.00444	1	21	21	CIRC
14	C 1	C 2	380.75	379.65	260	.00423	1	21	21	CIRC
15	C 2	C 3	379.15	378.35	555	.00505	1	27	27	CIRC
16	D 1	E 2	379.50	377.50	200	.01000	1	18	18	CIRC
18	E 1	E 2	378.40	377.50	205	.00439	1	18	18	CIRC
19	E 2	C 3	377.00	376.60	35	.01143	1	24	24	CIRC
20	C 3	A 7	375.10	373.60	305	.00492	1	42	42	CIRC
21	A 7	A 8	373.30	372.70	100	.00600	1	4	8	BOX

185.20 ℄

HYDRAULIC DATA

RUN	U.S. ID	D.S. ID	'N'	JUNC LOSS	FLOW	U.S. HEAD	D.S. HEAD	HYDR. GRAD	DEPTH	VELOC.	PIPE CAPAC.
1	A 1	A 2	.010	.00	12.50	383.72	383.38	.00181	.65	5.8	16.5
2	A 2	A 3	.010	.00	26.35	383.38	382.80	.00244	.65	7.8	34.8
3	A 3	A 4	.010	.00	42.44	382.80	382.53	.00158	.55	7.7	73.2
4	A 4	A 5	.013	.00	50.00	382.53	381.86	.00372	.72	6.6	58.0
ENTRANCE CONTROLS. TOTAL HEAD AT UPSTREAM END FOR RUN NO. 5 IS 3.52											
5	L 1	L 2	.013	.00	185.00	384.12	382.77	.00317	2.02‡	9.2	244.0
6	L 2	L 3	.013	.00	195.74	382.77	382.52	.00355	2.21‡	8.9	228.9
7	L 3	A 5	.013	.00	204.09	382.52	381.86	.00386	2.24‡	9.1	235.0
8	F 1	L 3	.010	.00	8.66	382.84	382.52	.00402	.80	5.7	8.9
9	A 5	A 6	.013	.00	252.24	381.86	380.94	.00450	3.09‡	11.7	275.3
10	6 1	A 6	.010	.00	3.59	381.45	380.94	.00601	.68	6.3	4.5
11	B 1	A 3	.010	.00	8.35	383.64	382.80	.00374	.75	5.9	9.1
12	A 6	A 7	.013	.00	266.68	380.94	378.55	.00503	3.20‡	11.9	278.1
13	J 1	A 7	.010	.00	11.41	378.69	378.55	.00307	.70	6.3	13.7
ENTRANCE CONTROLS. TOTAL HEAD AT UPSTREAM END FOR RUN NO. 14 IS 1.90											
14	C 1	C 2	.010	.00	10.05	382.65	381.07	.00238	.65	6.1	13.4
15	C 2	C 3	.010	.00	22.62	381.07	379.31	.00316	.67	8.0	28.6
ENTRANCE CONTROLS. TOTAL HEAD AT UPSTREAM END FOR RUN NO. 16 IS 3.28											
16	D 1	E 2	.010	.00	13.29	382.78	379.54	.00947	.80	8.8	13.7

18	E 1	E 2	.010	.00	7.46	380.15	379.54	.00299	.69	5.7	9.0
19	E 2	C 3	.010	.00	23.35	379.54	379.31	.00631	.64	11.0	31.4
20	C 3	A 7	.013	.00	50.41	379.31	378.55	.00251	.63	7.8	70.6
21	A 7	A 8	.013	.00	328.35	378.55	378.00	.00549	3.17*	12.9	343.2

* BOX DEPTHS IN FEET

328 - 185 = 143 cfs from elfc

4-17-92
BCA

Existing Condition

Quick TR-55 Ver.5.46 S/N:1315400181
Executed: 09:30:12 04-17-1992

WICHITA, 4-17-92 1399
Tc BASED ON UNIMPROVED CONDITION
SEE ATTACHMENT E, CITY OF WICHITA

Tc or Tt DATA

Subarea: SOUTH DESCRIPTION	LENGTH (feet)	VELOCITY (ft/sec)	TIME minutes		hours
UNIMPROVED SOUTH 1100 FT	1200	0.30	66.7	=	1.11
		TOTAL Tc --->	minutes 66.7	=	hours 1.11

Quick TR-55 Version: 5.46 S/N: 1315400181 Return Frequency: 5 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 04-17-1992 09:50:56
Watershed file: --> A:399E .MOP
Hydrograph file: --> A:399E5.HYD

WICHITA EXISTING CONDITION BVC 4-17-92 1399

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
SOUTH	27.80	85.0	1.00	0.00	4.80	3.18	I.07 .10

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 27.80 acres or 0.04344 sq.mi
Peak discharge = 49 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	* Tt (hr)	Rounded Values Tc (hr)	* Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
OUTH	1.10	0.00	1.00	0.00	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.

Return Frequency: 5 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 04-17-1992 09:50:56
Watershed file: --> A:399E .MOP
Hydrograph file: --> A:399E5.HYD

WICHITA EXISTING CONDITION BVC 4-17-92 1399

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
SOUTH	49	12.8
Composite Watershed	49	12.8

Return Frequency: 5 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 04-17-1992 09:50:56
Watershed file: --> A:399E .MOP
Hydrograph file: --> A:399E5.HYD

WICHITA EXISTING CONDITION BVC 4-17-92 1399

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
SOUTH	2	2	3	4	5	6	10	15	23
otal (cfs)	2	2	3	4	5	6	10	15	23

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
SOUTH	32	40	45	49	43	33	24	18	14
otal (cfs)	32	40	45	49	43	33	24	18	14

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
SOUTH	11	9	7	6	5	4	4	3	3
otal (cfs)	11	9	7	6	5	4	4	3	3

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
SOUTH	3	2	2	2	0
otal (cfs)	3	2	2	2	0

99E .MOP— Watershed inTypeII. 24hr Storm Hydrograph out —399E10.HYD

SOUTH TRACT EXISTING CONDITION

Subarea Description	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
SOUTH	60	12.8
Composite Watershed	60	12.8

Press <Enter> to continue. Press <Esc> to exit printout.

399E .MOP— Watershed inTypeII. 24hr Storm Hydrograph out —399E100.HYD

SOUTH TRACT EXISTING CONDITION

Subarea Description	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
SOUTH	99	12.8
Composite Watershed	99	12.8

Press <Enter> to continue. Press <Esc> to exit printout.

Quick TR-55 Version: 5.46 S/N: 1315400181

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 04-17-1992 09:50:56
Watershed file: --> A:399E .MOP
Hydrograph file: --> A:399E25.HYD

WICHITA EXISTING CONDITION BVC 4-17-92 1399

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
SOUTH	27.80	85.0	1.00	0.00	6.48	4.76	I.05 .10

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 27.80 acres or 0.04344 sq.mi
Peak discharge = 74 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	* Tt (hr)	Rounded Values Tc (hr)	* Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
SOUTH	1.10	0.00	1.00	0.00	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 04-17-1992 09:50:56
Watershed file: --> A:399E .MOP
Hydrograph file: --> A:399E25.HYD

WICHITA EXISTING CONDITION BVC 4-17-92 1399

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
SOUTH	74	12.8
Composite Watershed	74	12.8

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 04-17-1992 09:50:56
Watershed file: --> A:399E .MOP
Hydrograph file: --> A:399E25.HYD

WICHITA EXISTING CONDITION BVC 4-17-92 1399

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
SOUTH	2	3	4	6	7	10	15	23	35
Total (cfs)	2	3	4	6	7	10	15	23	35

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
SOUTH	48	60	68	74	65	49	36	27	21
Total (cfs)	48	60	68	74	65	49	36	27	21

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
SOUTH	17	13	10	8	7	6	5	5	4
Total (cfs)	17	13	10	8	7	6	5	5	4

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
SOUTH	4	4	3	2	0
Total (cfs)	4	4	3	2	0

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 04-17-1992 09:50:56
Watershed file: --> A:399E .MOP
Hydrograph file: --> A:399E100.HYD

WICHITA EXISTING CONDITION BVC 4-17-92 1399

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
SOUTH	27.80	85.0	1.00	0.00	8.16	6.37	I.04 .10

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 27.80 acres or 0.04344 sq.mi
Peak discharge = 99 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	* Tt (hr)	Rounded Values Tc (hr)	* Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
SOUTH	1.10	0.00	1.00	0.00	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 04-17-1992 09:50:56
Watershed file: --> A:399E .MOP
Hydrograph file: --> A:399E100.HYD

WICHITA EXISTING CONDITION BVC 4-17-92 1399

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
SOUTH	99	12.8
Composite Watershed	99	12.8

Quick TR-55 Version: 5.46 S/N: 1315400181

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 04-17-1992 09:50:56
Watershed file: --> A:399E .MOP
Hydrograph file: --> A:399E100.HYD

WICHITA EXISTING CONDITION BVC 4-17-92 1399

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
SOUTH	3	4	6	8	10	13	20	31	46
Total (cfs)	3	4	6	8	10	13	20	31	46

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
SOUTH	64	80	91	99	87	66	48	37	28
Total (cfs)	64	80	91	99	87	66	48	37	28

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
SOUTH	23	17	14	11	9	8	7	6	6
Total (cfs)	23	17	14	11	9	8	7	6	6

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
SOUTH	6	5	4	3	0
Total (cfs)	6	5	4	3	0

```
**********************************************************************************
*                                          * RIDE S/N      :                      *
*                                          * HMVersion     :  1.10                *
*                  RIDE                    * Date          :  4/17/92             *
*                                          * Time          : 16:53:24             *
*     Rainfall Intensity - Duration        * Input file    : C:\HYDRO\THYSYS\SEDGWIC*
*                Equations                 * Output file   : A:SEDGWICK.EBD       *
*
$ SEDGWICK CO, KS
$
$10 YEAR
RAIN
T= 5.      I= 7.41
T=10.      I= 6.09
T=15.      I= 5.22
T=30.      I= 3.76
T=60.      I= 2.53
RUN

Method Specified = RAIN - Calculated e,b,d

e =      .721
b =    54.7
d =    11.0

For use in the equation: I = b / (tc+d)**e

$ 25 YEAR
RAIN
T= 5.      I= 8.52
T=10.      I= 7.04
T=15.      I= 6.06
T=30.      I= 4.39
T=60.      I= 2.98
RUN

Method Specified = RAIN - Calculated e,b,d

e =      .710
b =    61.5
d =    11.2

$ 50 YEAR
RAIN
T= 5.      I= 9.48
T=10.      I= 7.86
T=15.      I= 6.78
T=30.      I= 4.94
T=60.      I= 3.37
RUN
```

Method Specified = RAIN - Calculated e,b,d

2/2

e = .701
b = 67.1
d = 11.3

$ 100 YEAR
RAIN
T= 5. I=10.32
T=10. I= 8.54
T=15. I= 7.37
T=30. I= 5.40
T=60. I= 3.73
RUN

Method Specified = RAIN - Calculated e,b,d

e = .663
b = 62.4
d = 10.1

Kaw Valley Engineering & Development, Inc.

2319 North Jackson
P.O. Box 1304
Junction City, Kansas 66441
Tel: (913) 762-5040
FAX: (913) 762-7744

122 NW Parkway
Riverside, Missouri 64150
Tel: (816) 587-5033
FAX: (816) 587-0129

Job 1399

Sheet No. _____ Of _____

Calculated By BVC Date 4-16-97

Checked By _____ Date _____

Scale _____

Tc; PROPOSED SOUTH SITE

Most remote

300' sheet flow proposed pavement

to A-1	1.4 ft/s (300) =	3.6 min
to A-2	190/5.9	0.5
" A3	235/8.0	0.5
A4	170/2.9	0.4
A5	180/6.7	0.4
A6	205/11.8	0.3
A7	475/12.0	0.7
A8	100/11.1	0.1
		6.5 min

North Tract Calculations

Quick TR-55 Version: 5.46 S/N: 1315400181

>>>>> DETENTION STORAGE ESTIMATE <<<<<

NORTH TRACT, WICHITA, ESTIMATE OF STORAGE REQUIRED 1399
BASED ON PROJECTED FULL COMM. DEVELOPMENT, BVC 4-21-92

CALCULATED
DISK FILE: B:399N .DET

Drainage Area (acres) 18.5 0.0289 sq.mi.
Rainfall Distribution (Type) II

	Storm #1	Storm #2	Storm #3
Frequency (years)	10	25	100
Peak Inflow, qi (cfs)	137	165	214
Inflow Runoff, Q (in)	4.71	5.66	7.32
Peak Outflow, qo (cfs)	54	67	90
qo/qi Ratio	0.394	0.406	0.421
* Vs/Vr Ratio	0.324	0.318	0.311
Inflow Volume, Vr (ac-ft)	7.3	8.7	11.3
STORAGE VOLUME, Vs (ac-ft)	2.4	2.8	3.5

Summary of Volume Computations

C0	0.682	0.682	0.682
C1	-1.430	-1.430	-1.430
C2	1.640	1.640	1.640
C3	-0.804	-0.804	-0.804
* Vs/Vr	0.324	0.318	0.311

$$* \quad Vs/Vr = C0 + (C1*(qo/qi)) + (C2*(qo/qi)^2) + (C3*(qo/qi)^3)$$

Graphical Peak Discharge File Used for Inflow Data:
B:399NP .GPD
Graphical Peak Discharge File Used for Outflow Data:
B:399NE .GPD

Quick TR-55 Version: 5.46 S/N: 1315400181

>>>>> GRAPHICAL PEAK DISCHARGE METHOD <<<<<

WICHITA-NORTH SITE,PROJECTED WITH COMMERCIAL DEVELOPMENT
1399-KVE-BVC 4-21-92-1399

CALCULATED
DISK FILE: B:399NP .GPD

Drainage Area	(acres)	18.5	--->	0.0289 sq.mi.
Runoff Curve Number	(CN)	93		
Time of Concentration,Tc	(hrs)	0.1		
Rainfall Distribution	(Type)	II		
Pond and Swamp Areas	(%)	0	--->	0.0 acres

	Storm #1	Storm #2	Storm #3
Frequency (years)	10	25	100
Rainfall, P, 24-hr (in)	5.52	6.48	8.16
Initial Abstraction, Ia (in)	0.151	0.151	0.151
Ia/p Ratio	0.027	0.023	0.018
Unit Discharge, * qu (csm/in)	1010	1010	1010
Runoff, Q (in)	4.71	5.66	7.32
Pond & Swamp Adjustment Factor	1.00	1.00	1.00
PEAK DISCHARGE, qp (cfs)	137	165	214

Summary of Computations for qu

Ia/p	#1	0.100	0.100	0.100
C0	#1	2.553	2.553	2.553
C1	#1	-0.615	-0.615	-0.615
C2	#1	-0.164	-0.164	-0.164
qu (csm)	#1	1009.997	1009.997	1009.997
Ia/p	#2	0.100	0.100	0.100
C0	#2	2.553	2.553	2.553
C1	#2	-0.615	-0.615	-0.615
C2	#2	-0.164	-0.164	-0.164
qu (csm)	#2	1009.997	1009.997	1009.997
* qu (csm)		1010	1010	1010

* Interpolated for computed Ia/p ratio (between Ia/p #1 & Ia/p #2)
If computed Ia/p exceeds Ia/p limits, bounding limit for Ia/p is used.

$$\log(qu) = C0 + (C1 * \log(Tc)) + (C2 * (\log(Tc))^2)$$

qp (cfs) = qu(csm) * Area(sq.mi.) * Q(in.) * (Pond & Swamp Adj.)

Quick TR-55 Version: 5.46 S/N: 1315400181

>>>>> GRAPHICAL PEAK DISCHARGE METHOD <<<<<

WICHITA-NORTH TRACT, EXISTING CONDITION
KVE-BVC-1399

CALCULATED
DISK FILE: B:399NE .GPD

Drainage Area	(acres)	18.5	--->	0.0289 sq.mi.
Runoff Curve Number	(CN)	85		
Time of Concentration, Tc	(hrs)	0.3		
Rainfall Distribution	(Type)	II		
Pond and Swamp Areas	(%)	5	--->	0.9 acres

	Storm #1	Storm #2	Storm #3
Frequency (years)	10	25	100
Rainfall, P, 24-hr (in)	5.52	6.48	8.16
Initial Abstraction, Ia (in)	0.353	0.353	0.353
Ia/p Ratio	0.064	0.054	0.043
Unit Discharge, * qu (csm/in)	676	676	676
Runoff, Q (in)	3.85	4.76	6.37
Pond & Swamp Adjustment Factor	0.72	0.72	0.72
PEAK DISCHARGE, qp (cfs)	54	67	90

Summary of Computations for qu

Ia/p	#1	0.100	0.100	0.100
C0	#1	2.553	2.553	2.553
C1	#1	-0.615	-0.615	-0.615
C2	#1	-0.164	-0.164	-0.164
qu (csm)	#1	676.110	676.110	676.110
Ia/p	#2	0.100	0.100	0.100
C0	#2	2.553	2.553	2.553
C1	#2	-0.615	-0.615	-0.615
C2	#2	-0.164	-0.164	-0.164
qu (csm)	#2	676.110	676.110	676.110
* qu (csm)		676	676	676

* Interpolated for computed Ia/p ratio (between Ia/p #1 & Ia/p #2)
If computed Ia/p exceeds Ia/p limits, bounding limit for Ia/p is used.

$$\log(qu) = C0 + (C1 * \log(Tc)) + (C2 * (\log(Tc))^2)$$

qp (cfs) = qu(csm) * Area(sq.mi.) * Q(in.) * (Pond & Swamp Adj.)

KILLARNEY PLAZA - 2nd

DRAINAGE AREA	1 AREA (ACRES)	2 PCCIM AREA	3 C_5	4 C_{100}	5 T_c (MIN)	6 I_5 (IN/HR)	7 I_{100} (IN/HR)	8 Q_5 (CFS)	9 Q_{100} (CFS)	10 PIPE SIZE	11 PIPE SLOPE	12 INLETS
AREA 'M' PART LOT 3 PLUS 1/2 - 36th ST. N.	0.90		0.74	0.86	21	16	3.90	7.18	2.6	5.6		
TOTAL TO SUMP OVER RCB SOUTH SIDE 36th ST. N. EAST SIDE INWOOD		6.17	0.77	0.85	21	16	3.90	7.18	18.5	37.7		3 L(:) = 10' (SUMP)
DRAINAGE EAST OF ROCK ROAD	124.40		0.69	0.80	25	24	2.99	5.79	255.8	576.2		
FROM ROCK ROAD STRUCTURES												
	PROPOSED SOUTH CHANNEL		4 FT BOTTOM WIDTH		4:1 SIDESLOPES					130.0		
	PROPOSED NORTH CHANNEL		4 FT BOTTOM WIDTH		4:1 SIDESLOPES					350.0		
		TOTAL								480.0		USE DUE TO LAKES EAST OF ROCK ROAD
UPSTREAM LAKE WEIR DESIGN										6.10		NORMAL POOL 190.0 FT (WICHITA) 100-YR POOL 191.9 FT (WICHITA)
DOWNSTREAM LAKE WEIR DESIGN										650		NORMAL POOL 187.0 FT (WICHITA) 100-YR POOL 189.3 FT (WICHITA)
	PROPOSED OUTLET CHANNEL		20 FT BOTTOM WIDTH 4:1 SIDE SLOPES									
DRAINAGE C INWOOD STRUCTURE		129.05	0.70	0.81	15	33	2.57	5.14	322.1	745.5	3- 10' x 4' RCB	