



**Professional Engineering Consultants, P.A.**

# DRAINAGE PLAN

FOR

# CHADSWORTH PLAZA

**An Addition to Wichita  
Sedgwick County, Kansas**

PEC Project No. 36-01320-5206

February 2002

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WICHITA

TOPEKA

LAWRENCE

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## Section 1 -Introduction

This report addresses the surface drainage design for Chadsworth Plaza Addition. The subdivision is located east of Maize Road and north of 21<sup>st</sup> Street North in Wichita, Sedgwick County, Kansas.

It is immediately adjacent to and a contributing drainage area of the Pracht Wetland (Cadillac Lake).

A 1994 Report, "Hydraulic Study for Pracht Wetland" determined the maximum stage for the wetland to be NGVD elevation 1350.1. This report identified the subject property to be contributing to the basin, but not providing detention as it lies above the 1350.1 elevation.

A detention pond is proposed in the eastern 1/3<sup>rd</sup> of the subdivision that will be used to detain on-site drainage in excess of the pre-developed condition. A static pool elevation will be maintained at the natural overflow elevation of approximately 1347.8, the elevation of the property adjacent to the north.

A combined underground storm sewer and paved overland channel will convey on-site drainage into the retention pond. No off-site drainage enters the site.

Attachment A illustrates the proposed drainage improvements and the local drainage basin, the position of the proposed pond and the proposed outfall.

Sections within the report show the calculations for the proposed internal storm sewer system, street flow capacities, and inlet capacities. A section is also included for the presentation of pond hydraulic calculations.

## Section 2 - Storm Sewer Hydrology and Hydraulics

The plat map in the report jacket pocket illustrates the proposed drainage system and gives node numbers for each structure for correlation to the enclosed hydrologic and hydraulic summaries.

Sub basins 120 and 130 were analyzed for both the 100 and 2 year events with the pipes sized to accommodate the 2 year event.

Tailwater elevations at the outfall were assumed to be at elevation 1349.1, which is above the 100 year design water surface elevation for the "local" basin.

Although the pipe system will not accommodate the full 100 year event, surface overflow routing will be provided to convey the larger storm runoff into the pond.

Hydrology Data - Chadsworth Plaza Addition							2/4/02	
Basin	Area	C2	C100	Tc	i2	i100	Q2	Q100
120	1.01	0.62	0.83	15	3.83	7.37	2.40	6.18
130	2.45	0.62	0.83	15	3.83	7.37	5.82	14.99

Street Capacity					
Node	Area	Q2	T(1)	Q100	T(1)
130W	1.72	4.08	10'	10.52	15*
130E	0.73	1.73	7.5'	4.47	11'
120W	0.31	0.74	5.3'	1.90	7.5'
120E	0.70	1.66	7.5'	4.28	11'
130W(rev.)		4.08	10'	9.00	14'
120W(rev.)		0.74	5.3'	3.42	12'
130		5.81	10'	13.47	14'
120		2.40	5.3'	7.70	12'

(1) from Chart 3 - Street Flooded width - one side

\* More than 1/2 Roadway, Use Roadway Capacity & add overtop to 120W

Inlet Capacity						
node	Total Q2	Condition	D (d+2")	inlet capacity (2)	Q100	Depth Req
120	4.06	Sump	0.40'	7.8	10.27	0.50'
130	7.55	Sump	0.48'	7.8	13.47	1.30'

(2) Based upon 5' Type 1A, and curb depth flow

Berl.stm

100 j,	1349.1000	100	1	5	4				
110 t,	Chadsworth Plaza								
120 m,	100	1350.10							
130 m,	110	1350.10							
140 i,	120	0.80	1.00	0.00	0.00	5.82	15.00	1352.00	
145 i,	130	0.80	2.45	-0.00	0.00	2.40	15.00	1352.00	
150 p,	130	120	30.00	15	0.013	0.00	0.00		
160 p,	120	110	265.00	24	0.013	90.00	0.00		
165 p,	110	100	30.00	24	0.013	45.00	0.00		
180 e									

Date: 02-18-2002  
Time: 11:39:59

Input File: ber1.stm

Chadsworth Plaza

Storm Frequency = 2-Year

\* \* \* H Y D R O L O G Y \* \* \*

Tributary Area		Hydrology				Conduit Data											
Node	C	Area (Ac)	Slope (%)	Length (Ft)	TC (Min)	I (In/Hr)	Q (CFS)	TC (Min)	I (In/Hr)	Q (CFS)	Sum Q (CFS)	Size	Velocity (Ft/Sec)	Length (Ft)	TT (Min)	TT+TC (Min)	
130	120	.80	2.45	.00	.0	15.00	3.83	2.40	15.00	3.83	2.40	2.40	15"	1.96	30.00	.26	15.26
120	110	.80	1.00	.00	.0	15.00	3.83	5.82	15.00	3.83	5.82	8.18	24"	2.60	265.00	1.70	16.70
110	100	.00	.00	.00	.0	.00	.00	.00	16.70	3.64	.00	8.18	24"	2.60	30.00	.19	16.89

Date: 02-18-2002  
Time: 11:39:59

Input File: ber1.stm

Chadsworth Plaza

Storm Frequency = 2-Year

\* \* \* H Y D R A U L I C S \* \* \*

Node	Hyd-Slope (Ft/Ft)	Friction (Ft)	Bend (Ft)	Transition (Ft)	Manhole (Ft)	Deflection (Ft)	Junction (Ft)	Total (Ft)	Hyd-Gl Elevation	Desired Elevation	Diff.
100	.00000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	1349.1000	1350.1000	1.00
110	.00131	.0392	.0000	.0000	.0053	.0526	.0065	.1037	1349.2040	1350.1000	.90
120	.00131	.3465	.0000	.0046	.0000	.0000	.2432	.5943	1349.7980	1352.0000	2.20
130	.00138	.0414	.0000	.0000	.0000	.0000	.0000	.0414	1349.8390	1352.0000	2.16

□

Date: 02-18-2002  
Time: 13:30:28

Input File: ber2.stm

Chadsworth Plaza

Storm Frequency = 100-Year

\* \* \* H Y D R A U L I C S \* \* \*

Node	Hyd-Slope (Ft/Ft)	Friction (Ft)	Bend (Ft)	Transition (Ft)	Manhole (Ft)	Deflection (Ft)	Junction (Ft)	Total (Ft)	Hyd-Gl Elevation	Desired Elevation	Diff.
100	.00000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	1349.1000	1350.1000	1.00
110	-.00875	.2625	.0000	.0000	.0352	.3522	.0438	.6938	1349.7940	1350.1000	.31
120	-.00875	2.3186	.0000	.2333	.0000	.0000	.0550	2.6069	1352.4010	1352.0000	-.40
130	-.04348	1.3044	.0000	.0000	.0000	.0000	.0000	1.3044	1353.7050	1352.0000	-1.71

□

Date: 02-18-2002  
Time: 13:28:46

Input File: ber2.stm

Chadsworth Plaza

Storm Frequency = 100-Year

\* \* \* H Y D R O L O G Y \* \*

Node	C	Area (Ac)	Slope (%)	Length (Ft)	TC (Min)	I (0) (In/Hr)	Q(0) (CFS)	TC (Min) (In/Hr)	I (In/Hr)	Q (CFS)	Sum Q (CFS)	TC (Min)	Size (In)	Velocity (Ft/Sec)	Length (Ft)	TT (Min)	TT+TC (Min)
130	120	.80	2.45	.00	.0	15.00	7.37	13.47	15.00	7.37	13.47	13.47	15"	10.98	30.00	.05	15.05
120	110	.80	1.00	.00	.0	15.00	7.37	7.70	15.05	7.36	7.69	21.16	24"	6.74	265.00	.66	15.70
110	100	.00	.00	.00	.0	.00	.00	.00	15.70	7.23	.00	21.16	24"	6.74	30.00	.07	15.78

Circular water for all angular triangular cross sections are sets.

For use of gutter water. To for an equation:

(4)

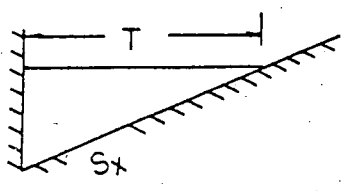
but view if

after part 3 used

(5)

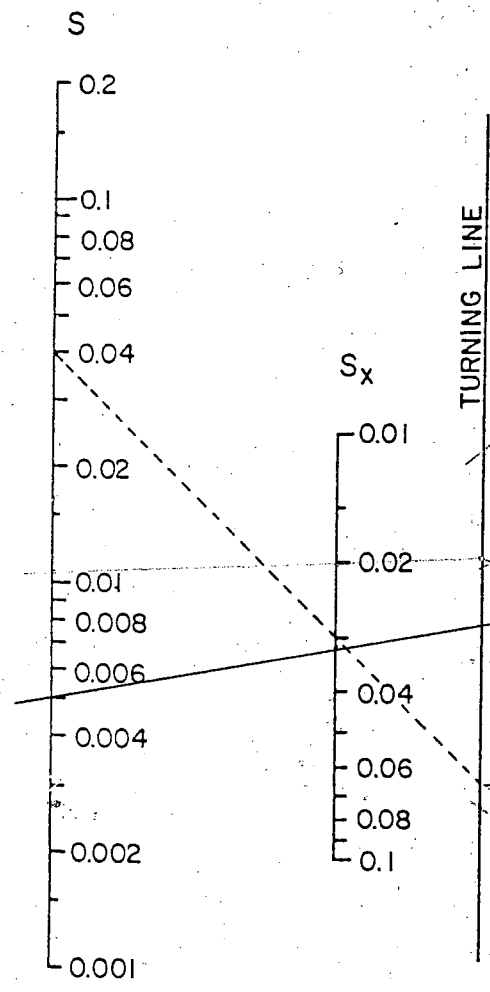
where the problem

form



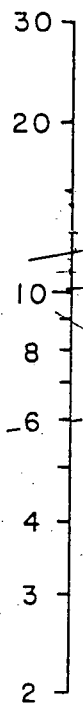
$$Q = \frac{0.56}{n} S_x^{1.67} S^{0.5} T^{2.67}$$

EXAMPLE: GIVEN:  
 $n=0.016$ ;  $S_x=0.03$   
 $S=0.04$ ;  $T=6$  FT  
 FIND:  
 $Q=2.4$  FT<sup>3</sup>/S  
 $Qn=0.038$  FT<sup>3</sup>/S

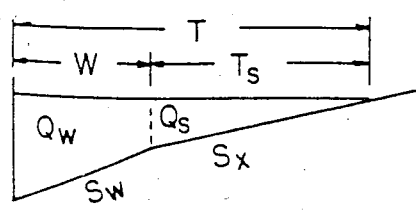
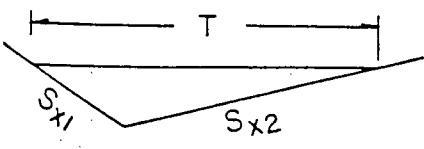
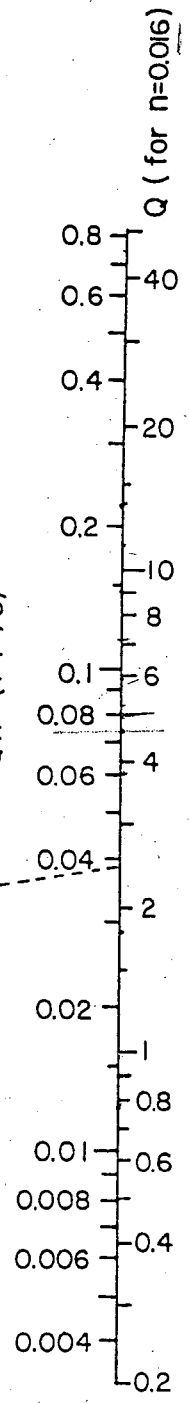


TURNING LINE

T (FT)



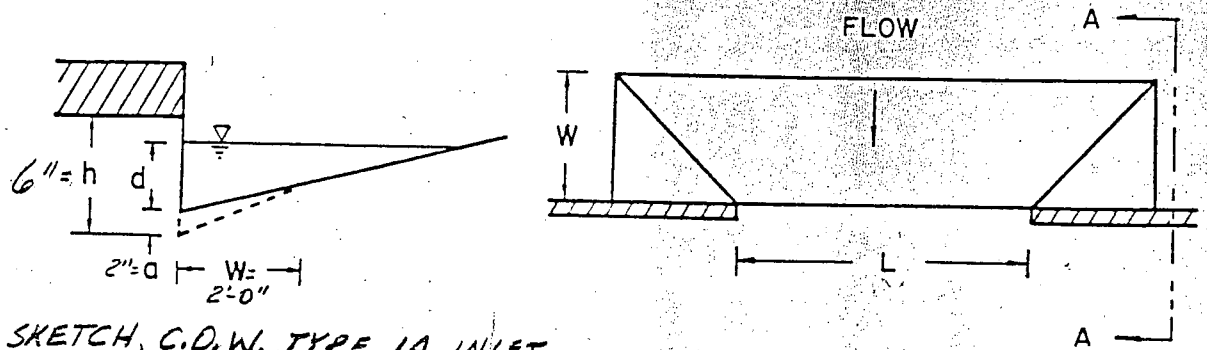
QN (FT<sup>3</sup>/S)



1) For V-Shape, use the nomograph with  $S_x = S_{x1} S_{x2} / (S_{x1} + S_{x2})$

2) To determine discharge in gutter with composite cross slopes, find  $Q_s$  using  $T_s$  and  $S_x$ . Then, use CHART 4 to find  $E_o$ . The total discharge is  $Q = Q_s / (1 - E_o)$ , and  $Q_w = Q - Q_s$ .

**CHART 3. Flow in triangular gutter sections.**



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

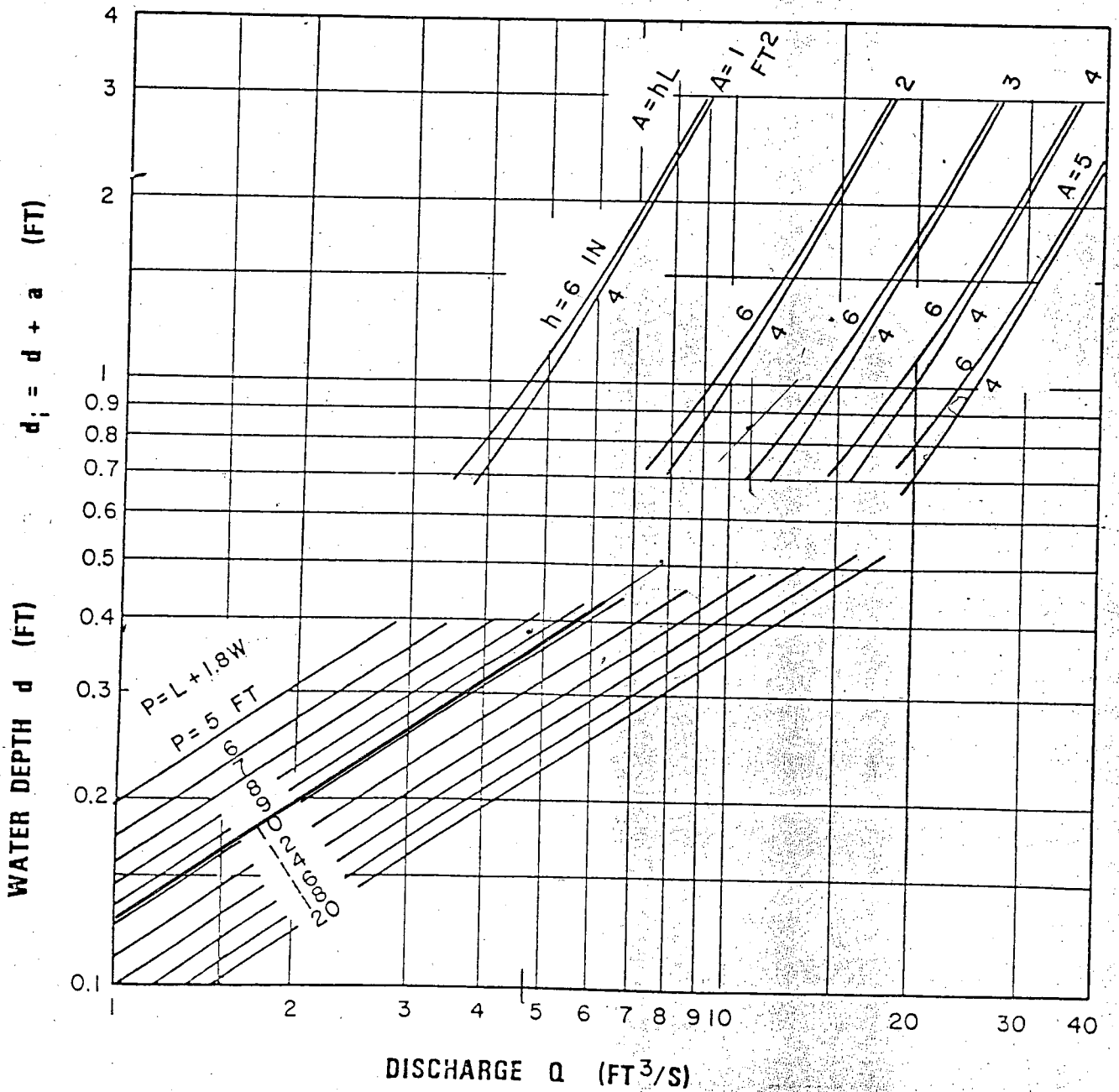


CHART 12. Depressed curb-opening inlet capacity in sump locations.

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

### Section 3 - Street Flows and Inlet Capacities

Both inlets are positioned in sumps, so the street capacity was reviewed based upon splitting flows by approach direction. The enclosed tabulation of results indicate that 5' curb inlets will have adequate. Roll curb will also have the required capacity to convey the 2 -year flows to the sumps, and the right-of-way will have sufficient capacity for the maximum design storm.

#### Section 4 - Pond Calculations

The proposed detention pond was designed to reduce the post-development flow rate to the pre-development rate during the 100 year "local" event. As stated in the introduction, the design storm for the Cadillac Basin will result in a design water surface elevation of 1350.1. Since the proposed pond is directly connected to Cadillac Lake and of insignificant size in comparison, it too will have a design water surface of 1350.1 during the design event. It reduces the local 100 year event flow from the pre-development Q of 16.07 cfs to a maximum discharge of 7 cfs.

Pre-development Hydrology								
Hydrology Data - Chadsworth Plaza Addition							2/4/02	
Basin	Area	C2	C100	Tc	i2	i100	Q2	Q100
120	1.01	0.28	0.63	15	3.83	7.37	1.08	4.69
130	2.45	0.28	0.63	15	3.83	7.37	2.63	11.38
Total							3.71	16.07

Post-development Hydrology								
Hydrology Data - Chadsworth Plaza Addition							2/4/02	
Basin	Area	C2	C100	Tc	i2	i100	Q2	Q100
120	1.01	0.62	0.83	15	3.83	7.37	2.40	6.18
130	2.45	0.62	0.83	15	3.83	7.37	5.82	14.99
Total							8.22	21.17

# Chadsworth Plaza - Pre and Post Developed Conditions - 2 and 100 Year Storms

```
*****  
*  
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *  
* FEBRUARY 1981 *  
* REVISED 02 AUG 88 *  
*  
* RUN DATE 02/25/2002 TIME 10:44:27 *  
*  
*****
```

```
*****  
*  
* U.S. ARMY CORPS OF ENGINEERS *  
* THE HYDROLOGIC ENGINEERING CENTER *  
* 609 SECOND STREET *  
* DAVIS, CALIFORNIA 95616 *  
* (916) 551-1748 *  
*  
*****
```

```
X X XXXXXX XXXX X  
X X X X X XX  
X X X X X  
XXXXXX XXXX X XXXX X  
X X X X X  
X X X X X  
X X XXXXXX XXXX XXX
```

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 -AMSK- 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

# Chadsworth Plaza - Pre and Post Developed Conditions - 2 and 100 Year Storms

HEC-1 INPUT

PAGE 1

```

LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
1         ID      HEC-1 ANALYSIS FOR CHADSWORTH PLAZA
2         ID      EXISTING AND PROPOSED CONDITIONS
3         ID      2 AND 100-YEAR STORMS

*** LIST ***
*** FREE ***

      *DIAGRAM
4         IT      15 01JAN02   1200       0 02JAN02   2000
5         IN      15 01JAN02   1200
6         IO      0          5
7         JR      PREC   3.5     7.8
      *
      *
      *

8         KK      UNDEV
9         KO      5
10        BA      0.0073
11        PB      1.00
12        PC      0.000   0.003   0.006   0.008   0.011   0.014   0.017   0.019   0.022   0.025
13        PC      0.029   0.032   0.035   0.038   0.042   0.045   0.048   0.052   0.056   0.060
14        PC      0.064   0.068   0.072   0.076   0.080   0.085   0.090   0.095   0.100   0.105
15        PC      0.110   0.115   0.120   0.127   0.134   0.140   0.147   0.155   0.163   0.172
16        PC      0.181   0.193   0.204   0.220   0.235   0.259   0.283   0.387   0.663   0.699
17        PC      0.735   0.754   0.772   0.786   0.799   0.810   0.820   0.828   0.835   0.843
18        PC      0.850   0.858   0.865   0.873   0.880   0.885   0.889   0.894   0.898   0.903
19        PC      0.907   0.912   0.916   0.921   0.925   0.929   0.934   0.938   0.943   0.947
20        PC      0.952   0.955   0.958   0.961   0.964   0.967   0.970   0.973   0.976   0.979
21        PC      0.982   0.985   0.988   0.991   0.994   0.997   1.000
22        LS      0          72          0
23        UD      0.150
      *

24        KK      DEV
25        KO      5
26        BA      0.0073
27        PB      1.00
28        PC      0.000   0.003   0.006   0.008   0.011   0.014   0.017   0.019   0.022   0.025
29        PC      0.029   0.032   0.035   0.038   0.042   0.045   0.048   0.052   0.056   0.060
30        PC      0.064   0.068   0.072   0.076   0.080   0.085   0.090   0.095   0.100   0.105
31        PC      0.110   0.115   0.120   0.127   0.134   0.140   0.147   0.155   0.163   0.172
32        PC      0.181   0.193   0.204   0.220   0.235   0.259   0.283   0.387   0.663   0.699
33        PC      0.735   0.754   0.772   0.786   0.799   0.810   0.820   0.828   0.835   0.843
34        PC      0.850   0.858   0.865   0.873   0.880   0.885   0.889   0.894   0.898   0.903
35        PC      0.907   0.912   0.916   0.921   0.925   0.929   0.934   0.938   0.943   0.947
36        PC      0.952   0.955   0.958   0.961   0.964   0.967   0.970   0.973   0.976   0.979
37        PC      0.982   0.985   0.988   0.991   0.994   0.997   1.000
38        LS      0          72          60
39        UD      0.150
      *
    
```

# Chadsworth Plaza - Pre and Post Developed Conditions - 2 and 100 Year Storms

HEC-1 INPUT

PAGE 2

LINE	ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
40	KK POND-1
41	KO 5
42	RS 1 ELEV 1347.7
43	SA 0.00 0.83 1.00
44	SE 1347.7 1347.8 1350.0
45	SQ 0 2 4 6 8 10 12 14
46	SE 1347.7 1348.07 1348.40 1348.71 1349.01 1349.31 1349.61 1349.90
	*
	*
47	ZZ

# Chadsworth Plaza - Pre and Post Developed Conditions - 2 and 100 Year Storms

## SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT	(V) ROUTING	(--->) DIVERSION OR PUMP FLOW
LINE		
NO.	(.) CONNECTOR	(<---) RETURN OF DIVERTED OR PUMPED FLOW
8	UNDEV	
	.	
24	.	DEV
	.	V
	.	V
40	.	POND-1

(\*\*\*) RUNOFF ALSO COMPUTED AT THIS LOCATION

# Chadsworth Plaza - Pre and Post Developed Conditions - 2 and 100 Year Storms

```
*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* FEBRUARY 1981
* REVISED 02 AUG 88
*
* RUN DATE 02/25/2002 TIME 10:44:27
*
*****
```

```
*****
*
* U.S. ARMY CORPS OF ENGINEERS
* THE HYDROLOGIC ENGINEERING CENTER
* 609 SECOND STREET
* DAVIS, CALIFORNIA 95616
* (916) 551-1748
*
*****
```

HEC-1 ANALYSIS FOR CHADSWORTH PLAZA  
EXISTING AND PROPOSED CONDITIONS  
2 AND 100-YEAR STORMS

```
6 IO      OUTPUT CONTROL VARIABLES
          IPRNT      0 PRINT CONTROL
          IPLOT      5 PLOT CONTROL
          QSCAL      0. HYDROGRAPH PLOT SCALE

IT        HYDROGRAPH TIME DATA
          NMIN      15 MINUTES IN COMPUTATION INTERVAL
          IDATE     1JAN 2 STARTING DATE
          ITIME     1200 STARTING TIME
          NQ        129 NUMBER OF HYDROGRAPH ORDINATES
          NDDATE    2JAN 2 ENDING DATE
          NDTIME    2000 ENDING TIME
          ICENT     19 CENTURY MARK

          COMPUTATION INTERVAL .25 HOURS
          TOTAL TIME BASE 32.00 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
          3.50      7.80
```

\*\*\*\*\*

```
*****
*
*
8 KK      * UNDEV *
*
*****
```

```
9 KO      OUTPUT CONTROL VARIABLES
          IPRNT      5 PRINT CONTROL
          IPLOT      5 PLOT CONTROL
          QSCAL      0. HYDROGRAPH PLOT SCALE
```

\*\*\*\*\*

```
*****
*
*
24 KK     * DEV *
*
*****
```

```
25 KO     OUTPUT CONTROL VARIABLES
          IPRNT      5 PRINT CONTROL
```

Chadsworth Plaza - Pre and Post Developed Conditions - 2 and 100 Year Storms

IPL0T 5 PLOT CONTROL  
QSCAL 0. HYDROGRAPH PLOT SCALE

\*\*\* \*\*

\*\*\*\*\*  
\* \*  
40 KK \* POND-1 \*  
\* \*  
\*\*\*\*\*

41 KO OUTPUT CONTROL VARIABLES  
IPRNT 5 PRINT CONTROL  
IPL0T 5 PLOT CONTROL  
QSCAL 0. HYDROGRAPH PLOT SCALE

# Chadsworth Plaza - Pre and Post Developed Conditions - 2 and 100 Year Storms

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

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO PRECIPITATION	
				RATIO 1	RATIO 2
				3.50	7.80
HYDROGRAPH AT					
+	UNDEV	.01	1	FLOW	5.
				TIME	21.
				12.00	12.00
HYDROGRAPH AT					
+	DEV	.01	1	FLOW	10.
				TIME	27.
				12.00	12.00
ROUTED TO					
+	POND-1	.01	1	FLOW	3.
				TIME	7.
				12.50	12.50
** PEAK STAGES IN FEET **					
			1	STAGE	1348.16
				TIME	1348.83
				12.50	12.50

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

*Rating Curve for  
15' Weir*

Elev.	Q	B	q	Yc	E	WSEL
1347.70	0	15.000	0.000	0.000	0.000	1347.70
1347.95	2	15.000	0.133	0.082	0.123	1348.07
1348.20	4	15.000	0.267	0.130	0.195	1348.40
1348.45	6	15.000	0.400	0.171	0.256	1348.71
1348.70	8	15.000	0.533	0.207	0.310	1349.01
1348.95	10	15.000	0.667	0.240	0.360	1349.31
1349.20	12	15.000	0.800	0.271	0.406	1349.61
1349.45	14	15.000	0.933	0.300	0.450	1349.90
1349.70	16	15.000	1.067	0.328	0.492	1350.19
1349.95	18	15.000	1.200	0.355	0.532	1350.48