PROFESSIONAL ENGINEERING CONSULTANTS
PROFESSIONAL ASSOCIATION
303 S. TOPEKA
WICHITA, KANSAS
ZIP CODE / 67202

CHAPEL HILL ADDITION

Wichita, Sedgwick County, Kansas

10/16/98

Chapel Hill Addition is a residential & commercial development in Northeast Wichita, Kansas. The plat encompasses approximately 43 acres, about 15 acres single family residential and about 25 acres commercial development. The drainage plan, supporting computations and data of Chapel Hill Addition drainage plan are presented herein.

Hydrology

The proposed plat lies in the E 1/2, SW 1/4, Section 10, T27S, R2E. The existing landscape is cultivated and there is a large drainage swale on the east side of the property. A pond will be used to collect storm water from 85-90% of the property. This pond will have an overflow to the K-96 Right-of Way to the east. There is an existing 54" RCP to carry the storm water under K-96 to the east. This pond will serve to detain the difference in storm water runoff between pre-developed and post-developed conditions.

Hydrologic models for the pond have been designed to establish minimum openings for lots abutting ponds. Minimum opening on other lots not near the pond is a function of storm sewer overflow locations for each locality and will be governed by the Four Corner Grading Plan.

The Rational Method has been used to determine runoff quantities for all storm sewer systems that serve the development in accordance with the reference materials. Runoff coefficients were estimated based on tables presented in the Design Aids section. A minimum time of concentration of 15 minutes has been assumed. For residential areas, the minor storm has a recurrence interval of two years and the major storm has a recurrence interval of one hundred years.

The analysis made is based on the available site data which includes the following: 1" = 100' topographic map with 2' contours of the site and adjacent areas, Sedgwick County Soil Survey Map and references noted herein.

Inlet Design

Conveyance for streets is based on the Modified Manning's Equation as shown in the Inlet and Pipe Design section. Curb-deep flow is tolerable for the minor storm and flow contained within the street and drainage easements is acceptable

for the major storm. The street inlets and pipes from them have been sized for the major storm, with flow contained in the streets, reserves and drainage easements. Emergency overflows will be routed through easements and reserves to the detention pond in the event of a system failure.

Inlet capacities were determined by the methods described in the reference materials using Chart #12 in the Design Aids section. It has been assumed that 3/8 in./ft. street cross-slopes and Type 1A street inlets will be used throughout. City of Wichita 3-5/8" roll curb and gutter can be used on Summerfield and Chapel Hill, north of Lot 1, Block 2. Standard curb (6-5/8") would be required on Crestwood, Bedford and Chapel Hill south of Lot 2, Block 1. The elevation at the street easement has been assumed to be 0.3 feet above top of curb unless otherwise noted.

Pipe Design

Storm sewers from the streets are designed for the major storm, with emergency overflows to be routed through easements and rights-of-way to an appropriate outlet.

Hydraulic computation for the storm sewer pipe systems was performed using Haestad's StormCAD computer program. This program uses Manning's Equation to calculate friction losses for pipes flowing full. Minor losses are computed by momentum principles at each structure. All pipes were assumed to be reinforced concrete with a Manning's "n" factor of 0.013. The hydraulic grade line has been checked to ensure that it is at or below the top of curb for the major storm in all cases.

To simplify the analysis it has been assumed that time of concentration is identical for both pipe flow and street flow for both major and minor storms; a conservative estimate since pipe velocities generally exceed gutter velocities.

Hydraulic Models for Detention

This plan utilizes a 3 acre pond for the purposes of aesthetic, borrow and storm water detention. The pond was analyzed using the US Army Corps of Engineers HEC-1 computer package.

The HEC-1 model used for this development is found in the Pond Design section of this document.

Design Aids

This section includes material used to assist in designing the drainage system. A 1"=100' scale drainage plan map is enclosed in the pocket.

Chapel Hill Addition
Hydrology

Basin	Land Use	Area (Ac)	C_2	i_2	Q_2	C_{100}	i_{100}	Q_{100}
A	Street & Right-of-way	1.6	0.59	3.8	3.59	0.79	7.36	9.30
B	Street & Right-of-way	2.2	0.59	3.8	4.93	0.79	7.36	12.79
C	Single Family	3.27	0.5	3.8	6.21	0.76	7.36	18.29
D	Single Family	1.3	0.5	3.8	2.47	0.76	7.36	7.27
E	Single Family	2.24	0.5	3.8	4.26	0.76	7.36	12.53
F	Single Family	2.26	0.5	3.8	4.29	0.76	7.36	12.64
G	Commercial	21.51	0.68	3.8	55.58	0.8	7.36	126.65
H	Single Family	1.23	0.5	3.8	2.34	0.76	7.36	6.88
I	Single Family	1.28	0.5	3.8	2.43	0.76	7.36	7.16

Street Flow

Chapel Hill Add.
10/16/98

2-Yr

Q (cfs)	Basin	Slope	d	dmax	Remarks
6.21	C	0.5%	0.39	0.55	OK
1.73	South 70% of D	0.5%	0.24	0.3	OK
3.4	80% of E (North)	0.4%	0.33	0.55	OK
3.4	North 80% of F	0.4%	0.33	0.55	OK
4.7	South 95% of B	>1%	0.31	0.55	OK
3.1	50% of C	0.5%	0.3	0.3	OK

By Inspection, roll type curb can be used on Summerfield and Chapel Hill between Crestwood and Summerfield.

Standard Curb would be required on Crestwood, Bedford and Chapel Hill between 13th Street North and Crestwood.

100-YR

	Basin	Q	Slope	Qmax
Max	E + F	25.2	0.4%	26.1 cfs
	C + D	25.6	0.5%	29.1 cfs

By Inspection, all basins that drain to streets have $Q_{100} < 26$ cfs. Therefore roll type curb and 0.3' from T.C. to 15' Street Easement is ok for all streets.

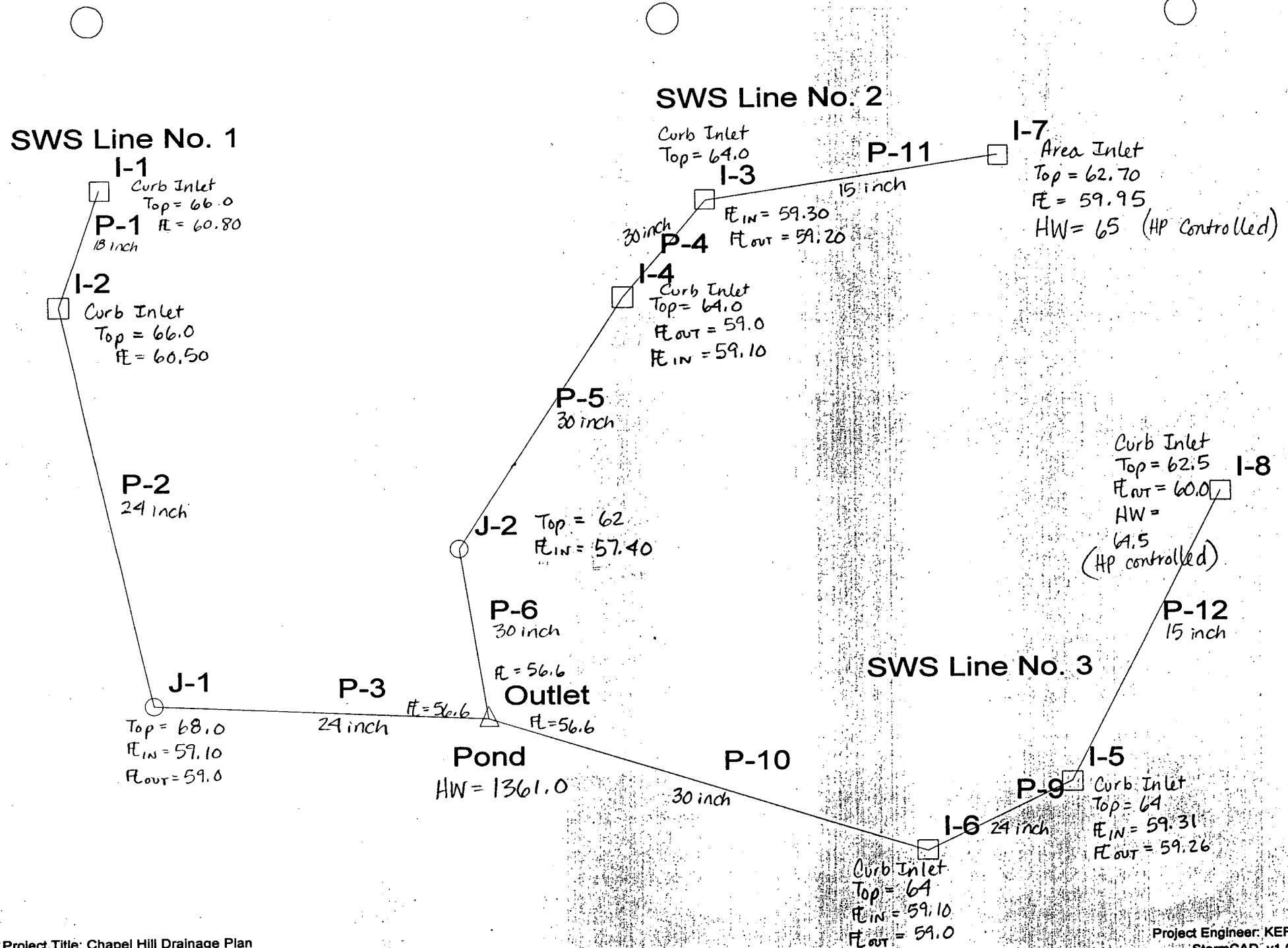
Inlet Sizing

BASIN	Inlet	Q_{100}	Location	Type 1A Size	Ponding Depth	
A	I1	9.3	Sump	5'	0.78'	ok
B	I2	12.8	Sump	5'	0.9'	ok
* C + ½ H	I3	21.7	Sump	10'	0.88	OK
D	I4	7.3	Sump	5'	0.55	OK
* E + ½ I	I5	16.11	Sump	10'	0.7	OK
F	I6	12.64	Sump	5'	0.9	OK

* Assuming ½ of the Q_{100} from basins H & I will spill over the curb because the SWS pipes in those basins were not sized for the 100-YR storm.

See Hydraulic grade line elevations for inlets I7 and I8. (Haestad's StormCAD DOT Report)

100 YR



Project Title: Chapel Hill Drainage Plan
s:\haestad\stmc\ch_100.stm
10/15/98 12:19:41 PM

Professional Engineering Consultants
Haestad Methods, Inc. 37 Brookside Road Waterbury, CT 06708 (203) 755-1666

Project Engineer: KER
StormCAD v1.0
Page 1 of 1

```
----------------- Beginning Calculation Cycle ------------------
Discharge: 9.30 cfs  at node I-1
Discharge: 22.09 cfs  at node I-2
Discharge: 22.09 cfs  at node J-1
Discharge: 6.88 cfs  at node I-7
Discharge: 25.17 cfs  at node I-3
Discharge: 32.44 cfs  at node I-4
Discharge: 32.44 cfs  at node J-2
Discharge: 7.16 cfs  at node I-8
Discharge: 19.69 cfs  at node I-5
Discharge: 32.33 cfs  at node I-6
Discharge: 86.86 cfs  at node Outlet
Beginning iteration 1
Discharge: 9.30 cfs  at node I-1
Discharge: 22.09 cfs  at node I-2
Discharge: 22.09 cfs  at node J-1
Discharge: 6.88 cfs  at node I-7
Discharge: 25.17 cfs  at node I-3
Discharge: 32.44 cfs  at node I-4
Discharge: 32.44 cfs  at node J-2
Discharge: 7.16 cfs  at node I-8
Discharge: 19.69 cfs  at node I-5
Discharge: 32.33 cfs  at node I-6
Discharge: 86.86 cfs  at node Outlet
Discharge Convergence Achieved in 1 iterations: relative error:  0.0
** Warning: Design constraints not met.
** Problem: Flooding in system
Warning: No Duration data exists in IDF Table
Information: Outlet Known flow propogated from upstream junctions.
Information: P-3 Surcharged condition
Information: P-6 Surcharged condition
Information: P-10 Surcharged condition
Information: P-9 Surcharged condition
Information: J-2 Known flow propogated from upstream junctions.
Information: P-5 Surcharged condition
Information: P-4 Surcharged condition
Violation: P-4 does not meet minimum slope constraint.
Information: P-11 Surcharged condition
Information: I-7 The hydraulic grade exceeds the Rim/Ground elevation
Information: I-7 Flooding condition.
Information: P-12 Surcharged condition
Information: I-8 The hydraulic grade exceeds the Rim/Ground elevation
Information: I-8 Flooding condition.
Information: J-1 Known flow propogated from upstream junctions.
Information: P-2 Surcharged condition
Information: P-1 Surcharged condition
-------------------- Calculations Complete ---------------------

** Analysis Options **
Friction method:  Manning's Formula
HGL Convergence Test:  0.001000
Maximum Network Traversals:  5
Number of Pipe Profile Steps:  5
Discharge Convergence Test:  0.001000
Maximum Design Passes:  3


 ---------------- Network Quick View -----------------------

                                         |     Hydraulic Grade      |
```

Label	Length	Size	Discharge	Upstream	Downstream
P-1	50.00	18 inch	9.30	64.16	63.77
P-2	150.00	24 inch	22.09	63.39	61.96
P-3	60.00	24 inch	22.09	61.57	61.00
P-4	40.00	30 inch	25.17	62.89	62.74
P-5	140.00	30 inch	32.44	62.40	61.53
P-6	30.00	30 inch	32.44	61.19	61.00
P-9	40.00	24 inch	19.69	62.60	62.30
P-10	155.00	30 inch	32.33	61.96	61.00
P-11	200.00	15 inch	6.88	65.37	63.10
P-12	160.00	15 inch	7.16	64.87	62.91

		Elevations	
Label	Discharge	Ground	Upstream HGL	Downstream HGL
I-1	9.30	66.00	64.16	64.16
I-2	22.09	66.00	63.77	63.39
J-1	22.09	68.00	61.96	61.57
Outlet	86.86	61.00	61.00	61.00
I-3	25.17	64.00	63.10	62.89
I-4	32.44	64.00	62.74	62.40
J-2	32.44	62.00	61.53	61.19
I-5	19.69	64.00	62.91	62.60
I-6	32.33	64.00	62.30	61.96
I-7	6.88	62.70	63.10	63.10
I-8	7.16	62.50	62.91	62.91

Elapsed: 0 minute(s) 2 second(s)

DOT Report

Pipe	-Node- Upstream Downstream	Inlet Area (acres)	Inlet CA (acres)	Total CA (acres)	-Ground- Upstream (ft) Downstream (ft)	-HGL- Upstream (ft) Downstream (ft)	-Slope- Energy Constructed (ft/ft)	-Section- Discharge Capacity (cfs)	Section- Shape Size	Length (ft)	Average Velocity (ft/s)	Description
P-12	I-8	0.00	0.00	0.00	62.50	64.87	0.012287	7.16	Circular	60.00	5.83	
	I-5				64.00	62.91	0.004312	4.24	15 inch			
P-9	I-5	0.00	0.00	0.00	64.00	62.60	0.007576	19.69	Circular	40.00	6.27	
	I-6				64.00	62.30	0.004000	14.31	24 inch			
P-10	I-6	0.00	0.00	0.00	64.00	61.96	0.006213	32.33	Circular	55.00	6.59	
	Outlet				61.00	61.00	0.015484	51.04	30 inch			
P-11	I-7	0.00	0.00	0.00	62.70	65.37	0.011345	6.88	Circular	00.00	5.61	
	I-3				64.00	63.10	0.003250	3.68	15 inch			
P-4	I-3	0.00	0.00	0.00	64.00	62.89	0.003766	25.17	Circular	40.00	5.13	
	I-4				64.00	62.74	0.002500	20.51	30 inch			
P-5	I-4	0.00	0.00	0.00	64.00	62.40	0.006256	32.44	Circular	40.00	6.61	
	J-2				62.00	61.53	0.011429	43.85	30 inch			
P-6	J-2	N/A	N/A	0.00	62.00	61.19	0.006256	32.44	Circular	30.00	6.61	
	Outlet				61.00	61.00	0.023333	62.65	30 inch			
P-1	I-1	0.00	0.00	0.00	66.00	64.16	0.007839	9.30	Circular	50.00	5.26	
	I-2				66.00	63.77	0.004000	6.64	18 inch			
P-2	I-2	0.00	0.00	0.00	66.00	63.39	0.009536	22.09	Circular	50.00	7.03	
	J-1				68.00	61.96	0.009333	21.85	24 inch			
P-3	J-1	N/A	N/A	0.00	68.00	61.57	0.009536	22.09	Circular	60.00	7.03	
	Outlet				61.00	61.00	0.040000	45.24	24 inch			

CURRENT DATE: 10-15-1998 FILE DATE: 10-15-1998
CURRENT TIME: 07:39:32 FILE NAME: CHOUT

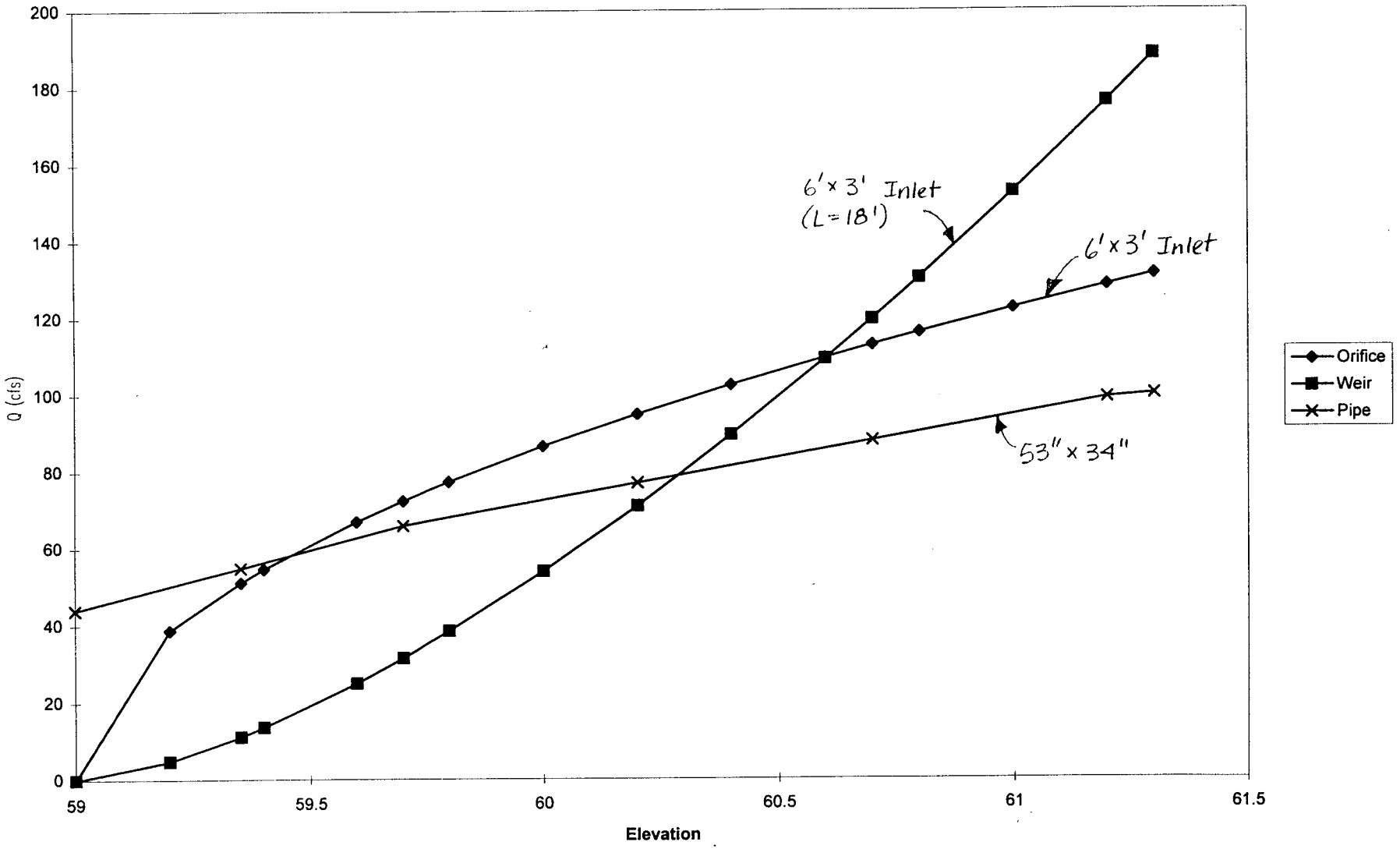
FHWA CULVERT ANALYSIS
HY-8, VERSION 3.2
SITE DATA CULVERT SHAPE, MATERIAL, INLET

INLET ELEV. (FT)	OUTLET ELEV. (FT)	CULVERT LENGTH (FT)	BARRELS SHAPE MATERIAL	SPAN (FT)	RISE (FT)	MANNING n	INLET TYPE
53.75	53.50	60.00	1 RCPE	4.42	2.83	.013	CONVENTIONAL

FILE: CHOUT CULVERT HEADWATER ELEVATION (FT) DATE: 10-15-1998

DISCHARGE	1	2	3	4	5	6	ROADWAY
0	58.50	0.00	0.00	0.00	0.00	0.00	62.00
11	58.53	0.00	0.00	0.00	0.00	0.00	62.32
22	58.64	0.00	0.00	0.00	0.00	0.00	62.51
33	58.80	0.00	0.00	0.00	0.00	0.00	62.66
44	59.04	0.00	0.00	0.00	0.00	0.00	62.81
55	59.35	0.00	0.00	0.00	0.00	0.00	62.93
66	59.72	0.00	0.00	0.00	0.00	0.00	63.06
77	60.16	0.00	0.00	0.00	0.00	0.00	63.17
88	60.67	0.00	0.00	0.00	0.00	0.00	63.28
99	61.24	0.00	0.00	0.00	0.00	0.00	63.39
100	61.30	0.00	0.00	0.00	0.00	0.00	63.39

Flow Control
Chapel Hill Addition
Pond Outflow



10/15/98

Chapel Hill Addition
Pond Outflow

Q (cfs)	Orifice	Weir	Pipe
59	0	0	44
59.2	38.73	4.83	
59.35	51.23	11.18	55
59.4	54.77	13.66	
59.6	67.08	25.10	
59.7	72.45	31.63	66
59.8	77.46	38.64	
60	86.60	54.00	
60.2	94.87	70.98	77
60.4	102.47	89.45	
60.6	109.54	109.29	
60.7	112.91	119.69	88
60.8	116.19	130.41	
61	122.47	152.74	
61.2	128.45	176.21	99
61.3	131.34	188.36	100

```
1*******************************************                          ****************************************
*                          *                          *                                *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                *  U.S. ARMY CORPS OF
ENGINEERS    *
*           MAY  1991           *                          *  HYDROLOGIC ENGINEERING CENTER   *
*          VERSION 4.0.1E          *                          *       609 SECOND STREET        *
*    Lahey F77L-EM/32 version 5.01    *                         *       DAVIS, CALIFORNIA 95616       *
*     Dodson & Associates, Inc.     *                          *       (916) 551-1748        *
*  RUN DATE  10/14/98  TIME  17:53:58  *                            *                          *
*******************************************                          ****************************************


                         X     X  XXXXXXX   XXXXX          X
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                         X     X  X         X              X
                         XXXXXXX  XXXX      X       XXXXX  X
                         X     X  X         X              X
                         X     X  X         X     X        X
                         X     X  XXXXXXX   XXXXX         XXX
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THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

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1                              HEC-1 INPUT                              PAGE  1

     LINE       ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

       1        ID      CHAPEL HILL, WICHITA KS
       2        ID      25-, & 100-Year Storms
       3        ID      Professional Engineering Consultants
       4        ID      Wichita, Ks
       5        ID      KER 10/6/98
       6        ID      File:  T:\DAR\HEC1\CHAPEL.ih1
       7        IT      6 12DEC97    0600       0 13DEC97    1154
       8        IN     30 12DEC97    0600
       9        IO      3      0
      10        JR    PREC  .78947    1.000
                *
                *DIAGRAM
                *

      11        KK    BAS1      Developed Residential
      12        BA    .017
      13        PB     7.8
      14        PC    0.08    .09    .10    .11    .12   .133   .147   .163   .181   .204
      15        PC    .235   .283   .663   .735   .772   .799   .820   .835   .850   .865
      16        PC    .880   .890   .900   .910   .916   .925   .934   .943   .952   .958
      17        PC    .964   .970   .976   .982   .988   .994  1.000
      18        LS       0     90      0
      19        UD     .15
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          *
          *

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 21       BA  .0334
 22       PB   7.8
 23       PC  0.08   .09   .10   .11   .12  .133  .147  .163  .181  .204
 24       PC  .235  .283  .663  .735  .772  .799  .820  .835  .850  .865
 25       PC  .880  .890  .900  .910  .916  .925  .934  .943  .952  .958
 26       PC  .964  .970  .976  .982  .988  .994  1.000
 27       LS    0    93     0
 28       UD   .15
          *
          *

 29       KK  BAS3      Street & Right of Way
 30       BA  .0059
 31       PB   7.8
 32       PC  0.08   .09   .10   .11   .12  .133  .147  .163  .181  .204
 33       PC  .235  .283  .663  .735  .772  .799  .820  .835  .850  .865
 34       PC  .880  .890  .900  .910  .916  .925  .934  .943  .952  .958
 35       PC  .964  .970  .976  .982  .988  .994  1.000
 36       LS    0    90     0
 37       UD   .15
          *

 38       KK  TOTAL
 39       HC    3
          *
          *
          *     6'X3' Inlet with 58"X34" RCPHE Outlet to K-96 Ditch
          *
1                          HEC-1 INPUT                          PAGE  2

 LINE     ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 40       KK   POND
 41       RS     1   ELEV    59
 42       SA  3.08    3.2   3.4   3.5
 43       SE    59     60    61    63
 44       SQ     0      4    13    25    39    54    71    77    83    88
 45       SQ    91     99   100
 46       SE  59.0   59.2  59.4  59.6  59.8    60  60.2  60.4  60.6  60.8
 47       SE    61   61.2  61.3
          *
 48       ZZ
1
        SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
LINE    (V) ROUTING        (--->) DIVERSION OR PUMP FLOW

NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

 11     BAS1
         .
         .
 20      .    BAS2
         .     .
         .     .
 29      .     .     BAS3
         .     .     .
         .     .     .
 38     TOTAL........................
         V
         V
 40     POND
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************                     *****************************************
*                                       *                     *                                       *
* FLOOD HYDROGRAPH PACKAGE (HEC-1)      *                     * U.S. ARMY CORPS OF ENGINEERS          *
*            MAY 1991                   *                     * HYDROLOGIC ENGINEERING CENTER         *
*          VERSION 4.0.1E               *                     *       609 SECOND STREET               *
* Lahey F77L-EM/32 version 5.01         *                     *     DAVIS, CALIFORNIA 95616           *
*   Dodson & Associates, Inc.           *                     *       (916) 551-1748                  *
* RUN DATE 10/14/98 TIME 17:53:58       *                     *                                       *
*****************************************                     *****************************************
```

CHAPEL HILL, WICHITA KS
25-, & 100-Year Storms
Professional Engineering Consultants
Wichita, Ks
KER 10/6/98
File: T:\DAR\HEC1\CHAPEL.ih1

```
 9 IO     OUTPUT CONTROL VARIABLES
            IPRNT       3  PRINT CONTROL
            IPLOT       0  PLOT CONTROL
            QSCAL       0. HYDROGRAPH PLOT SCALE

   IT     HYDROGRAPH TIME DATA
            NMIN        6  MINUTES IN COMPUTATION INTERVAL
            IDATE  12DEC97  STARTING DATE
            ITIME     0600  STARTING TIME
              NQ       300  NUMBER OF HYDROGRAPH ORDINATES
           NDDATE  13DEC97  ENDING DATE
           NDTIME     1154  ENDING TIME
            ICENT       19  CENTURY MARK

          COMPUTATION INTERVAL   0.10 HOURS
            TOTAL TIME BASE  29.90 HOURS

       ENGLISH UNITS
          DRAINAGE AREA         SQUARE MILES
          PRECIPITATION DEPTH   INCHES
          LENGTH, ELEVATION     FEET
          FLOW                  CUBIC FEET PER SECOND
          STORAGE VOLUME        ACRE-FEET
          SURFACE AREA          ACRES
          TEMPERATURE           DEGREES FAHRENHEIT

   JP     MULTI-PLAN OPTION
            NPLAN        1  NUMBER OF PLANS

   JR     MULTI-RATIO OPTION
           RATIOS OF PRECIPITATION
            0.79     1.00

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

        **************
        *            *
  11 KK *   BAS1     *      Developed Residential
        *            *
        **************
```

8 IN TIME DATA FOR INPUT TIME SERIES
JXMIN 30 TIME INTERVAL IN MINUTES
JXDATE 12DEC97 STARTING DATE
JXTIME 600 STARTING TIME

SUBBASIN RUNOFF DATA

12 BA SUBBASIN CHARACTERISTICS
TAREA 0.02 SUBBASIN AREA

PRECIPITATION DATA

13 PB STORM 7.80 BASIN TOTAL PRECIPITATION

14 PI INCREMENTAL PRECIPITATION PATTERN

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.08	0.08	0.08	0.08	0.08
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

18 LS SCS LOSS RATE
STRTL 0.22 INITIAL ABSTRACTION
CRVNBR 90.00 CURVE NUMBER
RTIMP 0.00 PERCENT IMPERVIOUS AREA

19 UD SCS DIMENSIONLESS UNITGRAPH
TLAG 0.15 LAG

***

UNIT HYDROGRAPH
10 END-OF-PERIOD ORDINATES

19.	41.	28.	12.	5.	2.	1.	0.	0.	0.

TOTAL RAINFALL = 7.80, TOTAL LOSS = 1.19, TOTAL EXCESS = 6.61

```
PEAK FLOW    TIME                MAXIMUM AVERAGE FLOW
                     6-HR     24-HR     72-HR    29.90-HR
+ (CFS)     (HR)
                (CFS)
+   64.     6.00        10.       3.        2.        2.
              (INCHES)  5.373     6.609     6.609     6.609
              (AC-FT)      5.        6.        6.        6.

              CUMULATIVE AREA =    0.02 SQ MI
```

*** *** *** *** ***

HYDROGRAPH AT STATION BAS1
FOR PLAN 1, RATIO = 0.79

```
 TOTAL RAINFALL =   6.16, TOTAL LOSS =   1.16, TOTAL EXCESS =   5.00

 PEAK FLOW    TIME                 MAXIMUM AVERAGE FLOW
                          6-HR      24-HR     72-HR   29.90-HR
+  (CFS)      (HR)
                 (CFS)
+    49.     6.00           7.        2.        2.        2.
               (INCHES)   4.082     5.000     5.000     5.000
               (AC-FT)      4.        5.        5.        5.

               CUMULATIVE AREA =   0.02 SQ MI


    ***        ***        ***        ***        ***

                HYDROGRAPH AT STATION    BAS1
                 FOR PLAN 1, RATIO = 1.00

 TOTAL RAINFALL =   7.80, TOTAL LOSS =   1.19, TOTAL EXCESS =   6.61

 PEAK FLOW    TIME                 MAXIMUM AVERAGE FLOW
                          6-HR      24-HR     72-HR   29.90-HR
+  (CFS)      (HR)
                 (CFS)
+    64.     6.00          10.        3.        2.        2.
               (INCHES)   5.373     6.609     6.609     6.609
               (AC-FT)      5.        6.        6.        6.

               CUMULATIVE AREA =   0.02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


        ***************
        *             *
 20 KK  *    BAS2     *        Developed Commercial
        *             *
        ***************


  8 IN       TIME DATA FOR INPUT TIME SERIES
               JXMIN        30  TIME INTERVAL IN MINUTES
               JXDATE   12DEC97  STARTING DATE
               JXTIME      600  STARTING TIME

          SUBBASIN RUNOFF DATA

 21 BA        SUBBASIN CHARACTERISTICS
                TAREA       0.03  SUBBASIN AREA

          PRECIPITATION DATA

 22 PB            STORM      7.80  BASIN TOTAL PRECIPITATION

 23 PI        INCREMENTAL PRECIPITATION PATTERN
```

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.08	0.08	0.08	0.08	0.08
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

```
27 LS     SCS LOSS RATE
           STRTL      0.15  INITIAL ABSTRACTION
          CRVNBR      93.00  CURVE NUMBER
           RTIMP      0.00  PERCENT IMPERVIOUS AREA

28 UD     SCS DIMENSIONLESS UNITGRAPH
           TLAG       0.15  LAG
```

***

UNIT HYDROGRAPH
10 END-OF-PERIOD ORDINATES

```
38.   81.   55.   23.   10.   4.   2.   1.   0.   0.
```

TOTAL RAINFALL = 7.80, TOTAL LOSS = 0.84, TOTAL EXCESS = 6.96

```
 PEAK FLOW   TIME              MAXIMUM AVERAGE FLOW
                     6-HR     24-HR    72-HR   29.90-HR
+  (CFS)     (HR)
                (CFS)
+   130.    6.00      20.       6.       5.       5.
              (INCHES)  5.610    6.964    6.964    6.964
              (AC-FT)   10.      12.      12.      12.

              CUMULATIVE AREA =   0.03 SQ MI
```

*** *** *** *** ***

HYDROGRAPH AT STATION BAS2
FOR PLAN 1, RATIO = 0.79

TOTAL RAINFALL = 6.16, TOTAL LOSS = 0.82, TOTAL EXCESS = 5.34

```
 PEAK FLOW   TIME              MAXIMUM AVERAGE FLOW
                     6-HR     24-HR    72-HR   29.90-HR
+  (CFS)     (HR)
                (CFS)
+   101.    6.00      16.       5.       4.       4.
              (INCHES)  4.325    5.338    5.338    5.338
              (AC-FT)   8.       10.      10.      10.

              CUMULATIVE AREA =   0.03 SQ MI
```

*** *** *** *** ***

HYDROGRAPH AT STATION BAS2
FOR PLAN 1, RATIO = 1.00

TOTAL RAINFALL = 7.80, TOTAL LOSS = 0.84, TOTAL EXCESS = 6.96

```
 PEAK FLOW   TIME              MAXIMUM AVERAGE FLOW
                     6-HR     24-HR    72-HR   29.90-HR
+  (CFS)     (HR)
                (CFS)
+   130.    6.00      20.       6.       5.       5.
              (INCHES)  5.610    6.964    6.964    6.964
```

```
          (AC-FT)      10.        12.        12.        12.

          CUMULATIVE AREA =    0.03 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

        **************
        *            *
29 KK   *    BAS3    *       Street & Right of Way
        *            *
        **************

 8 IN       TIME DATA FOR INPUT TIME SERIES
              JXMIN       30  TIME INTERVAL IN MINUTES
             JXDATE    12DEC97  STARTING DATE
             JXTIME      600  STARTING TIME

         SUBBASIN RUNOFF DATA

30 BA       SUBBASIN CHARACTERISTICS
              TAREA      0.01  SUBBASIN AREA

          PRECIPITATION DATA

31 PB             STORM      7.80  BASIN TOTAL PRECIPITATION

32 PI       INCREMENTAL PRECIPITATION PATTERN
             0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
             0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
             0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
             0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
             0.00    0.00    0.00    0.00    0.00    0.01    0.01    0.01    0.01    0.01
             0.01    0.01    0.01    0.01    0.01    0.08    0.08    0.08    0.08    0.08
             0.01    0.01    0.01    0.01    0.01    0.01    0.01    0.01    0.01    0.01
             0.01    0.01    0.01    0.01    0.01    0.00    0.00    0.00    0.00    0.00
             0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
             0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
             0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
             0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
             0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
             0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
             0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
             0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
             0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
             0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00

36 LS       SCS LOSS RATE
              STRTL      0.22  INITIAL ABSTRACTION
             CRVNBR     90.00  CURVE NUMBER
              RTIMP      0.00  PERCENT IMPERVIOUS AREA

37 UD       SCS DIMENSIONLESS UNITGRAPH
               TLAG      0.15  LAG

                                 ***

                              UNIT HYDROGRAPH
                           10 END-OF-PERIOD ORDINATES
            7.     14.     10.     4.     2.     1.     0.     0.     0.     0.

  TOTAL RAINFALL =    7.80, TOTAL LOSS =    1.19, TOTAL EXCESS =    6.61

PEAK FLOW     TIME                    MAXIMUM AVERAGE FLOW
```

```
                        6-HR      24-HR      72-HR     29.90-HR
+ (CFS)      (HR)
               (CFS)
+    22.     6.00              3.         1.         1.         1.
               (INCHES)     5.373      6.609      6.609      6.609
               (AC-FT)      2.         2.         2.         2.

               CUMULATIVE AREA =    0.01 SQ MI


    ***          ***          ***          ***          ***

               HYDROGRAPH AT STATION     BAS3
                FOR PLAN 1, RATIO = 0.79

  TOTAL RAINFALL =   6.16, TOTAL LOSS =   1.16, TOTAL EXCESS =   5.00

 PEAK FLOW    TIME                 MAXIMUM AVERAGE FLOW
                        6-HR      24-HR      72-HR     29.90-HR
+ (CFS)      (HR)
               (CFS)
+    17.     6.00              3.         1.         1.         1.
               (INCHES)     4.082      5.000      5.000      5.000
               (AC-FT)      1.         2.         2.         2.

               CUMULATIVE AREA =    0.01 SQ MI


    ***          ***          ***          ***          ***

               HYDROGRAPH AT STATION     BAS3
                FOR PLAN 1, RATIO = 1.00

  TOTAL RAINFALL =   7.80, TOTAL LOSS =   1.19, TOTAL EXCESS =   6.61

 PEAK FLOW    TIME                 MAXIMUM AVERAGE FLOW
                        6-HR      24-HR      72-HR     29.90-HR
+ (CFS)      (HR)
               (CFS)
+    22.     6.00              3.         1.         1.         1.
               (INCHES)     5.373      6.609      6.609      6.609
               (AC-FT)      2.         2.         2.         2.

               CUMULATIVE AREA =    0.01 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 38 KK    *   TOTAL    *
          *            *
          **************

 39 HC         HYDROGRAPH COMBINATION
               ICOMP         3  NUMBER OF HYDROGRAPHS TO COMBINE

                                          ***

    ***          ***          ***          ***          ***

               HYDROGRAPH AT STATION    TOTAL
                FOR PLAN 1, RATIO = 0.79
```

```
 PEAK FLOW     TIME                    MAXIMUM AVERAGE FLOW
                          6-HR      24-HR      72-HR    29.90-HR
+  (CFS)       (HR)
                     (CFS)
+    167.    6.00             26.        8.        6.        6.
                (INCHES)    4.226      5.201      5.201      5.201
                 (AC-FT)     13.        16.        16.        16.

                 CUMULATIVE AREA =    0.06 SQ MI


     ***        ***        ***        ***        ***

                  HYDROGRAPH AT STATION    TOTAL
                   FOR PLAN 1, RATIO = 1.00

 PEAK FLOW     TIME                    MAXIMUM AVERAGE FLOW
                          6-HR      24-HR      72-HR    29.90-HR
+  (CFS)       (HR)
                     (CFS)
+    216.    6.00             33.       10.        8.        8.
                (INCHES)    5.512      6.820      6.820      6.820
                 (AC-FT)     17.        20.        20.        20.

                 CUMULATIVE AREA =    0.06 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          ***************
          *              *
 40 KK    *    POND      *
          *              *
          ***************

            HYDROGRAPH ROUTING DATA

 41 RS        STORAGE ROUTING
               NSTPS         1  NUMBER OF SUBREACHES
                ITYP       ELEV  TYPE OF INITIAL CONDITION
              RSVRIC      59.00  INITIAL CONDITION
                  X        0.00 WORKING R AND D COEFFICIENT

 42 SA           AREA      3.1      3.2      3.4      3.5

 43 SE        ELEVATION     59.00    60.00    61.00    63.00

 44 SQ        DISCHARGE       0.       4.      13.      25.      39.      54.      71.      77.      83.      88.
                     91.      99.     100.

 46 SE        ELEVATION     59.00    59.20    59.40    59.60    59.80    60.00    60.20    60.40    60.60    60.80
                   61.00    61.20    61.30

                                         ***

                              COMPUTED STORAGE-ELEVATION DATA

          STORAGE      0.00      3.14      6.44     13.34
        ELEVATION     59.00     60.00     61.00     63.00

                            COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE      0.00      0.62      1.24      1.87      2.50      3.14      3.78      4.44      5.10      5.76
          OUTFLOW      0.00      4.00     13.00     25.00     39.00     54.00     71.00     77.00     83.00     88.00
```

ELEVATION	59.00	59.20	59.40	59.60	59.80	60.00	60.20	60.40	60.60	60.80

STORAGE	6.44	7.12	7.46	13.34
OUTFLOW	91.00	99.00	100.00	117.00
ELEVATION	61.00	61.20	61.30	63.00

*** *** *** *** ***

HYDROGRAPH AT STATION POND
FOR PLAN 1, RATIO = 0.79

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)				
	(CFS)				
+ 82.	6.20	25.	8.	6.	6.
	(INCHES)	4.133	5.198	5.200	5.200
	(AC-FT)	12.	16.	16.	16.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	29.90-HR
+ (AC-FT)	(HR)				
5.	6.20	2.	1.	1.	1.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	29.90-HR
+ (FEET)	(HR)				
60.57	6.20	59.57	59.22	59.18	59.18

CUMULATIVE AREA = 0.06 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION POND
FOR PLAN 1, RATIO = 1.00

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)				
	(CFS)				
+ 94.	6.30	33.	10.	8.	8.
	(INCHES)	5.423	6.815	6.819	6.819
	(AC-FT)	16.	20.	20.	20.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	29.90-HR
+ (AC-FT)	(HR)				
7.	6.30	2.	1.	1.	1.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	29.90-HR
+ (FEET)	(HR)				
61.09	6.30	59.74	59.28	59.23	59.23

CUMULATIVE AREA = 0.06 SQ MI

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS

FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

				RATIOS APPLIED TO PRECIPITATION	
OPERATION	STATION	AREA	PLAN	RATIO 1	RATIO 2

```
                                        0.79    1.00

HYDROGRAPH AT
+               BAS1    0.02    1  FLOW       49.    64.
                           TIME       6.00    6.00

HYDROGRAPH AT
+               BAS2    0.03    1  FLOW      101.   130.
                           TIME       6.00    6.00

HYDROGRAPH AT
+               BAS3    0.01    1  FLOW       17.    22.
                           TIME       6.00    6.00

 3 COMBINED AT
+               TOTAL   0.06    1  FLOW      167.   216.
                           TIME       6.00    6.00

ROUTED TO
+               POND    0.06    1  FLOW       82.    94.
                           TIME       6.20    6.30

                        ** PEAK STAGES IN FEET **
                        1  STAGE     60.57   61.09
                           TIME       6.20    6.30


*** NORMAL END OF HEC-1 ***
```

RAINFALL INTENSITY TABLE

SEDGWICK COUNTY
KANSAS

THIS TABLE CONTAINS AVERAGE RAINFALL INTENSITIES
IN INCHES PER HOUR.

DURATION, HR:MIN	RETURN PERIOD 1 YR	2 YR	5 YR	10 YR	25 YR	50 YR	100 YR
0:05	4.77	5.52	6.56	7.32	8.44	9.32	10.20
0:06	4.53	5.26	6.27	7.02	8.11	8.96	9.81
0:07	4.33	5.04	6.03	6.76	7.82	8.65	9.48
0:08	4.16	4.85	5.82	6.52	7.55	8.36	9.17
0:09	4.00	4.67	5.61	6.30	7.30	8.09	8.87
0:10	3.85	4.50	5.42	6.08	7.06	7.82	8.58
0:11	3.71	4.34	5.23	5.88	6.83	7.56	8.30
0:12	3.58	4.19	5.06	5.69	6.60	7.32	8.04
0:13	3.45	4.05	4.90	5.51	6.40	7.10	7.79
0:14	3.34	3.92	4.75	5.34	6.21	6.89	7.57
0:15	3.23	3.80	4.61	5.19	6.04	6.70	7.36
0:16	3.13	3.69	4.48	5.05	5.88	6.53	7.17
0:17	3.03	3.58	4.36	4.92	5.73	6.37	7.00
0:18	2.94	3.48	4.25	4.80	5.60	6.22	6.84
0:19	2.86	3.39	4.14	4.69	5.47	6.09	6.70
0:20	2.78	3.30	4.05	4.58	5.35	5.96	6.56
0:21	2.70	3.21	3.95	4.48	5.24	5.84	6.43
0:22	2.63	3.14	3.87	4.39	5.14	5.72	6.30
0:23	2.56	3.06	3.78	4.30	5.04	5.61	6.19
0:24	2.50	2.99	3.71	4.21	4.94	5.51	6.07
0:25	2.44	2.93	3.63	4.13	4.85	5.41	5.97
0:26	2.38	2.86	3.56	4.05	4.76	5.31	5.86
0:27	2.33	2.80	3.49	3.98	4.68	5.22	5.76
0:28	2.28	2.75	3.43	3.91	4.59	5.13	5.66
0:29	2.23	2.69	3.36	3.84	4.52	5.04	5.57
0:30	2.19	2.64	3.30	3.77	4.44	4.96	5.48
0:31	2.14	2.59	3.24	3.71	4.37	4.88	5.39
0:32	2.10	2.54	3.19	3.64	4.30	4.80	5.31
0:33	2.06	2.50	3.14	3.58	4.23	4.73	5.22
0:34	2.02	2.45	3.08	3.53	4.16	4.65	5.14
0:35	1.99	2.41	3.03	3.47	4.10	4.58	5.07
0:36	1.95	2.37	2.99	3.42	4.03	4.51	4.99
0:37	1.92	2.33	2.94	3.36	3.97	4.45	4.92
0:38	1.89	2.30	2.89	3.31	3.91	4.38	4.84
0:39	1.86	2.26	2.85	3.27	3.86	4.32	4.77
0:40	1.83	2.23	2.81	3.22	3.80	4.26	4.71
0:41	1.80	2.19	2.77	3.17	3.75	4.20	4.64
0:42	1.77	2.16	2.73	3.13	3.70	4.14	4.58
0:43	1.75	2.13	2.69	3.08	3.65	4.08	4.52
0:44	1.72	2.10	2.65	3.04	3.60	4.03	4.46
0:45	1.70	2.07	2.62	3.00	3.55	3.97	4.40

RAINFALL INTENSITY TABLE

SEDGWICK COUNTY
KANSAS

THIS TABLE CONTAINS AVERAGE RAINFALL INTENSITIES
IN INCHES PER HOUR.

DURATION, HR:MIN	RETURN PERIOD 1 YR	2 YR	5 YR	10 YR	25 YR	50 YR	100 YR
0:46	1.67	2.04	2.58	2.96	3.50	3.92	4.34
0:47	1.65	2.01	2.55	2.92	3.46	3.87	4.29
0:48	1.63	1.98	2.51	2.88	3.41	3.82	4.23
0:49	1.60	1.96	2.48	2.85	3.37	3.78	4.18
0:50	1.58	1.93	2.45	2.81	3.33	3.73	4.13
0:51	1.56	1.91	2.42	2.78	3.29	3.68	4.08
0:52	1.54	1.88	2.39	2.74	3.25	3.64	4.03
0:53	1.52	1.86	2.36	2.71	3.21	3.60	3.98
0:54	1.50	1.84	2.33	2.68	3.17	3.55	3.94
0:55	1.48	1.81	2.30	2.65	3.13	3.51	3.89
0:56	1.46	1.79	2.28	2.62	3.10	3.47	3.85
0:57	1.45	1.77	2.25	2.59	3.06	3.43	3.80
0:58	1.43	1.75	2.23	2.56	3.03	3.40	3.76
0:59	1.41	1.73	2.20	2.53	3.00	3.36	3.72
1:00	1.39	1.71	2.18	2.50	2.96	3.32	3.68
1:05	1.32	1.62	2.06	2.37	2.81	3.15	3.49
1:10	1.25	1.53	1.96	2.25	2.67	3.00	3.33
1:15	1.18	1.46	1.87	2.15	2.55	2.86	3.17
1:20	1.13	1.39	1.78	2.05	2.44	2.74	3.04
1:25	1.07	1.33	1.70	1.97	2.34	2.63	2.91
1:30	1.03	1.27	1.63	1.89	2.24	2.52	2.80
1:35	0.98	1.22	1.57	1.81	2.16	2.43	2.69
1:40	0.94	1.17	1.51	1.75	2.08	2.34	2.60
1:45	0.91	1.13	1.46	1.69	2.01	2.26	2.51
1:50	0.87	1.09	1.41	1.63	1.94	2.18	2.42
1:55	0.84	1.05	1.36	1.57	1.88	2.11	2.35
2:00	0.81	1.02	1.32	1.52	1.82	2.05	2.28
2:05	0.79	0.98	1.28	1.48	1.76	1.99	2.21
2:10	0.76	0.95	1.24	1.43	1.71	1.93	2.14
2:15	0.74	0.92	1.20	1.39	1.67	1.88	2.08
2:20	0.72	0.90	1.17	1.36	1.62	1.82	2.03
2:25	0.70	0.87	1.14	1.32	1.58	1.78	1.98
2:30	0.68	0.85	1.11	1.29	1.54	1.73	1.93
2:35	0.66	0.83	1.08	1.25	1.50	1.69	1.88
2:40	0.64	0.81	1.05	1.22	1.46	1.65	1.83
2:45	0.62	0.79	1.03	1.19	1.43	1.61	1.79
2:50	0.61	0.77	1.00	1.17	1.40	1.57	1.75
2:55	0.59	0.75	0.98	1.14	1.37	1.54	1.71
3:00	0.58	0.73	0.96	1.12	1.34	1.51	1.68

RAINFALL INTENSITY TABLE

SEDGWICK COUNTY
KANSAS

THIS TABLE CONTAINS AVERAGE RAINFALL INTENSITIES
IN INCHES PER HOUR.

DURATION, HR:MIN	RETURN PERIOD 1 YR	2 YR	5 YR	10 YR	25 YR	50 YR	100 YR
3:15	0.54	0.69	0.90	1.05	1.26	1.42	1.58
3:30	0.51	0.65	0.85	0.99	1.19	1.34	1.49
3:45	0.48	0.61	0.80	0.94	1.12	1.27	1.41
4:00	0.46	0.58	0.76	0.89	1.07	1.21	1.34
4:15	0.44	0.55	0.73	0.85	1.02	1.15	1.28
4:30	0.42	0.53	0.70	0.81	0.98	1.10	1.23
4:45	0.40	0.51	0.67	0.78	0.94	1.06	1.18
5:00	0.38	0.49	0.64	0.75	0.90	1.02	1.13
5:15	0.37	0.47	0.62	0.72	0.87	0.98	1.09
5:30	0.35	0.45	0.60	0.70	0.83	0.94	1.05
5:45	0.34	0.44	0.58	0.67	0.81	0.91	1.01
6:00	0.33	0.42	0.56	0.65	0.78	0.88	0.98
6:30	0.31	0.40	0.52	0.61	0.73	0.83	0.92
7:00	0.30	0.38	0.50	0.58	0.69	0.78	0.87
7:30	0.28	0.36	0.47	0.55	0.66	0.74	0.83
8:00	0.27	0.34	0.45	0.52	0.62	0.70	0.78
8:30	0.26	0.33	0.43	0.50	0.60	0.67	0.75
9:00	0.25	0.31	0.41	0.48	0.57	0.64	0.72
9:30	0.24	0.30	0.39	0.46	0.55	0.62	0.69
10:00	0.23	0.29	0.38	0.44	0.52	0.59	0.66
10:30	0.22	0.28	0.36	0.42	0.50	0.57	0.63
11:00	0.21	0.27	0.35	0.41	0.49	0.55	0.61
11:30	0.21	0.26	0.34	0.39	0.47	0.53	0.59
12:00	0.20	0.25	0.33	0.38	0.45	0.51	0.57
13:00	0.19	0.24	0.31	0.36	0.43	0.48	0.53
14:00	0.18	0.22	0.29	0.34	0.40	0.45	0.50
15:00	0.17	0.21	0.27	0.32	0.38	0.43	0.47
16:00	0.16	0.20	0.26	0.30	0.36	0.40	0.45
17:00	0.15	0.19	0.25	0.29	0.34	0.38	0.43
18:00	0.15	0.18	0.24	0.27	0.33	0.37	0.41
19:00	0.14	0.18	0.23	0.26	0.31	0.35	0.39
20:00	0.14	0.17	0.22	0.25	0.30	0.34	0.37
21:00	0.13	0.16	0.21	0.24	0.29	0.32	0.36
22:00	0.13	0.16	0.20	0.23	0.28	0.31	0.34
23:00	0.12	0.15	0.19	0.22	0.27	0.30	0.33
24:00	0.12	0.15	0.19	0.22	0.26	0.29	0.32

(3 pages)

ATTACHMENT D

DRAINAGE CRITERIA

CITY OF WICHITA, KANSAS

RECOMMENDED RUNOFF COEFFICIENTS FOR RATIONAL METHOD
AND PERCENT IMPERVIOUS FOR UNIT HYDROGRAPH METHOD

Land Use or Surface Characteristics	Percent Impervious	Frequency 2	5	10	100
1. Business:					
Downtown Areas	95	0.84	0.85	0.87	0.91
Neighborhood Areas	70	0.68	0.69	0.73	0.80
2. Residential:					
Single Family (Soil Group D)					
1/8 Acre	50	0.57	0.61	0.66	0.79
1/4 Acre	38	0.50	0.54	0.62	0.76
1/3 Acre	30	0.46	0.50	0.59	0.73
1/2 Acre	25	0.42	0.48	0.56	0.72
3/4 Acre	22	0.42	0.46	0.55	0.71
1 Acre	20	0.41	0.45	0.54	0.71
Multi-Family (Soil Group D)					
Multi-Unit (detached)	60	0.62	0.66	0.72	0.82
Multi-Unit (attached)	65	0.64	0.68	0.73	0.83
Apartments	75	0.70	0.73	0.79	0.86
Single Family (Soil Group C)					
1/8 Acre	50	0.55	0.58	0.64	0.73
1/4 Acre	38	0.48	0.51	0.57	0.68
1/3 Acre	30	0.43	0.46	0.53	0.65
1/2 Acre	25	0.40	0.43	0.50	0.63
3/4 Acre	22	0.39	0.42	0.49	0.62
1 Acre	20	0.37	0.40	0.48	0.61
Multi-Family (Soil Group C)					
Multi-Unit (detached)	60	0.60	0.63	0.69	0.77
Multi-Unit (attached)	65	0.63	0.66	0.71	0.79
Apartments	75	0.68	0.72	0.77	0.83
Single-Family (Soil Group B)					
1/8 Acre	50	0.52	0.54	0.59	0.67
1/4 Acre	38	0.44	0.46	0.52	0.61
1/3 Acre	30	0.39	0.41	0.47	0.57
1/2 Acre	25	0.36	0.38	0.44	0.54
3/4 Acre	22	0.34	0.36	0.42	0.52
1 Acre	20	0.33	0.35	0.40	0.51
Multi-Family (Soil Group B)					
Multi-Unit (detached)	60	0.58	0.60	0.65	0.72
Multi-Unit (attached)	65	0.61	0.64	0.68	0.75
Apartments	75	0.67	0.70	0.74	0.80

Land Use or Surface Characteristics	Percent Impervious	Frequency 2	5	10	100
Single Family (Soil Group A)					
1/8 Acre	50	0.47	0.50	0.54	0.60
1/4 Acre	38	0.39	0.41	0.45	0.52
1/3 Acre	30	0.33	0.35	0.39	0.47
1/2 Acre	25	0.30	0.31	0.35	0.44
3/4 Acre	22	0.28	0.29	0.33	0.42
1 Acre	20	0.26	0.28	0.32	0.40
Multi-Family (Soil Group A)					
Multi-Unit (detached)	60	0.55	0.57	0.61	0.67
Multi-Unit (attached)	65	0.58	0.60	0.64	0.70
Apartments	75	0.65	0.68	0.72	0.77
3. Industrial:					
Light Areas	70	0.68	0.69	0.73	0.80
Heavy Areas	80	0.74	0.76	0.79	0.84
4. Playgrounds:	15	0.33	0.35	0.42	0.55
5. Schools:	40	0.49	0.51	0.56	0.66
Railroad Yard Areas:	30	0.43	0.45	0.50	0.62
7. Undeveloped Urban Areas: Offsite Flow Analysis (when land use not defined)	45	0.52	0.54	0.59	0.68
8. Streets:					
Paved	99	0.87	0.88	0.90	0.93
Gravel	00	0.24	0.26	0.33	0.48
9. Drive, Parking Lots and Walks:	96	0.87	0.87	0.88	0.89
10. Roofs:	90	0.80	0.85	0.90	0.93
11. Urban Lawn Areas (See Note No. 1 below):					
Soil Group A					
Slope less than 1%	00	0.08	0.09	0.13	0.23
Slope 1% to 4%	00	0.12	0.13	0.17	0.27
Slope more than 4%	00	0.16	0.17	0.21	0.31
Soil Group B					
Slope less than 1%	00	0.26	0.18	0.24	0.37
Slope 1% to 4%	00	0.20	0.22	0.28	0.41
Slope more than 4%	00	0.24	0.26	0.32	0.45
Soil Group C					
Slope less than 1%	00	0.24	0.27	0.35	0.51
Slope 1% to 4%	00	0.26	0.29	0.37	0.53
Slope more than 4%.	00	0.28	0.31	0.39	0.55

Land Use or Surface Characteristics	Percent Impervious	Frequency 2	5	10	100
Soil Group D					
Slope less than 1%	00	0.28	0.33	0.43	0.63
Slope 1% to 4%	00	0.30	0.35	0.45	0.65
Slope more than 4%	00	0.32	0.37	0.47	0.67

Note No. 1: Coefficients shown in the above table are for pervious open space areas with thick turf which includes pervious areas in parks and cemeteries. Coefficients shown above must be increased 0.02 for use with agricultural pasture areas. Coefficients shown above must be reduced by 0.04 for use with agricultural cultivated areas. Group A soils are well-drained, coarse textured sands with high infiltration rates. Group B soils are moderately well-drained, moderately coarse textured soils with moderate infiltration rates. Group C soils are moderately poor-drained, moderately fine textured soils with slow infiltration rates. Group D soils are poor-drained, fine textured soils with very slow infiltration rates.

GENERAL NOTE: These Rational Formula Coefficients may not be valid for large basins.

TABLE 16.--SOIL AND WATER FEATURES

[Absence of an entry indicates the feature is not a concern. The definitions of "flooding" and "water table" in the Glossary explain such terms as "rare," "brief," and "perched." The symbol > means greater than]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness
					Ft			In	
Albion:									
[1]Aa:									
Albion part	B	None	---	---	>6.0	---	---	>60	---
Shellabarger part	B	None	---	---	>6.0	---	---	>60	---
[1]Ab:									
Albion part	B	None	---	---	>6.0	---	---	>60	---
Shellabarger part	B	None	---	---	>6.0	---	---	>60	---
Blanket: Ba, Bb	C	None	---	---	>6.0	---	---	>60	---
Canadian: Ca	B	Rare	---	---	>6.0	---	---	>60	---
[1]Cb:									
Canadian part	B	Rare	---	---	>6.0	---	---	>60	---
Waldeck part	C	Occasional	Brief	Mar-Oct	2.0-6.0	Apparent	Oct-Apr	>60	---
Carwile: Cc	D	Occasional	Brief to very long.	Apr-Oct	2.0-6.0	Apparent	Oct-Apr	>60	---
Clark:									
[1]Cd:									
Clark part	B	None	---	---	>6.0	---	---	>60	---
Ost part	B	None	---	---	>6.0	---	---	>60	---
Clime: Ce	C	None	---	---	>6.0	---	---	20-40	Rippable
Elandco: Ea, Eb, Ec	B	Rare to common.	Brief	Oct-May	>6.0	---	---	>60	---
Farnum: Fa, Fb, Fc	B	None	---	---	>6.0	---	-		
Goessel: Ga, Gb	D	None	---	---	>6.0	---	-		
Irwin: Ia, Ib, Ic	D	None	---	---	>6.0	---	-		
Lesho: La	C	Occasional	Very brief	Mar-Jul	2.0-6.0	Apparent	Ja		
Lincoln: Lb	A	Common	Very brief to brief.	Apr-Oct	5.0-8.0	Apparent	No		
Milan: Ma, Mb, Mc	B	None	---	---	>6.0	---	-		

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness
					Ft			In	
Naron: Na	B	None	---	---	>6.0	---	---	>60	---
Owens: Oc	D	None	---	---	>6.0	---	---	10-20	Rippable
[1]Od: Owens part	D	None	---	---	>6.0	---	---	10-20	Rippable
Rock outcrop part.									
Pits: Pa.									
Plevna: Pb	D	Frequent	Brief to long.	Mar-Oct	0-4.0	Apparent	Jan-Dec	>60	---
Pratt: Pc	A	None	---	---	>6.0	---	---	>60	---
[1]Pd: Pratt part	A	None	---	---	>6.0	---	---	>60	---
Tivoli part	A	None	---	---	>6.0	---	---	>60	---
Renfrow: Ra, Rb	D	None	---	---	>6.0	---	---	>60	---
[1]Rc: Renfrow part	D	None	---	---	>6.0	---	---	>60	---
Owens part	D	None	---	---	>6.0	---	---	10-20	Rippable
Rosehill: Rd	D	None	---	---	>6.0	---	---	20-40	Rippable
Shellabarger: Sa, Sb, Sc	B	None	---	---	>6.0	---	---	>60	---
Tabler: Ta	D	None	---	---	2.5-3.5	Perched	Oct-Apr	>60	---
[1]Tb: Tabler part	D	None	---	---	2.5-3.5	Perched	Oct-Apr	>60	---
Drummond part	D	Rare	---	---	2.0-6.0	Apparent	Nov-Apr	>60	---
Urban land: [1]Ua: Urban land part.									
Canadian part	B	Rare	---	---	>6.0	---	---	>60	---
[1]Ub: Urban land part.									
Elandco part	B	Rare to common.	Brief	Oct-May	>6.0	---	---	>60	---
[1]Uc: Urban land part.									
Farnum part	B	None	---	---	>6.0	---	---	>60	---

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness
					Ft			In	
Urban land:									
[1]Ud:									
Urban land part.									
Irwin part-----	D	None---------	---	---	>6.	---	---	>40	Hard
[1]Ue:									
Urban land part.									
Tabler part----	D	None---------	---	---	2.5-3.5	Perched	Oct-Apr	>60	---
Vanoss:									
Va, Vb, Vc, Vd---	B	None---------	---	---	>6.0	---	---	>60	---
Vernon:									
Ve, Vf----------	D	None---------	---	---	>6.0	---	---	>60	---
Waldeck:									
Wa----------	C	Occasional	Brief-----	Mar-Oct	2.0-6.0	Apparent	Oct-Apr	>60	---
Waurika:									
Wb----------	D	None---------	---	---	1.0-2.0	Perched	Mar-May	>60	---

[1]This map unit is made up of two or more dominant kinds of soil. See map unit description for the composition and behavior of the whole map unit.

Table 2-2.--Runoff curve numbers for selected agricultural, suburban, and urban land use. (Antecedent moisture condition II, and $I_a = 0.2S$)

LAND USE DESCRIPTION	HYDROLOGIC SOIL GROUP			
	A	B	C	D
Cultivated land[1]: without conservation treatment	72	81	88	91
: with conservation treatment	62	71	78	81
Pasture or range land: poor condition	68	79	86	89
good condition	39	61	74	80
Meadow: good condition	30	58	71	78
Wood or Forest land: thin stand, poor cover, no mulch	45	66	77	83
good cover[2]	25	55	70	77
Open Spaces, lawns, parks, golf courses, cemeteries, etc.				
good condition: grass cover on 75% or more of the area	39	61	74	80
fair condition: grass cover on 50% to 75% of the area	49	69	79	84
Commercial and business areas (85% impervious)	89	92	94	95
Industrial districts (72% impervious).	81	88	91	93
Residential:[3]				
Average lot size — Average % Impervious[4]				
1/8 acre or less — 65	77	85	90	92
1/4 acre — 38	61	75	83	87
1/3 acre — 30	57	72	81	86
1/2 acre — 25	54	70	80	85
1 acre — 20	51	68	79	84
Paved parking lots, roofs, driveways, etc.[5]	98	98	98	98
Streets and roads:				
paved with curbs and storm sewers[5]	98	98	98	98
gravel	76	85	89	91
dirt	72	82	87	89

[1] For a more detailed description of agricultural land use curve numbers refer to National Engineering Handbook, Section 4, Hydrology, Chapter 9, Aug. 1972.

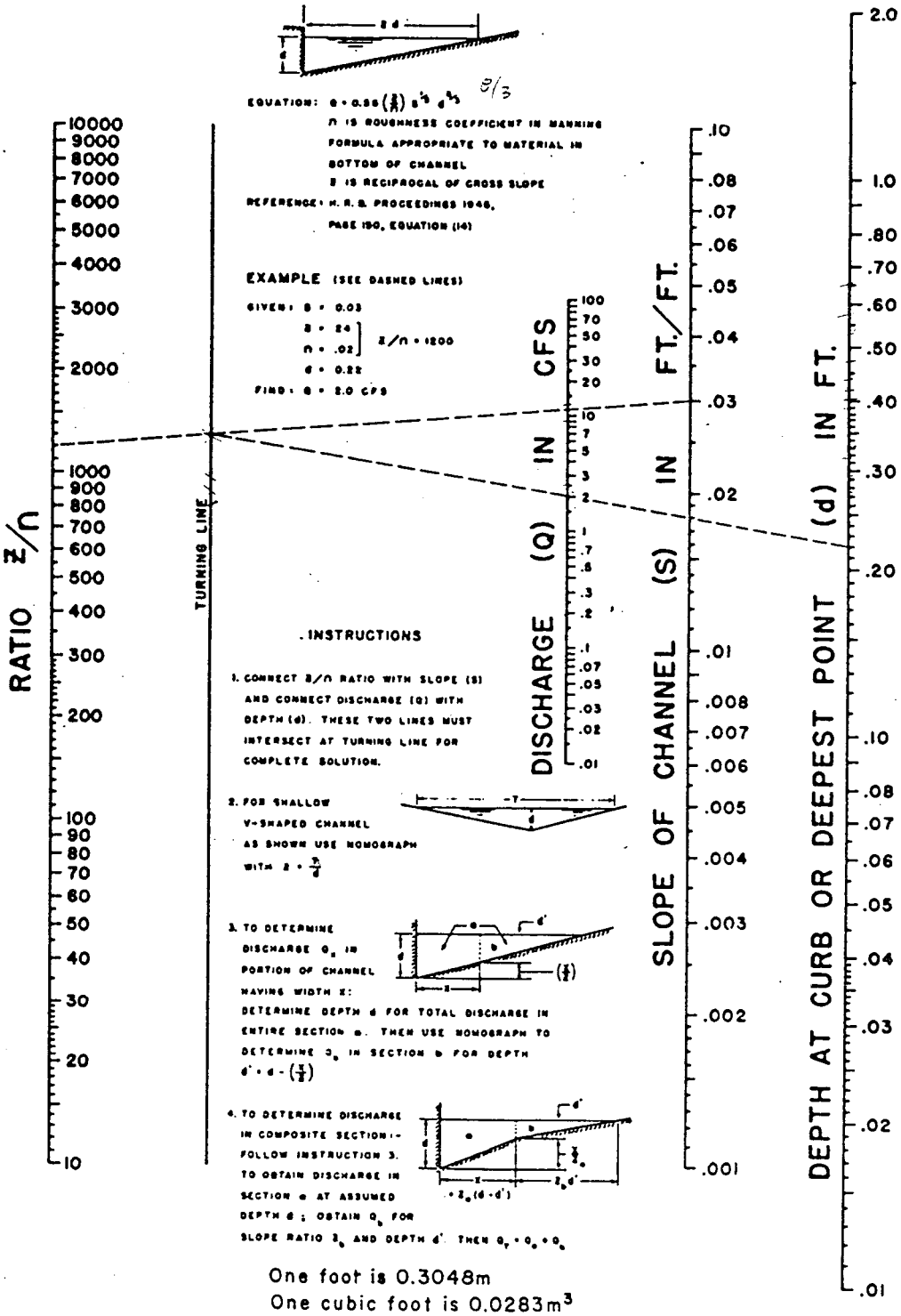
[2] Good cover is protected from grazing and litter and brush cover soil.

[3] Curve numbers are computed assuming the runoff from the house and driveway is directed towards the street with a minimum of roof water directed to lawns where additional infiltration could occur.

[4] The remaining pervious areas (lawn) are considered to be in good pasture condition for these curve numbers.

[5] In some warmer climates of the country a curve number of 95 may be used.

NOMOGRAPH FOR FLOW IN TRIANGULAR CHANNELS



One foot is 0.3048m

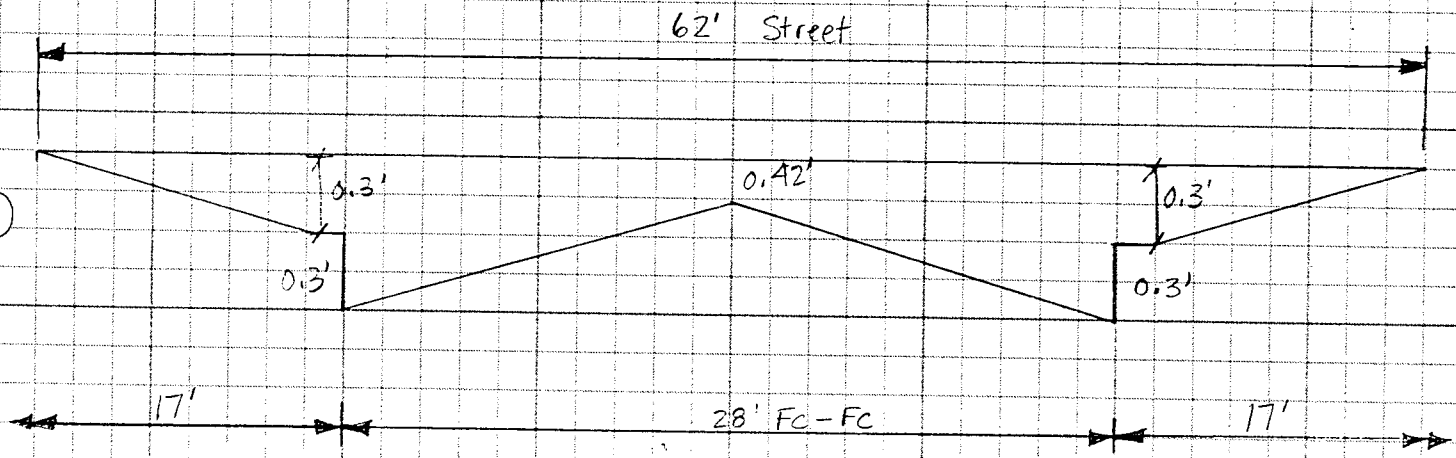
One cubic foot is $0.0283 m^3$

PROFESSIONAL ENGINEERING CONSULTANTS
603 S. TOPEKA
WICHITA, KANSAS
ZIP CODE / 67202

Date _____ Page _____ of _____

Project _____

Item Chapel Hill Roll-Curb



$$n = \frac{2(16.5 \times 0.03) + 2(2.8 \times 0.013) + 2(12 \times 0.016)}{62.6} = 0.02311$$

$$A = (28' \times 0.18') + 2\left(\tfrac{1}{2} \times 0.3 \times 17\right) + 2\left(\tfrac{1}{2} \times 0.42 \times 14\right)$$

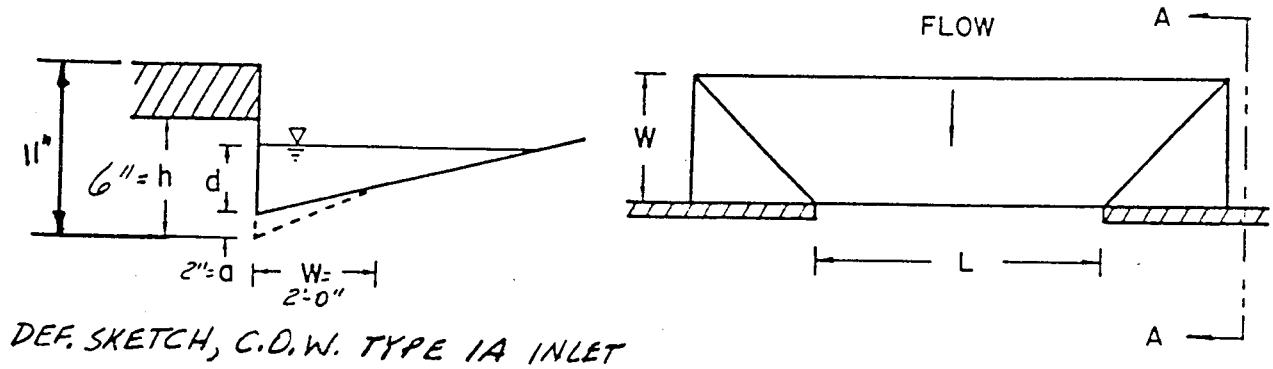
$$= 5.04 + 5.1 + 5.88$$

$$A = 16.02$$

$$P = 2(16.5 + 2.8 + 12) = 62.6$$

$$R = \frac{A}{P} = 0.2559 \qquad R^{2/3} = 0.40$$

$$Q = \frac{1.486}{n} \times A \times R^{2/3} \sqrt{S} \qquad Q_X = 412\sqrt{S}$$



DEF. SKETCH, C.O.W. TYPE 1A INLET

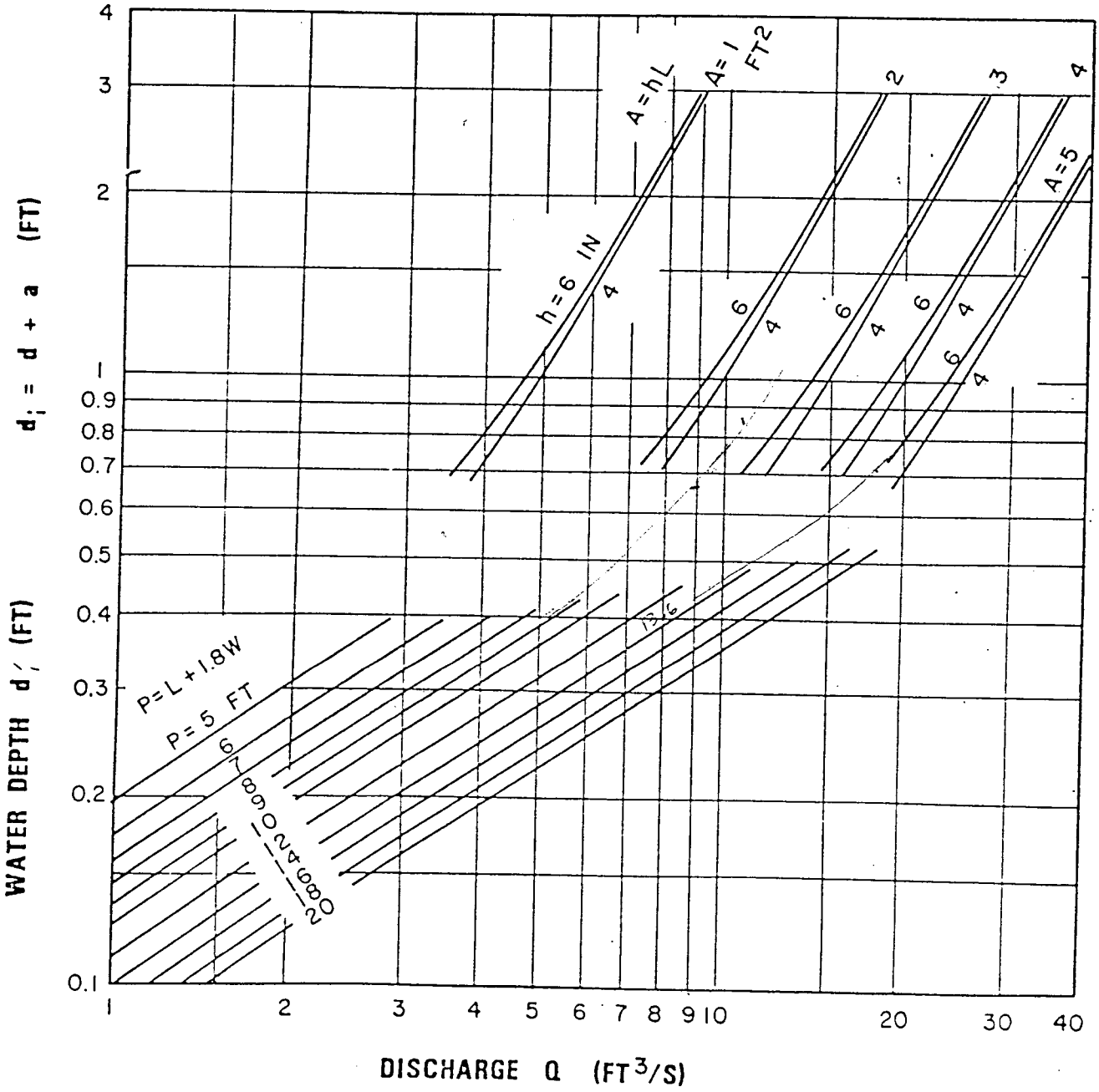


CHART 12. Depressed curb-opening inlet capacity in sump locations.

FROM: HEC-12, DRAINAGE OF HIGHWAY PAVEMENTS, F.H.W.A., MAR., 1984

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