FINAL REPORT

LATERAL DRAINAGE

OF

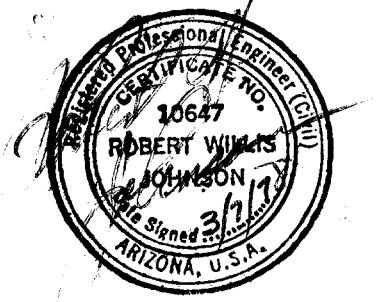
INDIAN BEND WASH PROJECT

FOR

FLOOD CONTROL DISTRICT

OF

MARICOPA COUNTY, ARIZONA



Prepared by

SULLIVAN & MASSON
CONSULTING ENGINEERS
PHOENIX, ARIZONA

SULLIVAN & MASSON
CONSULTING ENGINEERS
PHOENIX / TUCSON, ARIZONA

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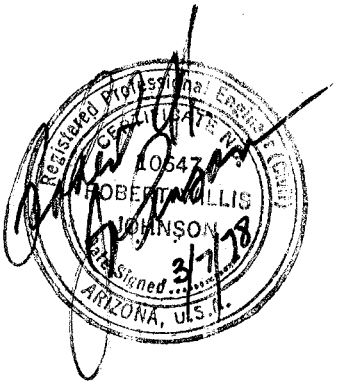
APPENDIX



FIGURES & EXHIBITS

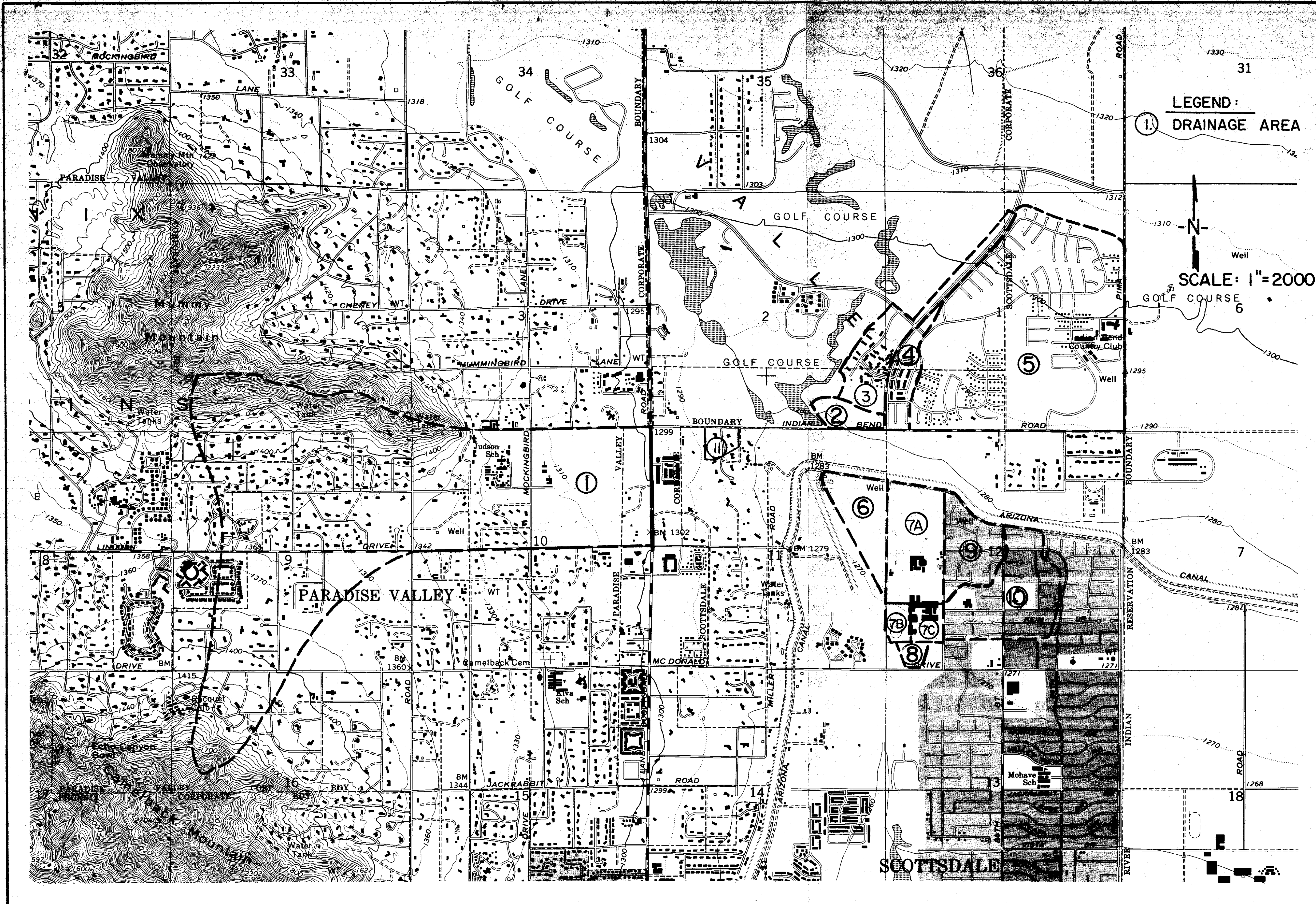
INDIAN BEND WASH PROJECT
DRAINAGE STUDY

1. OBJECTIVE

This study was initiated by the Flood Control District of Maricopa County, Arizona, for the purpose of determining the 100-year flood flows and alternative methods for handling these flows which would be diverted by the Indian Bend Wash Inlet Project. The drainage study is to include an evaluation of the flows at the intersections of Indian Bend Road with Scottsdale Road and with Hayden Road. It is also to include an area east of Hayden Road, south of the Arizona Canal, and north of Valley Vista Lane.

2. GENERAL INVESTIGATION

Drainage areas were developed from available aerial topography within the study area and additional aerial photography flown for the study. All drainage delineation as shown on Plate No. 1 was verified by field inspection of the study area. Flows for the 100-year flood were developed using the procedures outlined in the manual, "Hydrologic Design for Highway Drainage in Arizona", published by the Arizona Highway Department. The Arizona Highway Department uses two basic methods for computing runoff from small drainage basins, the Soil Conservation Service Method and the Rational Method.



SCALE 1" = 2000'

DATE NOV., 1977

SULLIVAN & MASSON

CONSULTING ENGINEERS

PHOENIX, ARIZONA

INDIAN BEND WASH INLET PROJECT

LATERAL DRAINAGE

VICINITY MAP

PLATE I

3. HYDROLOGIC INVESTIGATION

Flows were developed for four different areas as indicated on Plate No. 1: (1) Area west of Scottsdale Road shown as Area Number 1; (2) Areas north of Indian Bend Road between Pima Road and Indian Bend Wash shown as Area Numbers 2, 3, 4, 5; (3) Area east of Indian Bend Wash south of the Arizona Canal shown as Area Numbers 6, 7, 8, 9, and 10, and (4) Area south of Indian Bend Road shown as Area 11. For Area Number 1, the "Soil Conservation Method" was used for computing the runoff. Although this area is basically an urban area, the one acre zoning and the nature of the terrain indicated that the S.C.S. "Unit Hydrograph Approach" would yield the most realistic results of the study.

Because of the size of the areas, and the extent of existing and anticipated development in the areas east of Indian Bend Wash, the Rational Method was used for computing the runoff.

A. Rainfall

Rainfall Depth - Duration Frequency curves were developed for the study area from the precipitation maps prepared by the U.S. Weather Bureau. Rainfall amounts for the 100-year frequency with durations of 5 minutes to 24 hour durations are shown on Plate No. 2.

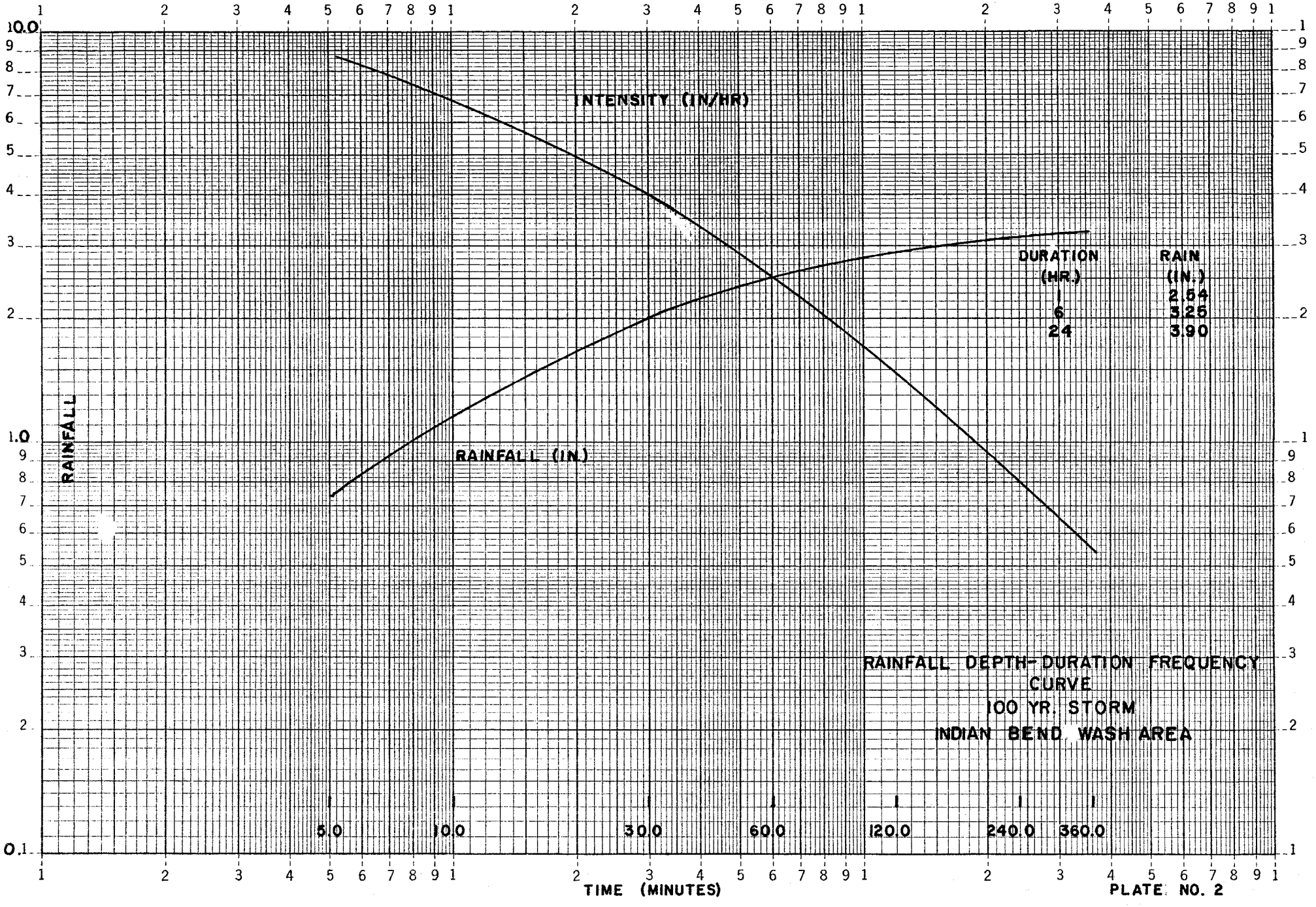


PLATE NO. 2

B. Rainfall-Runoff.

Runoff for the unit hydrograph method was computed using the S.C.S. "Runoff Curve Number" procedure. The curve number is indicative of the amount of runoff a storm will produce depending on the land use, type of vegetation, and the hydrologic soil group. The general vegetation in the area west of Scottsdale Road is desert brush with an estimated density of 15%. The hydrologic soil group in this area is Group "C". Based on these combined factors, a runoff curve number of 89 was used.

In the two study areas east of Indian Bend Wash, the urbanization consists primarily of single-family homes with some multi-family units. The ASCE manual "Design and Construction of Sanitary and Storm Sewers", dated 1969, shows a range of Runoff Coefficients for the Rational Method as follows:

Description of Area	Runoff Coefficients
Residential	
Single Family	0.30 - 0.50
Multi-Units	0.40 - 0.60

A conservative runoff coefficient of 0.50 was selected for use in the study.

4. RESULTS OF STUDY

A. Area 1.

This area of 1.43 square miles begins on the north slope of Camelback Mountain and flows for 2.4 miles in an easterly direction, draining the area bounded on the north by Indian Bend Road, and, generally, Lincoln Drive on the south. The drainage flows through a fairly well defined wash north of Lincoln Drive until it reaches a point just west of Scottsdale Road. At this point, the flows become divided sheet flow breaking to the northeast and the southeast. The flows that find their way to Indian Bend Road and ultimately Indian Bend Wash are the flows this study is concerned with. The total 100-year flow for Area No. 1 was computed to be 1,235 CFS. A complete breakdown of the computations is shown on Exhibit No. 1. Of the total 100-year flow reaching Scottsdale Road, 640 CFS is estimated to flow northeasterly and 595 CFS southeasterly as shown on Exhibit No. 2.

75 CFS of the total northeasterly flow (640 CFS) will pass under Scottsdale Road via CMP culverts located along the roadway as shown on Exhibit No. 3. The remaining runoff, 565 CFS will flow to the north paralleling Scottsdale Road to its intersection with Indian Bend Road. At this point 55 CFS will be carried under Scottsdale Road directly into McCormick Railroad Park while 250 CFS will pass over Indian Bend Road and flow

EXHIBIT NO. 1

HYDROLOGIC DESIGN DATA SHEET

S C S METHOD: PART I

LOCATION DATA:

Highway Indian Bend Road @ Scottsdale Rd. County _____

Location _____

Project No. Indian Bend Wash Station _____

Name of Stream Area No. 1

DESIGN DATA:

Design Frequency	100	years
Drainage Area	1.43	square miles
Drainage Length	12,700	feet
Elevation		
Top of Drainage Area	2,000	feet
At Structure	1,300	feet
Drainage Area Slope	5.4	%
Drainage Width	3,800	feet
Width factor W_f	0.89	
Vegetative Cover Type	Desert Brush	
Vegetative Cover Density	15	%
Soil Group	C	
Precipitation		
P = 6 hour =	3.25	inches
P = 24 hour =	3.90	inches

DESIGN COMPUTATION:

Precipitation	P = 1 hour =	2.54	inches
Curve Number		89	
Runoff	Q =	1.50	inches
Time of Concentration	Tc	0.95	hours
Time of Peak	$Tp = (Tc)(W_f)$	0.84	hours

Peak Discharge $Qp = \frac{484AQ}{Tp} = \frac{484(1.43)(15)}{0.84}$

$= 1,235$ cfs

Computed by D. Gilbertson Date 1/6/78

(1) STA	Slope	T_c
0+00 - 16+00 = S1 = 650/1600 =	35%	0.06 Hr.
16+00 - 127+00 = S2 = 140/11,100 =	1.3%	0.89 Hr.
	Total	0.95 Hr.

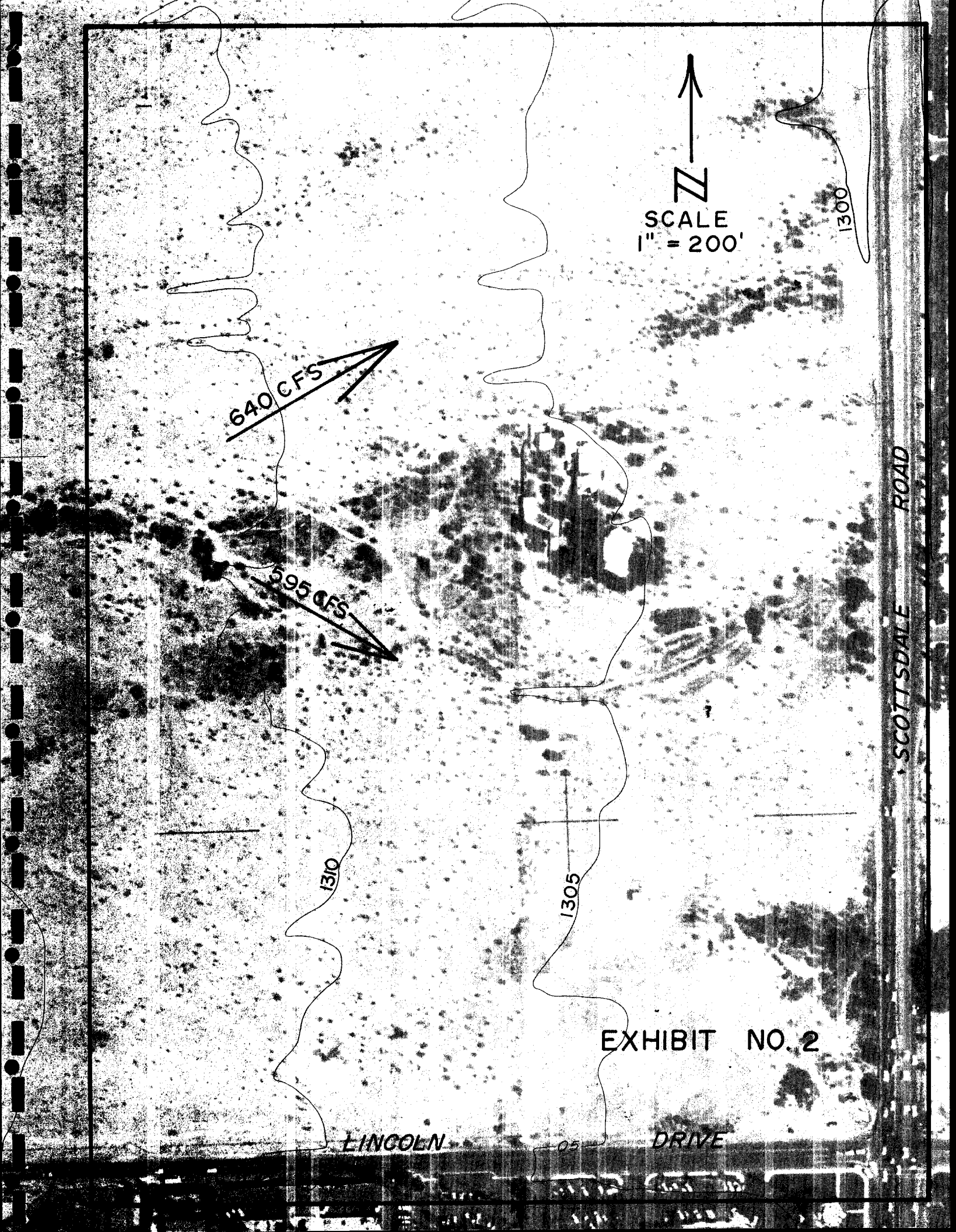

N
SCALE
1" = 200'
640 CFS
595 CFS
1300
1310
1305
SCOTTSDALE ROAD
LINCOLN DRIVE

EXHIBIT NO. 2

250 CFS

1 - 22"X36" CMP

45 CFS

260 CFS

55 CFS

IND. BEND RD.

350 CFS

NEW CHANNEL
700 CFS

NEW BOX CULVERT

375 CFS

2-EA. 29"X18"
CMP

BEGIN PROJECT

FLOW INTO
INTERSECTION
565 CFS

X935

1-EA. 29"X18"
CMP

25 CFS

X890

2-EA. 29"X18"
CMP

SCOTTSDALE RD

50 CFS

640 CFS
N.E.

85

SCALE
1" = 200'

EXHIBT NO. 3

DIVISION OF FLOW INDIAN BEND
AND SCOTTSDALE ROAD

northward along Scottsdale Road. 260 CFS will flow easterly across the intersection into Indian Bend Road, this flow will be divided equally between east and west bound traffic lanes. A contemporaneous flow of 45 CFS will flow under Scottsdale Road through a CMP culvert located immediately north of the intersection. See Appendix A and Exhibit No. 3 for further information regarding the division of flow at the intersection of Scottsdale Road and Indian Bend Road.

To accommodate runoff intercepted by the vertical relocation of Indian Bend Road, a drainage structure is required under the roadway approximately 1200 feet east of Scottsdale Road. The facility should be designed to have a capacity of 375 CFS. Also an open channel is required north of and parallel to Indian Bend Road from the projects beginning to Indian Bend Wash. The design capacity of this channel should be 700 CFS. See Exhibit No. 3 for location, and design flows for the aforementioned improvements.

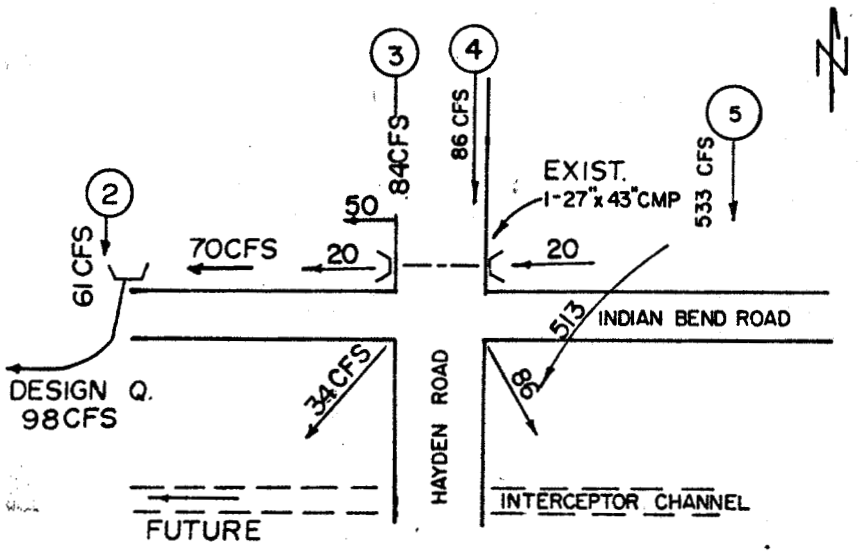
B. Areas 2, 3, 4 & 5.

These areas have a combined drainage area of 0.8 square miles and are located on the north side of Indian Bend Road between Indian Bend Wash and Pima Road. Each of the areas drain south to Indian Bend Road. The 100-year peak flow was computed using the

Rational Method for each of these areas as shown below:

Area No.	Drainage Area (AC)	100-Yr. Discharge (CFS)
2	18	61
3	42	84
4	32	86
5	418	533

Complete computations are shown on Exhibit No. 4. The direction and estimated 100-year flow at the intersection of Indian Bend Road and Hayden Road are shown below:



Except for 20 CFS that flows west through the culvert under Hayden Road, all runoff from Area No. 5 will cross Indian Bend Road and flow into the interceptor channel when it is constructed. Runoff from Area No. 4 flows south across the intersection and will drain

EXHIBIT NO. 4

INDIAN BEND WASH PROJECT

INDIAN BEND ROAD
AT
HAYDEN ROAD

AREA NO.		2	3	4	5
DRAINAGE AREA (AC)		18	152	32	418
Length	(Ft.)	1,560	5,500	3,200	6,800
Elev. (Max.)	(Ft.M.S.L.)			1,292	1,307
Elev. (Min.)	(Ft.M.S.L.)			1,282	1,281
Elev.	(Ft.)			10	26
Slope	(%)	0.30(1)	0.31(1)	0.31	0.38
Vel.	(Ft./Sec.)	2.5(2)	3.2(2)	3.2(2)	
T_c	(Min.)	11	29	17	60(3)
C		0.50	0.50	0.50	0.50
I	(In/Hr.)	6.80	4.0	5.40	2.55
A	(AC)	18	42	32	418
Q = CIA	(CFS)	61	84	86	533

(1) Based on Street Plans

(2) Based on Est. Vel. of Flow In Street

(3) $T_c = \frac{.04593\ L^{.77}}{S^{.385}}$ (KIRPICH EQUATION)

directly into the proposed interceptor channel. Area No. 3 flows down the west side of Hayden Road to its intersection with Indian Bend Road. At this point 50 CFS would enter a ditch adjacent Indian Road, and flow west into Indian Bend Wash. Since the roadside ditch has a maximum capacity of 70 CFS, 34 CFS from Area No. 3 would flow across the intersection. Area No. 2 discharges directly into Indian Bend Road via 78th Place.

Vertical relocation of Indian Bend Road will necessitate construction of a storm drain sized to accommodate approximately 98 CFS. The inlet for this facility should be constructed on the east side of 78th Place north of Indian Bend Road. The outlet would discharge directly into the wash some 1100 feet to the west. A flap gate will be required on this facility. Appendix B contains calculations regarding the division of flows for the intersection of Indian Bend and Hayden Roads.

C. Areas 6, 7, 8, 9 & 10.

These areas are located south of the Arizona Canal and flow southerly, ultimately discharging into Indian Bend Wash. The 100-year peak flows computed using the Rational Method are shown below:

Area No.	Drainage Area (AC)	100-Yr. Drainage (CFS)
6	51	84
7A	80	156
7B	13	62
7C	9	29
8	8	20
9	48	96
10	97	150

Complete computations are shown on Exhibit No. 5. Under project conditions Area No. 6 will drain directly to Indian Bend Wash. Area No. 7 will drain generally to the south and southwest to the intersection of Valley Vista and Hayden Road. Area No. 8 is on a fill and drains to the intersection of Valley Vista and Hayden Road. Runoff from Areas No. 9 and No. 10 (145 acres) flow to the south along 82nd Street, dividing eventually entering Indian Bend Wash. During peak flows, runoff from Areas No. 9 and No. 10 is diverted through the Saguaro High School grounds and along Valley Vista Lane west to Hayden Road. A diagram showing the direction and quantity of flows for the 100-year flood is shown on Exhibit No. 6. See Appendix C detailed hydrologic and hydraulic data.

The vertical relocation of Hayden Road and Valley Vista Lane and attendant flood wall construction will intercept storm water generated Areas Nos. 7 thru 10. To accommodate these flows, several side drains

EXHIBIT NO. 5

INDIAN BEND WASH PROJECT

HAYDEN ROAD

AT

VALLEY VISTA AVENUE

AREA NO.	6	7A	7B	7C	8	9	10
DRAINAGE AREA (AC)	51	80	9	13	8	48	97
Length (Ft.)	3,200	2,800	800	800	900	2,700	4,200
Elev. (Ft.)	7.0	10.0	3.0	2.0	0.5	10.0	12.0
Slope (Ft/Ft.)	0.0022	0.0036	0.0038	0.0025	0.0006	0.0037	0.0029
T_c (1) (Min.)	41	31	11	14	21	30	46
C (Fig. 3-3)	0.5	0.5	0.5	0.8	0.5	0.5	0.5
I (In/Hr.)	3.3	3.9	6.5	6.0	4.9	4.0	3.1
A (Ac)	51	80	9	13	8	48	97
Q = CIA (CFS)	84	156	29	62	20	96	150

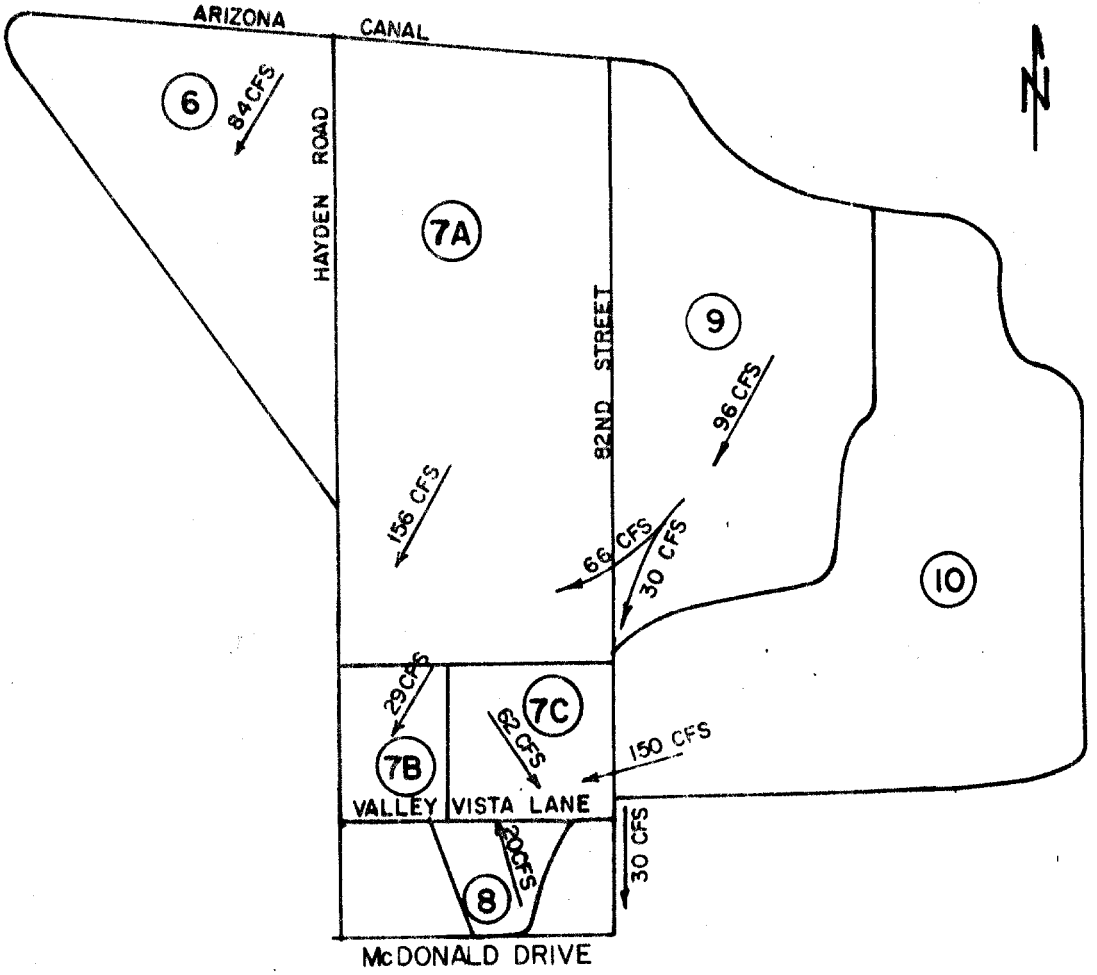
(1) KIRPICH EQUATION $T_c = \frac{.04593}{S^{.385}} L^{.77}$

EXHIBIT NO. 6

INDIAN BEND WASH PROJECT

HAYDEN ROAD AT VALLEY VISTA LANE

DIVISION OF FLOWS



are required. Exhibit No. 7 depicts the location and design flows for each drainage structure. Following is a brief description of each storm drain.

Hayden Road

A side drain is required approximately 2000 feet north of McDonald to replace the existing 24" reinforced concrete pipe that will be abandoned with flood wall construction. The structure should be considered a replacement facility and have a design capacity of 11 CFS. See Sheet C-2.

Valley Vista Lane
Areas 7A & 7B

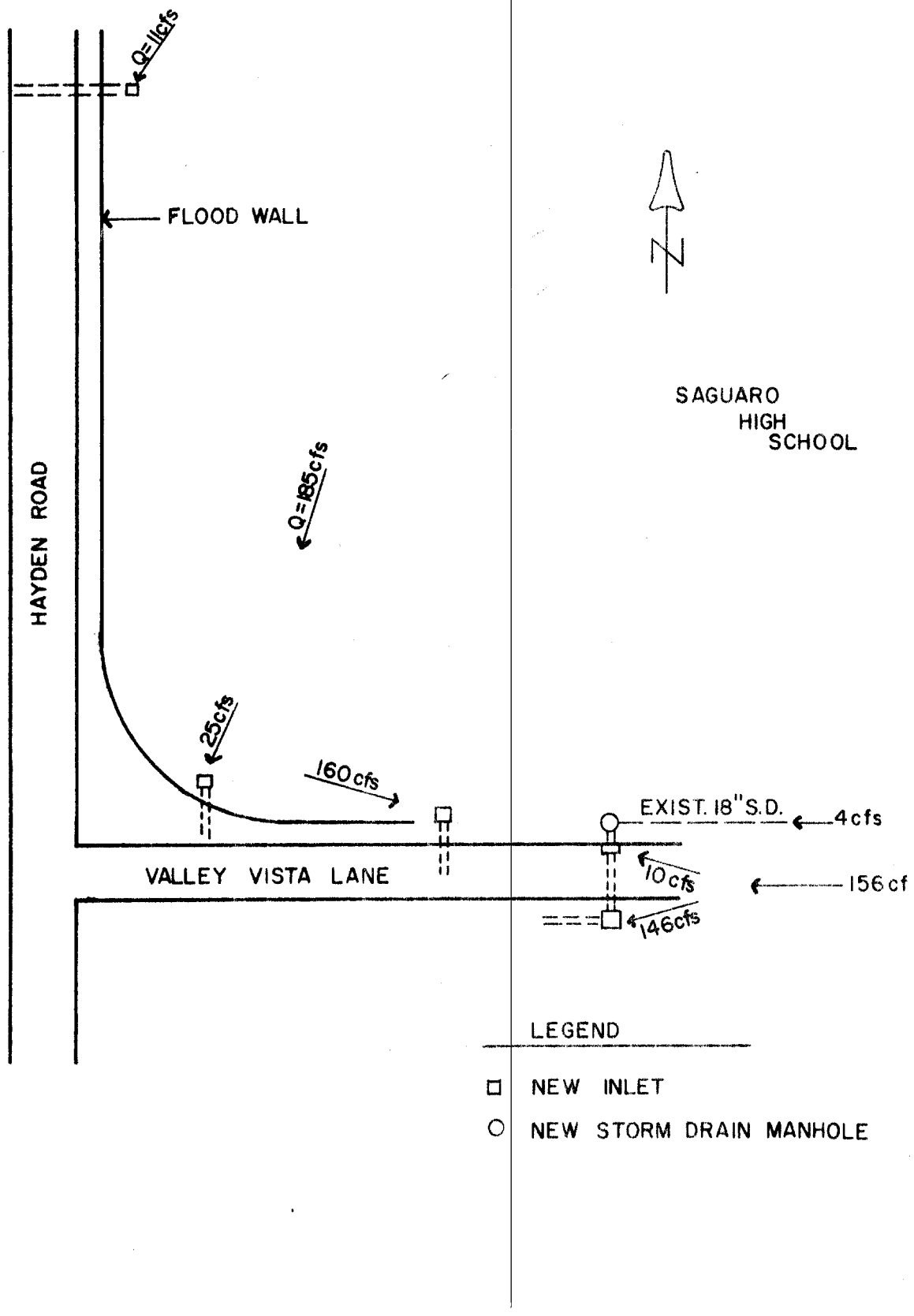
Storm water generated in Areas 7A and 7B, 185 cfs will flow to southwest corner of Area 7B where it will be intercepted by the flood wall. An inlet should be constructed approximately 170 feet east of Hayden Road adjacent to flood wall. The design capacity should be 25 CFS. A second inlet should be located approximately 450 feet east of Hayden Road to accommodate the remaining 100-year flow of 160 CFS.

The 66 CFS diverted from Area 9 to Area 7A will not necessitate an increase in the 185 CFS design discharge due to a long flow time from 82nd Street to the inlet. Since the area north of Saguaro High School from Hayden Road to 82nd Street is irrigated playgrounds, a large shallow ponding area is created.

Areas 7C, 8 & 10

Storm water produced in these areas will be intercepted by the vertical relocation of Valley Vista Lane. Sheet No. 3 of Appendix C indicates the design flow for the combined areas to be 156 CFS. To accommodate this flow two structures should be constructed on the north and south sides of Valley Vista Lane approximately 680 feet east of Hayden Road.

EXHIBIT NO. 7
INDIAN BEND WASH PROJECT
SIDE DRAINS HAYDEN ROAD & VALLEY VISTA LANE



The first located on the north side of the roadway should be a curb inlet designed to accommodate 10 CFS while the second structure should be adjacent the south right-of-way line and have a capacity of 146 CFS.

A storm drain manhole should be constructed as shown on Exhibit No. 6 to intercept an existing 18" storm drain. The 18" reinforced concrete pipe must be abandoned when the flood wall is constructed and flow from it 4 CFS will have to be added to the 100-year discharge of Areas 7C, 8 and 10 when sizing the storm drain.

Exhibit No. 6 depicts the location and design flows of side drains required by the project at Hayden Road and Valley Vista Lane.

D. Area 11

Area 11 is located south of Indian Bend Road and west of the proposed hotel access road. See Figure 1. The 100-year peak flow from Area No. 11 computed by the rational method follows:

DRAINAGE AREA		11
SIZE	(Acres)	8.3
	Length	830
	Elev.	7.5
	Slope (Ft/Ft.)	0.009
	T_c (Min.)	8.5
	C	0.5
	I	72. in/hr.
	A (Ac)	8.3 Ac
	Q	30 CFS

$$T_c = \frac{0.04593}{S^{0.385}} L^{0.77}$$

To accommodate the 100-year runoff (30 CFS), a side drain is required, and should be located approximately 1950 feet east of Scottsdale Road. Since this facility

discharges directly into Indian Bend Road, a flap gate is required.

6. RECOMMENDATIONS

Following is a summary of the drainage improvements recommended in this report by location, type and maximum design flow.

LOCATION	TYPE	DESIGN FLOW CFS
Indian Bend Road Station 1		
17+90	Box Culvert	375
16+50 to 23+00	Open Channel	700
24+40	Side Drain w/Flap Gate	30
50+00	Side Drain w/Flap Gate	98
Hayden Road Station 2		
19+80	Side Drain w/Flap Gate	11
Valley Vista Lane Station 3		
1+70	Side Drain w/Flap Gate	25
4+50	Side Drain w/Flap Gate	160
6+80	Manhole	4
	Curb Inlet	10
	Headwall & Inlet	146

1. Intersection of Scottsdale Road and Indian Bend Road
   Monument line = 5+00

2. Intersection of McDonald Drive and Hayden Road
   Monument line = 0+00

3. Intersection of Valley Vista Lane and Hayden Road
   Monument line = 0+00

NOTE: Stationing proceeds south to north and east to west.

APPENDIX A

SULLIVAN & MASSON CONSULTING ENGINEERS
725 WEST McDOWELL ROAD — PHOENIX, ARIZONA 85007 — 602-257-8525

IND. BEND WASH S&M 7091

date: Sht. No. A-

by: D. GILBERTSON

ck:

- SHEETS A-2 THRU A-6 PRESENT CALS CONCERNING IND. BEND RD. · SCOTTSDALE RD DIVISION OF FLOWS.

- SHEETS A-7 THRU A-9 PRESENT DESIGN CALCS. FOR OPEN CHANNEL & BOX CULVERT RESPECTIVELY.

PROJECT: IND. BEND WASH

DESIGNER: D. GILBERTSON

DATE: _____

HYDROLOGIC AND CHANNEL INFORMATION

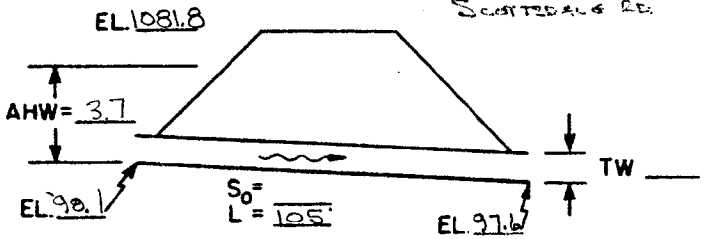
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100}).

SKETCH

STATION: 1280' N. INT. IND. BEND RD & SCOTTSDALE RD.



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q cfs	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	INLET CONT. HW	OUTLET CONTROL K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	OUTLET CONTROL HW	CONTROLLING H.W.	OUTLET VELOCITY	COST	COMMENTS
CMP HEADWALL	25EA	29"X 18"	2.5	3.7												
	15EA				0.5	2.8	1.2	1.4	1.4	1.4	0.5	3.7				

SUMMARY & RECOMMENDATIONS: USE 25 cfs EA. TOTAL 50 cfs MAX FLOW

5-18

Figure 7

A-2

PROJECT: IND. BEND WASH

DESIGNER: D. CAMPBELL

DATE: _____

HYDROLOGIC AND CHANNEL INFORMATION

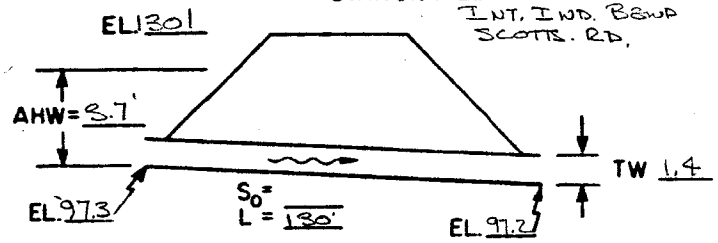
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100}).

SKETCH

STATION: 770' S INT. INT. IND. BEND SCOTTS. RD.



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	? Q cfs	1EA SIZE	HEADWATER COMPUTATION										CONTROLLING H.W.	OUTLET VELOCITY	COST	COMMENTS
			INLET CONT.		OUTLET CONTROL HW = H + h_o − LS_o											
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
CMP-ARCH HEADWALL	25	29"x 18"	2.5	3.7												
	13				0.5	2.4	1.2	1.4	1.4	1.4	0.1	3.7				

SUMMARY & RECOMMENDATIONS:

USE MAX Q = 25 cfs MAX FLOW

Figure 7

A-2

PROJECT: IND BEND WASH

DESIGNER: D. GILBERTSON

DATE: _____

HYDROLOGIC AND CHANNEL INFORMATION

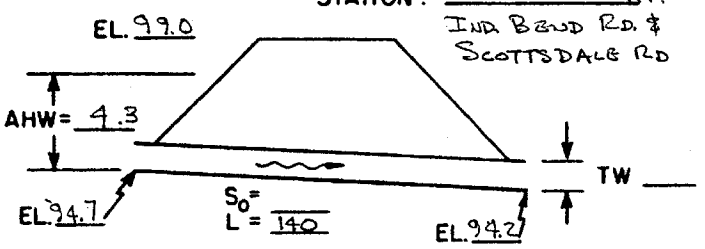
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: S. SIDE INT. IND BEND RD. & SCOTTSDALE RD



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	P Q cfs	2EA SIZE	HEADWATER COMPUTATION										CONTROLLING H W	OUTLET VELOCITY	COST	COMMENTS
			INLET CONT.		OUTLET CONTROL HW=H + h_o - LS_o											
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
CMP HEADWALL	28 EA	29"x 18"	2.9	4.3												
	17 EA				0.5	3.4	1.2	1.4	1.4	1.4	0.5	4.3				

SUMMARY & RECOMMENDATIONS:

28 cfs EA. TOTAL 56 cfs USE 55 cfs MAX. FLOW

Figure 7

5-18

A-4

PROJECT: IND. BEND WASH

DESIGNER: D. GILBERTSON

DATE: _____

HYDROLOGIC AND CHANNEL INFORMATION

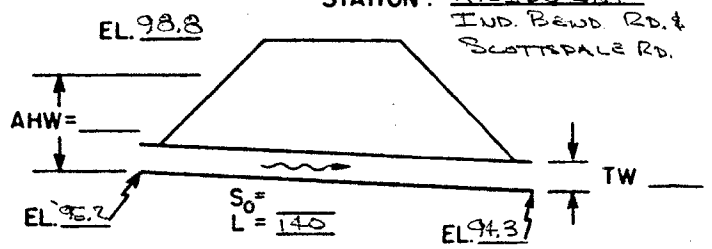
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100}).

SKETCH

STATION: N SIDE INT IND. BEND RD. & SCOTTSDALE RD.



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	P. Q cfs	1EA SIZE	HEADWATER COMPUTATION										CONTROLLING H.W.	OUTLET VELOCITY	COST	COMMENTS
			INLET CONT.		OUTLET CONTROL HW=H + h_o - LS_o											
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
HEADWALL CMP	45	36"X 22"	2.0	3.6												
	24				0.5	2.9	1.4	1.6	1.6	1.6	0.9	3.6				

SUMMARY & RECOMMENDATIONS:

USE 45cfs MAX. FLOW

5-18

Figure 7

A-51

SULLIVAN & MASSON CONSULTING ENGINEERS
725 WEST McDOWELL ROAD — PHOENIX, ARIZONA 85007 — 602-257-8525

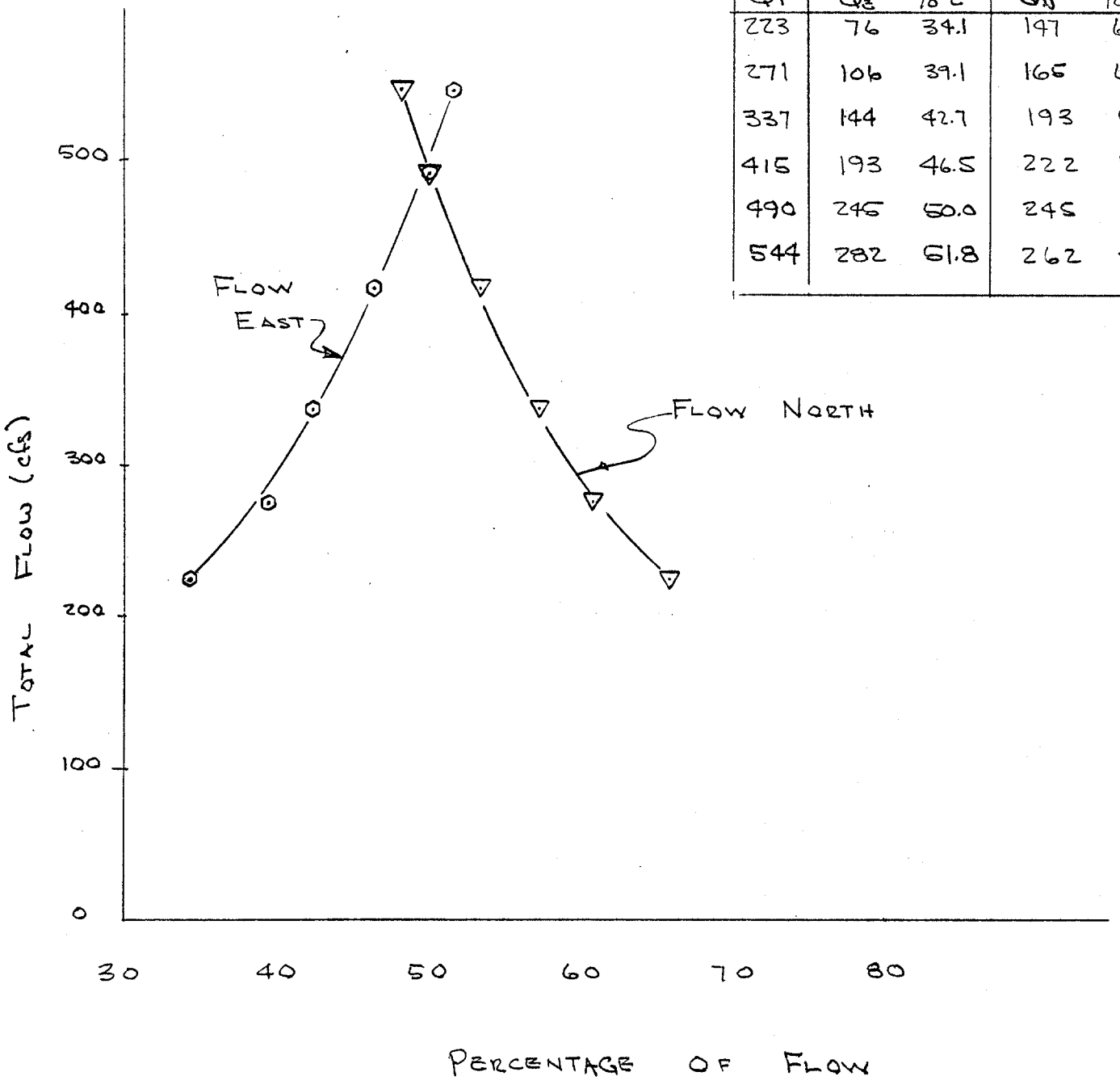
date: Sht. No.

INDIAN BEND WASH by:

ck:

DIVISION OF FLOWS AT SCOTTSDALE RD & INDIAN BEND RD.

	E. on Ind. Bend		N on Scottsdale Rd.	
Q_T	Q_E	% E	Q_N	% N
223	76	34.1	147	65.9
271	106	39.1	165	60.9
337	144	42.7	193	57.3
415	193	46.5	222	53.5
490	245	50.0	245	50.0
544	282	61.8	262	48.2



SULLIVAN & MASSON CONSULTING ENGINEERS
725 WEST McDOWELL ROAD — PHOENIX, ARIZONA 85007 — 602-257-8525

date: Sht. No. A-

by: D. GILBERTSON

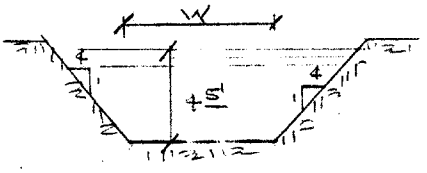
ck:

INDIAN BEND WASH SIM 7091

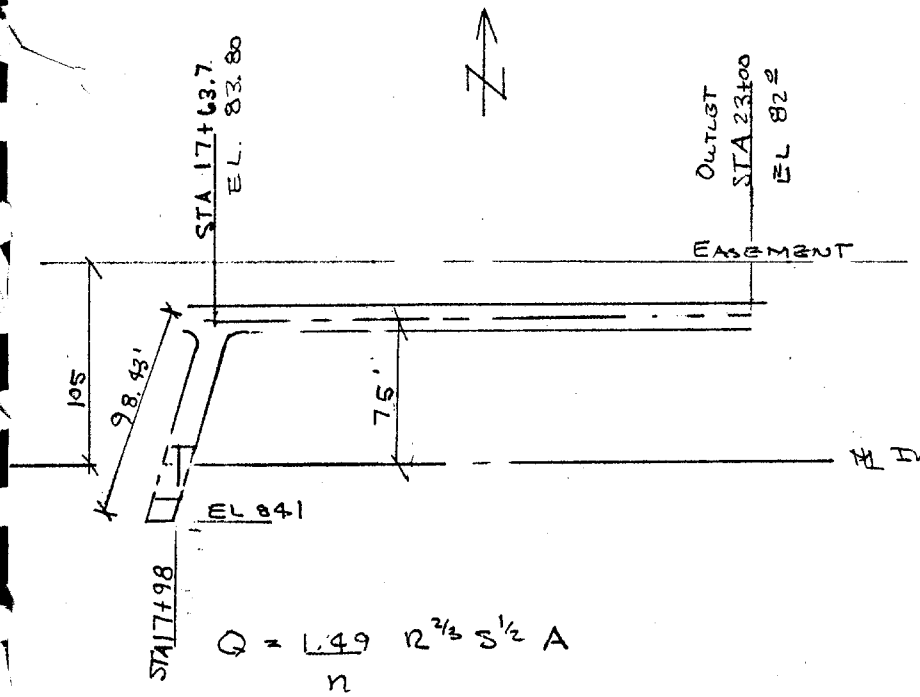
OPEN CHANNEL DESIGN 75' N IND. BEND. RD.

DESIGN Q = 700 cfs

n = 0.030



LOCATION 80' N. ℄ IWD BEND RD. (℄ CHANN



$$Q = \frac{1.49}{n} R^{2/3} S^{1/2} A$$

SLOPE = 0.0034/FT

$A = (W)(4.5) + (18)4.5$

$WP = W + 2(18.6)$

$WP = W + 37.2$

$R_H = \frac{4.5W+81}{W+37.2}$

$$700 = \frac{1.49}{0.03}\left(\frac{4.5W+81}{W+37.2}\right)^{2/3}(0.0034)^{1/2}(4.5W+81)$$

$$245.3 = \left(\frac{4.5W+81}{W+37.2}\right)^{2/3}(4.5W+81)$$

$$(245.3)^{3/2} = \frac{(4.5W+81)(4.5W+81)^{3/2}}{W+37.2}$$

$$(3841.9)(W+37.2) = (4.5W+81)(4.5W+81)^{3/2}$$

$$3841.9W + 14,291.7 = (4.5W+81)^{5/2}$$

OR

$$142,918.7 = (4.5W+81)^{5/2} - 3841.9W$$

W TRY 10.

$142,918.7 \neq 139,788.6$

W TRY 10.5

$142,918.7 \neq 145,930.3$

USE W = 10.5'

SULLIVAN & MASSON CONSULTING ENGINEERS
725 WEST McDOWELL ROAD — PHOENIX, ARIZONA 85007 — 602-257-8525

IND. BEND WASH - S&M 7091

date: Sht. No. A-6

by: D. GILBERTSON

ck:

CK CAPACITY WITH W = 10.5'

$Q = V A$

$Q = (5.5 fps)(128.2 Ft^2)$

$Q = \underline{705}$ cfs

$\therefore$ OK

Use $W = \underline{10.5}'$

$V = \frac{1.49}{n} R^{2/3} S^{1/2}$

$V = \frac{1.49}{0.03}\left(\frac{128.2}{47.7}\right)^{2/3}(0.0033)^{1/2}$

$V = 5.5$ fps

$n = 0.030$

$A = (10.5)(4.5) + \left[\frac{(18)(4.5)}{2}\right]2$

$A = 128.2 Ft^2$

$WP = 10.5 + 37.2$

$= \underline{47.7}$

$S = 0.0033'/Ft$

PROJECT: IND. BAND
VYASH

DESIGNER: D. GILBERTSON

DATE: _____

HYDROLOGIC AND CHANNEL INFORMATION

DESIGN Q = 375 cfs

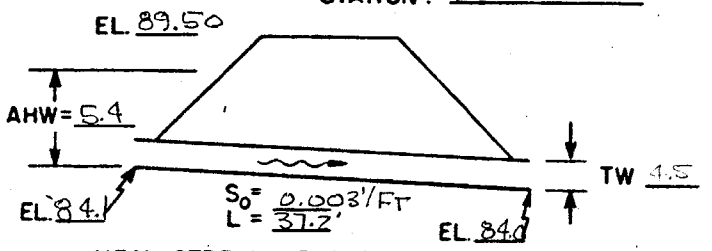
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100}).

SKETCH

STATION: 17+91



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	cfs Q	Ht. SIZE & MAT	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o-LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
BOX, HEADWALL 90°	30/FT	3.8	1.4	5.4												REQ WIDTH = 12.5
	37				0.5	1.0	–	–	4.5	4.5	0.1	5.4				REQ AREA 60 SF

SUMMARY & RECOMMENDATIONS: USE BOX CULVERT WITH MIN. AREA OF 60 SF. (3.8' X 16')

5-18

Figure 7

A-9

APPENDIX B

SULLIVAN & MASSON CONSULTING ENGINEERS
725 WEST McDOWELL ROAD — PHOENIX, ARIZONA 85007 — 602-257-8525

date: Sht. No. B-

IND. BEND. WASH S&M7091

by: D. GILBERTSON

ck:

- SHEET B-2 PROF IND. BEND RD.
- SHEET B-3 CMP CULVERT CAP. UNDER HAYDEN RD.
- SHEET B-4 ROADSIDE DITCH CALS
- SHEET B-5 CMP STORM DRAIN CAPACITY
- SHEET B-6 THRU B-8 HYDROGRAPH CALCS

SULLIVAN & MASSON CONSULTING ENGINEERS
725 WEST McDOWELL ROAD — PHOENIX, ARIZONA 85007 — 602-257-8525

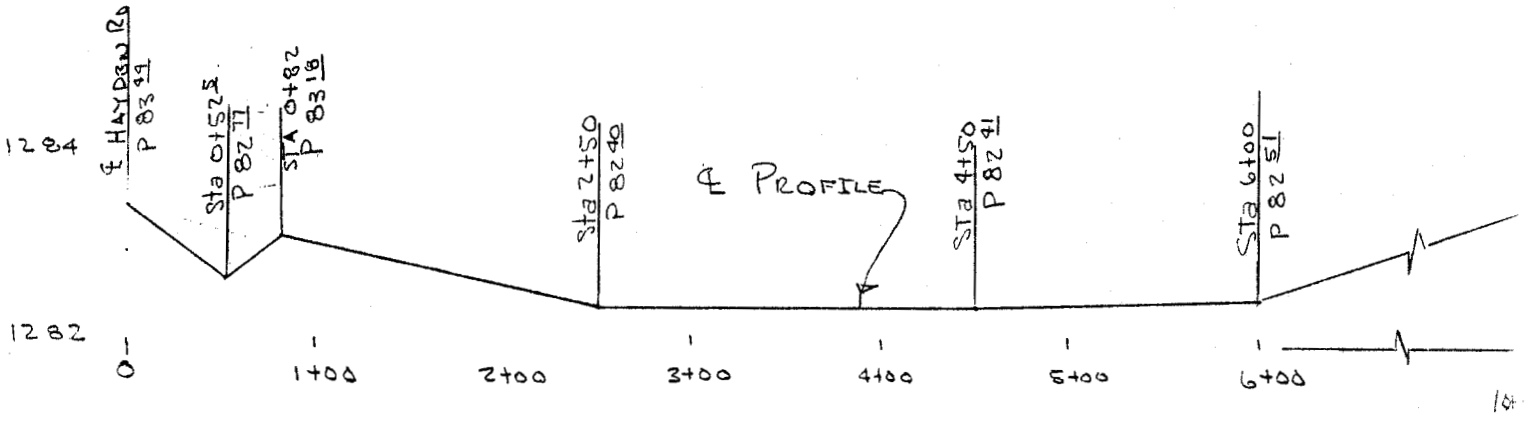
date: Sht. No. B-2

by: D. GILBERTSON

ck:

IND. BEND WASH - S&M 7091

WEIR FLOW OVER INDIAN BEND RD E. OF HAYDEN RD



CHECK WEIR CAPACITY (STA 2+50 TO 4+50, D=1')

$Q = CLH^{3/2}$ $C = 2.6$, $L = 100.$ $H = 1'$

$Q = (2.6)(200')(1)^{1.5}$

$Q = 520$ cfs

TOTAL WEIR CAPACITY > THAN TOTAL 533CFS Q FROM AREA 5

PROJECT: Indian Bend Wash

S & M 7091

DESIGNER: _____

DATE: _____

HYDROLOGIC AND CHANNEL INFORMATION

Q_1 = _____ TW_1 = _____

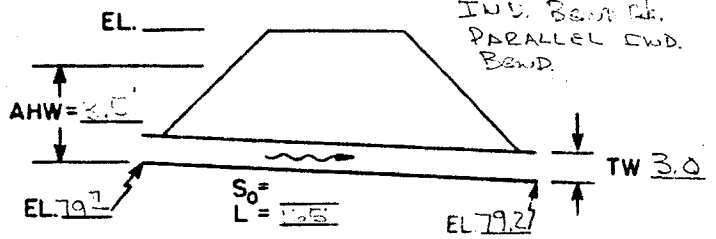
Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

N. Side

STATION: Int. Hayden & Int. Bend Rd. Parallel Cwd. Bend



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION										CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			INLET CONT.		OUTLET CONTROL HW=H + h_o − LS_o											
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
CMP Headwall	45	48" 27	1.55	3.6												
	70	48" 27			0.5	1	/	/	3.0	3.0	0.5	3.5				

SUMMARY & RECOMMENDATIONS:

Since Ditch at Outlet End will likely be Full use Outlet Control Cond. 20 cfs

Figure 7

5-18

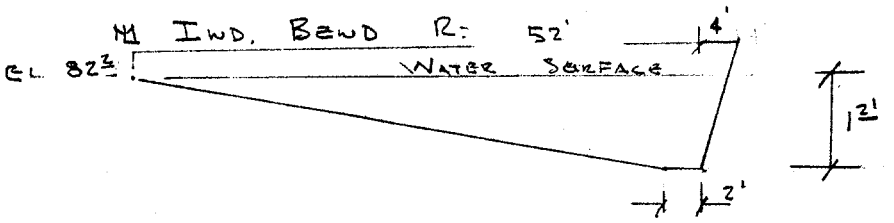
B-13

IND. BEND WASH S&M 7091

SULLIVAN & MASSON CONSULTING ENGINEERS
725 WEST McDOWELL ROAD — PHOENIX, ARIZONA 85007 — 602-257-8525

DITCH CAPACITY CALCS - EXISTING DITCH - N. SIDE IND BEND RD.

- DITCH CAPACITY STA 54+95



A = 35 FT²
WP = 56 , n = 0.022
S = 0.0033'/FT

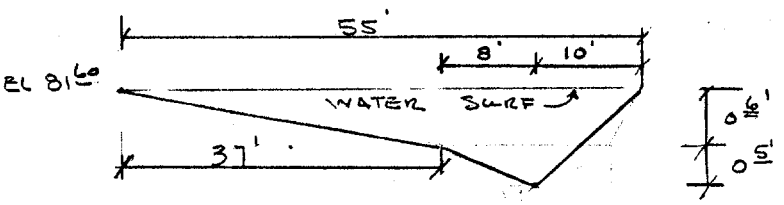
$$Q = \frac{1.49}{n} R^{2/3} S^{1/2} A$$

$$Q = \frac{1.49}{0.022}\left(\frac{35}{56}\right)^{2/3}(0.0033)^{1/2}(35\ Ft^2)$$

$$Q = (1730.1)(0.0033)^{1/2}$$

$$Q = 94\ CFS$$

- DICH CAPACITY STA 52+00



A = 23 SF
WP = 57' S = 0.0033'/FT
n = 0.022

$$Q = \frac{1.49}{n} R^{2/3} S^{1/2} A$$

$$Q = \frac{1.49}{0.022}\left(\frac{23}{57}\right)^{2/3}(0.0033)^{1/2}\ 23$$

$$Q = 48\ cfs$$

AVG CAPACITY $\frac{94 + 48}{2} \cong 70 cfs$ USE 70 CFS

IND. BEND WASH

date: Sht. No. 5

by: D. GILBERTSON

ck:

SULLIVAN & MASSON CONSULTING ENGINEERS
725 WEST McDOWELL ROAD — PHOENIX, ARIZONA 85007 — 602-257-8525

CAPACITY OF 43" X27" CMP PARALLEL HAYDEN RD N. IND. BEND.

USING MANNING EQ

$Q = \underline{20}$ cfs

$S = 0.003'/FT$

$n = 0.024$

Eq. PIPE DIA 36"

SULLIVAN & MASSON CONSULTING ENGINEERS
725 WEST McDOWELL ROAD — PHOENIX, ARIZONA 85007 — 602-257-8525

CAL. OF PEAK FLOW INTERCEPTED BY VERT. RELOCATION OF IND. BEND RD. - STRUCTURE LOC. - STA. 50+00 -

CONTRIBUTING DRAINAGE AREAS

-(A) AREA 2 · VIA 78TH PLACE

-(B) AREA 3 INTO ROADSIDE DITCH N. SIDE IND. BEND. RD. VIA
- 43"X27" CMP W. SIDE HAYDEN RD.
- OVERFLOW OF CURB AT INT OF HAYDEN & IND. BEND. RD.

(C) AREA 5 VIA 43"X27" CMP UNDER HAYDEN RD.

HYDROGRAPH SHOWN ON SHT B-

T_1 = FLOW TIME FROM INT OF IND. BEND RD & HAYDEN RD (STA 56+50±) TO STRUCTURE STA 50+00 (AREA 3)

$T_1 = L_1/V_1$ V_1 = VEL IN ROADSIDE DITCH

$V_1 = \frac{70 cfs}{29 FT^2} = 2.4 fps$

$T_1 = \frac{650'}{(2.4 fps)(60 sec/min)}$ SEE SHT B-

$T_1 = 4.5 min$

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725 WEST McDOWELL ROAD — PHOENIX, ARIZONA 85007 — 602-257-8525

date: Sht. No. B-

IND. BEND WASH S&M 7091

by: D. GILBERTSON

ck:

T_2 = FLOW TIME FROM OUTLET OF AREA 5 (1150' EAST OF INT HAYDEN & IND. BEND) TO STRUCTURE

$T_2 = L_2/V_2$ V_2 = USE 2.4'/SEC FROM PREVIOUS CALS

$T_2 = \frac{(1150' + 650')}{(2.4'/\text{sec})\ 60\ \text{sec/min}}$

$T_2 = 12.5$ min

NOTE: DESIGN Q= 98 cfs, 50 & 20 cfs MAX FLOWS FROM AREAS 3 & 5 RESPECTIVELY ARE BASED ON LIMITING CAPACITY OF

1) ROADSIDE DITCH ADJACENT IND BEND RD 70 cfs CAP.
2) 43"X27" CMP UNDER IND. BEND RD. 20 cfs CAP.

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725 WEST McDOWELL ROAD — PHOENIX, ARIZONA 85007 — 602-257-8525

date: Sht. No. B-9

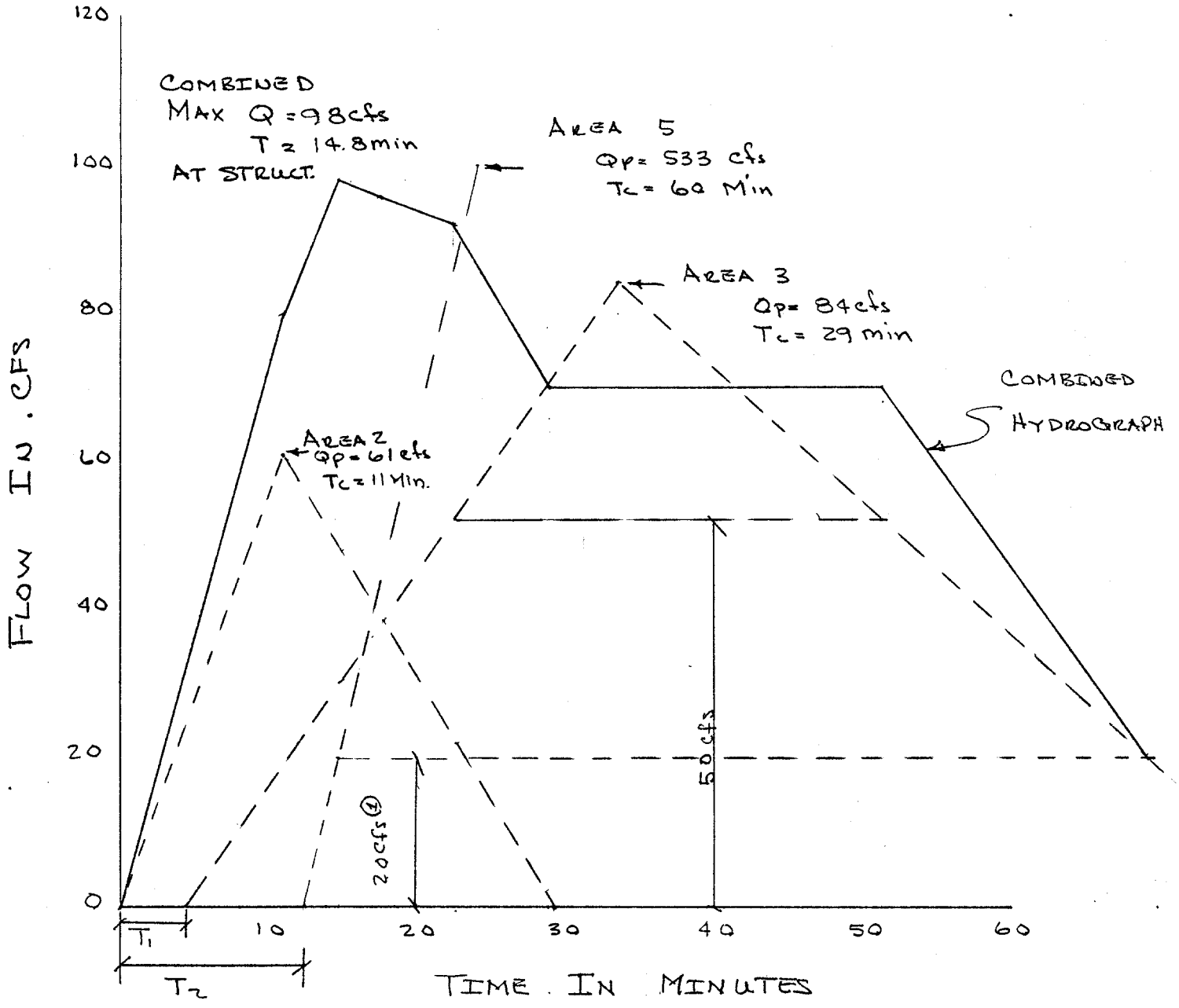
IND. BEND WASH SIM 7091

by: D. GILBERTSON

ck:

HYDROGRAPH AT DRAINAGE STRUCTURE

STA 50+00 N SIDE IND. BEND RD.



① MAX FLOW FROM DRAINAGE AREA TO STRUCTURE LIMITED BY DITCH & CMP CAP.

APPENDIX C

IND BEND WASH S&M 7091

date: Sht. No. C-

by: D. GILBERTSON

ck:

SULLIVAN & MASSON CONSULTING ENGINEERS
725 WEST McDOWELL ROAD — PHOENIX, ARIZONA 85007 — 602-257-8525

- SHEET C-2 CAP 24" RCP HAYDEN RD.

- SHEET C-3 THRU C-5, INFO VALLEY VISTA, & 82ND ST. HYDROGRAPH

SULLIVAN & MASSON CONSULTING ENGINEERS
725 WEST McDOWELL ROAD — PHOENIX, ARIZONA 85007 — 602-257-8525

date: Sht. No. C-3

by: D. GILBERTSON

ck:

IND. BEND WASH SIM 7091

CHECK CAPACITY OF 24" RCP

FROM SRP B-112-152.1

n=0.012

S=0.002'/FT

D= 24" RCP

USING MANNING EQ - FIELDS HYD. CAL

Q = 11 cfs

SULLIVAN & MASSON CONSULTING ENGINEERS
725 WEST McDOWELL ROAD — PHOENIX, ARIZONA 85007 — 602-257-8525

date: Sht. No. C-3

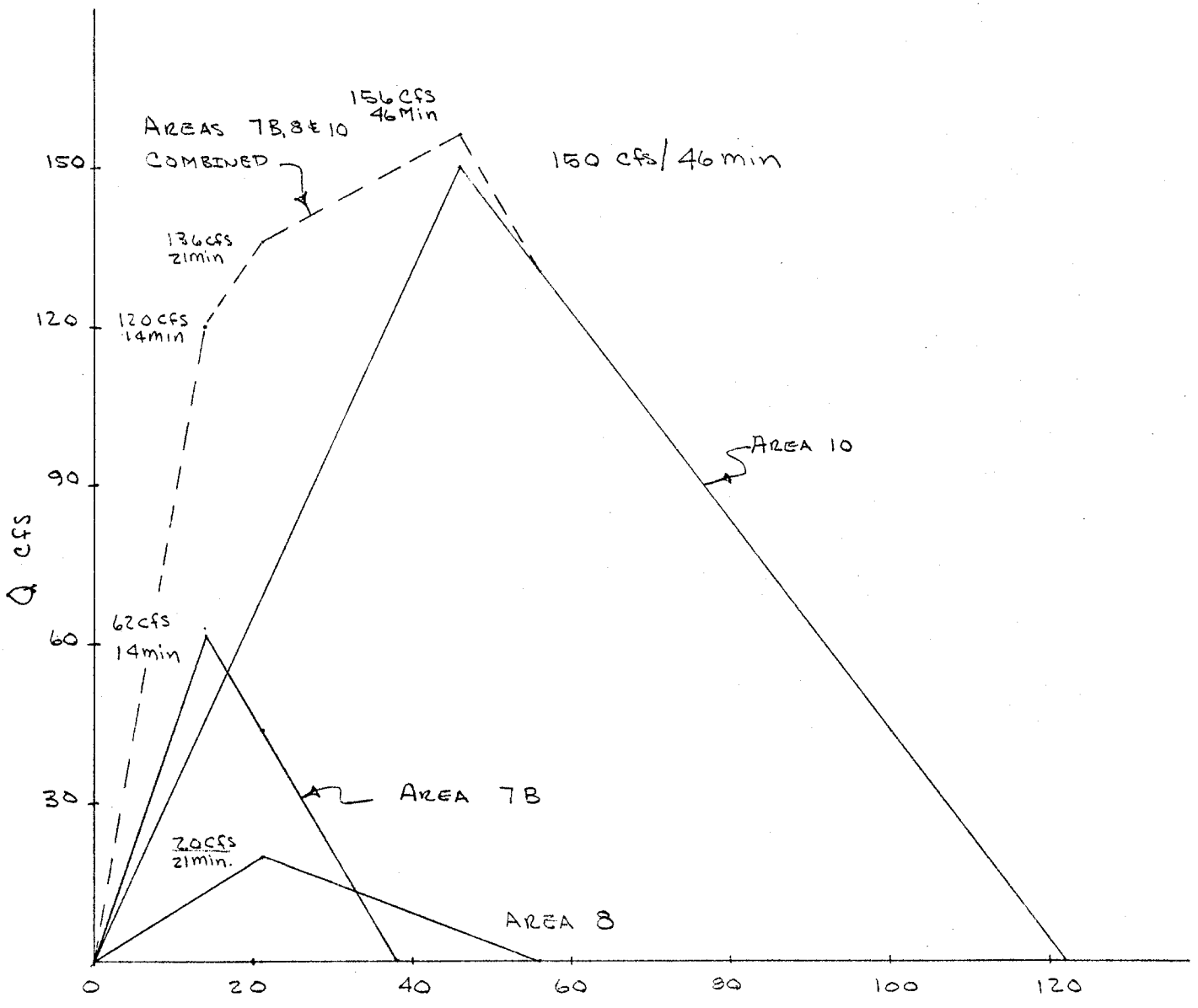
by: D. GILBERTSON

ck:

IND BEND WASH SIM 7091

100 YR. EVENT VALLEY VISTA LANE

COMBINED HYDROGRAPH



SULLIVAN & MASSON CONSULTING ENGINEERS
725 WEST McDOWELL ROAD — PHOENIX, ARIZONA 85007 — 602-257-8525

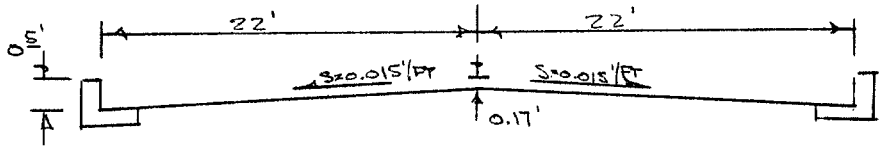
date: Sht. No. C-4

by: D. GILBERTSON

ck:

IND. BEND WASH SIM 7091

STREET CAPACITY CALCS. - 82ND ST.



$A = \left(\frac{0.5' + 0.17'}{2}\right)(22')\,2$

$= 14.7\ FT^2$

$WP = (22 + 0.5')\,2$

$= 45'$

$R = \frac{14.7\ FT^2}{45'}$

$= 0.33$

CAPACITY CALCULATIONS

AT ROSE LANE $S = 0.0019'/FT$, $n = 0.015$

$V = \frac{1.49}{n} R^{2/3} S^{1/2}$

$V = \frac{1.49}{0.015}(0.33)^{2/3}(0.0019)^{1/2}$

$V = 2.06\ FPS$

$Q = VA$

$Q = (2.06 FPS)(14.7 FT^2)$

$= 30.28$

$= \underline{30\ cfs}$ USE

AT VALLEY VISTA LANE

$S = 0.0015$ $n = 0.015$

$V = \frac{1.49}{n} R^{2/3} S^{1/2}$

$V = \frac{1.49}{0.015}(0.33)^{.67}(0.0015)^{1/2}$

$V = 1.83\ FPS$

$Q = VA$

$Q = (1.83 FPS)(14.7 FT^2)$

$= \underline{27\ cfs}$

IND. BEND WASH SIM 7091

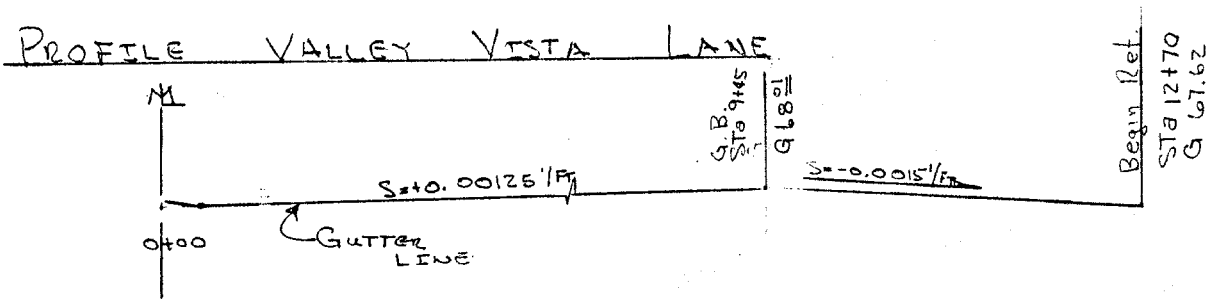
date: Sht. No. C-5

by: D. GILBERTSON

ck:

SULLIVAN & MASSON CONSULTING ENGINEERS
725 WEST McDOWELL ROAD — PHOENIX, ARIZONA 85007 — 602-257-8525

PROFILE VALLEY VISTA LANE



SINCE AN ADVERSE CROWN EXISTS ON VALLEY VISTA LANE 82ND ST. WILL CARRY APPROX. 30 CFS TO McDONALD RD.

- CHECK CAPACITY OF 18" RCP 28' N. OF MH ON VALLEY VISTA LANE.
  - ASSUME PIPE FLOW S=0.0014'/FT n=0.012
    - Q= 4 fps Manning Eq.
    - FIELD HYD. CAL.