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DRAINAGE REPORT
for the
SUPERSTITION FREEWAY

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DRAINAGE REPORT
for the
SUPERSTITION FREEWAY
(Val Vista to Power Road Section)
F-028-1-420 PE

Registered Professional Engineer (Civil)
CERTIFICATE NO.
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RAYMOND W.
STADLER
Date Signed 8/31/82
ARIZONA, U.S.A.

Ray's Residence
245-0505

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INTRODUCTION

DRAINAGE REPORT

for the

SUPERSTITION FREEWAY

(Val Vista to Power Road Section)

INTRODUCTION

The following report will investigate both the onsite and offsite drainage which affects the Val Vista to Power Road Section of the Superstition Freeway. The data obtained in the above mentioned investigation will be used to design a storm drain system to effectively collect and dispose of the anticipated runoff from a 50-year Storm.

The freeway section under considerstion in this report is situated in Southeasterly portion of the City of Mesa approximately one half mile North of and parallel to Baseline Road. The proposed roadway will be predominently depressed however it will be become elevated to cross the Eastern Canal and Greenfield Road, and to cross the Roosevelt Water Conservation District (RWCD) Canal and the proposed RWCD Floodway.

The freeway right of way is flat agricultural land having a gentle slope to the Southwest of approximately 0.5 percent.

PART II - OFFSITE DRAINAGE

INTRODUCTION

PART II - OFFSITE DRAINAGE

INTRODUCTION

The offsite drainage affecting the Val Vista to Power Road section of the Superstition Freeway is separated into two sections divided by the Roosevelt Water Conservation District (RWCD) Canal. West of the RWCD Canal the design will follow the recommendations presented in Yost and Gardner Engineers' report titled Superstition Freeway, Conceptual Study for Drainage (Tempe Canal - RWCD Canal) (Feb 1975).

East of the RWCD Canal the offsite drainage will be analyzed using a study done by the Soil Conservation Service for the design of the RWCD Floodway to be located on the east side of the RWCD Canal. The analysis was revised to reflect changes in existing conditions within the drainage areas. A more detailed explanation of the criteria and methods used for this analysis will be presented in a subsequent section of this report.

The drainage design for both East and West of the RWCD Canal will incorporate a channel along the north side of the freeway to intercept the anticipated runoff. The channel west of the RWCD Canal will connect to an existing channel on the previous section of the freeway. The channel east of the RWCD Canal will outlet into the proposed RWCD Floodway.

OFFSITE DRAINAGE:
VAL VISTA DRIVE TO RWCD CANAL

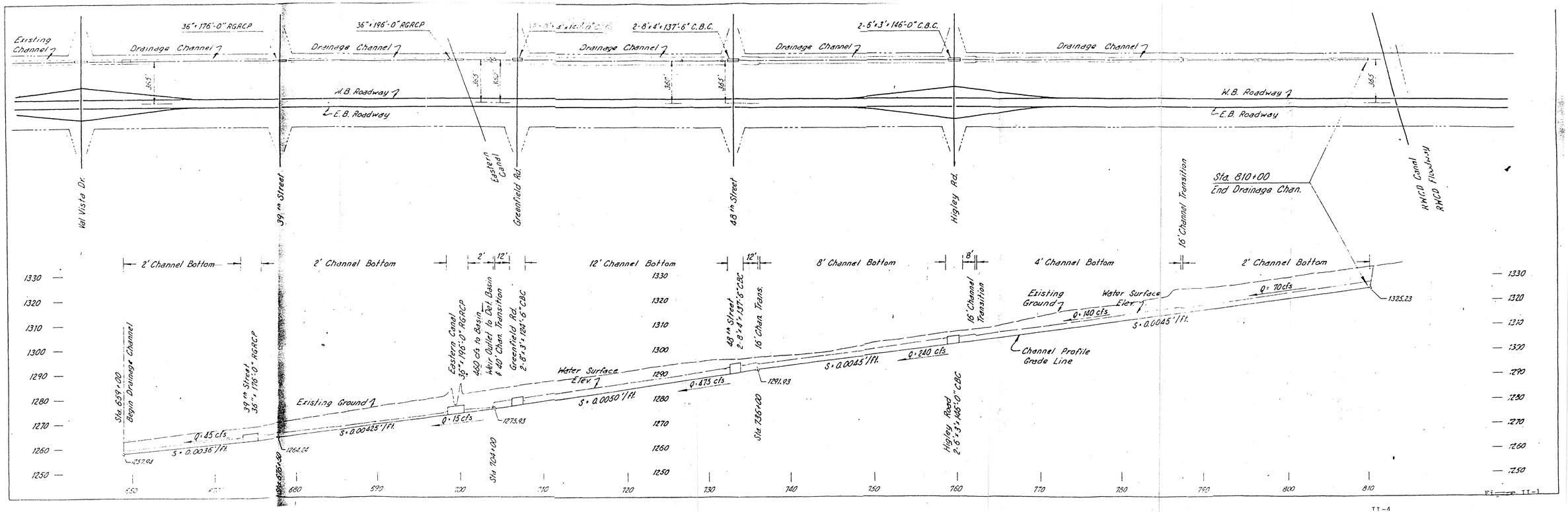
OFFSITE DRAINAGE - SUPERSTITION FREEWAY

VAL VISTA DRIVE TO RWCD CANAL

The offsite drainage affecting the Val Vista Drive to RWCD Canal portion of the Superstition Freeway was analyzed in the Yost and Gardner Report mentioned above. The report recommended the construction of a concrete lined trapezoidal channel along the north side of the freeway to intercept the anticipated runoff and dispose of it to the west. In conjunction with the channel a retention basin in the vicinity of Greenfield Road with a side wier outlet from the channel to the basin is also proposed. The retention basin will be built by the City of Mesa and the wier outlet will be placed in the channel to suit the final retention basin location.

The Yost and Gardner Report also makes recommendation for culvert crossings under the Eastern Canal, Greenfield Road, and Higley Road. Required culvert crossings at 39th Street and 48th Street which were not provided for in the Yost and Gardner report are designed in this report.

The recommended concrete lined channel is trapezoidal with 2:1 side slopes. The following list is the recommended channel as per the Yost and Gardner Report.



Existing Channel
Drainage Channel
36" x 176'-0" RGRCP
36" x 196'-0" RGRCP
2-8'x4'x137'-6" C.B.C.
2-6'x3'x146'-0" C.B.C.
W.B. Roadway
E.B. Roadway
Val Vista Dr.
39th Street
Eastern Canal
Greenfield Rd.
48th Street
Higley Rd.
16' Channel Transition
Sta. 810+00
End Drainage Chan.
RWCD Canal
RWCD Floodway
2' Channel Bottom
12' Channel Bottom
8' Channel Bottom
4' Channel Bottom
Sta. 659+00
Begin Drainage Channel
39th Street
36" x 176'-0" RGRCP
Eastern Canal
36" x 196'-0" RGRCP
460 cfs to Basin
Weir Outlet to Det. Basin
& 40' Chan. Transition
Greenfield Rd.
2-8'x3'x124'-6" CBC
48th Street
2-8'x4'x137'-6" CBC
16' Chan. Trans.
16' Channel Transition
Existing Ground
Water Surface Elev.
Channel Profile Grade Line
Q = 45 cfs
S = 0.0036'/ft.
Q = 15 cfs
S = 0.00425'/ft.
Q = 475 cfs
S = 0.0050'/ft.
Q = 240 cfs
S = 0.0045'/ft.
Q = 140 cfs
S = 0.0045'/ft.
Q = 70 cfs
1257.94
1264.24
1275.93
1291.93
1325.23
Sta. 676+50
Sta. 704+00
Sta. 736+00
Higley Road
2-6'x3'x146'-0" CBC
1330
1320
1310
1300
1290
1280
1270
1260
1250
680
690
700
710
720
730
740
750
760
770
780
790
800
810

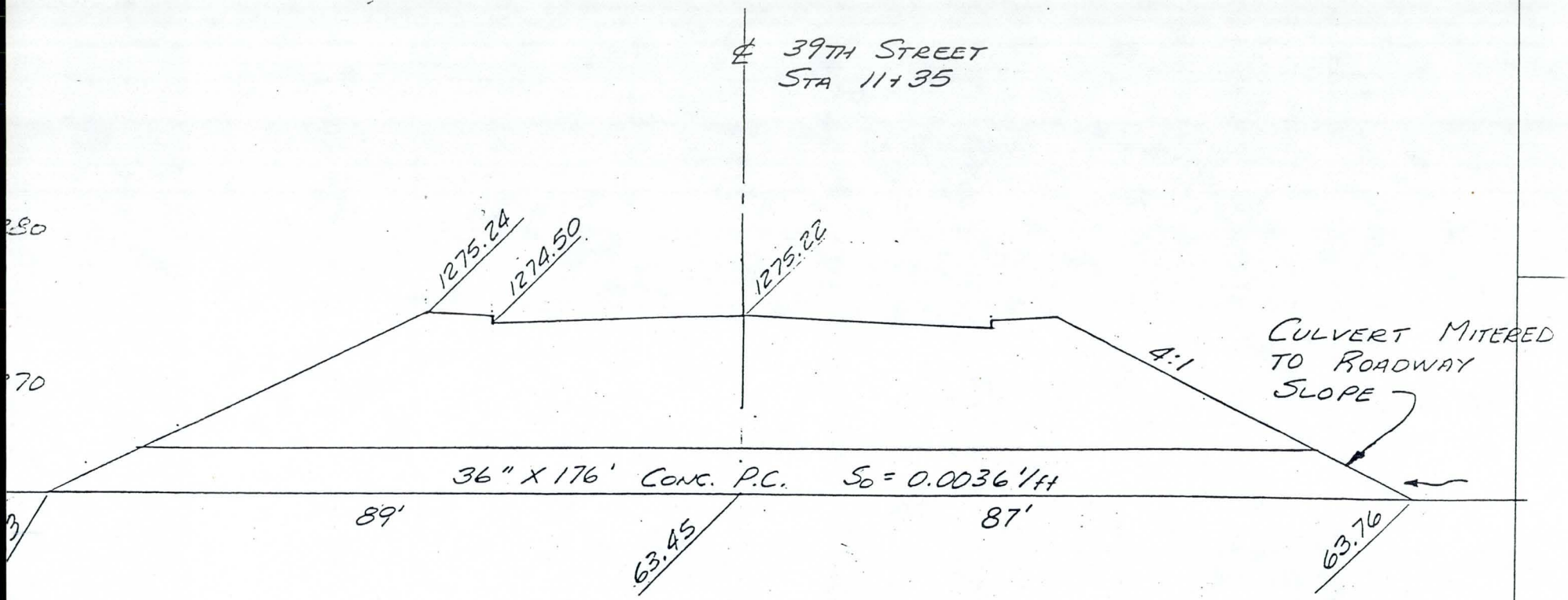
Figure II-1

Channel Location	Bottom Width	Slope
RWCD Canal to 1/2 mile west Q = 70 cfs	2.0'	0.005 ft/ft
1/2 mile west to Higley Road Q = 140 cfs	4.0'	0.005 ft/ft
Higley Road to 1/2 mile west Q = 240 cfs	8.0'	0.005 ft/ft
1/2 mile west to Greenfield Road Q = 475 cfs	12.0'	0.005 ft/ft
Eastern Canal to 40th Street Q = 15 cfs	2.0'	0.005 ft/ft
40th Street to Val Vista Drive Q = 45 cfs	2.0'	0.0036 ft/ft

The recommended culvert crossings are as follows:

Higley Road	2 - 6' x 3' Conc. Box Culverts	Q = 240 cfs
Greenfield Road	2 - 8' x 4' Conc. Box Culverts	Q = 475 cfs
Eastern Canal	36" Conc. Pipe Culvert	Q = 15 cfs

The final channel and culvert design as shown in the Channel Profile (Fig. II-1) was analyzed using the HEC-2 Water Surface Profile program developed by the Corps of Engineers. The computed water surface profile is plotted on the channel profile. A copy of the HEC-2 printout is included in Appendix I.



CULVERT PROFILE

39TH STREET CROSSING DESIGN

ARIZONA HIGHWAY DEPARTMENT

CULVERT COMPUTATION SHEET

PROJECT: SUPERSTITION FREEWAY (VAL VISTA - POWER RD)

DESIGNER: R.W.S.

STATION: 39TH STREET

DATE: 5/81

HYDROLOGIC AND CHANNEL INFORMATION

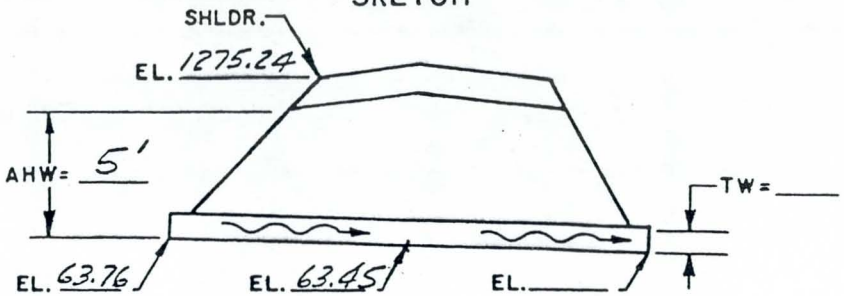
DRAINAGE AREA _____

Q_1 = 45 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50})

SKETCH



S_0 = 0.0036 L = 176' L/100 S_0 = _____

MEAN STREAM VELOCITY = _____

CULVERT DESCRIPTION		Q	CAP. CHART HW	HEADWATER COMPUTATION										CONTROL HW	OUTLET VELOCITY	COST	DHW ELEV.	COMMENTS
				INLET CONT.		OUTLET CONTROL $HW = H + h_0 - LS_0$												
SIZE	ENTR. TYPE	CFS		$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c + D}{2}$	TW	h_0	LS_0	HW					
42"		45		0.92	3.22	0.7	0.83	2.1	2.8	1.6	2.8	0.63	3.00					
36"		45		1.23	3.69	0.7	1.6	2.2	2.6	1.6	2.6	0.63	3.57					

SUMMARY & RECOMMENDATIONS

USE 36" CONC. PIPE CULVERT

HD 20-050 12-69

SIDE OUTLET WIER

A SIDE OUTLET WIER IS REQUIRED WEST OF GREENFIELD ROAD TO DISCHARGE FLOW INTERCEPTED BY THE DRAINAGE CHANNEL ALONG THE NORTH SIDE OF THE FREEWAY, INTO A PROPOSED RETENTION BASIN NORTH OF THE FREEWAY RIGHT OF WAY. THE PROPOSED RETENTION BASIN WILL BE CONSTRUCTED BY THE CITY OF MESA AT A SITE LYING BETWEEN GREENFIELD ROAD AND THE EASTERN CANAL. THE SIDE OUTLET WIER WILL BE CONSTRUCTED TO THE RIGHT OF WAY LINE AS PART OF THE SUPERSTITION FREEWAY CONSTRUCTION EFFORT.

THE SIDE OUTLET WIER WILL CONSIST OF A CHANNEL BLOCK TO POND THE FLOW AND BROAD CRESTED WIER CONSTRUCTED THROUGH THE NORTH CHANNEL LINING. THE CHANNEL BLOCK WILL BE CONSTRUCTED WITH AN OPENING AT THE BOTTOM SIZED TO ALLOW AN ACCEPTABLE FLOWBY DURING PEAK RUNOFF AND A PUMPING RATE THAT WILL EMPTY THE RETENTION BASIN IN LESS THAN ONE WEEK. ALSO THE OPENING WILL ALLOW NUISANCE FLOWS TO PASS DOWNSTREAM UNINTERRUPTED.

SUPERSTITION FREEWAY

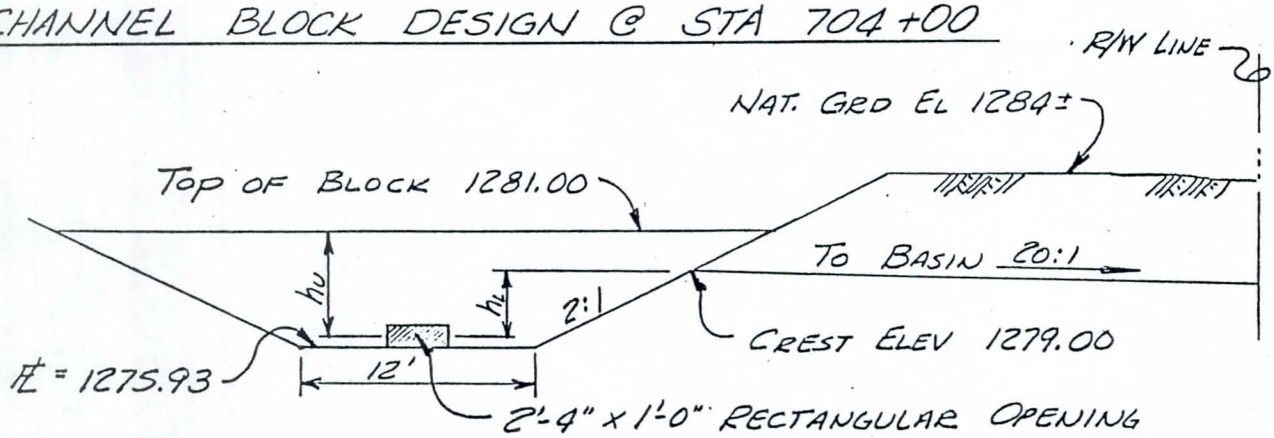
CHANNEL BLOCK DESIGN
RETENTION BASIN 11
(EAST OF EASTERN CANAL)

THE FLOWBY LIMITS DETERMINED IN PREVIOUS STUDIES RELATIVE TO THE SUPERSTITION FREEWAY CHANNEL AND RETENTION BASIN NETWORK WEST OF THE RWCD CANAL ARE AS FOLLOWS:

UPPER LIMIT = 24 CFS
LOWER LIMIT = 6 CFS

THE UPPER LIMIT REPRESENTS MAXIMUM ALLOWABLE FLOW THROUGH THE BLOCK OPENING WHEN THE SIDE WIER IS OPERATING AT PEAK FLOW. THE LOWER LIMIT REPRESENTS MINIMUM DESIRED FLOW WHEN THE PONDED DEPTH BEHIND THE CHANNEL BLOCK IS AT THE CREST OF THE SIDE WIER.

CHANNEL BLOCK DESIGN @ STA 704+00



DISCHARGE CALCULATIONS THRU 2'-4" x 1'-0" RECTANGULAR OPENING

$$Q = Ca\sqrt{2gh}$$

$C = 0.6$
$a = 2.33\ ft^2$
$h \begin{cases} h_u = 81 - 76.43 = 4.57 \\ h_L = 79 - 76.43 = 2.57 \end{cases}$

LOWER LIMIT

$$Q = 0.6(2.33)\sqrt{2(32.2)2.57} = 13.1\ CFS > 6\ OK$$

UPPER LIMIT

SUPERSTITION FREEWAY

SIDE WIER DESIGN
OUTLET TO RETENTION BASIN 1
(EAST OF EASTERN CHANNEL)

FOR A BROAD CRESTED WIER WITH ROUNDED UPSTREAM CORNER, 2:1 INCLINED UPSTREAM FACE AND 20:1 DOWNSTREAM SLOPE THE WIER COEFFICIENT $C = 3.4$ (FROM KINGS HANDBOOK)

USE AN 87% DRAWDOWN OVER WIER CREST FROM MAIN CHANNEL DEPTH OF FLOW

ADJUSTING C-VALUE FOR DRAWDOWN AND FROUDE NO.

$$C = \frac{3.4}{(.87)^{3/2}} - \frac{1.81\, y_c}{y_1}$$

WHERE y_c & y_1 ARE JUST UPSTREAM OF WIER

$Q = 530$
$S_o = 0.005$
$n = 0.014$

$y_c = 3.25$

$y_1 = (1281.00 - 1276.60) = 4.4'$

$$C = \frac{3.4}{(0.87)^{3/2}} - \frac{1.81(3.25)}{4.40} = 2.85$$

WEIR LENGTH

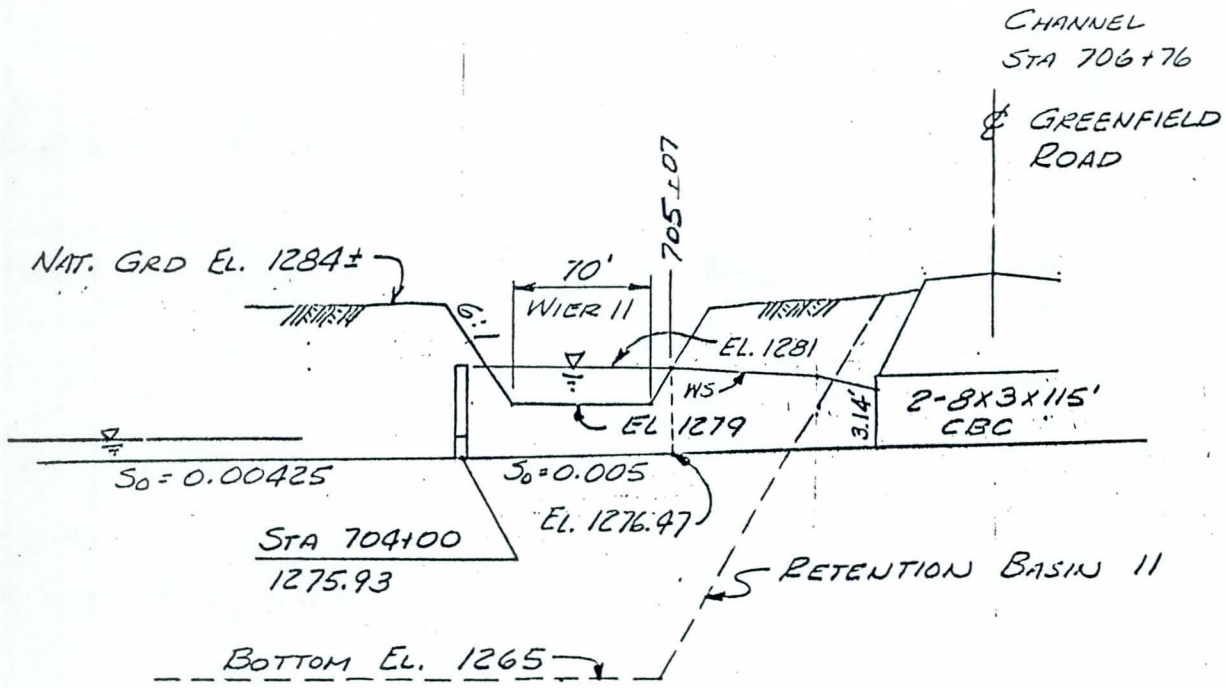
$Q = CLH^{3/2}$

$C = 2.85$
$H = 2.0'$
$Q_{IN} = 530$ CFS

$$L = \frac{Q}{CH^{3/2}} = \frac{530}{2.85(2)^{3/2}} = 65.75 \text{ FT}$$

$\therefore$ USE $L = 70'$

SUPERSTITION FREEWAY
SIDE WIER DESIGN



CHANNEL PROFILE

THE CHANNEL BLOCK OPENNING WILL DISCHARGE THE MAXIMUM ALLOWABLE 24 CFS WHEN THE PEAK FLOW OF 530 CFS IS BEING DISCHARGED THROUGH THE SIDE WIER TO THE RETENTION BASIN. THEREFORE THE RETENTION BASIN DESIGN CAPACITY (76 AC-FT) WILL NOT BE EXCEEDED FOR THE ANTICIPATED 50-YEAR RUNOFF.

BACKWATER

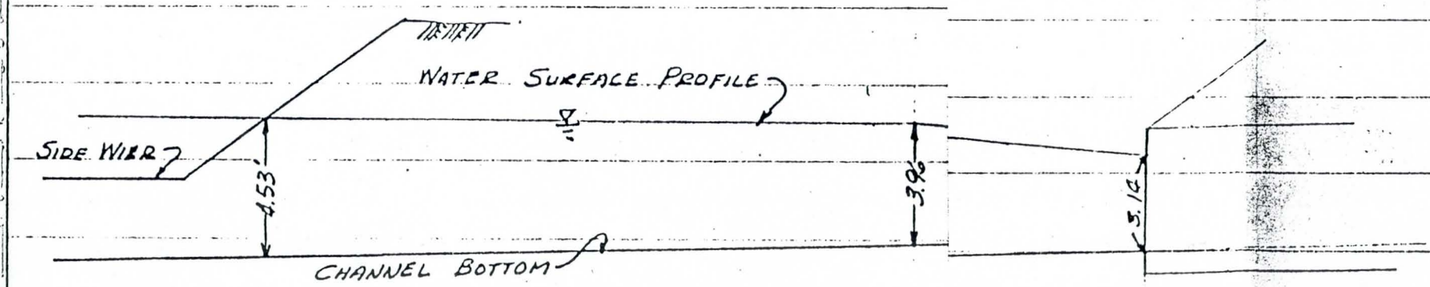
THE FOLLOWING COMPUTER PRINT OUT TABULATES THE WATER SURFACE PROFILE (CWSEL) EXTENDING FROM THE SIDE WIER TO THE OUTLET OF THE GREENFIELD ROAD STRUCTURE, RESULTING FROM THE CHANNEL BLOCK AND WIER INSTALLATION.

GREENFIEL BACKWATER

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q		CWSEL	CRIWS	EG	10K*S	VCH	AREA	.01K
	70507.000	0.0	0.0	0.0	1276.47	530	.00	1281.00	0.0	1281.48	6.47	5.56	95.28	208.41
	70591.000	84.00	0.0	0.0	1276.89	530	.00	1280.85	0.0	1281.55	10.84	6.71	79.03	161.01
*	70621.000	30.00	0.0	0.0	1277.04	530	.00	1280.18	1280.18	1281.76	30.04	10.10	52.48	96.69

SECNO	DEPTH
70507.00	4.53
70591.00	3.96
70621.00	3.14



ARIZONA HIGHWAY DEPARTMENT

CULVERT COMPUTATION SHEET

PROJECT: SUPERSTITION FREEWAY

DESIGNER: WGW

STATION: _____

DATE: 8/82

HYDROLOGIC AND CHANNEL INFORMATION

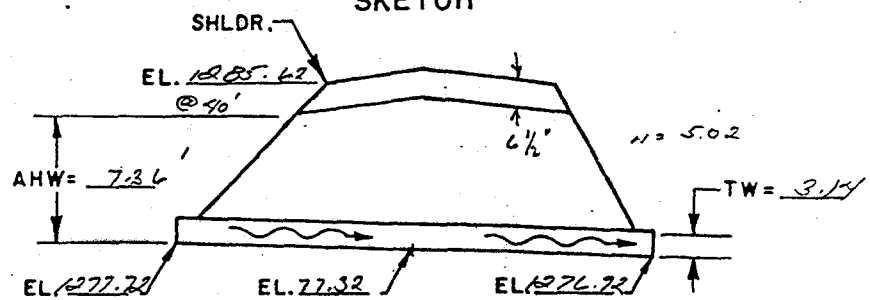
DRAINAGE AREA _____

Q_1 = 530 TW_1 = 3.14

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50})

SKETCH



S_0 = 0.005'/' L = 146' L/100 S_0 = 0.73

MEAN STREAM VELOCITY = _____

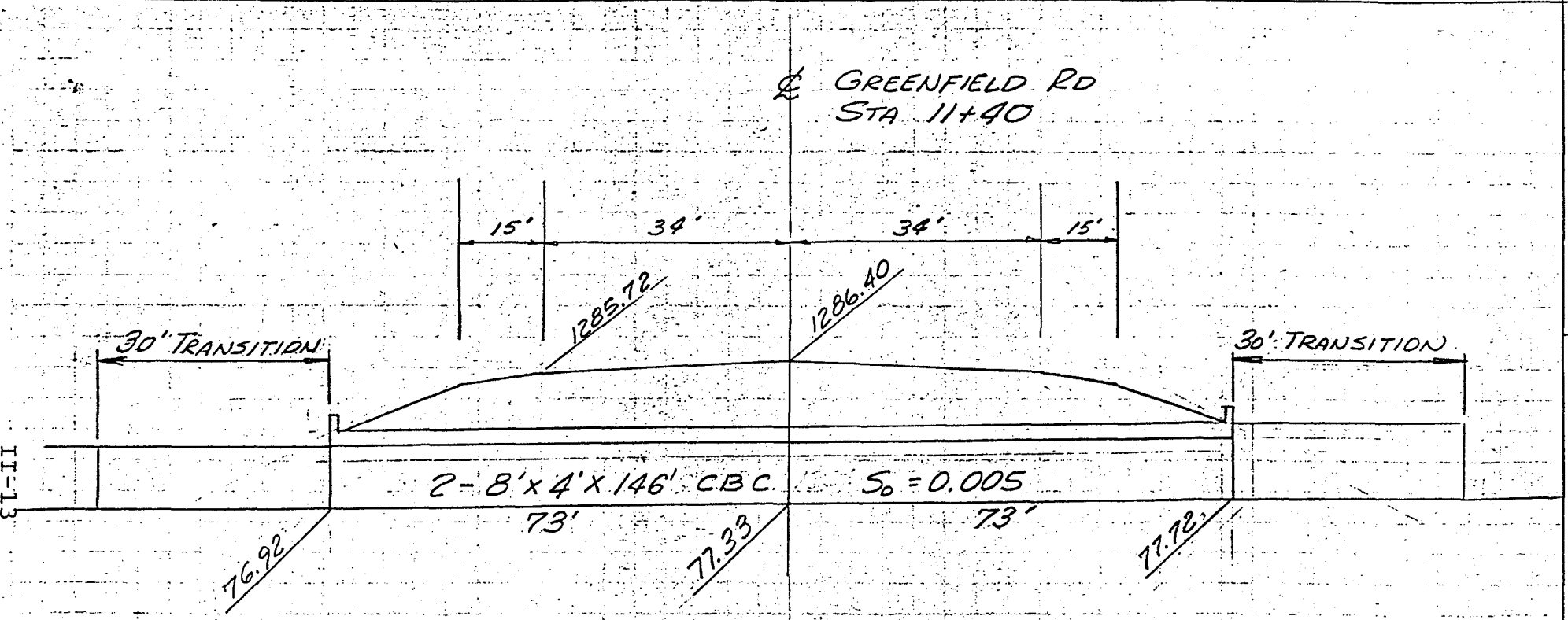
CULVERT DESCRIPTION		Q/ barrel	CAP. CHART HW	HEADWATER COMPUTATION										CONTROL HW	OUTLET VELOCITY	COST	DHW ELEV.	COMMENTS
				INLET CONT.		OUTLET CONTROL $HW = H + h_0 - LS_0$												
SIZE	ENTR. TYPE			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c + D}{2}$	TW	h_0	LS_0	HW					
2-8'x4' CBC	SMOOTH TRANS	265		1.48	5.92	0.2	1.6	3.3	3.65	3.14	3.65	0.73	4.52	5.92				SEE NOTE 1

SUMMARY & RECOMMENDATIONS

1. The highwater depth calculated by this procedure is less than the allowable 7.36' depth. It is felt that the actual highwater will be something less than the 4.5' depth calculated.

AHD 20-050 12-69

NATIONAL 42-389 200 SHEETS 5 SQUARE



CULVERT PROFILE

GREENFIELD ROAD CROSSING

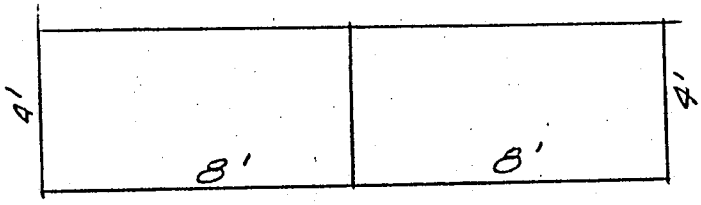
48TH STREET CROSSING

THE 48TH STREET CROSSING WILL USE A DOUBLE 8' WIDE CONCRETE BOX CULVERT THE SAME AS PROPOSED FOR GREENFIELD ROAD EXCEPT THE HEIGHT OF THE STRUCTURE WILL BE 4 FEET.

$n = 0.012$

$S_o = 0.005$

$Q = 475$ CFS



$d = 2.55$

$A = 40.8$
$WP = 26.2$
$R = 1.56$

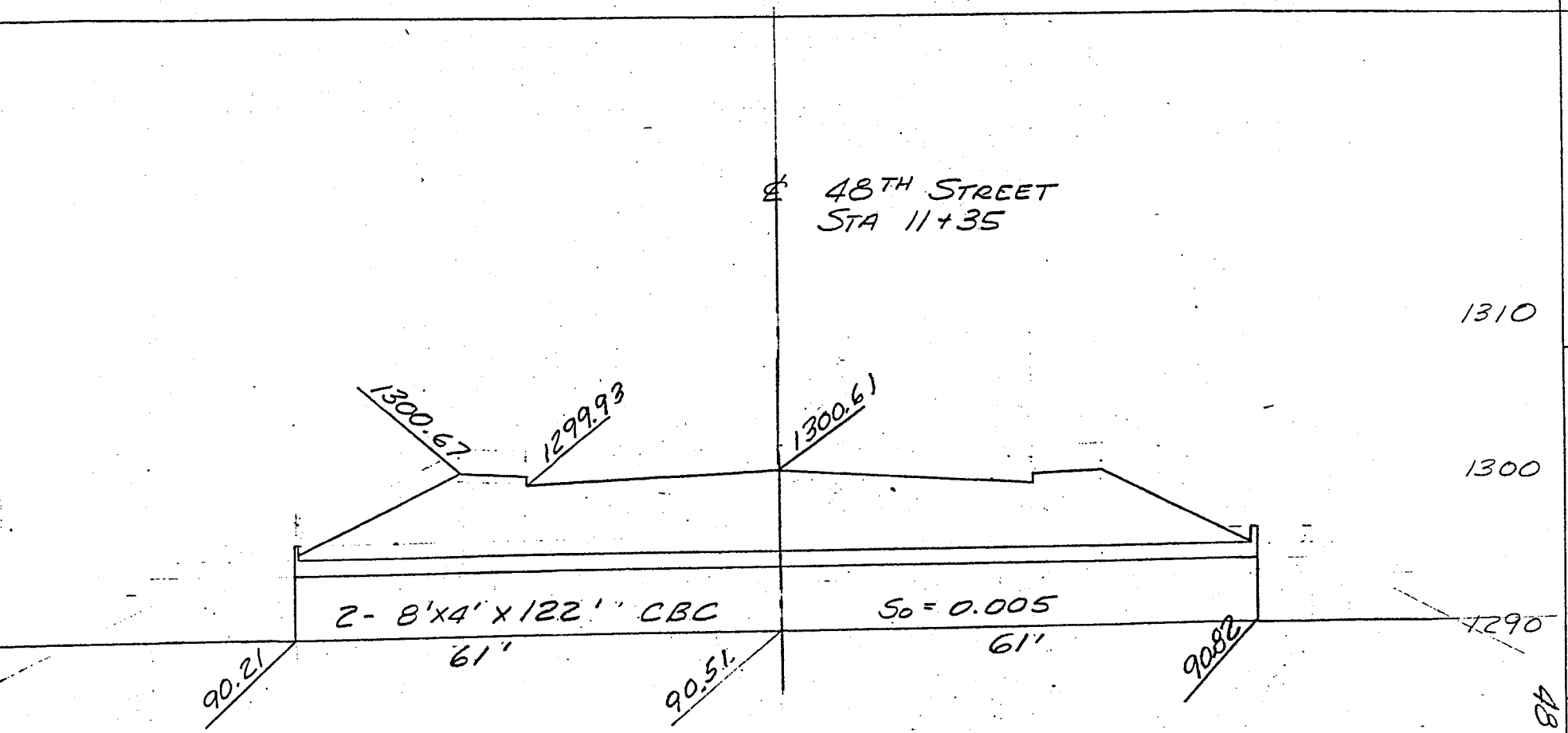
$$Q = \frac{1.486}{n} A S_o^{1/2} R^{2/3} = 479$$

$V = 11.74$ fps

NORMAL DEPTH IN THE BOX IS 2.55'

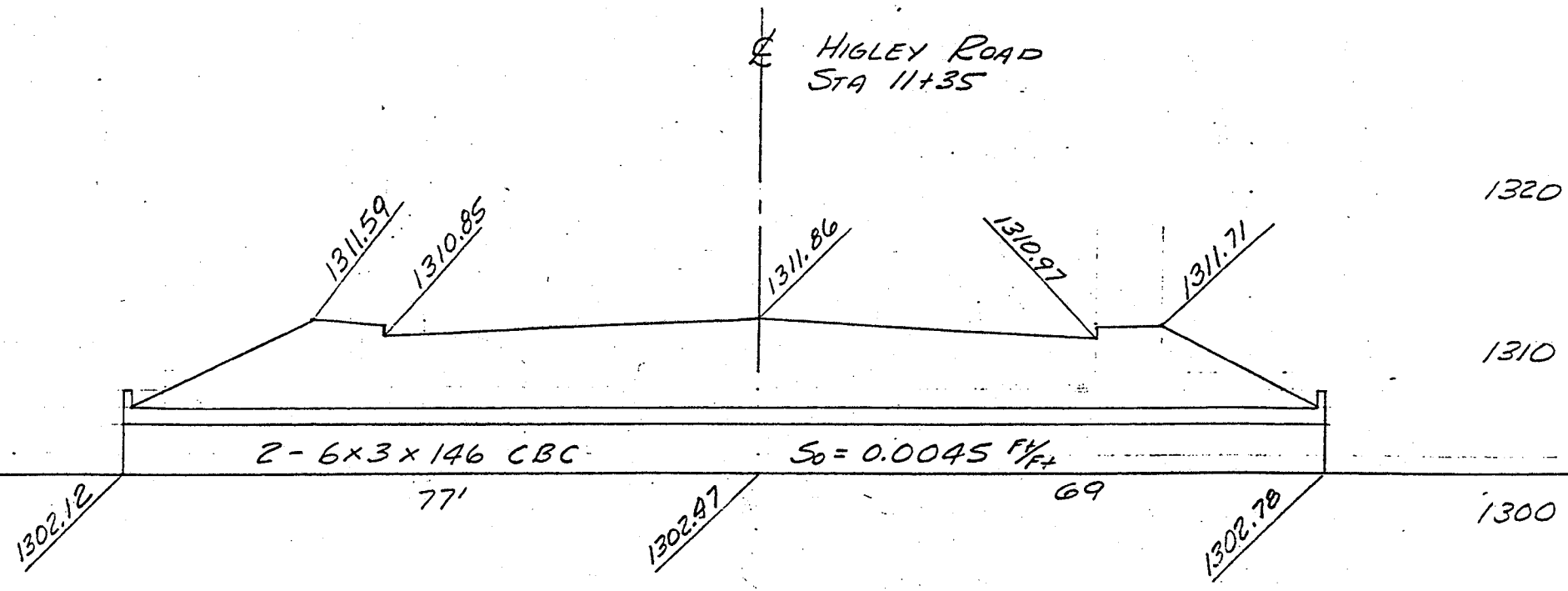
HOWEVER THE WATER SURFACE PROFILE COMPUTED BY THE HEC-2 PROGRAM INDICATES A DEPTH SLIGHTLY GREATER THAN 3 FEET, THEREFORE THE BOX HEIGHT OF 4.0 FEET IS RECOMMENDED.

NATIONAL 42-381 SHEETS 5 SQUARE
42-382 100 SHEETS 5 SQUARE
42-389 200 SHEETS 5 SQUARE



CULVERT PROFILE

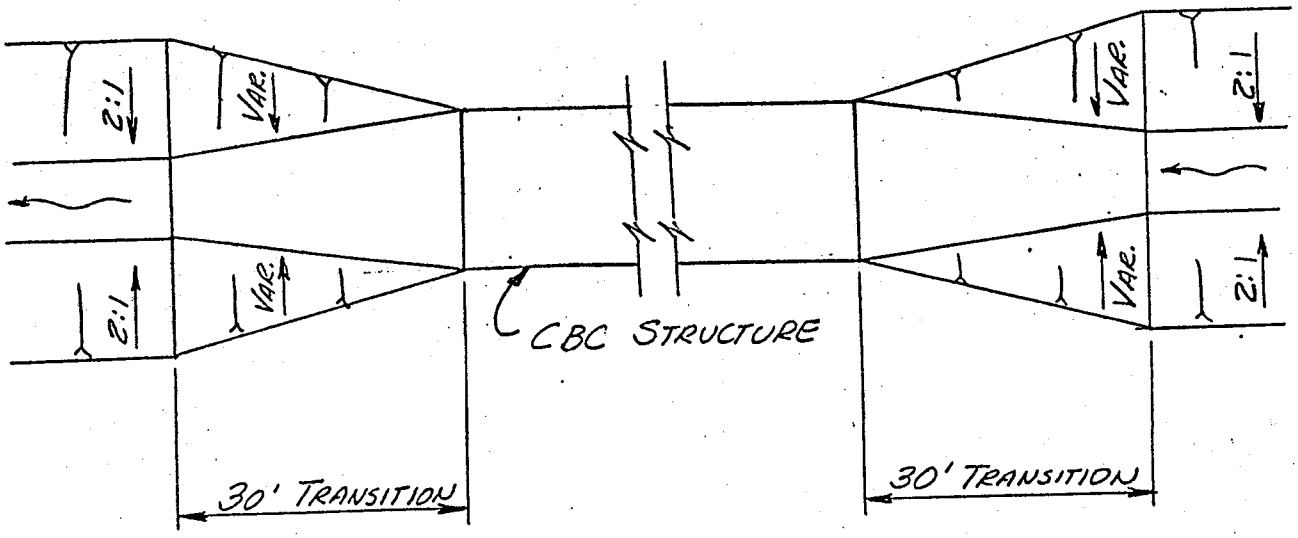
48TH STREET CROSSING
DESIGN



HIGLEY ROAD
CHANNEL CROSSING
STA 11+35

BOX CULVERT TRANSITIONS

THE BOX CULVERTS AT HIGLEY ROAD, 48TH STREET AND GREENFIELD ROAD WILL HAVE 30 FOOT, STRAIGHT LINE TRANSITIONS ON BOTH THE INLET AND OUTLET ENDS OF THE STRUCTURE. THE BOTTOM SLOPE OF THE TRANSITIONS SHALL BE THE SAME AS THE SLOPE OF THE STRUCTURE.



TYPICAL TRANSITION INSTALLATION PLAN

NATIONAL 42-381 50 SHEETS 5 SQUARE 42-382 100 SHEETS 5 SQUARE 42-389 200 SHEETS 5 SQUARE Made in U.S.A.

OFFSITE DRAINAGE

RWCD CANAL TO POWER ROAD

OFFSITE DRAINAGE - SUPERSTITION FREEWAY

RWCD CANAL TO POWER ROAD

The following is a hydrologic study to determine the maximum offsite storm runoff for the 50 year design frequency along the Superstition Freeway from the Roosevelt Water Conservation District Floodway (RWCD) to Power Road.

The Soil Conservation Service (SCS) in 1974 completed a detailed hydrologic study for the RWCD Floodway. This study involved the use of a TR-20 watershed model to determine the 10, 25 and 100 year flows for the region.

SCI Consulting Engineers, Inc., updated the SCS TR-20 model, to reflect current (December, 1980) conditions. It was determined after field investigation of the area that some of the runoff areas modeled by the SCS were invalid due to drainage pattern changes caused by new construction. The SCS study shows no apparent obstructions to washes flowing southwest from the Spook Hill retention structure to the RWCD Canal, through Leisure World Development. SCI revised the TR-20 model to represent the present drainage characteristics north of the proposed Superstition Freeway.

TR-20 Modifications

1. A channel located on the north side of Broadway Road, starting at Power Road diverts flow to the west along Broadway Road to the RWCD Canal.

2. Power Road, south of Broadway Road, presently is an inverted crown section. According to M.C.H.D. plans, Power Road will be reconstructed for standard two way crown and open ditch south of Southern Avenue. The runoff is directed south along Power Road into the Superstition Canal.
3. An earthern channel is located approximately 1/2 mile east of Power Road, from just north of Apache Trail to the Superstition Freeway. The channel flows south approximately 10,000 feet where it intersects with an earthern channel flowing east to west. This east-west channel presently daylights at Power Road. A new channel will be designed within the Freeway right-of-way on the north side that will outlet into the RWCD Floodway.

The new channels and revised surface flow routings were modeled in the modified TR-20 model of the Soil Conservation Service by SCI Consulting Engineers, Inc. Drainage areas, times of concentration, reach lengths and other changes necessary to reflect the changes for the TR-20 model were made to update the model. The determination of the 50 year frequency precipitation value was produced by interpolating between the 10, 25, and 100 year precipitation values of the SCS study (see Fig. 1).

The attached 'Offsite Drainage Areas' map shows the revised SCI drainage areas and the original areas by the SCS. The map also shows the TR-20 model schematic and the location of the computer node numbers and reach lengths. The following table shows the Hydrologic Parameters of Drainage Areas (DA), Curve Numbers (CN), Time of Concentration (Tc) and the 50 year runoff of the revised TR-20.

The hundred (100) year runoff for the total drainage area from the SCS study is 4712 cfs at node 109. The revised study by SCI at the same location results in a 100 year flow of 3990 cfs. The resulting reduced flows are mainly due to the increase of reach length and also time of concentration changes in the revised drainage areas.

HYDROLOGIC PARAMETERS

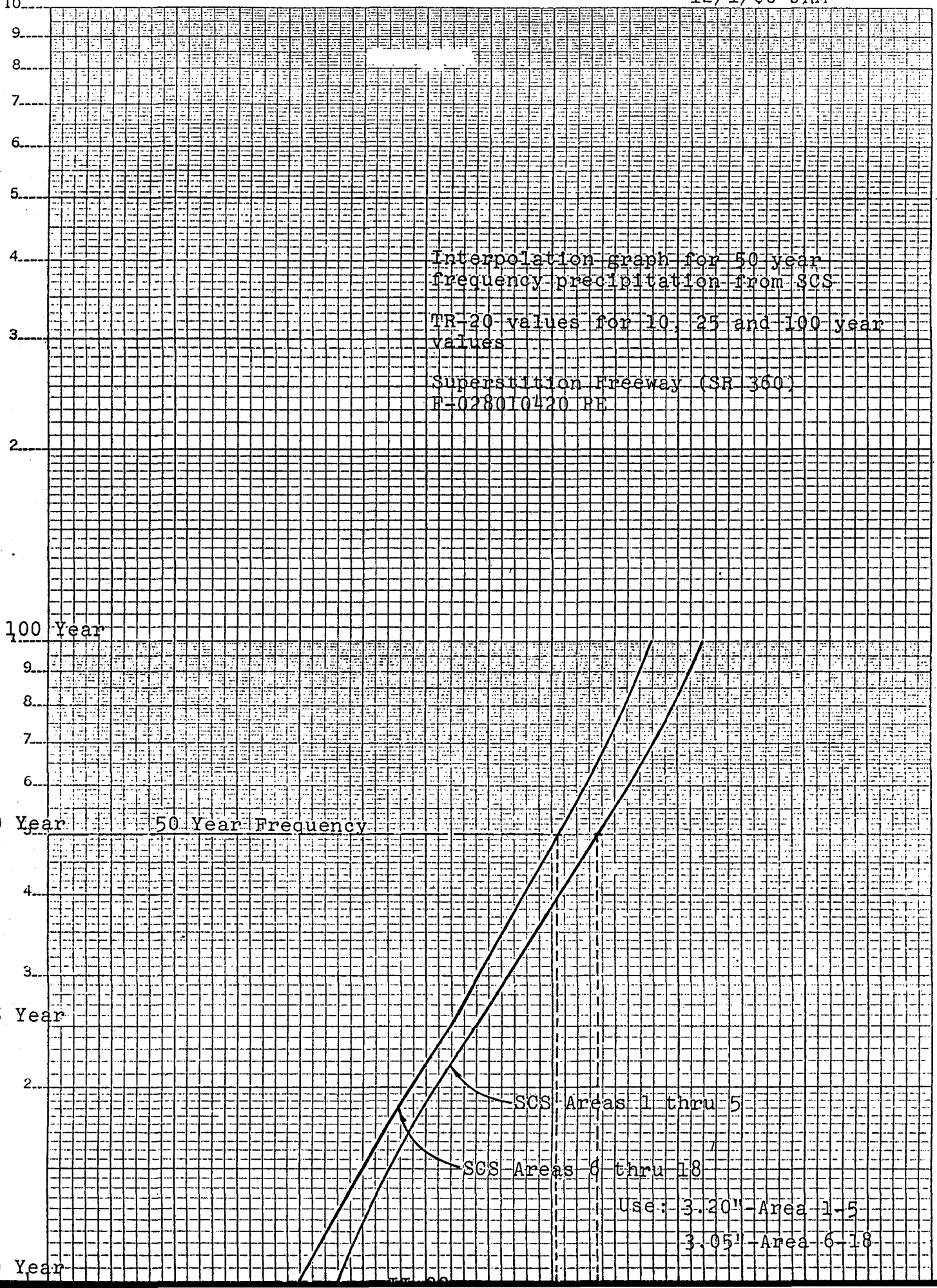
DRAINAGE AREAS (DA), CURVE NUMBERS (CN), TIME OF CONCENTRATION (Tc), 50 YEAR RUNOFF

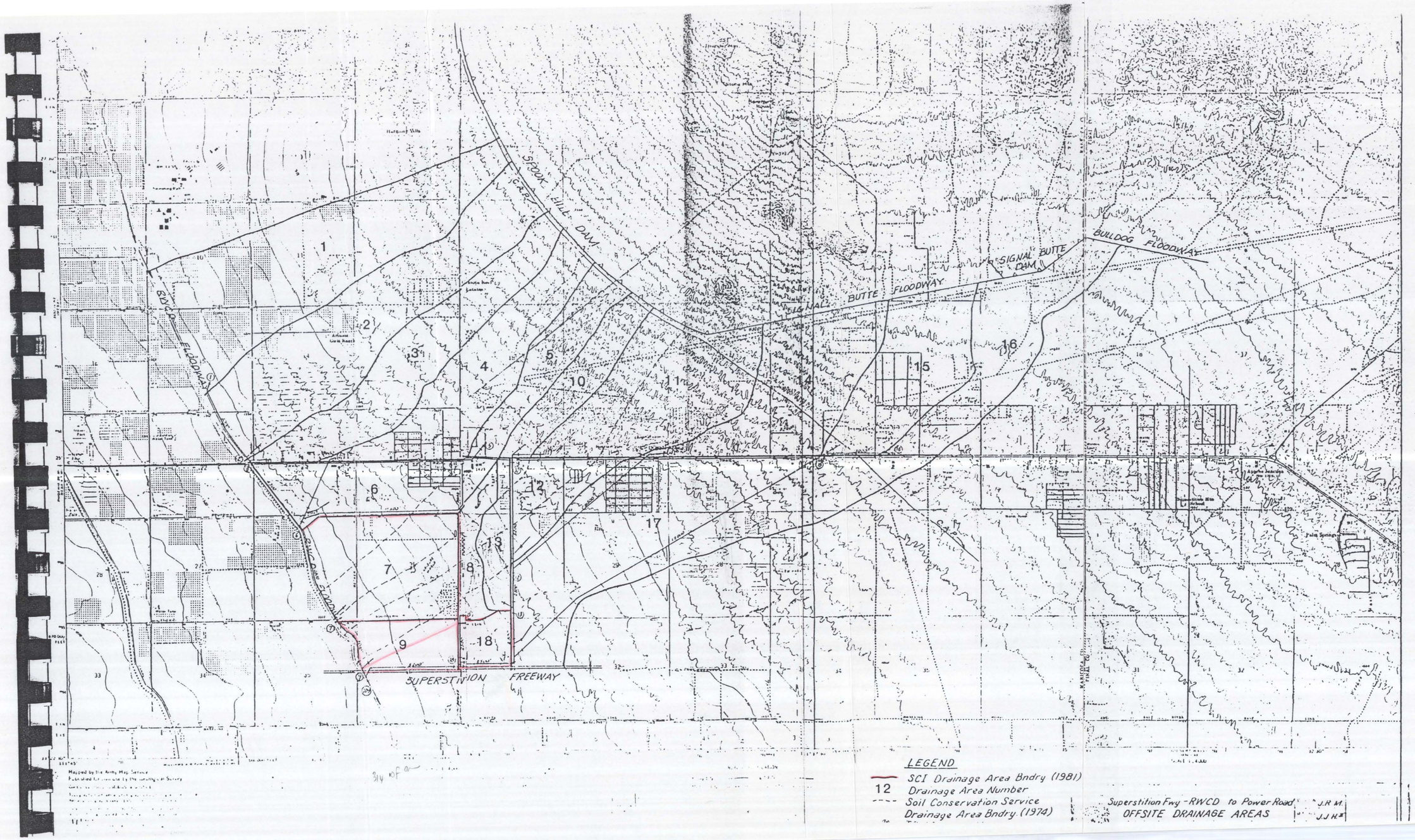
DA/CP[1] NO	DA sq.mi.	CN	Tc hrs.	50 yr. Runoff[2] Q cfs	
1	3.00	72 (79)	0.8	880	
2	2.58	74	1.0	1576	
3	1.58	75	1.0	2060	
4	1.42	75	0.75	470	
5	.71	74	0.61	255	
6	1.05	73	1.17	2605	
7	1.42	73	0.89	2725	
8	0.33	73	0.85	90	
9	0.54	73	0.59	~~1510~~	183 cfs. Geza Kmetty 1/7/83
10	0.62	74	0.51	800	
11	1.76	73	0.61	585	
12	0.53	73	0.80	715	
13	0.31	73 (79)	0.89	685	
14	1.56	73 (79)	1.60	270	
15	1.27	75 (79)	0.65	810	
16	1.20	75 (79)	0.75	400	
17	3.29	75	2.51	1575	
18	0.24	73	0.40	1575	
109	N/A	N/A	N/A	3080	

1) DA/CP = Drainage area/concentration point - See the 'Offsite Drainage - TR-20 Schematic Map' (node numbers)

2) Runoff in cfs at this concentration point

12/1/80 JRM


Interpolation graph for 50 year frequency precipitation from SCS
TR-20 values for 10, 25 and 100 year values
Superstition Freeway (SR 360)
F-028010420 PE
100 Year
50 Year
50 Year Frequency
25 Year
10 Year
SCS Areas 1 thru 5
SCS Areas 6 thru 18
Use: 3.20"-Area 1-5
3.05"-Area 6-18


SPOOK HILL DAM
SIGNAL BUTTE DAM
SIGNAL BUTTE FLOODWAY
BULLDOG FLOODWAY
SUPERSTITION FREEWAY
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
LEGEND
SCI Drainage Area Bndry (1981)
12 Drainage Area Number
Soil Conservation Service
Drainage Area Bndry (1974)
Superstition Fwy - RWCD to Power Road
OFFSITE DRAINAGE AREAS
J.R.M.
J.J.H.

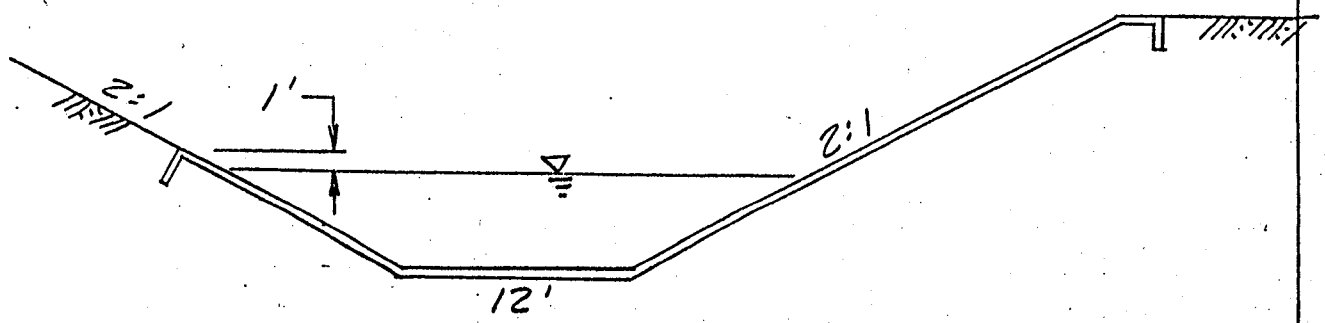
CHANNEL DESIGN

The channel design will be based on the 50 year peak flow of 1575 cfs as determined by the analysis and procedures outlined in the previous section.

The proposed channel plan and profile is shown in Figure II-3 with the computed water surface profile determined using the Corps of Engineers HEC-2 program. A copy of the HEC-2 program printout is included in Appendix III. The channel profile has been depressed to the depth shown in the vicinity of 845+00 to allow for the disposed of onsite drainage into the channel by gravity flow.

The channel will be a concrete lined, trapezoidal channel with a 12' bottom width and 2:1 sideslopes. The channel lining will extend to existing on the north side and approximately 1 foot above the water surface profile on the south side.

TYPICAL CHANNEL SECTION



TYPICAL CHANNEL SECTION

$Q = 1575$ $n = 0.016$

CHANNEL REACH	NORMAL DEPTH		CRITICAL DEPTH
RWCD FLOODWAY TO STA 845+00 $S_o = 0.00157$	6.66'	V = 9.33 Fps	6.01
STA 845+00 TO STA 860+00 $S_o = 0.0150$	3.78	V = 21.28 Fps	6.01.
STA 860+00 TO STA 870+00 $S_o = 0.0053$	4.92	V = 14.56 Fps	6.01

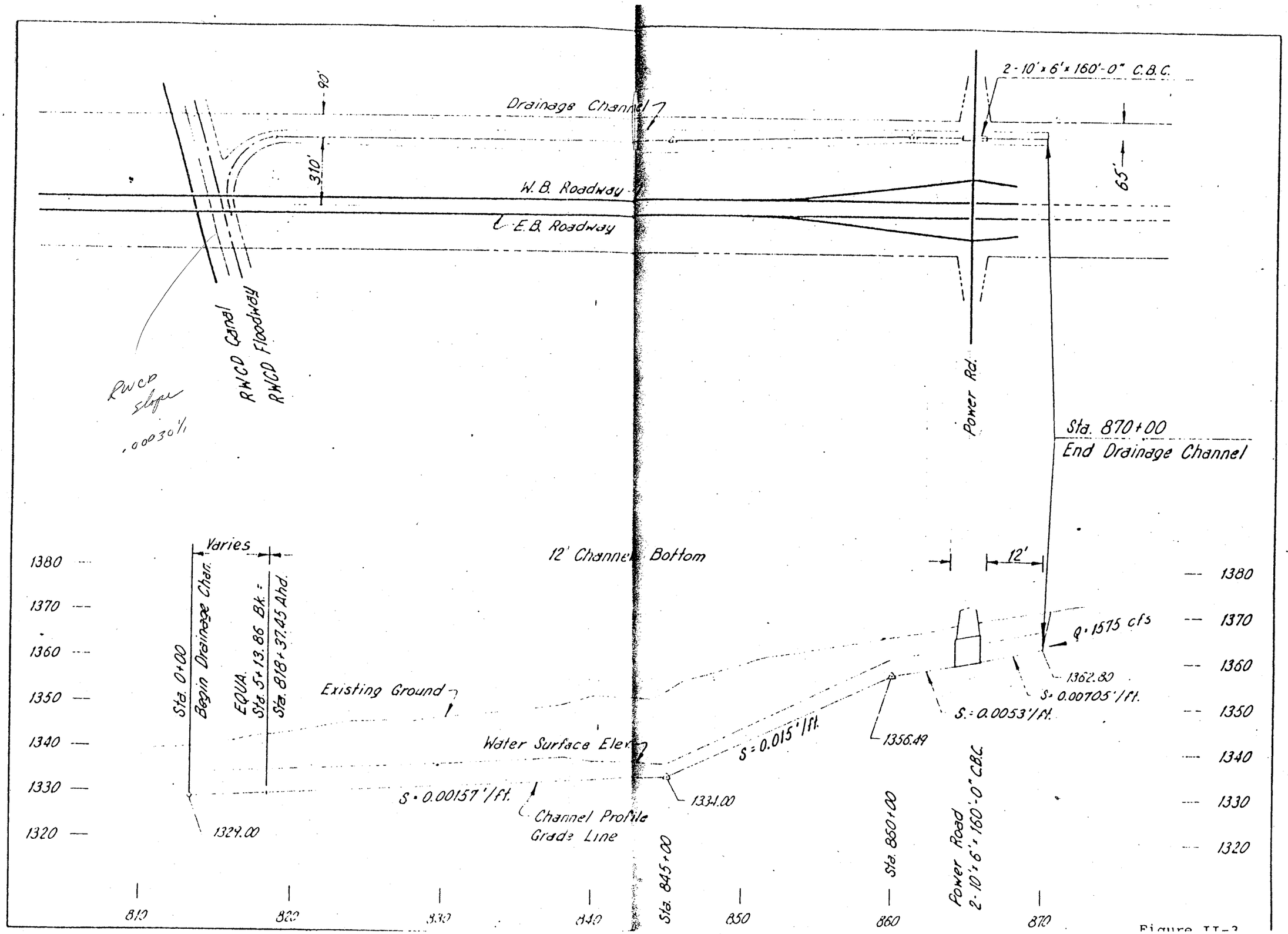
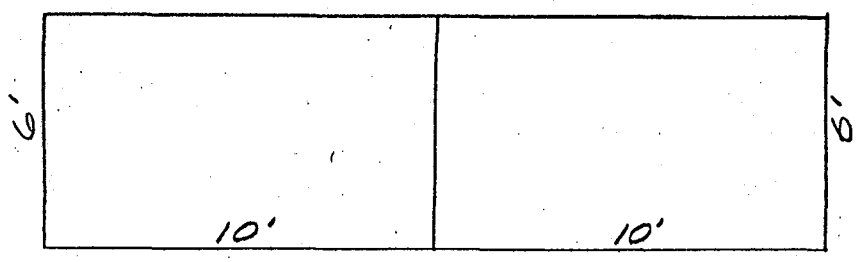

2-10' x 6' x 160'-0" C.B.C.
90'
Drainage Channel
310'
W.B. Roadway
E.B. Roadway
65'
RWCD Canal
RWCD Floodway
RWCD slope .00030'/'
Power Rd.
Sta. 870+00
End Drainage Channel
Varies
12' Channel Bottom
12'
1380
1370
1360
1350
1340
1330
1320
Sta. 0+00
Begin Drainage Chan.
EQUA.
Sta. 5+13.86 Bk. =
Sta. 818+37.45 Ahd.
Existing Ground
Q=1575 cfs
1362.80
S=0.00705'/ft.
S=0.0053'/ft.
1356.49
S=0.015'/ft.
Water Surface Elev.
S=0.00157'/ft.
1334.00
Channel Profile
Grade Line
1324.00
Sta. 845+00
Sta. 860+00
Power Road
2-10' x 6' x 160'-0" C.B.C.
810
820
830
840
850
860
870

Figure II-3

POWER ROAD
CHANNEL CROSSING STRUCTURE

THE NORTH DRAINAGE CHANNEL WILL CROSS UNDER POWER ROAD IN A DOUBLE 10'X6' CONCRETE BOX CULVERT.



$Q = 1575$ CFS $\quad n = 0.012 \quad S_o = 0.0053$ '/FT

Q PER BARREL = 787.5 CFS

CRITICAL DEPTH

$$K_c' = \frac{Q}{b^{5/2}} = \frac{787.5}{10^{5/2}} = 2.490$$

$$\frac{D_c}{b} = 0.578 \quad \text{(FROM KINGS HANDBOOK)}$$

$$D_c = 10 \times .578 = 5.78'$$

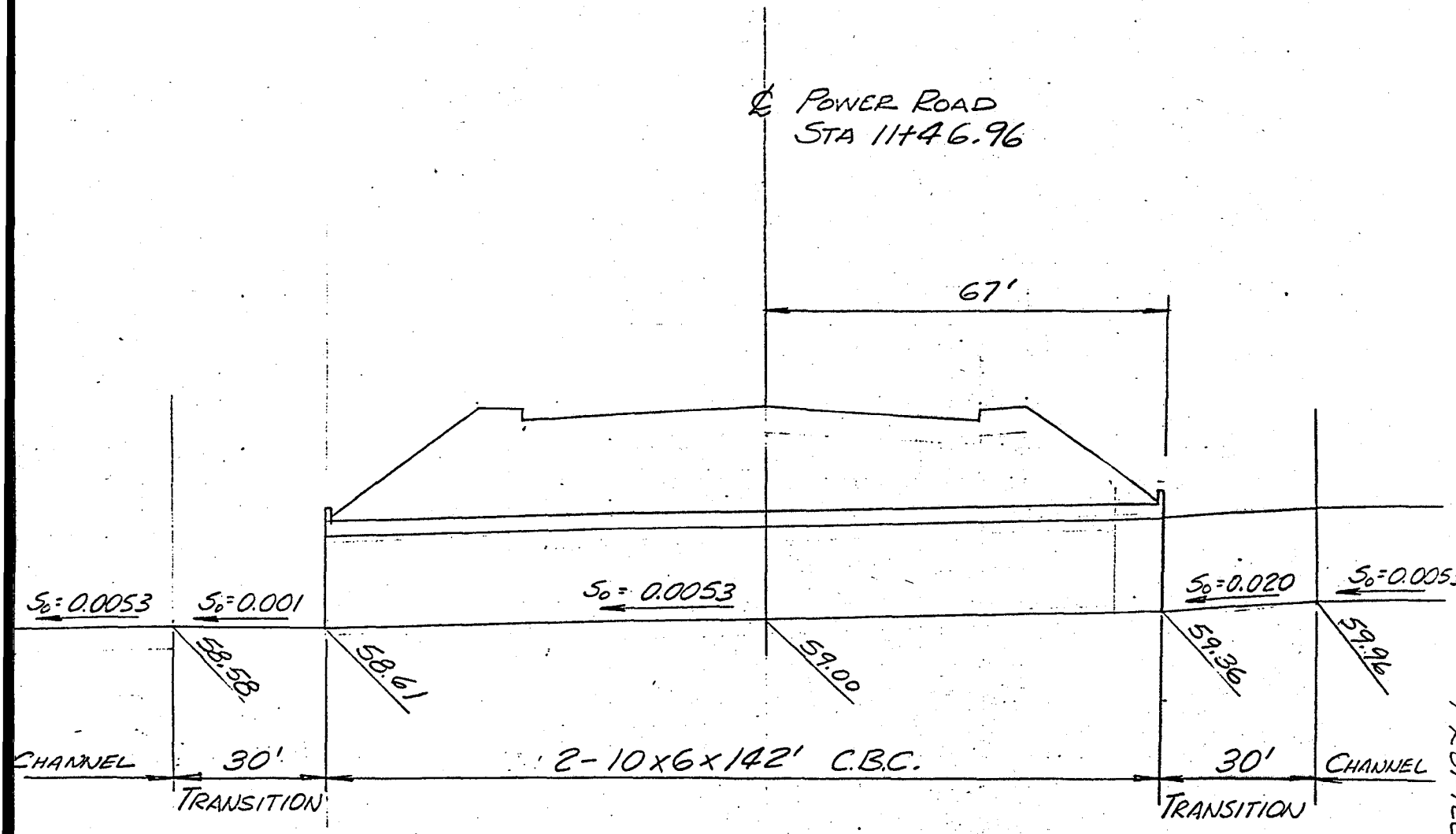
NORMAL DEPTH

$$K_n' = \frac{Qn}{b^{8/3} S^{1/2}} = \frac{787.5(.012)}{(10^{8/3})(0.0053)^{1/2}} = 0.280$$

$$\frac{D_n}{b} = 0.481 \quad \text{(FROM KINGS HANDBOOK)}$$

$$D_n = 10 \times .481 = 4.81'$$

NATIONAL 42-381 50 SHEETS 5 SQUARE
42-382 100 SHEETS 5 SQUARE
42-389 200 SHEETS 5 SQUARE
Made in U.S.A.



POWER ROAD
BOX CULVERT & TRANSITION
PROFILE

ARIZONA HIGHWAY DEPARTMENT
STRUCTURES SECTION
HYDRAULICS BRANCH

HIGHWAY SUPERSTITION FREEWAY
LOCATION VAL VISTA - POWER RD
PROJECT NO. _____

WATER SURFACE PROFILE COMPUTATION SHEET

CHANNEL TYPE INLET TRANSITION L = 30'

n = 0.014, $C^2 = (1.486/n)^2$ = 11266, Q = 1575, S_0 = 0.020, b = 12'/2', d_c = 5.89, d_n = 4.93

7.07' 4.77

	Y	A	WP	R	$R^{4/3}$	V	$V^2/2g$	h_e	E	S_f $\frac{V^2}{(C^2R^{4/3})}$	S_{fm}	$S_0 - S_{fm}$	ΔE $E_2 - (E_1 - h_e)$	ΔL	$\Sigma\Delta L$
0+00	4.93	107.77	34.05	3.165	4.647	14.615	3.317		8.247	.0041					
								0.018			0.0041	.0159	.167	10.5	
0+10	4.90	104.974	31.22	3.362	5.037	15.004	3.496		8.396	.0040					
								.017			.0041	0.0159	0.159	10.0	20.5
0+20	4.87	102.479	29.504	3.473	5.260	15.369	3.668		8.538	.0040					
								0.017			0.0043	0.0157	0.162	10.3	30.8
0+30	4.85	100.250	30.37	3.301	4.915	15.711	3.833		8.683	0.0045					

COMPUTED BY R.W.S. CHECKED BY G.K. DATE 5/81

ARIZONA HIGHWAY DEPARTMENT
STRUCTURES SECTION
HYDRAULICS BRANCH

HIGHWAY SUPERSTITION FREEWAY
LOCATION VAL VISTA - POWER RD.
PROJECT NO. _____

WATER SURFACE PROFILE COMPUTATION SHEET

CHANNEL TYPE OUTLET TRANSITION L = 30'

n = 0.014, $C^2 = (1.486/n)^2$ = 11266, Q = 1575, S_0 = 0.001, b = 20.67, d_c = 7.07', d_n = 4.77

*S_0 = 0.0053 12' 2:1 5.89 4.93

	Y	A	WP	R	$R^{4/3}$	V	$V^2/2g$	h_e	E	$\frac{V^2}{(C^2R^{4/3})}$	S_{fm}	$S_0 - S_{fm}$	$E_2 - (E_1 - h_e)$	ΔL	$\Sigma\Delta L$
0+00	5.26	108.72	31.19	3.486	5.285	14.486	3.259		8.519	.0035					
								.038			.0036	-0.0026	-0.300	11.5	
0+10	5.00	105.65	29.82	3.543	5.402	14.908	3.451		8.451	.0037					
								.013			0.0039	-0.0029	-0.033	11.4	22.9
0+20	4.89	104.69	31.187	3.357	5.024	15.045	3.515		8.405	0.004					
								.009			0.0043	-0.0033	-0.024	7.3'	30.2'
0+30	4.81	103.992	33.511	3.103	4.526	15.145	3.561		8.372	0.0045					
								—			0.0041	.0012*	.125	104	
	4.93	107.77	34.048	3.165	4.647	14.615	3.317		8.247	.0041					

COMPUTED BY R.W.S. CHECKED BY GK DATE 5/81

APPENDICES

APPENDIX I
TR 20 PRINTOUT

```
DATAIN--NULLFILE:-                                    -- TIME 11:35:11 DATE 02/23/81
00001    JOB                                  FULL
00002    TITLE        SUPERSTITION FWY-RWCD TO POWER ROAD-OFFSITE (SCS)-REV. SCI 12/80
00003     5 RAINFL 1                 0.5
00004     8            0.0          0.005        0.0110       0.0160       0.0220
00005     8            0.0280       0.0350       0.0410       0.0480       0.0560
00006     8            0.0630       0.0710       0.0800       0.0890       0.0980
00007     8            0.1090       0.1200       0.1330       0.1470       0.1630
00008     8            0.1810       0.2040       0.2350       0.2830       0.6630
00009     8            0.7350       0.7720       0.7990       0.8200       0.8380
00010     8            0.8540       0.8680       0.8800       0.8910       0.9020
00011     8            0.9120       0.9210       0.9290       0.9370       0.9450
00012     8            0.9520       0.9590       0.9650       0.9720       0.9780
00013     8            0.9840       0.9890       0.9950       1.0000       1.0000
00014     9 ENDTBL
00015     6 RUNOFF 1 001        1 3.0          72.          0.8                    1
00016     6 REACH  3 002   1    2 4000.        0.75                                1
00017     6 RUNOFF 1 002        3 2.58         74.          1.00                   1
00018     6 ADDHYD 4 002   2 3 4                                                   1
00019     6 RUNOFF 1 003        1 1.58         75.          1.00                   1
00020     6 ADDHYD 4 003   4 1 2                                                   1
00021     6 REACH  3 006   2    7 4300.        0.75                                1
00022     6 RUNOFF 1 004        1 1.42         75.          0.75                   1
00023     6 REACH  3 006   1    3 3700.        0.61                                1
00024     6 RUNOFF 1 006        1 1.05         73.          1.17                   1
00025     6 ADDHYD 4 006   1 3 2                                                   1
00026     6 RUNOFF 1 005        4 0.71         74.          0.61                   1
00027     6 REACH  3 006   4    5 11500.       0.51                                1
00028     6 ADDHYD 4 006   5 2 6                                                   1
00029     6 ADDHYD 4 006   6 7 1                                                   1
00030     6 REACH  3 007   1    2 4800.        0.75                                1
00031     6 RUNOFF 1 007        3 1.42         73.          0.89                   1
00032     6 ADDHYD 4 007   2 3 4                                                   1
00033     6 REACH  3 009   4    1 3000.        0.75                                1
00034     6 RUNOFF 1 009        2 0.54         73.          0.59                   1
00035     6 ADDHYD 4 009   1 2 7                                       1 1 1 1     1
00036     6 RUNOFF 1 014        1 1.56         73.          1.6                    1
00037     6 REACH  3 012   1    2 8500.        0.61                                1
00038     6 RUNOFF 1 011        3 1.76         73.          0.61                   1
00039     6 REACH  3 010   3    4 1000.        0.78                                1
00040     6 RUNOFF 1 010        5 0.62         74.          0.51                   1
00041     6 ADDHYD 4 010   4 5 3                                                   1
00042     6 REACH  3 012   3    4 5200.        0.45                                1
00043     6 RUNOFF 1 012        5 0.53         73.          0.80                   1
00044     6 ADDHYD 4 012   4 5 6                                                   1
00045     6 ADDHYD 4 012   2 6 3                                                   1
00046     6 REACH  3 013   3    4 2500.        0.45                                1
00047     6 RUNOFF 1 013        5 0.31         73.          0.89                   1
00048     6 ADDHYD 4 013   4 5 1                                                   1
00049     6 REACH  3 017   1    2 2500.        0.45                                1
00050     6 RUNOFF 1 017        3 3.29         75.          2.51                   1
00051     6 ADDHYD 4 017   2 3 4                                                   1
00052     6 RUNOFF 1 016        1 1.20         75.          0.75                   1
00053     6 REACH  3 015   1    2 3000.        0.78                                1
00054     6 RUNOFF 1 015        3 1.27         75.          0.65                   1
00055     6 ADDHYD 4 015   2 3 5                                                   1
00056     6 REACH  3 017   5    6 19000.       0.61                                1
00057     6 ADDHYD 4 017   4 6 5                                                   1
00058     6 REACH  3 018   5    1 2500.        0.61                                1
00059     6 RUNOFF 1 008        5 0.33         73.          0.85                   1
```

```
00060      6 REACH  3 018    5    4 2500.        0.51                                  1
00061      6 RUNOFF 1 018         2 0.24         73.         0.40         1 1 1 1    1
00062      6 ADDHYD 4 018    2 4 3                                        1 1 1 1    1
00063      6 ADDHYD 4 018    1 3 4                                        1 1 1 1    1
00064      6 REACH  3 009    4    2 5200.        0.61                     1 1 1 1    1
00065      6 ADDHYD 4 109    2 7 5                                        1 1 1 1    1
00066        ENDATA
00067      7 INCREM 6               0.2
00068      7 COMPUT 7 00100 00300 0.0            3.60        1.0          1 2  03  01
00069      7 COMPUT 7 00600 10900 0.0            3.4         1.0          1 2  03  01
00070        ENDCMP 1
00071      7 COMPUT 7 00100 00300 0.0            3.2         1.0          1 2  03  02
00072      7 COMPUT 7 00600 10900 0.0            3.05        1.0          1 2  03  02
00073        ENDCMP 1
00074      7 COMPUT 7 00100 00300 0.0            2.70        1.0          1 2  03  03
00075      7 COMPUT 7 00600 10900 0.0            2.60        1.0          1 2  03  03
00076        ENDCMP 1
00077      7 COMPUT 7 00100 00300 0.0            2.15        1.0          1 2  03  04
00078      7 COMPUT 7 00600 10900 0.0            2.00        1.0          1 2  03  04
00079        ENDCMP 1
00080        ENDJOB 2
NORMAL TERMINATION
TOTAL EDIT CARDS INSERTED = 00080
TOTAL OUTPUT RECORDS GENERATED = 00080
```

```
EXECUTIVE CONTROL CARD          OPERATION  INCREM,     MAIN TIME INCREMENT=  0.20
EXECUTIVE CONTROL CARD          OPERATION  CCMPUT,     FROM XSECTN/STRUCT   1/  0     TO XSECTN/STRUCT   3/  0
      STARTING TIME=  0.0       RAIN DEPTH=  3.60     RAIN DURATION=  1.00     RAIN TABLE NO.= 1     SOIL CONDITION= 2
      ALTERNATE NO.= 3          STORM NO.= 1
```

PASS= 1

EXECUTIVE CONTROL CARD OPERATION COMPUT, FROM XSECTN/STRUCT 6/ 0 TO XSECTN/STRUCT 109/ 0
STARTING TIME= 0.0 RAIN DEPTH= 3.40 RAIN DURATION= 1.00 RAIN TABLE NO.= 1 SOIL CONDITION= 2
ALTERNATE NO.= 3 STORM NO.= 1

SUBROUTINE ADDHYD CROSS SECTION 9

TIME HYDROGRAPH, TZERO= 0.0 DELTA T= 0.20 DRAINAGE AREA= 12.30

0.0	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.00	DISCHG	0.0	0.0	0.0	0.01	0.12	0.82	3.75	11.52	34.03	128.97
12.00	DISCHG	365.30	735.89	1240.95	1964.20	2785.75	3365.60	3490.83	3218.39	2757.56	2295.25
14.00	DISCHG	1908.33	1605.86	1373.26	1192.18	1048.23	932.49	839.50	764.10	702.57	651.67
16.00	DISCHG	608.70	571.78	539.07	509.67	483.56	460.99	442.11	426.71	414.63	404.49
18.00	DISCHG	394.78	384.59	373.35	361.46	349.48	337.72	326.72	317.28	309.88	304.19
20.00	DISCHG	299.61	295.51	290.98	285.38	278.78	272.02	266.00	260.71	255.58	250.79
22.00	DISCHG	247.52	246.13	245.25	243.19	239.29	234.36	229.53	224.97	220.21	215.62
24.00	DISCHG	212.40	209.67	204.23	194.35	178.05	153.54	122.72	91.06	63.99	43.94
26.00	DISCHG	30.19	20.91	14.56	10.13	6.99	4.75	3.17	2.08	1.33	0.83
28.00	DISCHG	0.52	0.32	0.20	0.12	0.07	0.04	0.0			

SUBROUTINE RUNOFF CROSS SECTION 18

TIME HYDROGRAPH, TZERO= 0.0 DELTA T= 0.20 DRAINAGE AREA= 0.24

0.0	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.00	DISCHG	0.0	0.0	0.0	0.0	0.01	0.19	0.92	2.32	7.85	48.95
12.00	DISCHG	112.12	120.27	69.04	47.52	32.92	24.91	21.01	17.78	16.42	14.51
14.00	DISCHG	13.32	12.54	11.63	11.24	10.62	10.23	9.81	9.22	8.93	8.30
16.00	DISCHG	7.88	7.61	7.29	7.18	7.16	7.17	7.02	6.73	6.58	6.26
18.00	DISCHG	6.04	5.81	5.50	5.38	5.35	5.35	5.36	5.37	5.33	5.03
20.00	DISCHG	4.82	4.76	4.75	4.70	4.39	4.18	4.30	4.61	4.69	4.41
22.00	DISCHG	4.21	4.15	4.13	4.08	3.77	3.55	3.67	3.97	4.05	3.78
24.00	DISCHG	3.56	2.58	0.91	0.27	0.08	0.02	0.00			

SUBROUTINE ADDHYD CROSS SECTION 18

TIME HYDROGRAPH, TZERO= 0.0 DELTA T= 0.20 DRAINAGE AREA= 0.57

0.0	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.00	DISCHG	0.0	0.0	0.0	0.0	0.01	0.19	0.96	2.52	8.55	51.55
12.00	DISCHG	122.67	153.90	135.43	139.33	130.97	114.87	97.22	80.28	67.01	55.87
14.00	DISCHG	47.67	41.60	36.75	33.36	30.44	28.31	26.56	24.95	23.78	22.38
16.00	DISCHG	21.24	20.28	19.32	18.64	18.12	17.75	17.32	16.83	16.49	15.95
18.00	DISCHG	15.48	14.96	14.34	13.90	13.56	13.28	13.08	12.95	12.83	12.47
20.00	DISCHG	12.18	11.97	11.78	11.57	11.13	10.77	10.71	10.84	10.83	10.58
22.00	DISCHG	10.40	10.31	10.19	10.03	9.61	9.27	9.21	9.34	9.34	9.08
24.00	DISCHG	8.90	7.86	5.93	4.68	3.54	2.49	1.65	1.05	0.66	0.40
26.00	DISCHG	0.24	0.14	0.08	0.05	0.02	0.01	0.01	0.0		

SUBROUTINE ADDHYD CROSS SECTION 18

TIME				HYDROGRAPH, TZERO= 0.0			DELTA T= 0.20		DRAINAGE AREA= 11.11		
0.0	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.00	DISCHG	0.0	0.0	0.01	0.05	0.17	0.64	2.10	5.44	16.59	70.27
12.00	DISCHG	171.92	251.45	316.61	437.19	574.61	724.25	882.12	1061.85	1279.12	1513.44
14.00	DISCHG	1738.92	1904.87	1989.86	1981.73	1897.77	1766.03	1607.25	1442.34	1284.07	1139.63
16.00	DISCHG	1012.87	904.22	812.75	736.09	672.39	618.79	573.97	535.42	502.73	473.88
18.00	DISCHG	448.79	426.57	406.97	389.88	374.86	361.51	349.41	338.29	327.75	317.50
20.00	DISCHG	307.67	298.45	289.73	281.82	274.44	267.90	262.24	257.19	252.21	247.15
22.00	DISCHG	242.37	237.85	233.50	229.19	224.79	220.79	217.44	214.55	211.65	208.51
24.00	DISCHG	205.37	201.22	195.74	190.31	184.18	177.12	169.46	160.90	151.51	140.71
26.00	DISCHG	128.14	113.97	98.52	82.91	67.90	54.41	42.79	33.14	25.41	19.31
28.00	DISCHG	14.63	11.04	8.36	6.32	4.82	3.68	2.82	2.17	1.67	1.29
30.00	DISCHG	0.99	0.76	0.58	0.45	0.34	0.25	0.18	0.13	0.09	0.06
32.00	DISCHG	0.03	0.02	0.0							

SUBROUTINE REACH CROSS SECTION 9

TIME				HYDROGRAPH, TZERO= 0.0			DELTA T= 0.20		DRAINAGE AREA= 11.11		
0.0	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.00	DISCHG	0.0	0.0	0.0	0.0	0.01	0.04	0.17	0.61	1.82	5.21
12.00	DISCHG	18.65	58.06	124.29	197.13	275.66	375.80	496.49	633.37	784.53	955.43
14.00	DISCHG	1151.39	1365.60	1577.79	1757.30	1877.75	1923.92	1897.68	1813.16	1688.76	1543.23
16.00	DISCHG	1391.87	1245.57	1111.12	991.87	888.70	800.87	726.83	664.58	612.22	567.88
18.00	DISCHG	530.10	497.53	469.24	444.47	422.74	403.68	386.94	372.13	358.87	346.80
20.00	DISCHG	335.58	324.94	314.81	305.21	296.18	287.78	280.02	273.00	266.75	261.12
22.00	DISCHG	255.84	250.73	245.82	241.14	236.62	232.21	227.87	223.78	220.12	216.84
24.00	DISCHG	213.73	210.63	207.36	203.48	198.84	193.67	187.88	181.37	174.15	166.13
26.00	DISCHG	157.21	147.11	135.55	122.49	108.20	93.28	78.48	64.55	52.03	41.21
28.00	DISCHG	32.17	24.84	19.02	14.48	10.99	8.34	6.33	4.82	3.68	2.82
30.00	DISCHG	2.16	1.66	1.28	0.98	0.76	0.58	0.44	0.33	0.25	0.18
32.00	DISCHG	0.13	0.09	0.06	0.03	0.02	0.0				

SUBROUTINE ADDHYD CROSS SECTION 109

TIME				HYDROGRAPH, TZERO= 0.0			DELTA T= 0.20		DRAINAGE AREA= 23.41		
0.0	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.00	DISCHG	0.0	0.0	0.0	0.01	0.12	0.87	3.93	12.13	35.85	134.19
12.00	DISCHG	383.95	793.95	1365.24	2161.32	3061.41	3741.39	3987.32	3851.76	3542.08	3250.68
14.00	DISCHG	3059.72	2971.46	2951.05	2949.48	2925.98	2856.40	2737.17	2577.26	2391.33	2194.90
16.00	DISCHG	2000.58	1817.35	1650.19	1501.54	1372.26	1261.87	1168.93	1091.30	1026.85	972.36
18.00	DISCHG	924.88	882.12	842.58	805.93	772.22	741.40	713.67	689.41	668.75	650.99
20.00	DISCHG	635.19	620.45	605.79	590.60	574.96	559.80	546.03	533.72	522.34	511.92
22.00	DISCHG	503.35	496.85	491.08	484.32	475.91	466.57	457.40	448.75	440.33	432.46

24.00	DISCHG	426.13	420.30	411.58	397.84	376.89	347.21	310.60	272.44	238.14	210.07
26.00	DISCHG	187.41	168.02	150.11	132.62	115.18	98.03	81.66	66.63	53.36	42.04
28.00	DISCHG	32.69	25.16	19.21	14.60	11.07	8.38	6.33	4.82	3.68	2.82
30.00	DISCHG	2.16	1.66	1.28	0.98	0.76	0.58	0.44	0.33	0.25	0.18
32.00	DISCHG	0.13	0.09	0.06	0.03	0.02	0.0				

ENDCMP

EXECUTIVE CONTROL CARD OPERATION COMPUT, FROM XSECTN/STRUCT 1/ 0 TO XSECTN/STRUCT 3/ 0
STARTING TIME= 0.0 RAIN DEPTH= 3.20 RAIN DURATION= 1.00 RAIN TABLE NO.= 1 SOIL CONDITION= 2
ALTERNATE NO.= 3 STORM NO.= 2

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XECUTIVE CONTROL CARD OPERATION CCMPUT, FROM XSECTN/STRUCT 6/ 0 TO XSECTN/STRUCT 109/ 0
STARTING TIME= 0.0 RAIN DEPTH= 3.05 RAIN DURATION= 1.00 RAIN TABLE NO.= 1 SOIL CONDITION= 2
ALTERNATE NO.= 3 STORM NO.= 2

UBROUTINE ADDHYD CROSS SECTION 9

TIME HYDROGRAPH, TZERO= 0.0 DELTA T= 0.20 DRAINAGE AREA= 12.30

0.0	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.13	1.32	10.39	70.17
12.00	DISCHG	239.15	515.49	896.02	1451.12	2097.25	2570.77	2697.57	2511.23	2169.45	1818.76
14.00	DISCHG	1521.72	1287.70	1106.66	965.01	851.88	760.53	686.84	626.87	577.73	536.90
16.00	DISCHG	502.28	472.40	445.83	421.88	400.57	382.14	366.71	354.14	344.29	336.02
18.00	DISCHG	328.09	319.75	310.51	300.73	290.87	281.18	272.11	264.34	258.26	253.59
20.00	DISCHG	249.84	246.48	242.76	238.15	232.70	227.11	222.14	217.78	213.54	209.59
22.00	DISCHG	206.90	205.78	205.09	203.39	200.17	196.08	192.08	188.29	184.35	180.55
24.00	DISCHG	177.88	175.62	171.06	162.78	149.11	128.58	102.77	76.27	53.62	36.84
26.00	DISCHG	25.34	17.56	12.24	8.52	5.88	4.00	2.68	1.75	1.12	0.70
28.00	DISCHG	0.44	0.27	0.17	0.10	0.06	0.04	0.0			

SUBROUTINE RUNOFF CROSS SECTION 18

TIME HYDROGRAPH, TZERO= 0.0 DELTA T= 0.20 DRAINAGE AREA= 0.24

0.0	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.04	0.50	4.04	33.67
12.00	DISCHG	85.03	94.72	55.17	38.45	26.84	20.42	17.27	14.65	13.55	11.99
14.00	DISCHG	11.02	10.38	9.64	9.33	8.82	8.50	8.15	7.67	7.43	6.91
16.00	DISCHG	6.57	6.34	6.08	5.99	5.98	5.99	5.86	5.62	5.50	5.23
18.00	DISCHG	5.05	4.86	4.60	4.50	4.48	4.48	4.49	4.50	4.47	4.22
20.00	DISCHG	4.04	3.99	3.98	3.95	3.69	3.51	3.61	3.87	3.94	3.71
22.00	DISCHG	3.54	3.49	3.47	3.43	3.17	2.99	3.09	3.34	3.41	3.18
24.00	DISCHG	3.00	2.17	0.76	0.23	0.07	0.02	0.00			

SUBROUTINE ADDHYD CROSS SECTION 18

TIME HYDROGRAPH, TZERO= 0.0 DELTA T= 0.20 DRAINAGE AREA= 0.57

0.0	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.04	0.51	4.14	34.74
12.00	DISCHG	91.44	118.29	104.27	108.23	102.61	90.78	77.45	64.40	54.11	45.37
14.00	DISCHG	38.90	34.09	30.22	27.51	25.16	23.44	22.02	20.70	19.75	18.60
16.00	DISCHG	17.67	16.88	16.09	15.53	15.11	14.80	14.45	14.05	13.77	13.32
18.00	DISCHG	12.94	12.51	12.00	11.63	11.35	11.12	10.95	10.85	10.75	10.45
20.00	DISCHG	10.21	10.04	9.88	9.70	9.33	9.04	8.99	9.10	9.10	8.88
22.00	DISCHG	8.74	8.66	8.56	8.43	8.08	7.79	7.75	7.86	7.85	7.64
24.00	DISCHG	7.49	6.61	4.99	3.94	2.98	2.10	1.39	0.89	0.55	0.34
26.00	DISCHG	0.28	0.12	0.07	0.04	0.02	0.01	0.0			

SUBROUTINE ADDHYD CROSS SECTION 18

TIME		HYDROGRAPH, TZERO= 0.0				DELTA T= 0.20			DRAINAGE AREA= 11.11		
0.0	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.00	DISCHG	0.0	0.0	0.0	0.0	0.01	0.06	0.28	1.56	8.05	45.48
12.00	DISCHG	124.00	185.97	234.39	326.48	432.32	547.96	669.81	808.84	978.41	1163.73
14.00	DISCHG	1345.22	1482.54	1557.82	1559.83	1501.45	1404.04	1283.84	1157.36	1034.91	922.38
16.00	DISCHG	823.08	737.57	665.26	604.43	553.69	510.84	474.89	443.85	417.45	394.08
18.00	DISCHG	373.71	355.62	339.62	325.67	313.39	302.45	292.53	283.40	274.73	266.28
20.00	DISCHG	258.17	250.54	243.33	236.77	230.65	225.22	220.53	216.34	212.21	208.01
22.00	DISCHG	204.03	200.28	196.66	193.07	189.41	186.08	183.29	180.90	178.49	175.87
24.00	DISCHG	173.26	169.79	165.19	160.64	155.49	149.55	143.10	135.88	127.96	118.86
26.00	DISCHG	108.25	96.28	83.23	70.04	57.36	45.96	36.13	27.99	21.46	16.31
28.00	DISCHG	12.36	9.33	7.06	5.34	4.07	3.10	2.38	1.83	1.41	1.09
30.00	DISCHG	0.84	0.65	0.49	0.38	0.29	0.21	0.16	0.11	0.08	0.05
32.00	DISCHG	0.03	0.01	0.0							

SUBROUTINE REACH CROSS SECTION 9

TIME		HYDROGRAPH, TZERO= 0.0				DELTA T= 0.20			DRAINAGE AREA= 11.11		
0.0	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.01	0.07	0.36	1.89
12.00	DISCHG	10.40	38.53	88.43	143.97	203.58	279.94	372.55	477.97	594.59	726.86
14.00	DISCHG	879.58	1048.26	1217.66	1363.73	1465.17	1509.02	1495.84	1436.04	1343.69	1233.42
16.00	DISCHG	1117.33	1004.16	899.47	806.10	724.94	655.55	596.82	547.26	505.42	469.85
18.00	DISCHG	439.45	413.16	390.25	370.14	352.45	336.92	323.25	311.14	300.27	290.38
20.00	DISCHG	281.16	272.40	264.05	256.12	248.66	241.70	235.27	229.45	224.27	219.60
22.00	DISCHG	215.22	210.98	206.90	203.01	199.26	195.58	191.97	188.57	185.52	182.80
24.00	DISCHG	180.21	177.63	174.91	171.67	167.79	163.45	158.59	153.12	147.04	140.29
26.00	DISCHG	132.77	124.25	114.50	103.48	91.40	78.80	66.30	54.53	43.95	34.80
28.00	DISCHG	27.17	20.98	16.06	12.23	9.28	7.04	5.35	4.07	3.11	2.38
30.00	DISCHG	1.83	1.40	1.08	0.83	0.64	0.49	0.37	0.28	0.21	0.15
32.00	DISCHG	0.11	0.07	0.05	0.03	0.01	0.0				

SUBROUTINE ADDHYD CROSS SECTION 109

TIME		HYDROGRAPH, TZERO= 0.0				DELTA T= 0.20			DRAINAGE AREA= 23.41		
0.0	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.00	DISCHG	0.0	0.0	0.0	0.0	0.0	0.0	0.14	1.38	10.75	72.06
12.00	DISCHG	249.55	554.03	984.45	1595.09	2300.82	2850.72	3070.11	2989.20	2764.04	2545.62
14.00	DISCHG	2401.30	2335.96	2324.32	2328.74	2317.05	2269.54	2182.68	2062.91	1921.42	1770.32
16.00	DISCHG	1619.61	1476.56	1345.30	1227.98	1125.51	1037.70	963.53	901.41	849.71	805.87
18.00	DISCHG	767.55	732.91	700.76	670.87	643.32	618.09	595.36	575.47	558.53	543.97
20.00	DISCHG	531.00	518.88	506.81	494.28	481.36	468.82	457.42	447.23	437.81	429.19
22.00	DISCHG	422.12	416.76	411.99	406.40	399.43	391.66	384.04	376.86	369.87	363.34

24.00	DISCHG	358.09	353.25	345.97	334.45	316.90	292.03	261.36	229.39	200.66	177.13
26.00	DISCHG	158.11	141.82	126.74	112.00	97.28	82.80	68.98	56.28	45.07	35.51
28.00	DISCHG	27.61	21.25	16.23	12.33	9.34	7.08	5.35	4.07	3.11	2.38
30.00	DISCHG	1.83	1.40	1.08	0.83	0.64	0.49	0.37	0.28	0.21	0.15
32.00	DISCHG	0.11	0.07	0.05	0.03	0.01	0.0				

ENDCMP