STORMWATER DETENTION ANALYSIS

O'FALLON INDUSTRIAL CENTER

BAX PROJECT NO. 89-3102

PREPARED FOR:

O'FALLON INDUSTRIAL CENTER TRUST
C/O HOLIDAY INN SOUTHWEST
10709 WATSON ROAD
ST. LOUIS, MO 63127
TELEPHONE: 314/821-6600

PREPARED BY:

BAX ENGINEERING CO., INC.
221 POINT WEST BOULEVARD
ST. CHARLES, MO 63301
TELEPHONE: 314/946-6588

MAY 22, 1992

Scott O. Kolkmeyer

I. PURPOSE

The purpose of this report is to estimate the increase in the storm water runoff rate due to development of the tract of land known as "O'FALLON INDUSTRIAL CENTER" and to estimate the attenuation characteristics of the stormwater detention facilities that are proposed to be constructed as part of the site improvements. Based upon such estimates, a comparison is made between the pre-developed rate of stormwater runoff and the post-developed rate of stormwater runoff.

II. SCOPE

This report estimates the expected increase in stormwater runoff rate and attenuation characteristics during a 25 year and 100 year frequency storm of 20 minutes duration, utilizing the rational method of estimating stormwater runoff to the detention facilities. The stormwater runoff rate to the facility for a 15 year frequency storm of 20 minutes duration is also included.

III. DETENTION CONCEPT

The proposed site improvements include construction of two dry detention basins located at the north and south ends of the project. The storage volume and outflow rates have been proportioned to insure that the peak rate of runoff leaving the sub-watershed of the site under post-developed conditions is less than or equal to the peak rate of runoff leaving the sub-watershed of the site under pre-developed conditions for the design 25 year frequency storm.

IV. STORMWATER RUNOFF INFORMATION

Runoff calculations for the tract and calculations of required attenuations are shown on Exhibit 'A.'

Estimate Inflow Hydrograph calculations for the design 25 year storm as well as the 15 year and 100 year storm are shown on Exhibit 'B.'

V. DETENTION BASIN CHARACTERISTICS

The depth-storage characteristics of the proposed detention basin are shown on Exhibit 'C.'

VI. OVERFLOW STRUCTURE CHARACTERISTICS

The overflow structure has been designed to pass a design 100 year 20 minute storm with all areas upstream fully developed. Estimate Inflow Hydrograph calculations for the design 100 year storm are shown on Exhibit 'D.'

VII. ROUTING PROCEDURE

The H.E.C. 1 computer program analysis was used to calculate the routing of the storm through the detention basins. H.E.C. 1 uses the modified Puls routing procedure. The inflow hydrograph, depth-storage, and size of outflow were included in the input file. These calculations and results are shown in Exhibit 'E.'

VIII. SUMMARY

The proposed detention basins will meet the outflow requirement which is based on the peak rate of runoff for the design 25 year frequency storm under pre-developed conditions.

The south basin is allowed a maximum outflow of 119.20 c.f.s. The peak outflow for the design storm is 116 c.f.s. The north basin is allowed a maximum outflow of 256.40 c.f.s. The peak outflow for the design storm of the north basin is 253 c.f.s. Although detention is not required for a 100 year storm, the storm was routed and some detention will take place at both basins as can be seen in Exhibit 'E' as well as the inflow-outflow hydrograph which is found in Exhibit 'F.'

Graphs of the basin's inflow-time characteristics and depth-storage characteristics are all shown on Exhibit 'F.'

A drainage area map for the surrounding area is shown on Exhibit 'G.'

EXHIBITS

4) The area of the two phases of development on the subject tract contains approximately 39.82 Ac. The runoff flow to the tract discharges into the subwatersheds within the project area. The southern (front) portion will be developed with two basins being constructed and connected with a pipe serving as one basin to insure the post developed discharge will be less than or equal to the pre-developed discharge to the subwatershed from the site. The northern (back) portion will have one detention basin constructed to insure that the post developed discharge will be less than or equal to the pre-developed discharge to the subwatershed from the site. The basins will be lettered "A-C" with Basin "A" being the southwest basin, Basin "B" being the southeast basin, and Basin "C" being the north basin.

5.) Under pre-developed conditions, the discharge to the southern subwatershed is as follows: (25 year storm)

10.85 Ac (onsite)	@ 2.31 c.f.s./Ac	= 25.06 c.f.s.
7.12 Ac (offsite)	@ 2.31 c.f.s./Ac	= 16.45 c.f.s.
2.85 Ac (offsite)	@ 3.26 c.f.s./Ac	= 9.29 c.f.s.
19.0 Ac (offsite)	@ 4.75 c.f.s./Ac	= 90.25 c.f.s.
39.82 Ac		141.05 c.f.s.

EXHIBIT 'A'
Sh't. 2 OF 4

6.) Under pre-developed conditions, the discharge to the north subwatershed is as follows: (25 year storm)

8.07 A^c (onsite) @ 2.31 c.f.s./A^c = 18.64 c.f.s.
48.39 A^c (offsite) @ 2.31 c.f.s./A^c = 111.78 c.f.s.
32.4 A^c (offsite) @ 3.26 c.f.s./A^c = 105.62 c.f.s.
7.62 A^c (offsite) @ 4.75 c.f.s./A^c = 36.20 c.f.s.
96.48 A^c TOTAL = 272.24 c.f.s.

7.) Under post-developed conditions, the discharge to the southern subwatershed is as follows: (25 year storm)

7.12 A^c (offsite to basin 'A') @ 2.31 c.f.s./A^c = 16.45 c.f.s.
2.85 A^c (offsite to basin 'A') @ 3.26 c.f.s./A^c = 9.29 c.f.s.
19.0 A^c (offsite to basin 'A') @ 4.75 c.f.s./A^c = 90.25 c.f.s.
2.59 A^c (onsite to basin 'A') @ 4.75 c.f.s./A^c = 12.30 c.f.s.
2.71 A^c (onsite to basin 'B') @ 4.75 c.f.s./A^c = 12.87 c.f.s.
4.60 A^c (onsite direct runoff) @ 4.75 c.f.s./A^c = 21.85 c.f.s.
38.81 A^c 163.01 c.f.s.

8.) Under post-developed conditions, the discharge to the northern subwatershed is as follows: (25 year storm)

7.62 A^c (offsite to basin 'C') @ 4.75 c.f.s./A^c = 36.20 c.f.s.
32.4 A^c (offsite to basin 'C') @ 3.26 c.f.s./A^c = 105.62 c.f.s.
48.09 A^c (offsite to basin 'C') @ 2.31 c.f.s./A^c = 111.09 c.f.s.
0.3 A^c (offsite direct runoff) @ 2.31 c.f.s./A^c = 0.69 c.f.s.
4.13 A^c (onsite to basin 'C') @ 4.75 c.f.s./A^c = 19.62 c.f.s.
1.7 A^c (onsite to basin 'C' - grassed) @ 2.31 c.f.s./A^c = 3.93 c.f.s.
3.19 A^c (onsite direct runoff) @ 4.75 c.f.s./A^c = 15.15 c.f.s.
97.43 A^c TOTAL = 292.30 c.f.s.

EXHIBIT 'A'
Sht. 3 OF 4

9.) The required attenuation of the basins is found by subtracting the pre-developed discharge rate to the sub-watershed from the post-developed discharge rate to the sub-watershed.

South Basin:

Attenuation = 163.01 c.f.s. − 141.05 c.f.s. = 21.96 c.f.s.

North Basin:

Attenuation = 292.30 c.f.s. − 272.24 c.f.s. = 20.06 c.f.s.

10.) The required attenuation when considering the entire 18.92 acre tract is:

$(18.92\ A^c - 1.7\ A^c \text{(grassed)})\ (4.75\ \text{c.f.s.}/A^c - 2.31\ \text{c.f.s.}/A^c)$

$17.22\ A^c \times 2.44\ \text{c.f.s.}/A^c = 42.02\ \text{c.f.s.}$

21.96 c.f.s. + 20.06 c.f.s. = 42.02 c.f.s. ✓

EXHIBIT 'A'
Cl't. 4 OF 4

INFLOW HYDROGRAPH CALCULATIONS

1.) From the drainage area map of the project, the peak rates of runoff to the detention basins are:

SOUTH BASIN	A_c	DESIGN STORM (20 MINUTES DURATION) 15 YR (c.f.s.)	25 YR (c.f.s.)	100 YR (c.f.s.)
Offsite to basin 'A' (undeveloped)	7.12	13.31	16.45	21.00
Offsite to basin 'A' (residential)	2.85	7.52	9.29	11.88
Offsite to basin 'A' (comm/ind.)	19.0	73.15	90.25	115.52
Onsite to basin 'A' (comm)	2.59	9.97	12.30	15.75
Onsite to basin 'B' (comm.)	2.71	10.43	12.87	16.48
		114.38	141.16	180.63

NORTH BASIN	A_c	DESIGN STORM (20 MINUTES DURATION) 15 YR (c.f.s.)	25 YR (c.f.s.)	100 YR (c.f.s.)
offsite to basin 'C' (comm/ind.)	7.62	29.34	36.20	46.33
offsite to basin 'C' (residential)	32.4	85.54	105.62	135.11
Offsite to basin 'C' (undeveloped)	48.09	89.93	111.09	141.87
Onsite to basin 'C' (comm.)	4.13	15.90	19.62	25.11
Onsite to basin 'C' (grassed)	1.7	3.18	3.93	5.02
		223.89	276.46	353.44

EXHIBIT 'B'

Sht. 1 OF 6

2.) Of the inflows that will inflow to the proposed detention basins, the most remote point of origination lies offsite for both basins. The time of concentration is calculated as follows:

A. SOUTH BASIN:

The most distant point is approximately 2000 feet upstream offsite. The flow will travel approximately 550 feet over residential area (grassed) with an elevation difference of approximately 15 feet. It will then travel approximately 1450 feet over industrial area (assumed paved) with an elevation difference of 40±feet. From Figure 1 Exhibit 'B' sht. 3 of 6 the travel time is:

$T_{travel} = (4 \times 2) + (8 \times .4) = 8 + 3.2 = 11.2$ minutes

∴ Time of concentration will be assumed 10 minutes.

B. NORTH BASIN:

The most distant point is approximately 3600 feet offsite upstream. This area will be assumed developed with storm sewers throughout and an average velocity of 7 fps.

therefore the travel time = $\frac{3600 ft}{1} \times \frac{1}{7 ft/sec} = 514$ sec. = 8.57 minutes

∴ Time of concentration will be assumed as 8 minutes.

EXHIBIT 'B'
Sh't. 2 OF 6

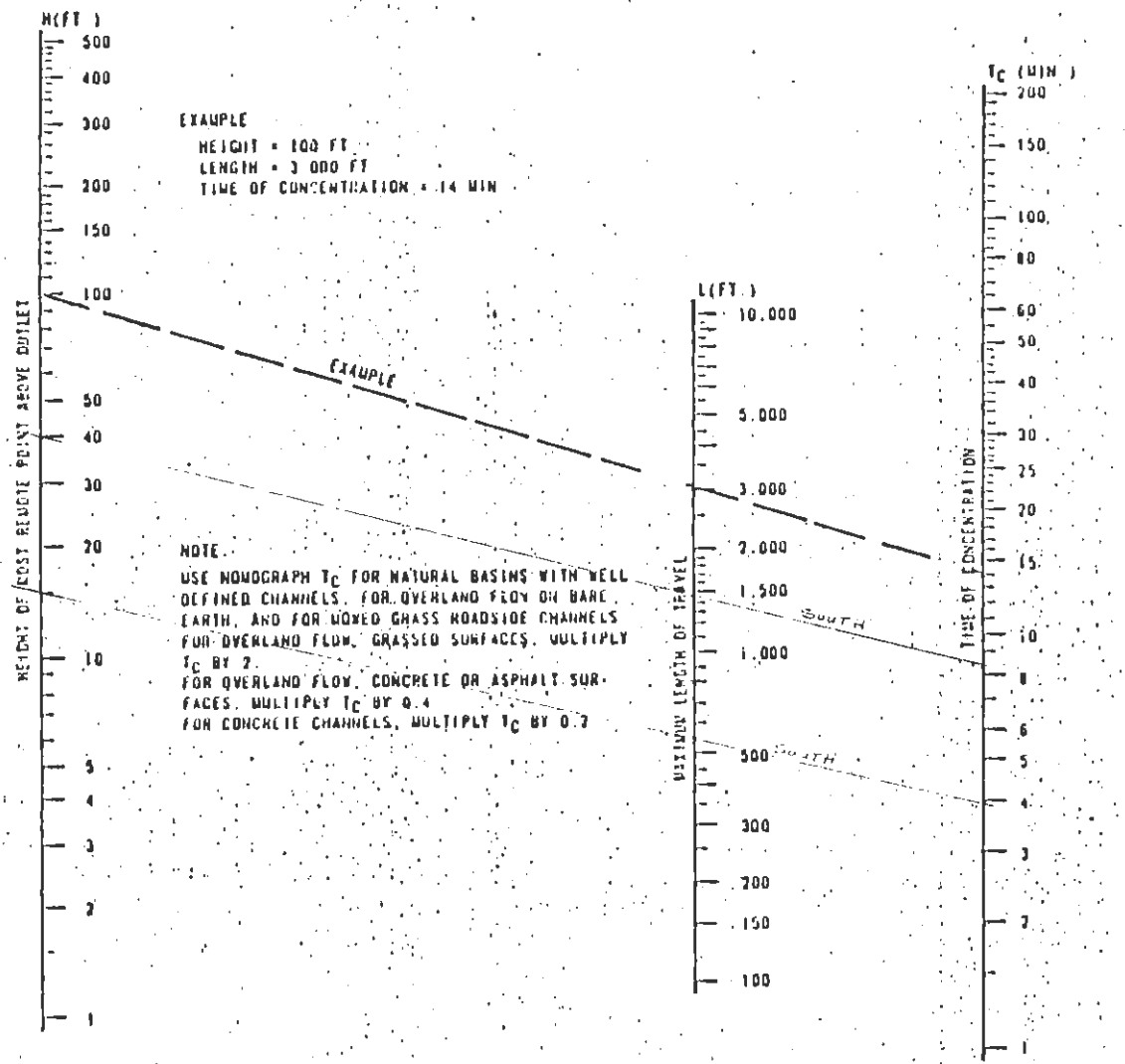


FIGURE 1

TIME OF CONCENTRATION OF SMALL DRAINAGE BASINS

BAX ENGINEERING CO., INC.

LAND PLANNING — LAND SURVEYING — SITE ENGINEERING

EXHIBIT 'B'
Sht. 3 of 6

3.) Inflow hydrographs for the 15, 25, and 100 year frequency storm of 20 minutes to each of the basins.

SOUTH BASIN: Tc = 10 minutes

TIME (minutes)	15 YEAR (c.f.s.)	25 YEAR (c.f.s.)	100 YEAR (c.f.s.)	REMARKS
0	0	0	0	Desig Rain Begins
2	22.88	28.23	36.13	
4	45.75	56.46	72.25	
6	68.63	84.70	108.38	
8	91.50	112.93	144.50	
10	114.38	141.16	180.63	All Areas Contributing Begin Peak Inflow
12	114.38	141.16	180.63	
14	114.38	141.16	180.63	
16	114.38	141.16	180.63	
18	114.38	141.16	180.63	
20	114.38	141.16	180.63	Design Rain Ends
22	91.50	112.93	144.50	
24	68.63	84.70	108.38	
26	45.75	56.46	72.25	
28	22.88	28.23	36.13	
30	0	0	0	Inflow Ends

EXHIBIT 'B'

Sht. 4 of 6

NORTH BASIN : T_c = 8 minutes

TIME (minutes)	15 YEAR	25 YEAR	100 YEAR	REMARKS
0	0	0	0	Design Rain Begins
2	55.97	69.12	88.36	
4	111.95	138.23	176.72	
6	167.92	207.35	265.08	
8	223.89	276.46	353.44	All Areas Contributing Begin Peak Inflow
10	223.89	276.46	353.44	
12	223.89	276.46	353.44	
14	223.89	276.46	353.44	
16	223.89	276.46	353.44	
18	223.89	276.46	353.44	
20	223.89	276.46	353.44	Design Rain Ends
22	167.92	207.35	265.08	
24	111.95	138.23	176.72	
26	55.97	69.12	88.36	
28	0	0	0	Inflow Ends

EXHIBIT 'B'
Sh't. 5 OF 6

4.) The permitted release rate of each basin is found by subtracting the required attenuation of each basin from the peak inflow rate to each basin for the basin 25 year frequency storm of 20 minutes duration.

SOUTH BASIN:

Permitted Release Rate = 141.16 c.f.s. − 21.96 c.f.s.* = 119.20 c.f.s.

NORTH BASIN:

Permitted Release Rate = 276.46 c.f.s. − 20.06 c.f.s.* = 256.40 c.f.s.

*From Exhibit 'A' Sh't 4 of 4

EXHIBIT 'B'
Sh't. 6 of 6

DEPTH-VOLUME STORAGE CALCULATIONS

SOUTH BASIN:

Two basins ('A' & 'B') will be connected with a storm sewer pipe to form one basin. The pipe will be required to pass a 50 year storm with two feet of freeboard. All areas upstream will be assumed fully developed.

Inflow to basin 'A': (50 year storm)

Offsite to basin 'A' (comm./ind.) $26.12 A^c$ @ 5.38 c.f.s./A^c = 140.53 c.f.s.

offsite to basin 'A' (residential) $2.85 A^c$ @ 3.69 c.f.s./A^c = 10.52 c.f.s.

Onsite to basin 'A' (comm./ind.) $2.59 A^c$ @ 5.38 c.f.s./A^c = 13.93 c.f.s.

TOTAL = 164.98 c.f.s.

IE pipe = 480.0

Top berm = 487.0

Allowable High Water = 485.0

From Chart 2 EXHIBIT 'C' sh't. 2 OF

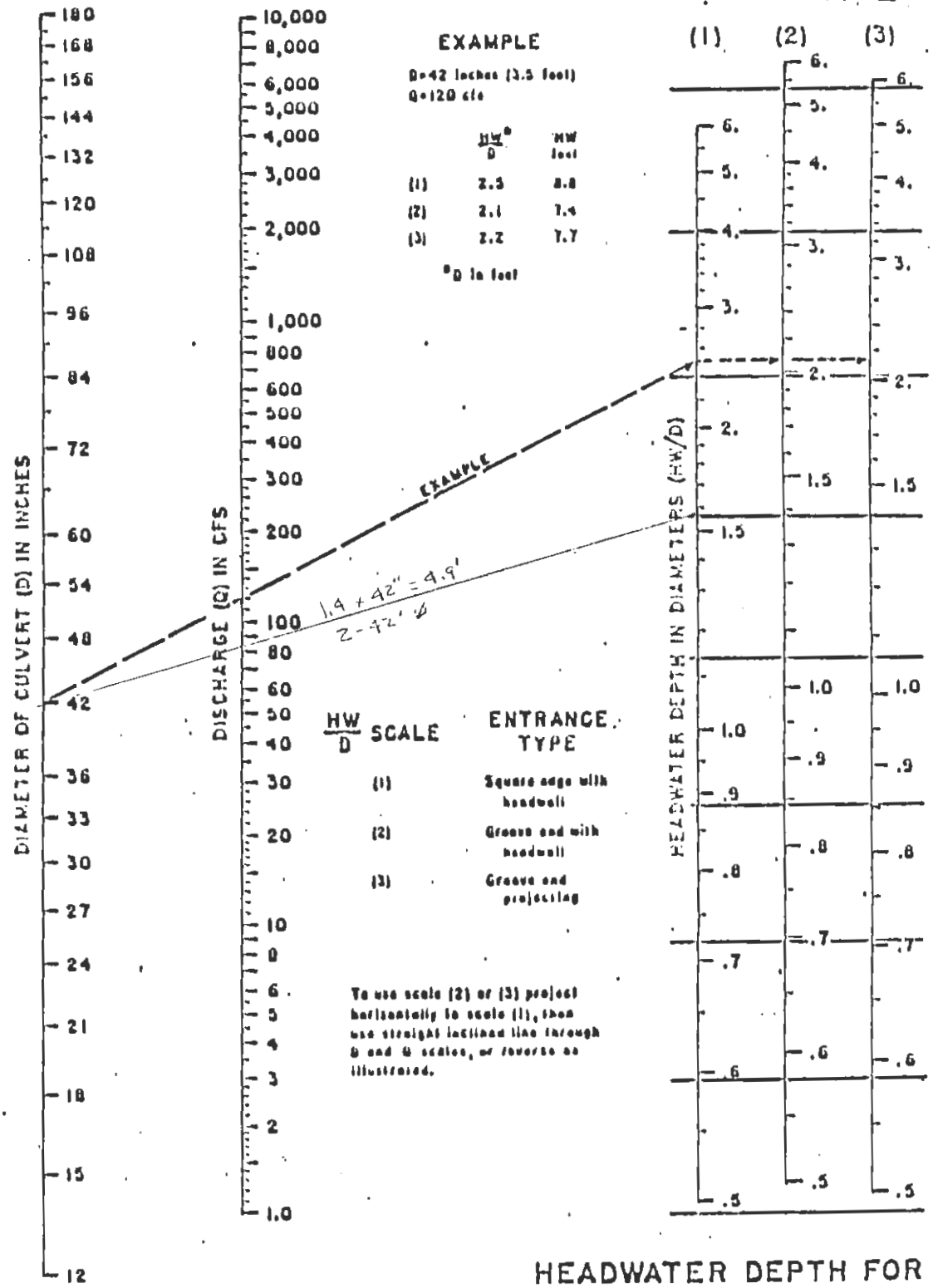
Hw = 4.9' (2 - 42" Ø concrete Pipes)

∴ Highwater = 484.9 < 485.0 ✓

EXHIBIT 'C'

sh't. 1 OF 7

CHART 2



HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

BAX ENGINEERING CO., INC.
LAND PLANNING — LAND SURVEYING — SITE ENGINEERING

EXHIBIT 'C'
Sh't. 2 of 7

The storage of basin 'A', basin 'B', and the two 42"ø pipes will be added to make the total storage of the South Basin.

Basin A:

ELEVATION	AREA (Ac)	AVERAGE AREA (Ac)	INCREMENT OF DEPTH (FT.)	INCREMENT OF VOLUME (Ac-Ft.)	TOTAL VOLUME (Ac-Ft.)
480.0	0				0
		0.0685	2.0	0.137	
482.0	0.137				0.137
		0.172	2.0	0.344	
484.2	0.207				0.481
		0.2465	2.0	0.493	
486.0	0.286				0.974

Basin B:

477.3	0				
		0.008	0.3	0.002	
478.0	0.0116				0.002
		0.0545	2.0	0.109	
480.0	0.093				0.111
		0.1195	2.0	0.239	
482.0	0.146				0.350
		0.1745	2.0	0.349	
484.2	0.203				0.699
		0.2405	2.0	0.481	
486.2	0.278				1.180

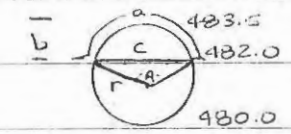
EXHIBIT 'C'

Sht. 3 OF 7

STORAGE OF 2-42" DIAMETER PIPES

℄ = 480.0 (upstream)

Elevation 482.0 Volume =



$$\text{Area} = S - \left[\frac{ar - c(r-b)}{2}\right] = S - \left[\frac{SA^\circ}{360} - \frac{c(r-b)}{2}\right]$$

$S = \pi R^2 = \pi\left(\frac{3.5}{2}\right)^2 = 9.62 \text{ Ft.}^2$

$b = 3.5 - 2.0 = 1.5 \text{ Ft.}$

$$b = 2r\sin^2\frac{A^\circ}{4}$$

$$1.5 = 2(1.75)\sin^2\frac{A^\circ}{4}$$

$$\sin^2\frac{A^\circ}{4} = 0.4285$$

$A^\circ = 163.57^\circ$

$$c = 2r\sin\frac{A^\circ}{2}$$

$$c = 2(1.75)\sin\frac{163.57}{2}$$

$c = 3.46 \text{ Ft.}$

$$\text{Area} = 9.62 - \left[\frac{9.62(163.57)}{360} - \frac{3.46(1.75-1.5)}{2}\right]$$

$$= 9.62 - [4.37 - 0.43]$$

$$= 9.62 - 3.94 = 5.68$$

Volume @ 482.0 = 5.68 Ft.^{2} × length

= 5.68 Ft.^{2} × 120 Ft. = 681.6 Ft.^{3}

2 PIPES ⇒ 681.6 × 2 = 1363.2 Ft.^{3} = 0.031 Ac-Ft.

Volume @ 484.0 = $(\pi)(1.75^2)\times 2 \times 120$ = 2309.1 Ft^3 = 0.053 Ac-Ft.

EXHIBIT 'C'

Sh't. 4 OF 7

When adding the storage of basin 'A', basin 'B' and the pipes, the following will show results:

ELEVATION Ft.	INDIVIDUAL TOTAL VOLUME 'A' AC-FT.	'B' AC-FT.	'PIPES' AC-FT.	SOUTH BASIN TOTAL VOLUME AC-FT
477.2	0	0	0	0
478.0	0	0.002	0	0.002
480.0	0	0.111	0	0.111
482.0	0.137	0.350	0.031	0.518
484.0	0.481	0.649	0.053	1.233
486.0	0.974	1.180	0.053	2.207

EXHIBIT 'C'

EXH. 5 OF 7

NORTH BASIN:

ELEVATION	AREA (AC)	AVERAGE AREA (AC)	INCREMENT OF DEPTH (FT.)	INCREMENT OF VOLUME (AC. FT.)	TOTAL VOLUME (AC. FT.)
478.0	0				0
		0.11	2.0	0.22	
480.0	0.22				0.22
		0.42	2.0	0.84	
482.0	0.62				1.06

UNDER EXISTING CONDITIONS THE HIGH WATER ELEVATION FOR THE DESIGN 25 YEAR-20 MINUTE STORM AT THE PROPERTY LINE IN THE CHANNEL OF THE PROPOSED DETENTION BASIN IS 485.9 (See Exhibit 'C' Sh. 7 of 7) FOR THE DESIGN 100 YEAR -20 MINUTE STORM THE HIGH WATER ELEVATION ALLOWED IS IN EXCESS OF 487.0. FOR THIS ANALYSIS 487.0 WILL BE THE LIMIT ALLOWED.

INFLOW-OUTFLOW HYDROGRAPH

SOUTH BASIN

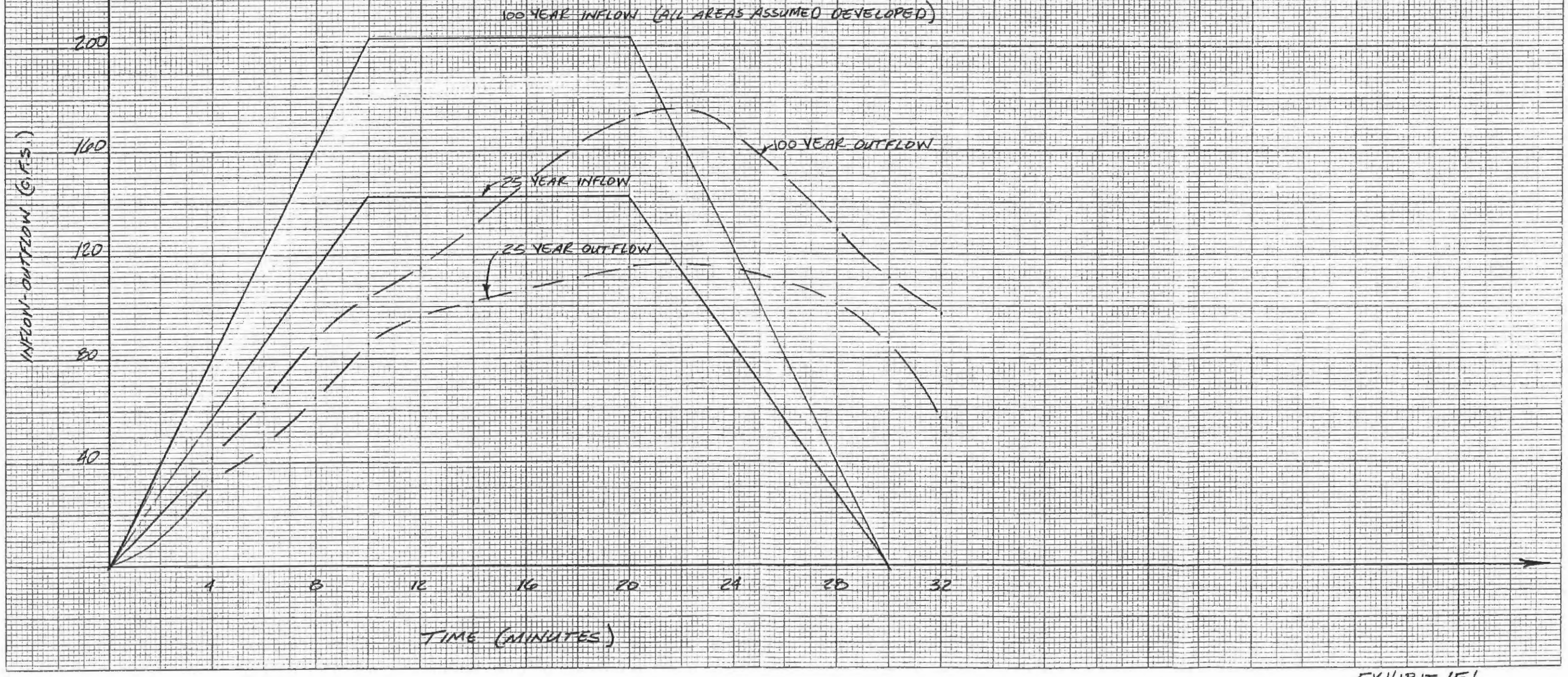
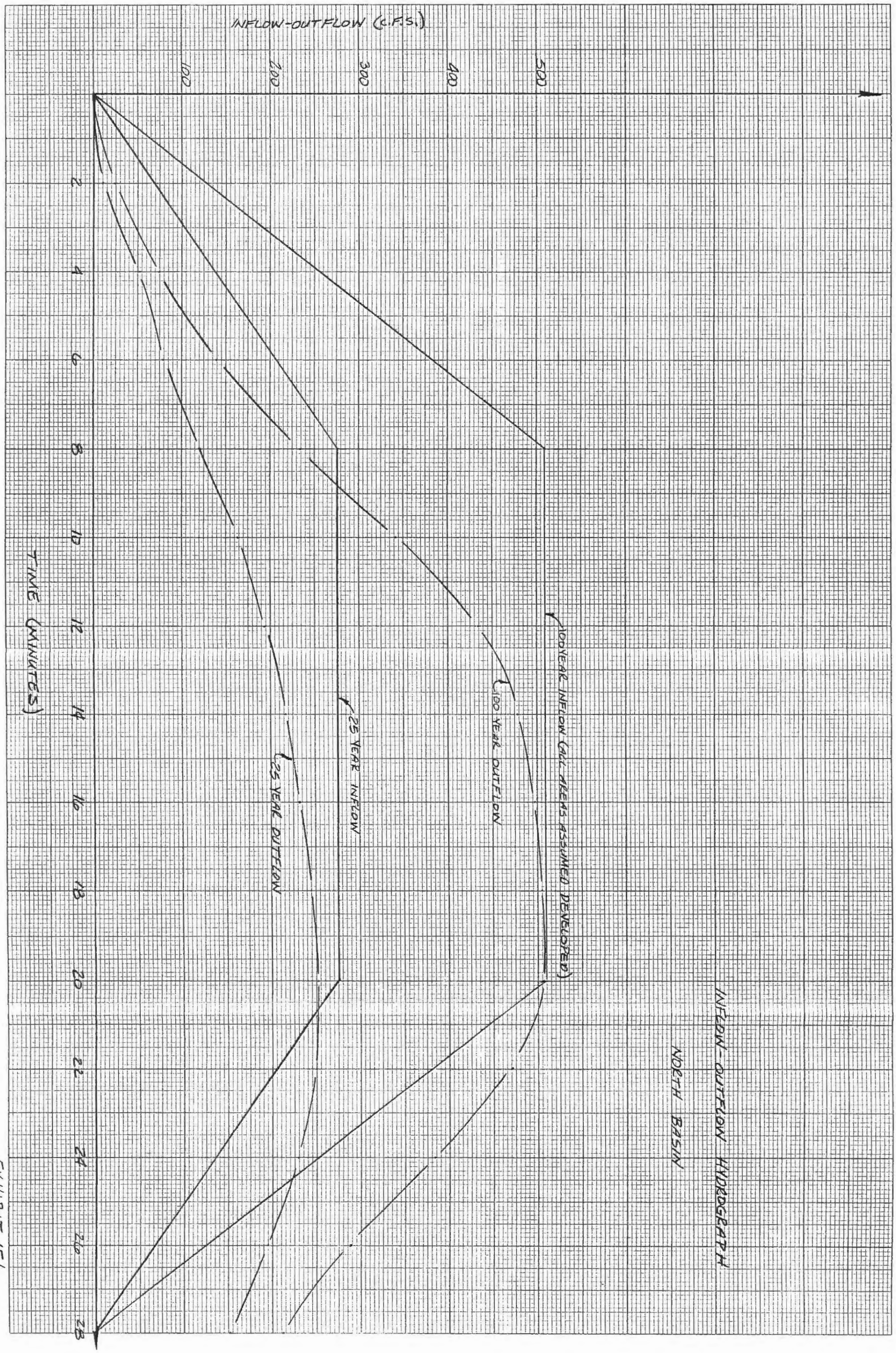


EXHIBIT 'F'
Sh4. 1 of 4



INFLOW-OUTFLOW HYDROGRAPH
NORTH BASIN

EXHIBIT 'F'
SH'T. 2 OF 4

DEPTH - STORAGE CURVE

SOUTH BASIN

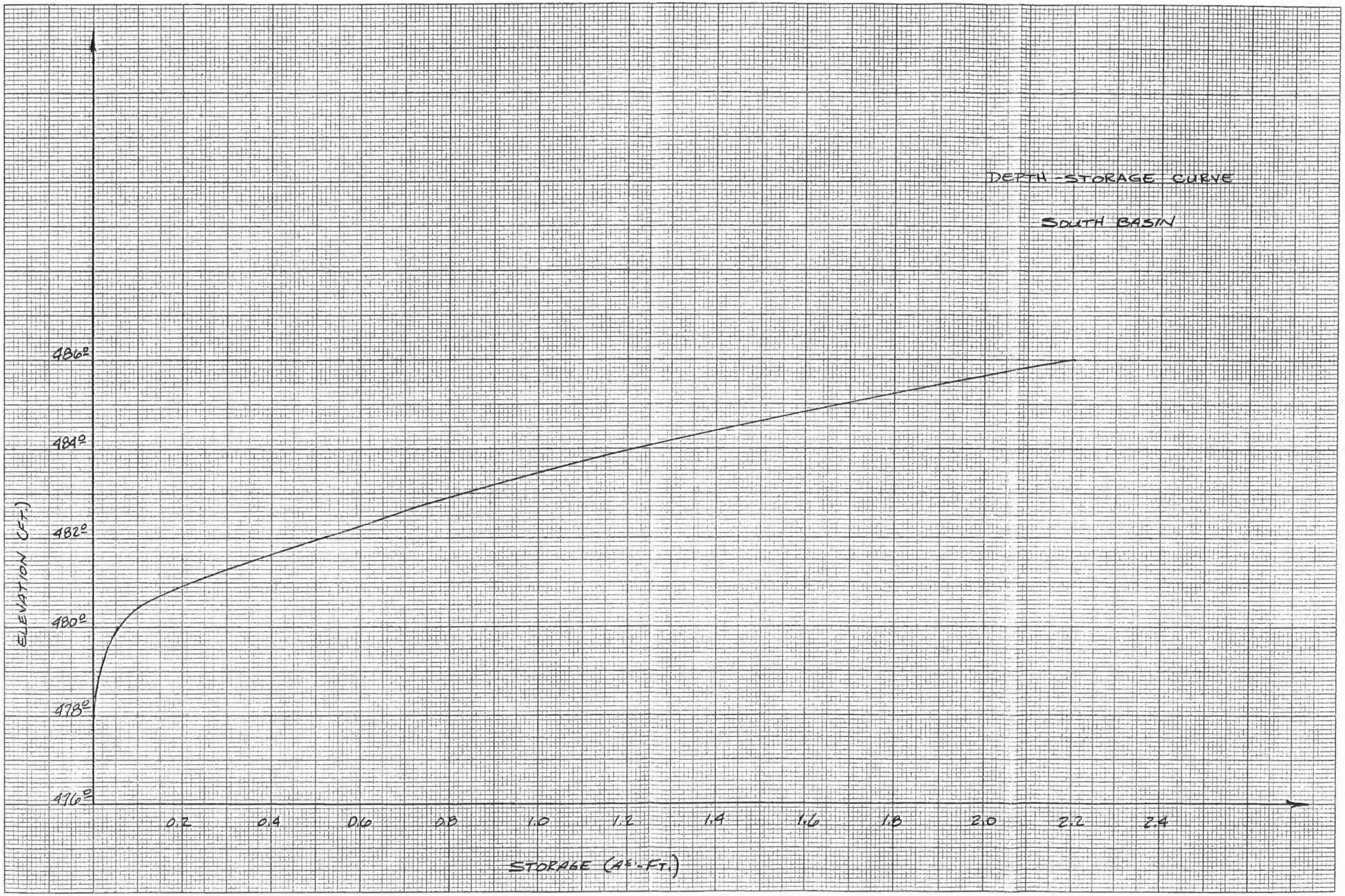
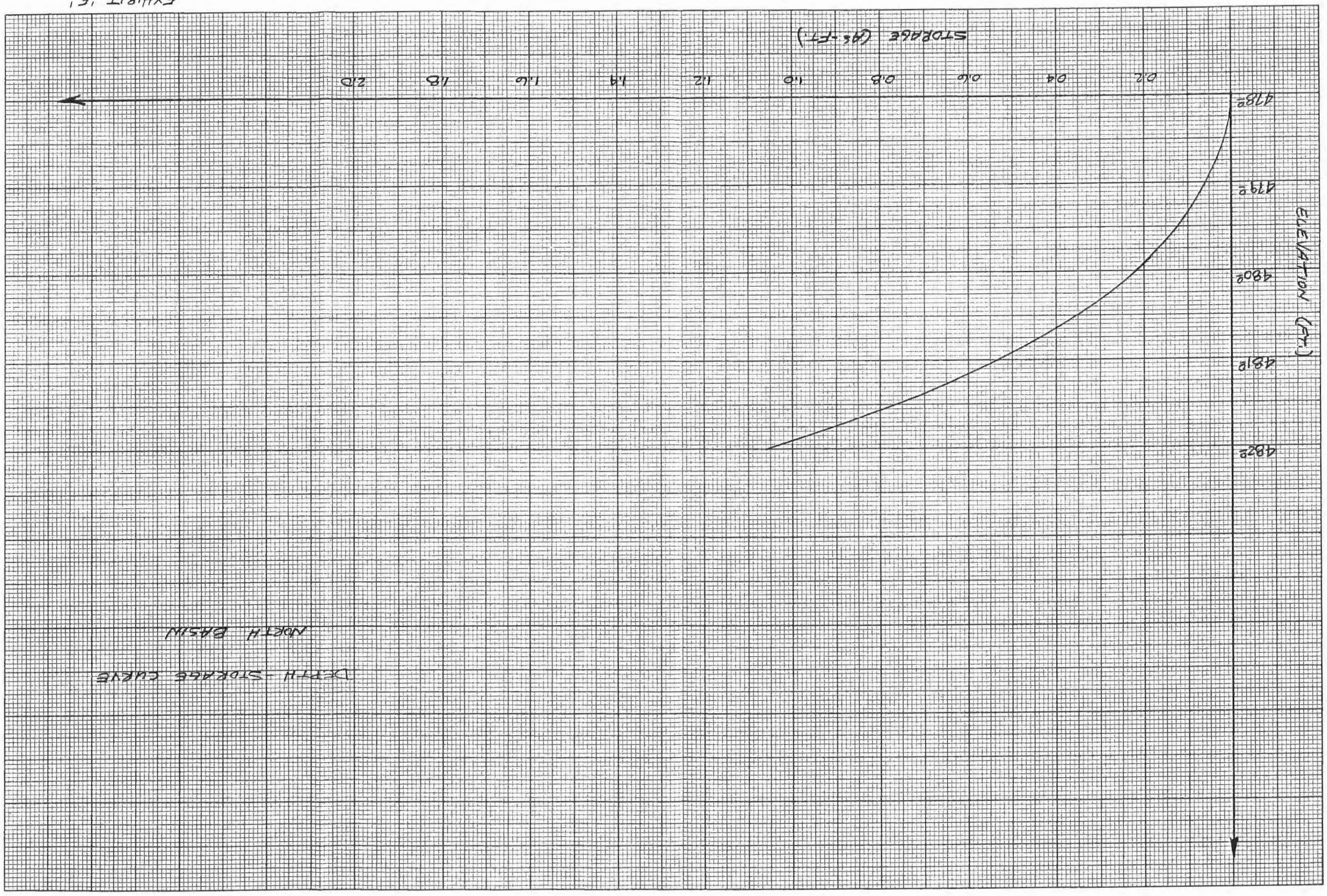


EXHIBIT 'F'
SH'T. 3 OF 4

EXHIBIT 'E'
Sht. 4 of 4

DEPTH - STORAGE CURVE

NORTH BASIN



47 1242

OVERFLOW STRUCTURE CALCULATIONS

1.) The overflow structure will be sized to pass a 100 year - 20 minute design storm with all areas upstream assumed to be fully developed. The peak rates of runoff to the detention basins are:

SOUTH BASIN:	A^c		100 YR. C.F.S.
Offsite (comm./ind. assumed)	7.12	@ 6.08 C.F.S./A^c	43.29
Offsite (residential)	2.85	@ 4.17 C.F.S./A^c	11.88
Offsite (comm./ind.)	19.0	@ 6.08 C.F.S./A^c	115.52
Onsite (comm/ind)	2.59	@ 6.08 C.F.S./A^c	15.75
onsite (comm/ind)	2.71	@ 6.08 C.F.S./A^c	16.48
		TOTAL	202.92 C.F.S.

NORTH BASIN			
Offsite (comm/ind.)	7.62	@ 6.08 C.F.S./A^c	46.33
Offsite (residential)	32.4	@ 4.17 C.F.S./A^c	135.11
Offsite (comm./ind. assumed)	48.09	@ 6.08 C.F.S./A^c	292.39
Onsite (comm/ind.)	4.13	@ 6.08 C.F.S./A^c	25.11
Onsite (comm/ind.)	1.7	@ 6.08 C.F.S./A^c	10.34
		TOTAL	509.28 C.F.S.

EXHIBIT 'D'
SH. 1 OF 2

2.) Inflow hydrographs for the 100 year - 20 minute storm, all areas developed, to the South and North basin

South Basin $T_c = 10$ minutes

North Basin $T_c = 8$ minutes

TIME (minutes)	SOUTH BASIN (100 yr. c.f.s.)	NORTH BASIN (100 yr. c.f.s.)
0	0	0
2	40.58	127.32
4	81.17	254.64
6	121.75	381.96
8	162.34	509.28
10	202.92	509.28
12	202.92	509.28
14	202.92	509.28
16	202.92	509.28
18	202.92	509.28
20	202.92	509.28
22	162.34	381.96
24	121.75	254.64
26	81.17	127.32
28	40.58	0
30	0	

EXHIBIT 'L'
PG. 2 OF 2

EXHIBIT E

H.E.C. 1 ANALYSIS

(The following H.E.C. 1 Analysis contains routing calculations of the design 25 year frequency storm of 20 minutes duration (under existing conditions) as well as the 100 year-20 minute storm (all areas fully developed) through the two storm water detention facilities.)

****

FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM AT 512K VERSION) FEB 1,1985

U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616

****

THIS HEC-1 VERSION CONTAINS ALL OPTIONS EXCEPT ECONOMICS, AND THE NUMBER OF PLANS ARE REDUCED TO 5

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

           1       ID
           2       ID   O'FALLON INDUSTRIAL CENTER
           3       ID   STORMWATER DETENTION ANALYSIS     SOUTH BASIN
           4       ID   (Bax Project No. 89-31v2)
           5       ID
           6       ID
           7       ID   MAY 19, 1992
           8       ID
           9       ID
          10       ID   25 YEAR FREQUENCY STORM - 20 MINUTE DURATION
          11       ID
          12       ID
          13       ID
*** FREE ***
          14       IT     2.0 19MAY92    0000      17
          15       IN     2.0 19MAY92    0000
          16       ID       0       0

          17       KK  STEP-1
          18       KM   INFLOW HYDROGRAPH TO BASIN D
          19       QI       0   28.23   56.46   84.70  112.93  141.16  141.16  141.16  141.16  141.16
          20       QI  141.16  112.93   84.70   56.46   28.23     0.1       0

          21       KK  STEP-2
          22       KM   MODIFIED PULS ROUTING THROUGH BASIN
          23       RS       1    ELEV   477.7
          24       SV       0   0.002   0.111   0.518   1.233   2.207
          25       SE   477.7   478.0   480.0   482.0   484.0   486.0
          26       SL  479.70   12.57     0.6     0.5 <-- 48"Ø PIPE @ IE EL. 477.7 ℄ EL. 479.7
          27       SS   483.5     8.5     3.0     1.5 <-- WEIR: 8.5 FT. @ EL. 483.5
          28       ZZ
```

```
                                        ****
                FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
 U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616
                                        ****



              O'FALLON INDUSTRIAL CENTER
              STORMWATER DETENTION ANALYSIS     SOUTH BASIN
              (Bax Project No. 89-3102)


              MAY 19, 1992


              25 YEAR FREQUENCY STORM - 20 MINUTE DURATION



16 IO        OUTPUT CONTROL VARIABLES
                   IPRNT           0  PRINT CONTROL
                   IPLOT           0  PLOT CONTROL
                   QSCAL          0.  HYDROGRAPH PLOT SCALE

   IT        HYDROGRAPH TIME DATA
                    NMIN           2  MINUTES IN COMPUTATION INTERVAL
                   IDATE     19MAY92  STARTING DATE
                   ITIME        0000  STARTING TIME
                      NQ          17  NUMBER OF HYDROGRAPH ORDINATES
                  NDDATE     19MAY92  ENDING DATE
                  NDTIME        0032  ENDING TIME

             COMPUTATION INTERVAL     .03 HOURS
                  TOTAL TIME BASE     .53 HOURS

      ENGLISH UNITS



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


          **************
          *            *
 17 KK    *   STEP-1   *
          *            *
          **************
                INFLOW HYDROGRAPH TO BASIN D

 15 IN        TIME DATA FOR INPUT TIME SERIES
                   JXMIN           2  TIME INTERVAL IN MINUTES
                  JXDATE     19MAY92  STARTING DATE
                  JXTIME           0  STARTING TIME

           SUBBASIN RUNOFF DATA

  0 BA        SUBBASIN CHARACTERISTICS
                   TAREA         .00  SUBBASIN AREA

                                        ***
```

HYDROGRAPH AT STATION STEP-1

DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW
19 MAY 0000	1	0.	19 MAY 0010	6	141.	19 MAY 0020	11	141.	19 MAY 0030	16	0.
19 MAY 0002	2	28.	19 MAY 0012	7	141.	19 MAY 0022	12	113.	19 MAY 0032	17	0.
19 MAY 0004	3	56.	19 MAY 0014	8	141.	19 MAY 0024	13	85.			
19 MAY 0006	4	85.	19 MAY 0016	9	141.	19 MAY 0026	14	56.			
19 MAY 0008	5	113.	19 MAY 0018	10	141.	19 MAY 0028	15	28.			

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	.53-HR
141.	.17	(CFS)	88.	88.	88.	88.
		(INCHES)	.000	.000	.000	.000
		(AC-FT)	4.	4.	4.	4.

CUMULATIVE AREA = .00 SQ MI

```
          ***************
          *             *
21 KK     *    STEP-2   *
          *             *
          ***************
                    MODIFIED PULS ROUTING THROUGH BASIN

               HYDROGRAPH ROUTING DATA

23 RS          STORAGE ROUTING
                    NSTPS          1  NUMBER OF SUBREACHES
                     ITYP       ELEV  TYPE OF INITIAL CONDITION
                    RSVRIC     477.70  INITIAL CONDITION
                        X        .00 WORKING R AND D COEFFICIENT

24 SV            STORAGE         .0       .0       .1       .5      1.2      2.2

25 SE          ELEVATION     477.70   478.00   480.00   482.00   484.00   486.00

26 SL          LOW-LEVEL OUTLET
                    ELEVL     479.70  ELEVATION AT CENTER OF OUTLET
                    CAREA      12.57  CROSS-SECTIONAL AREA
                     COQL        .60  COEFFICIENT
                     EXPL        .50  EXPONENT OF HEAD

27 SS          SPILLWAY
                     CREL     483.50  SPILLWAY CREST ELEVATION
                    SPWID       8.50  SPILLWAY WIDTH
                     COOW       3.00  WEIR COEFFICIENT
                     EXPW       1.50  EXPONENT OF HEAD

                                  ***

                    COMPUTED OUTFLOW-ELEVATION DATA

          OUTFLOW       .00      .00    82.08    85.80    85.88    94.37    99.32   104.83   110.99   117.91
```

OUTFLOW	125.73	130.82	137.63	146.40	157.33	170.68	186.65	205.48	227.39	252.62
ELEVATION	483.77	483.91	484.07	484.27	484.49	484.73	485.01	485.31	485.64	486.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	.00	.00	.09	.11	.42	.46	.50	.52	.57	.66
OUTFLOW	.00	.00	.00	33.13	82.08	85.80	89.88	91.75	94.37	99.32
ELEVATION	477.70	478.00	479.70	480.00	481.54	481.71	481.91	482.00	482.13	482.40
STORAGE	.77	.90	1.05	1.15	1.20	1.23	1.27	1.30	1.47	1.59
OUTFLOW	104.83	110.99	117.91	125.73	130.82	134.44	137.63	146.40	157.33	170.68
ELEVATION	482.70	483.07	483.50	483.77	483.91	484.00	484.07	484.27	484.49	484.73
STORAGE	1.72	1.87	2.03	2.21						
OUTFLOW	186.65	205.48	227.39	252.62						
ELEVATION	485.01	485.31	485.64	486.00						

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 0. TO 33.
THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

****

HYDROGRAPH AT STATION STEP-2

****

DA MON HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA MON HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA MON HRMN	ORD	OUTFLOW	STORAGE	STAGE
19 MAY 0000	1	0.	.0	477.7	19 MAY 0012	7	96.	.6	482.2	19 MAY 0024	13	114.	1.0	483.3
19 MAY 0002	2	0.	.0	478.7	19 MAY 0014	8	102.	.7	482.5	19 MAY 0026	14	109.	.9	482.9
19 MAY 0004	3	33.	.1	480.0	19 MAY 0016	9	107.	.8	482.8	19 MAY 0028	15	101.	.7	482.5
19 MAY 0006	4	46.	.2	480.4	19 MAY 0018	10	111.	.9	483.1	19 MAY 0030	16	86.	.5	481.7
19 MAY 0008	5	65.	.3	481.0	19 MAY 0020	11	115.	1.0	483.3	19 MAY 0032	17	57.	.3	480.8
19 MAY 0010	6	86.	.5	481.7	19 MAY 0022	12	116.	1.0	483.4					

← PEAK OUTFLOW

****

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	.53-HR
116.	.37	(CFS)	82.	82.	82.	82.
		(INCHES)	.000	.000	.000	.000
		(AC-FT)	4.	4.	4.	4.

PEAK STORAGE (AC-FT)	TIME (HR)	MAXIMUM AVERAGE STORAGE 6-HR	24-HR	72-HR	.53-HR
1.	.37	1.	1.	1.	1.

PEAK STAGE (FEET)	TIME (HR)	MAXIMUM AVERAGE STAGE 6-HR	24-HR	72-HR	.53-HR
483.38	.37	481.80	481.80	481.80	481.80

CUMULATIVE AREA = .00 SQ MI

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	STEP-1	141.	.17	88.	88.	88.	.00		
ROUTED TO	STEP-2	116.	.37	82.	82.	82.	.00	483.38	.37

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

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

        1       ID
        2       ID   O'FALLON INDUSTRIAL CENTER
        3       ID   STORMWATER DETENTION ANALYSIS     SOUTH BASIN
        4       ID   (Bax Project No. 89-31o2)
        5       ID
        6       ID
        7       ID   MAY 19, 1992
        8       ID
        9       ID
       10       ID   100 YEAR FREQUENCY STORM - 20 MINUTE DURATION
       11       ID
       12       ID
       13       ID
*** FREE ***
       14       IT     2.0 19MAY92    0000      17
       15       IN     2.0 19MAY92    0000
       16       ID       0       0

       17       KK  STEP-1
       18       KM   INFLOW HYDROGRAPH TO BASIN D
       19       QI       0   40.58   81.17  121.75  162.34  202.92  202.92  202.92  202.92  202.92
       20       QI  202.92  162.34  121.75   81.17   40.58     0.1       0

       21       KK  STEP-2
       22       KM   MODIFIED PULS ROUTING THROUGH BASIN
       23       RS       1    ELEV   477.7
       24       SV       0   0.002   0.111   0.518   1.233   2.207
       25       SE   477.7   478.0   480.0   482.0   484.0   486.0
       26       SL  479.70   12.57     0.6     0.5 <-- 48"Ø PIPE @ IE El. 477.7 ℄ El. 479.7
       27       SS   483.5     8.5     3.0     1.5 <-- WEIR : 8.5 Ft. @ El. 483.5
       28       ZZ
```

****

FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616

****

```
                O'FALLON INDUSTRIAL CENTER
                STORMWATER DETENTION ANALYSIS     SOUTH BASIN
                (Bax Project No. 89-3102)


                MAY 19, 1992


                100 YEAR FREQUENCY STORM - 20 MINUTE DURATION


16 IO         OUTPUT CONTROL VARIABLES
                   IPRNT          0  PRINT CONTROL
                   IPLOT          0  PLOT CONTROL
                   QSCAL          0.  HYDROGRAPH PLOT SCALE

  IT          HYDROGRAPH TIME DATA
                    NMIN          2  MINUTES IN COMPUTATION INTERVAL
                   IDATE    19MAY92  STARTING DATE
                   ITIME       0000  STARTING TIME
                      NQ         17  NUMBER OF HYDROGRAPH ORDINATES
                  NDDATE    19MAY92  ENDING DATE
                  NDTIME       0032  ENDING TIME

               COMPUTATION INTERVAL     .03 HOURS
                    TOTAL TIME BASE     .53 HOURS

      ENGLISH UNITS


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


        **************
        *            *
 17 KK  *   STEP-1   *
        *            *
        **************
                  INFLOW HYDROGRAPH TO BASIN D

 15 IN          TIME DATA FOR INPUT TIME SERIES
                    JXMIN          2  TIME INTERVAL IN MINUTES
                   JXDATE    19MAY92  STARTING DATE
                   JXTIME          0  STARTING TIME

          SUBBASIN RUNOFF DATA

  0 BA          SUBBASIN CHARACTERISTICS
                    TAREA        .00  SUBBASIN AREA
```

***

HYDROGRAPH AT STATION STEP-1

DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW
19 MAY 0000	1	0.	19 MAY 0010	6	203.	19 MAY 0020	11	203.	19 MAY 0030	16	0.
19 MAY 0002	2	41.	19 MAY 0012	7	203.	19 MAY 0022	12	162.	19 MAY 0032	17	0.
19 MAY 0004	3	81.	19 MAY 0014	8	203.	19 MAY 0024	13	122.			
19 MAY 0006	4	122.	19 MAY 0016	9	203.	19 MAY 0026	14	81.			
19 MAY 0008	5	162.	19 MAY 0018	10	203.	19 MAY 0028	15	41.			

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
(CFS)	(HR)		6-HR	24-HR	72-HR	.53-HR
203.	.17	(CFS)	127.	127.	127.	127.
		(INCHES)	.000	.000	.000	.000
		(AC-FT)	6.	6.	6.	6.

CUMULATIVE AREA = .00 SQ MI

*** ***

```
          **************
          *            *
 21 KK    *   STEP-2   *
          *            *
          **************
                 MODIFIED PULS ROUTING THROUGH BASIN

            HYDROGRAPH ROUTING DATA

 23 RS        STORAGE ROUTING
                   NSTPS           1  NUMBER OF SUBREACHES
                    ITYP        ELEV  TYPE OF INITIAL CONDITION
                  RSVRIC      477.70  INITIAL CONDITION
                       X         .00  WORKING R AND D COEFFICIENT

 24 SV          STORAGE          .0         .0         .1         .5        1.2        2.2

 25 SE        ELEVATION      477.70     478.00     480.00     482.00     484.00     486.00

 26 SL        LOW-LEVEL OUTLET
                   ELEVL      479.70  ELEVATION AT CENTER OF OUTLET
                   CAREA       12.57  CROSS-SECTIONAL AREA
                    COQL         .60  COEFFICIENT
                    EXPL         .50  EXPONENT OF HEAD

 27 SS         SPILLWAY
                    CREL      483.50  SPILLWAY CREST ELEVATION
                   SPWID        8.50  SPILLWAY WIDTH
                    COQW        3.00  WEIR COEFFICIENT
                    EXPW        1.50  EXPONENT OF HEAD
```

***

COMPUTED OUTFLOW-ELEVATION DATA

OUTFLOW	.00	.00	52.08	[illegible]	86.85	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

OUTFLOW	125.73	130.82	137.63	146.40	157.33	170.68	186.65	205.48	227.39	252.62
ELEVATION	483.77	483.91	484.07	484.27	484.49	484.73	485.01	485.31	485.64	486.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	.00	.00	.09	.11	.42	.46	.50	.52	.57	.66
OUTFLOW	.00	.00	.00	33.13	82.08	85.80	89.68	91.73	94.37	99.32
ELEVATION	477.70	478.00	479.70	480.00	481.54	481.71	481.91	482.00	482.13	482.40

STORAGE	.77	.90	1.05	1.15	1.20	1.23	1.27	1.35	1.47	1.59
OUTFLOW	104.83	110.99	117.91	125.73	130.82	134.44	137.63	146.40	157.33	170.68
ELEVATION	482.70	483.07	483.50	483.77	483.91	484.00	484.07	484.27	484.49	484.73

STORAGE	1.72	1.87	2.03	2.21
OUTFLOW	186.65	205.48	227.39	252.62
ELEVATION	485.01	485.31	485.64	486.00

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 0. TO 65.
THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

****

HYDROGRAPH AT STATION STEP-2

****

DA MON HRMN ORD	OUTFLOW	STORAGE	STAGE	*	DA MON HRMN ORD	OUTFLOW	STORAGE	STAGE	*	DA MON HRMN ORD	OUTFLOW	STORAGE	STAGE
19 MAY 0000 1	0.	.0	477.7	*	19 MAY 0012 7	115.	1.0	483.3	*	19 MAY 0024 13	166.	1.6	484.7
19 MAY 0002 2	0.	.1	479.0	*	19 MAY 0014 8	131.	1.2	483.9	*	19 MAY 0026 14	150.	1.4	484.3
19 MAY 0004 3	42.	.2	480.3	*	19 MAY 0016 9	148.	1.4	484.3	*	19 MAY 0028 15	129.	1.2	483.9
19 MAY 0006 4	63.	.3	480.9	*	19 MAY 0018 10	162.	1.5	484.6	*	19 MAY 0030 16	111.	.9	483.1
19 MAY 0008 5	88.	.5	481.8	*	19 MAY 0020 11	173.	1.6	484.8	*	19 MAY 0032 17	97.	.6	482.3
19 MAY 0010 6	103.	.7	482.6	*	19 MAY 0022 12	176.	1.6	484.8	*				

← PEAK OUTFLOW

****

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
(CFS)	(HR)		6-HR	24-HR	72-HR	.53-HR
176.	.37	(CFS)	113.	113.	113.	113.
		(INCHES)	.000	.000	.000	.000
		(AC-FT)	5.	5.	5.	5.

PEAK STORAGE	TIME		MAXIMUM AVERAGE STORAGE			
(AC-FT)	(HR)		6-HR	24-HR	72-HR	.53-HR
2.	.37		1.	1.	1.	1.

PEAK STAGE	TIME		MAXIMUM AVERAGE STAGE			
(FEET)	(HR)		6-HR	24-HR	72-HR	.53-HR
484.82	.37		482.89	482.89	482.89	482.89

CUMULATIVE AREA = .00 SQ MI

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	STEP-1	203.	.17	127.	127.	127.	.00		
ROUTED TO	STEP-2	176.	.37	113.	113.	113.	.00	484.82	.37

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

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

           1       ID
           2       ID   O'FALLON INDUSTRIAL CENTER
           3       ID   STORMWATER DETENTION ANALYSIS     NORTH BASIN
           4       ID   (Bax Project No. 89-3102)
           5       ID
           6       ID
           7       ID   MAY 19, 1992
           8       ID
           9       ID
          10       ID   25 YEAR FREQUENCY STORM - 20 MINUTE DURATION
          11       ID
          12       ID
          13       ID
*** FREE ***
          14       IT     2.0 19MAY92    0000      16
          15       IN     2.0 19MAY92    0000
          16       IO       0       0

          17       KK  STEP-1
          18       KM   INFLOW HYDROGRAPH TO BASIN 0
          19       QI       0   69.12  138.23  207.35  276.46  276.46  276.46  276.46  276.46  276.46
          20       QI  276.46  207.35  138.23   69.12     0.1       0

          21       KK  STEP-2
          22       KM   MODIFIED PULS ROUTING THROUGH BASIN
          23       RS       1    ELEV   478.0
          24       SV       0    0.22    1.06
          25       SE   478.0   480.0   482.0
          26       SS   478.0     5.5     3.0     1.5 ← WEIR : 5.5 Ft. @ El. 478.0
          27       ZZ
```

```
                                             ****
                          FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM AT 512K VERSION) -FEB 1,1985
              U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616
                                             ****



                     O'FALLON INDUSTRIAL CENTER
                     STORMWATER DETENTION ANALYSIS     NORTH BASIN
                     (Bax Project No. 89-3102)


                     MAY 19, 1992


                     25 YEAR FREQUENCY STORM - 20 MINUTE DURATION



 16 IO        OUTPUT CONTROL VARIABLES
                  IPRNT          0  PRINT CONTROL
                  IPLOT          0  PLOT CONTROL
                  QSCAL         0.  HYDROGRAPH PLOT SCALE

    IT        HYDROGRAPH TIME DATA
                   NMIN          2  MINUTES IN COMPUTATION INTERVAL
                  IDATE    19MAY92  STARTING DATE
                  ITIME       0000  STARTING TIME
                     NO         16  NUMBER OF HYDROGRAPH ORDINATES
                 NDDATE    19MAY92  ENDING DATE
                 NDTIME       0030  ENDING TIME

               COMPUTATION INTERVAL     .03 HOURS
                    TOTAL TIME BASE     .50 HOURS

          ENGLISH UNITS



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


           **************
           *            *
 17 KK     *   STEP-1   *
           *            *
           **************
                      INFLOW HYDROGRAPH TO BASIN 0

 15 IN        TIME DATA FOR INPUT TIME SERIES
                  JXMIN          2  TIME INTERVAL IN MINUTES
                 JXDATE    19MAY92  STARTING DATE
                 JXTIME          0  STARTING TIME

             SUBBASIN RUNOFF DATA

  0 BA        SUBBASIN CHARACTERISTICS
                  TAREA        .00  SUBBASIN AREA

                                             ***
```

HYDROGRAPH AT STATION STEP-1

DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW
19 MAY 0000	1	0.	19 MAY 0006	5	276.	19 MAY 0012	9	276.	19 MAY 0024	13	138.
19 MAY 0002	2	69.	19 MAY 0010	6	276.	19 MAY 0018	10	276.	19 MAY 0026	14	69.
19 MAY 0004	3	138.	19 MAY 0012	7	276.	19 MAY 0020	11	276.	19 MAY 0028	15	0.
19 MAY 0006	4	207.	19 MAY 0014	8	276.	19 MAY 0022	12	207.	19 MAY 0030	16	0.

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	50-HR
276.	.13	(CFS)	184.	184.	184.	184.
		(INCHES)	.000	.000	.000	.000
		(AC-FT)	0.	0.	0.	0.

CUMULATIVE AREA = .00 SQ MI

*** ***

21 KK STEP-2

MODIFIED PULS ROUTING THROUGH BASIN

HYDROGRAPH ROUTING DATA

23 RS STORAGE ROUTING

NSTPS	1	NUMBER OF SUBREACHES
ITYP	ELEV	TYPE OF INITIAL CONDITION
RSVRIC	478.00	INITIAL CONDITION
X	.00	WORKING R AND D COEFFICIENT

24 SV STORAGE .0 .2 1.1

25 SE ELEVATION 478.00 480.00 482.00

26 SS SPILLWAY

CREL	478.00	SPILLWAY CREST ELEVATION
SPWID	5.50	SPILLWAY WIDTH
COQW	3.00	WEIR COEFFICIENT
EXPW	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

OUTFLOW	.00	.00	.02	.18	.61	1.45	2.83	4.89	7.76	11.59
ELEVATION	478.00	478.00	478.01	478.05	478.11	478.20	478.31	478.44	478.60	478.79
OUTFLOW	16.50	22.63	30.13	39.11	49.73	62.11	76.39	92.71	111.20	132.00
ELEVATION	479.00	479.23	479.49	479.78	480.09	480.42	480.78	481.16	481.57	482.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

	...	...	...	...	...	...	...	...	...	...
OUTFLOW	.00	.02	.18	.61	1.45	2.83	4.89	7.76	11.59	16.50
ELEVATION	478.00	478.01	478.05	478.11	478.20	478.31	478.44	478.60	478.79	479.00
STORAGE	.14	.16	.20	.22	.26	.40	.55	.71	.88	1.06
OUTFLOW	22.63	30.13	39.11	46.67	49.73	62.11	76.39	92.71	111.20	132.00
ELEVATION	479.23	479.49	479.78	480.00	480.09	480.42	480.78	481.16	481.57	482.00

****

HYDROGRAPH AT STATION STEP-2

****

DA MON HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA MON HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA MON HRMN	ORD	OUTFLOW	STORAGE	STAGE
19 MAY 0000	1	0.	.0	478.0	19 MAY 0012	7	194.	1.6	483.3	19 MAY 0024	13	229.	1.9	484.0
19 MAY 0002	2	10.	.1	478.7	19 MAY 0014	8	217.	1.8	483.8	19 MAY 0026	14	195.	1.6	483.3
19 MAY 0004	3	52.	.3	480.1	19 MAY 0016	9	233.	1.9	484.1	19 MAY 0028	15	151.	1.2	482.4
19 MAY 0006	4	79.	.6	480.8	19 MAY 0018	10	245.	2.0	484.3	19 MAY 0030	16	110.	.9	481.5
19 MAY 0008	5	121.	1.0	481.8	19 MAY 0020	11	253.	2.1	484.5					
19 MAY 0010	6	164.	1.3	482.7	19 MAY 0022	12	250.	2.1	484.5					

← PEAK OUTFLOW

****

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
(CFS)	(HR)		6-HR	24-HR	72-HR	.50-HR
253.	.33	(CFS)	163.	163.	163.	163.
		(INCHES)	.000	.000	.000	.000
		(AC-FT)	7.	7.	7.	7.

PEAK STORAGE	TIME		MAXIMUM AVERAGE STORAGE			
(AC-FT)	(HR)		6-HR	24-HR	72-HR	.50-HR
2.	.33		1.	1.	1.	1.

PEAK STAGE	TIME		MAXIMUM AVERAGE STAGE			
(FEET)	(HR)		6-HR	24-HR	72-HR	.50-HR
484.52	.33		482.54	482.54	482.54	482.54

CUMULATIVE AREA = .00 SQ MI

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	STEP-1	276.	.33	184.	184.	184.	.00		
ROUTED TO	STEP-2	253.	.33	183.	183.	183.	.00	484.52	.33

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

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

           1      ID
           2      ID   O'FALLON INDUSTRIAL CENTER
           3      ID   STORMWATER DETENTION ANALYSIS     NORTH BASIN
           4      ID   (Bax Project No. 89-3102)
           5      ID
           6      ID
           7      ID   MAY 19, 1992
           8      ID
           9      ID
          10      ID   100 YEAR FREQUENCY STORM - 20 MINUTE DURATION
          11      ID
          12      ID
          13      ID
*** FREE ***
          14      IT     2.0 19MAY92    0000      16
          15      IN     2.0 19MAY92    0000
          16      ID       0       0

          17      KK  STEP-1
          18      KM   INFLOW HYDROGRAPH TO BASIN D
          19      QI       0  127.32  254.64  381.96  509.28  509.28  509.28  509.28  509.28  509.28
          20      QI  509.28  381.96  254.64  127.32     0.1       0

          21      KK  STEP-2
          22      KM   MODIFIED PULS ROUTING THROUGH BASIN
          23      RS       1    ELEV   478.0
          24      SV       0    0.22    1.06
          25      SE   478.0   480.0   482.0
          26      SS   478.0     5.5     3.0     1.5 <-- WEIR : 5.5 Ft. @ El. 478.0
          27      ST   484.6    10.0     3.0     1.5 <-- WEIR : 10.0 Ft. @ El. 484.6
          28      ZZ
```

****

FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM X) 512K VERSION) -FEB 1,1985

U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616

****

O'FALLON INDUSTRIAL CENTER
STORMWATER DETENTION ANALYSIS   NORTH BASIN
(Bax Project No. 89-3102)

MAY 19, 1992

100 YEAR FREQUENCY STORM - 20 MINUTE DURATION

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

   IT         HYDROGRAPH TIME DATA
                    NMIN           2  MINUTES IN COMPUTATION INTERVAL
                   IDATE     19MAY92  STARTING DATE
                   ITIME        0000  STARTING TIME
                      NQ          16  NUMBER OF HYDROGRAPH ORDINATES
                  NDDATE     19MAY92  ENDING DATE
                  NDTIME        0030  ENDING TIME

               COMPUTATION INTERVAL     .03 HOURS
                    TOTAL TIME BASE     .50 HOURS

       ENGLISH UNITS
```

*** ***

```
          **************
          *            *
 17 KK    *   STEP-1   *
          *            *
          **************
                   INFLOW HYDROGRAPH TO BASIN D

 15 IN          TIME DATA FOR INPUT TIME SERIES
                    JXMIN           2  TIME INTERVAL IN MINUTES
                   JXDATE     19MAY92  STARTING DATE
                   JXTIME           0  STARTING TIME

            SUBBASIN RUNOFF DATA

  0 BA          SUBBASIN CHARACTERISTICS
                    TAREA         .00  SUBBASIN AREA
```

***

HYDROGRAPH AT STATION STEP-1

DA HON HRMN	ORD	FLOW	DA HON HRMN	ORD	FLOW	DA HON HRMN	ORD	FLOW	DA HON HRMN	ORD	FLOW
19 MAY 0000	1	0.	19 MAY 0008	5	509.	19 MAY 0016	9	509.	19 MAY 0024	13	255.
19 MAY 0002	2	127.	19 MAY 0010	6	509.	19 MAY 0018	10	509.	19 MAY 0026	14	127.
19 MAY 0004	3	255.	19 MAY 0012	7	509.	19 MAY 0020	11	509.	19 MAY 0028	15	0.
19 MAY 0006	4	382.	19 MAY 0014	8	509.	19 MAY 0022	12	382.	19 MAY 0030	16	0.

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	.30-HR
509.	.13	(CFS)	340.	340.	340.	340.
		(INCHES)	.000	.000	.000	.000
		(AC-FT)	14.	14.	14.	14.

CUMULATIVE AREA = .00 SQ MI

```
          **************
          *            *
21 KK     *   STEP-2   *
          *            *
          **************
                  MODIFIED PULS ROUTING THROUGH BASIN

             HYDROGRAPH ROUTING DATA

23 RS          STORAGE ROUTING
                    NSTPS          1  NUMBER OF SUBREACHES
                     ITYP       ELEV  TYPE OF INITIAL CONDITION
                    RSVRIC     478.00  INITIAL CONDITION
                        X        .00 WORKING R AND D COEFFICIENT

24 SV            STORAGE         .0       .2      1.1

25 SE          ELEVATION     478.00   480.00   482.00

26 SS          SPILLWAY
                     CREL     478.00  SPILLWAY CREST ELEVATION
                    SPWID       5.50  SPILLWAY WIDTH
                     COQW       3.00  WEIR COEFFICIENT
                     EXPW       1.50  EXPONENT OF HEAD

27 ST          TOP OF DAM
                    TOPEL     484.60  ELEVATION AT TOP OF DAM
                   DAMWID      10.00  DAM WIDTH
                     COQD       3.00  WEIR COEFFICIENT
                     EXPD       1.50  EXPONENT OF HEAD

                                  ***

                  COMPUTED OUTFLOW-ELEVATION DATA

                  (EXCLUDING FLOW OVER DAM)
```

OUTFLOW	16.50	22.63	30.13	39.11	49.73	62.11	76.34	92.71	111.20	132.00
ELEVATION	479.00	479.23	479.49	479.78	480.09	480.42	480.78	481.16	481.57	482.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	.00	.01	.01	.02	.03	.05	.07	.09	.11
OUTFLOW	.00	.02	.18	.61	1.45	2.83	4.89	7.76	11.59	16.50
ELEVATION	478.00	478.01	478.05	478.11	478.20	478.31	478.44	478.60	478.79	479.00
STORAGE	.14	.18	.20	.22	.26	.40	.55	.71	.88	1.06
OUTFLOW	22.63	30.13	39.11	46.67	49.73	62.11	76.34	92.71	111.20	132.00
ELEVATION	479.23	479.49	479.78	480.00	480.09	480.42	480.78	481.16	481.57	482.00

****

HYDROGRAPH AT STATION STEP-2

****

DA MON HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA MON HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA MON HRMN	ORD	OUTFLOW	STORAGE	STAGE
19 MAY 0000	1	0.	.0	478.0	19 MAY 0012	7	435.	2.8	486.1	19 MAY 0024	13	383.	2.6	485.7
19 MAY 0002	2	24.	.1	479.3	19 MAY 0014	8	479.	2.9	486.4	19 MAY 0026	14	288.	2.2	484.7
19 MAY 0004	3	75.	.5	480.7	19 MAY 0016	9	497.	3.0	486.6	19 MAY 0028	15	212.	1.7	483.5
19 MAY 0006	4	138.	1.1	482.1	19 MAY 0018	10	505.	3.0	486.6	19 MAY 0030	16	148.	1.2	482.3
19 MAY 0008	5	233.	1.8	483.8	19 MAY 0020	11	507.	3.0	486.6					
19 MAY 0010	6	342.	2.4	485.3	19 MAY 0022	12	470.	2.9	486.4					

PEAK OUTFLOW

****

PEAK OUTFLOW IS 507. AT TIME .33 HOURS

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	.50-HR
507.	.33	(CFS)	311.	311.	311.	311.
		(INCHES)	.000	.000	.000	.000
		(AC-FT)	13.	13.	13.	13.

PEAK STORAGE (AC-FT)	TIME (HR)	MAXIMUM AVERAGE STORAGE 6-HR	24-HR	72-HR	.50-HR
3.	.33	2.	2.	2.	2.

PEAK STAGE (FEET)	TIME (HR)	MAXIMUM AVERAGE STAGE 6-HR	24-HR	72-HR	.50-HR
486.65	.33	484.27	484.27	484.27	484.27

CUMULATIVE AREA = .00 SQ MI

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	STEP-1	509.	.13	340.	340.	340.	.00		
ROUTED TO	STEP-2	507.	.33	311.	311.	311.	.00	466.65	.33

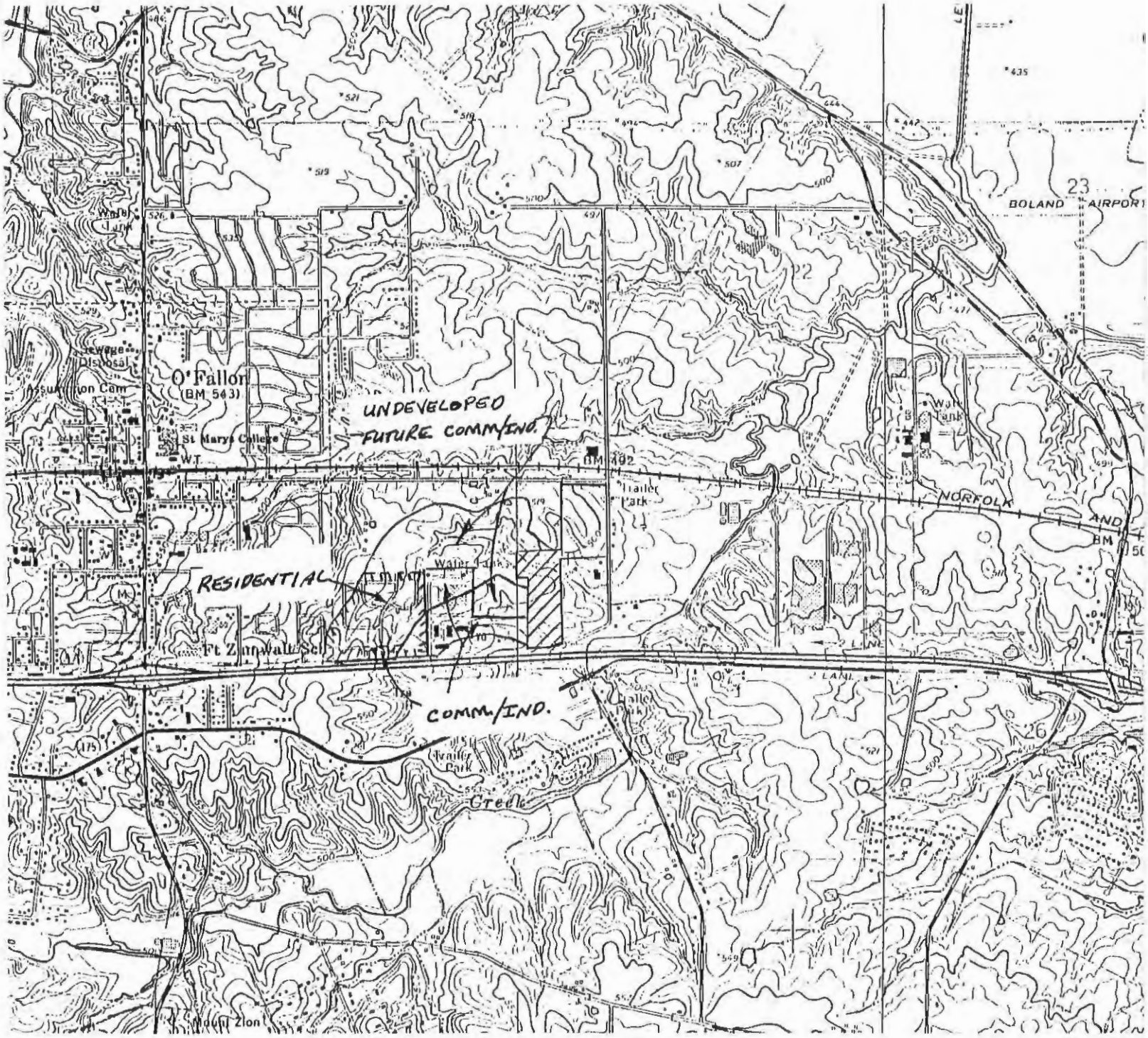
SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION STEP-2

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	478.00	478.00	484.50
STORAGE	0.	0.	2.
OUTFLOW	0.	0.	280.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	486.65	2.05	3.	507.	.30	.33	.00

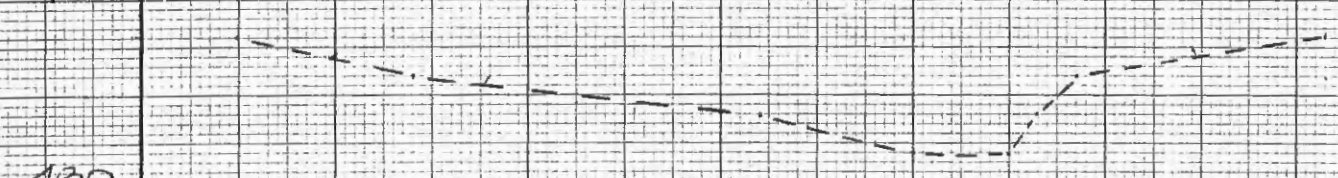
*** NORMAL END OF HEC-1 ***



OFFSITE DRAINAGE AREA MAP

SCALE: 1"=2000'

EXHIBIT 'G'
SHT. 1 OF 1



100 YEAR-20 MIN. STORM
Q= 509.28
n= 0.05
S= 0.0054'/Ft.
@ El. 487.0 A=112 Ft.²
R_h = 2.310
Q= 433.6 C.F.S.

CROSS SECTION OF CREEK
AT PROPERTY LINE
PRE-DEVELOPED CONDITIONS
(LOOKING DOWNSTREAM)

25 YEAR-20 MIN. STORM
Q = 36.20 + 105.62 + 111.09 - (5.5A² x 2.31)
= 240.21 C.F.S.

$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$
n = 0.05
S = 0.0054 '/Ft.

@ El. 486 A = 74 Ft.²
R_h = 2
Q = 256.5 C.F.S.

@ El 485.5 A = 56 Ft.²
R_h = 1.70
Q = 174.2 C.F.S.

∴ WHEN Q = 240.21 C.F.S. El. = 485.9

EXHIBIT 'C'
SH. 7 OF 7