PVSP DRAINAGE STUDY
PHASE III

Prepared for

Town of Paradise Valley
City of Scottsdale
City of Phoenix
Flood Control District of Maricopa County

VOLUME I

Prepared by

Collar, Williams and White Engineering, Inc.
Water Resources Associates, Inc.
Scottsdale, Arizona
July 15, 1978

Collar, Williams & White Engineering, Inc.

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July 21, 1978

Town of Paradise Valley
City of Scottsdale
City of Phoenix
Flood Control District of Maricopa County

Gentlemen:

We are pleased to transmit herewith our Report on Phase III of the PVSP Drainage Study, contracted on February 7, 1977.

This Report contains as much detail as possible in order that work may proceed on final design and construction, if desired.

It has been a pleasure working with the Members of the Committee and Staff.

If there are any questions pertaining to the Report, please let us know.

Respectfully submitted,
Collar, Williams & White Eng., Inc.

Donald H. Collar

Donald H. Collar, P.E.

DHC:dn

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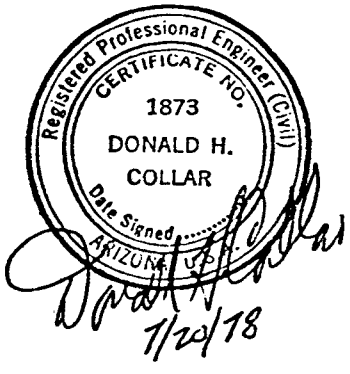

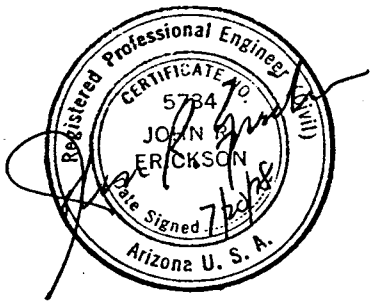

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PVSP DRAINAGE STUDY
PHASE III

Introduction

On December 1, 1977, the Flood Control District notified the Consultants by letter that the PVSP Committee had agreed on certain basic concepts of an alternative to flood protection in the PVSP study area. The details for Phase III were outlined in that letter.

A number of modifications were made to the general concept particularly with regard to the studies of detention basins, some of which were done by City staff members.

The following report includes essentially the basic concepts outlined by the PVSP Committee with the modifications which were subsequently adopted.

The area extends from 56th Street to Pima Road, (except for the Scottsdale area below Cactus Road and east of Scottsdale Road), and from the Granite Reef Aqueduct to Indian Bend Wash.

This report consists of two volumes. Volume One contains (1) the Introduction to the Report, (2) the Hydraulics Section, (3) the Section on Cost Estimates, and (4) a pocket containing 3 Plates and 2 Profile Sheets. Volume Two is the Hydrology Report.

The Hydraulics Section of the Report contains a solution to the requirements for PVSP within the frame work provided by the PVSP Committee.

Hydrologic analysis is for fully developed conditions. The Hydrology Section shows where and how the Project is beneficial to the area and where major problems would still exist.

Substantial benefits will accrue from the Project. Additional detention basin sights should be sought and further channelization should be considered, particularly in the area impacting on the Invergordon/Berniel System.

The entire Project is estimated to cost $6,677,000.

H Y D R A U L I C S

HYDRAULIC REPORT
SUMMARY OF METHODS AND RESULTS

The solution of the hydraulic requirements for PVSP Phase III was approached by breaking the entire drainage system into six units.

Because of the size and complexity of three of the units, they have been designated as Projects A, B and C. These three have their entire length stationed in plan and in profile on scales of 1" - 800' horizontal and 1" = 20' vertical. No profiles or stations were developed for any of the other units.

Project A, on the west, follows the main alignment of 56th Street. Project B, in the center area, follows the main alignment of 64th Street. Project C, on the east, follows the main alignment of Scottsdale Road.

At 60th Place and 66th Street, flood protection systems were analyzed individually. No profiles or stationing were developed for 60th Place and 66th Street as these reaches are entirely street flows. The Desert Cove channel system also has been treated individually.

The hydraulic features and analysis of the entire drainage system is shown on 8½" x 11" plates and described on a plate-by-plate basis. There are a total of 41 plates. Project A has 8 plates. Project B has 9 plates and Project C has 19 plates. 60th Place and 66th Street each have 2 plates, and Desert Cove has 1 plate.

Descriptive tests accompany each plate for Projects A, B and C. The other plates contain all of the information pertaining to those units.

The hydraulic analysis starts in detention basins in the upstream reach of each project and continues in a downstream direction to a final point of discharge.

Manning's equation was used in determining normal depth for trapezoidal and rectangular channels as well as pipe designs which are longer than average culvert dimensions. Culvert

design charts were used to determine the size of pipes in average street crossing lengths.

It was assumed that the friction-slope value in Manning's formula was equal to the invert slope, thus arriving at a normal depth solution.

The pipe designs were assumed to operate with free flow and flowing at .8 of its diameter. The development of a head at each detention basin would of course increase the pipe discharges in response to increasing heads.

The "n" values in Manning's formula were taken as .013 in pipes, .014 in concrete lined channels, and .025 in trapezoidal channels with grouted side slopes. Other slightly different "n" values were used in mixed cross-sections.

In developing studies to determine the capacity of existing streets, two approaches were used. In streets with depressed crowns, a rectangular cross-section was assumed and satisfactory answers were developed. In streets with a raised crown, the formula developed by the Bureau of Public Roads was used. This formula assumes a triangular channel for one-half of the street and satisfactory answers were developed.

It will be noted that some designs exceeded velocities of 6 feet per second. Rip-rap, gabions or drop structures to reduce these velocities were not evaluated because an adjustment in the invert slopes, at time of final design, give the same results. A visual inspection of the profiles reveals a sufficient top-to-bottom head and therefore, intermediate slope adjustments may be easily determined. Topographic mapping on the order of 1" to 50' will be required for construction and invert slopes as well as other features of hydraulic design. Refinements at this stage of feasibility would be unrealistic.

At the direction of the Maricopa County Flood Control District or the City of Scottsdale, the following items, which were included in the initial studies, have been deleted from Phase III:

1. Upper Invergordon (64th Street) Flood Protection System West
   Parts A and B
2. Hayden Road Channel System
   Parts A, B and C
3. Desert Cove Channel System
   Parts A, B and C
   (This item was modified to include only a capacity study of the existing ditch and the development of a hydrograph at Cactus.)
4. Lower Scottsdale Road Drainage System
   Part A

PVSP PHASE III HYDRAULIC DESIGN

Project A of PVSP, Phase III, consists of a waterway beginning upstream in Detention Basin No. 3 as described in the Master Drainage Plan for Desert Springs and discharging in Indian Bend Wash downstream a distance of approximately 3.2 miles.

The over-all project is shown in its entirety in Plan (Plate I) which also includes Projects B and C of PVSP, Phase III.

The details of the hydraulic features of Project A are shown in Plates A1 through A8, and are described as follows:

Plate No. A1: Surface area of detention basin covers 10.1 acres with a volume of 44 acre feet and a 6' depth of excavation with 1 on 8 side slopes.

Plate No. A2: A 42" diameter pipe required to empty detention basin in approximately 12 hours at the rate of 50 cfs and to daylight at Thunderbird Road a distance of 2800 feet. Manning's formula was used to design this length of pipe with an "n" value of .013 and an invert slope of .005. A free flow of 50 cfs was used although the actual flow would vary from 0 to 100 cfs with a 3-foot head. The velocity of free flow would be approximately 4.4 feet/second.

Plate No. A3: The capacity of 58th Street (which has a depressed crown) was analyzed as a rectangular channel using Manning's formula with an "n" value of .018 and an invert slope of .0071. This street was found to be adequate to control the discharge of 50 cfs from the 42" pipe designed to empty the detention basin upstream.

Plate No. A4: Describes the conveyance of 50 cfs through Sereno Park in a 42" diameter pipe under assumed

free flow conditions. The Sereno Park outlet is assumed to be at the intersection of 56th and Sweetwater Streets. The velocity at this point was found to be 5.2 feet/second.

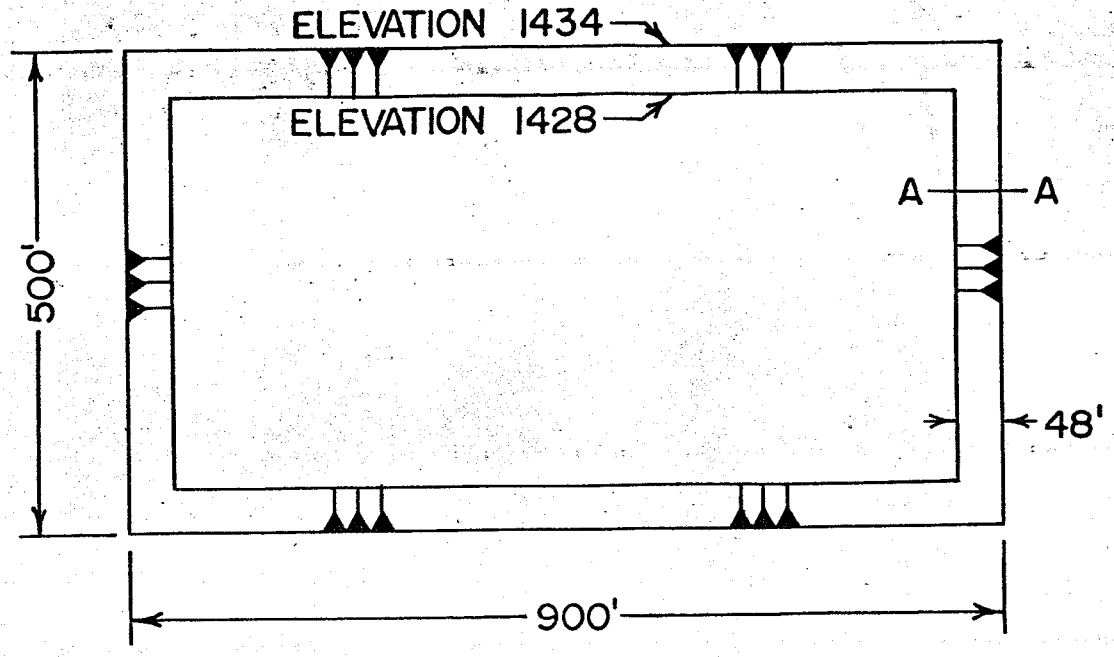
Plate No. A5: Shows the existing cross-section of 56th Street with a raised crown from Sweetwater to Cactus. A triangular channel was assumed to approximate the capacity of 50 cfs for this reach of 56th Street. The invert slope was found to be .005 and an "n" value of .018 was used. The resultant velocity was 3.1 feet/second.

Plate No. A6: Shows the existing cross-section of 56th Street with a depressed crown from Cactus to Shea, a distance of approximately 5200 feet. Again a rectangular cross-section was assumed to evaluate the capacity of 56th Street for this reach. The invert slope was found to be .005 and an "n" value of .018 was used with a resultant velocity of 3.8 feet/second for a discharge of 300 cfs.

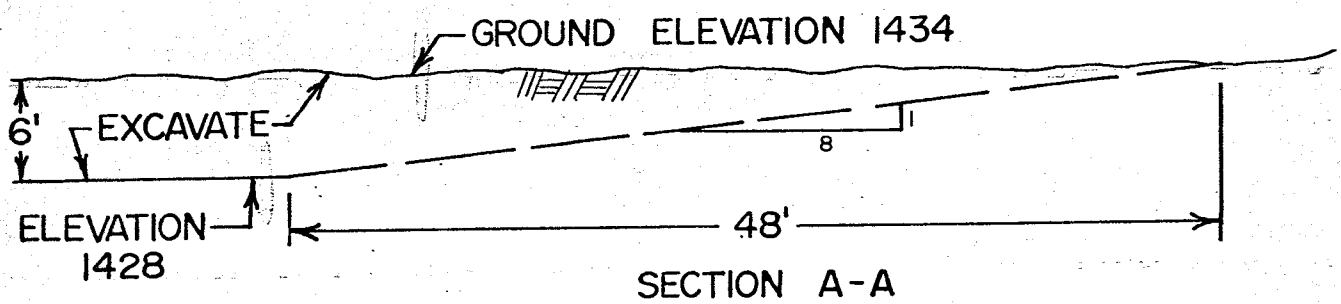
Plate No. A7: Indicates one design of 56th Street south of Shea to carry the required flow of 400 cfs from Shea Blvd. to Indian Bend Wash, a distance of approximately 4000 feet. The invert slope was found to be .00375 and an "n" value of .018 was used in Manning's formula to generate a velocity of 4.8 feet/second with a discharge of 400 cfs.

Plate No. A8: Shows an optional or alternate design that merits attention. This concept of conveying flood waters in the middle of the street is already in use on 64th Street. The actual dimensions would vary in response to the required discharges.

10.1 ACRES
44 Ac/ft
50 cfs out
1 Ac/ft. = 1613 cu. yds.



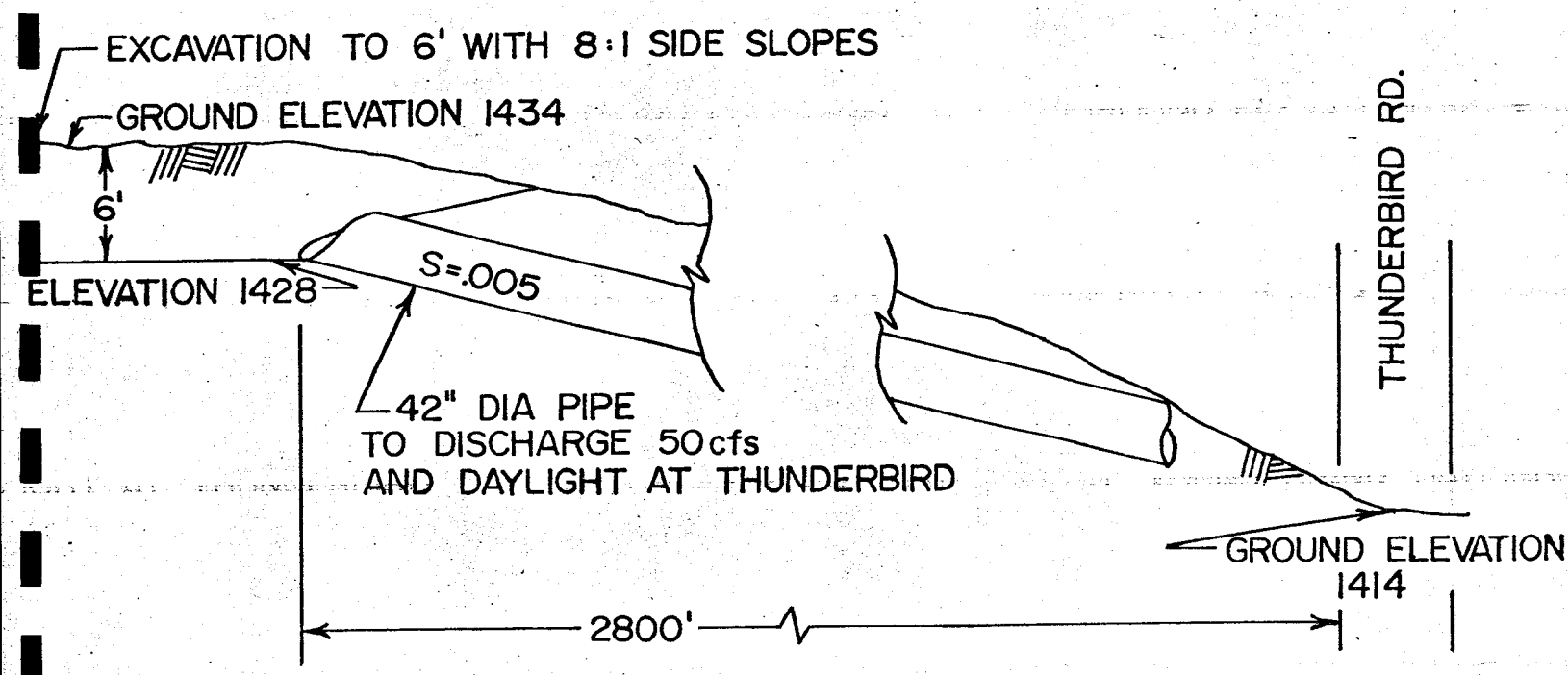
SCALE 1" = 200'



SECTION A-A

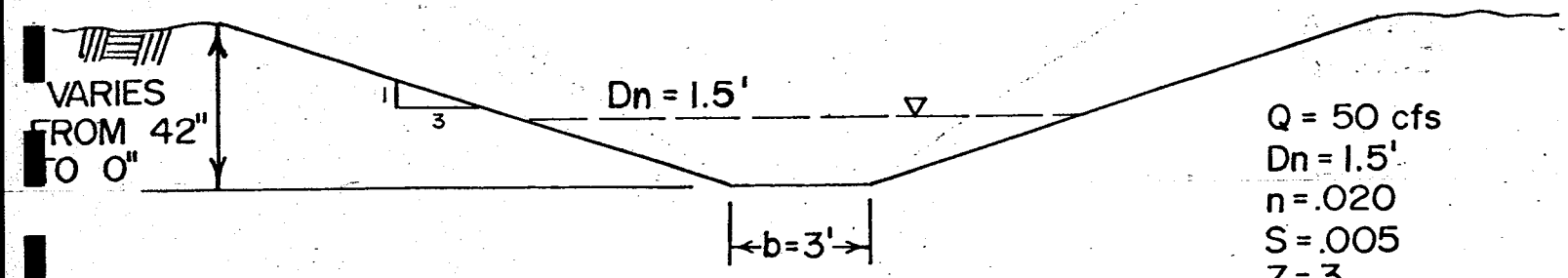
VERTICAL AND HORIZONTAL
SCALE 1" = 10'

PLATE 1
Project "A"
(56th ST.)



NOT TO SCALE

NOTE : *Length of above pipe may be reduced in length and continuing conveyance of flow (50 cfs) in a trapezoidal channel of following cross-section :*

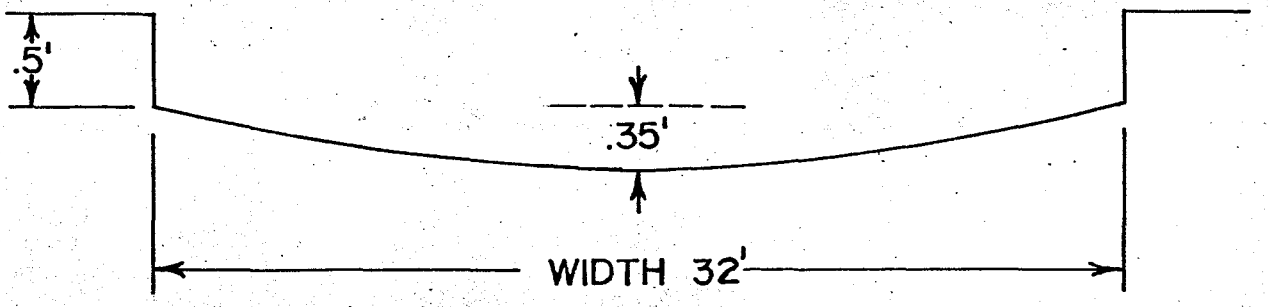


Q = 50 cfs
Dn = 1.5'
n = .020
S = .005
Z = 3
V = 4.4'/sec.

SCALE 1" = 4'

PLATE 2
Project "A"
(56 th ST.)

CAPACITY OF 58th ST.
DOWNSTREAM OF THUNDERBIRD RD.

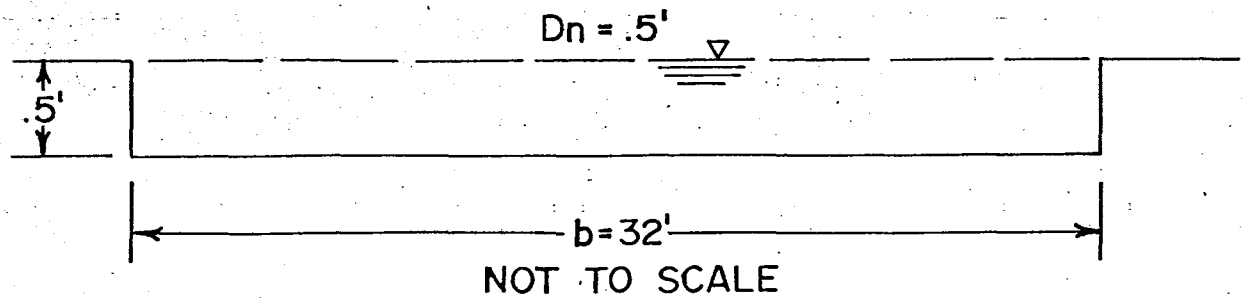


NOT TO SCALE

NOTE: *Required discharge from detention basin to be 50 cfs from a 42" dia pipe*

$$\frac{Qn}{S\frac{1}{2}} = \frac{50 \times .018}{.0843} = 11 \text{ and } Dn = .5'$$

$$\frac{Q}{b} = \frac{50}{32} = 1.56 \text{ and } Dc = .3$$



NOT TO SCALE

ASSUME RECTANGULAR CROSS-SECTION
FOR CAPACITY STUDY FOR DEPRESSED CROWN

Dn = .5'
Dc = .3
V = 3'/sec.

EXISTING STREET IS ADEQUATE TO TAKE 50cfs

PLATE 3
Project "A"
(56th ST)

1 Ac/ft. = 1613 cu. yds.

EXCAVATION WITHIN SERENO PARK TO ACCOMMODATE 40 AC/FT AND DISCHARGE 50 cfs AT THE DOWNSTREAM END.
(TO BE DONE BY OTHERS)

UPSTREAM EL. 1404 L = 1400'
DOWNSTREAM EL. 1400
4

$$S = \frac{h}{L} = \frac{4}{1400} = .00286$$

$$S^{\frac{1}{2}} = .0534$$

REQUIRED PIPE FOR 50 cfs:

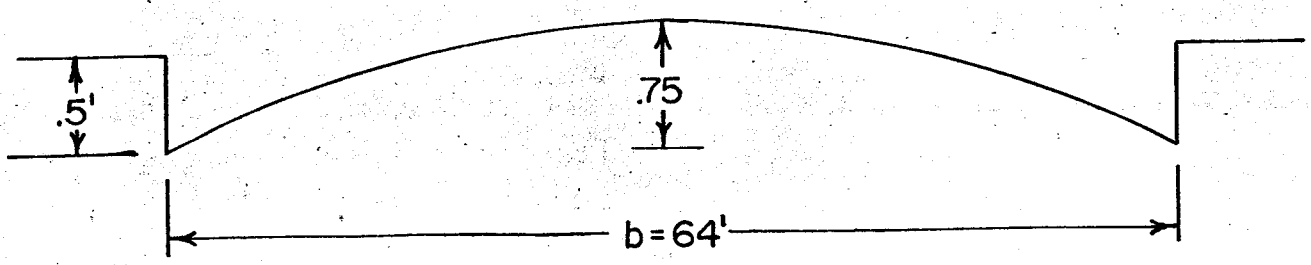
$$\frac{Qn}{S^{\frac{1}{2}}} = \frac{(50)(.013)}{.0534} = 12.17$$

FROM CURVES Dn = 3.4
USE 42" DIA PIPE (FREE FLOW)
TO DISCHARGE 50 cfs FROM A POINT DOWNSTREAM OF SERENO PARK, AT SWEETWATER AND 56th ST

Q = 50 cfs
n = .013
V = 5.2'/sec.

PLATE 4
Project "A"
(56th ST.)

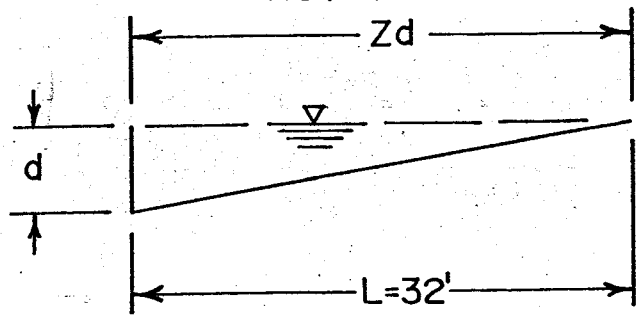
CROSS – SECTION
56th ST. (NEAR SWEETWATER TO CACTUS)



NOT TO SCALE

TO FIND CAPACITY OF
TRIANGULAR CHANNEL
(APPROXIMATE STREET
FLOW WITH RAISED CROWN)

ASSUME FOLLOWING CROSS – SECTION
NOT TO SCALE



$Q = .56 (\frac{Z}{n}) S^{\frac{1}{2}} \cdot d^{\frac{8}{3}}$

$Q = .56 \times 3555 \times .0707 \times .157$

$Q = 22$ cfs

TOTAL STREET CAPACITY
WITH BOTH SIDES

$Q = 22 \times 2 = 44$

ASSUME THAT 50cfs WILL BE
CONTROLLED WITH THIS CROSS-SECTION

GIVEN:

$n = .018$

$d = .5$

$S = .005$

$S^{\frac{1}{2}} = .0707$

Z = Reciprocal of cross-slope

cross-slope $= \frac{d}{L}$

$\frac{.5}{32} = .0156$

$Z = \frac{1}{.0156} = 64$

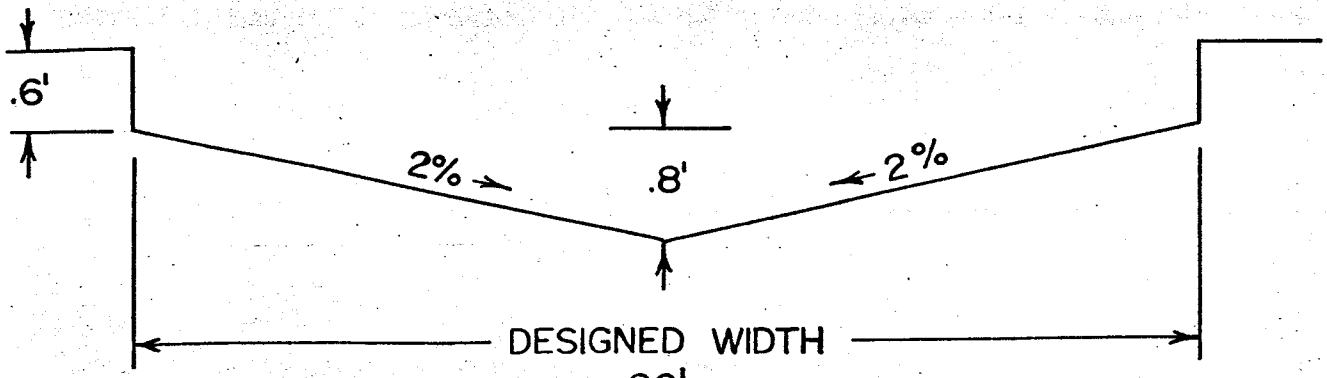
$\frac{Z}{n} = \frac{64}{.018} = 3555$

$d^{\frac{8}{3}} = .5^{2.67} = .157$

$V = 3.12$ '/sec.

PLATE 5
Project "A"
(56th ST)

DESIGN 56th ST.
DOWNSTREAM OF CACTUS AND
CARRY DESIGN TO SHEA FOR
A CAPACITY OF 300 cfs.



NOT TO SCALE

Q = 300 cfs

n = .018 (Asphalt)

S = .005

$S^{\frac{1}{2}} = .0707$

$\frac{Qn}{S^{\frac{1}{2}}} = \frac{(300)(.018)}{.0707} = 76$

Dn = 1'

AREA OF FLOW = 80 sq ft

$V = \frac{Q}{A} = \frac{300}{80} = 3.75$ ft/sec

UPSTREAM EL 1386 Cactus

DOWNSTREAM EL 1360 Shea

26

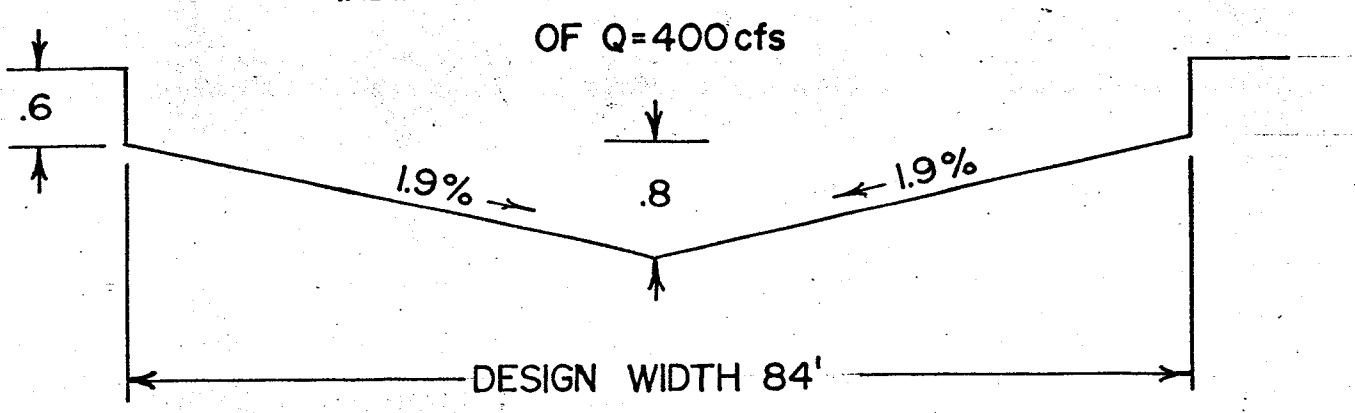
L = 5200

$S = \frac{h}{L} = \frac{26}{5200} = .005$

$S^{\frac{1}{2}} = .0707$

PLATE 6
Project "A"
(56th ST.)

DESIGN 56th ST.
DOWNSTREAM OF SHEA BLVD. TO
INDIAN BEND WASH FOR A CAPACITY
OF Q=400cfs



NOT TO SCALE

Q = 400 cfs
n = .018 (Asphalt)
S = .00375
$S^{\frac{1}{2}}$ = .0612

$\frac{Qn}{S^{\frac{1}{2}}} = \frac{(400)(.018)}{.0612} = 118$

Dn = 1' AREA OF FLOW = 84 sq ft

$V = \frac{Q}{b} = \frac{400}{84} = 4.76$ ft./sec

Dc = .9

UPSTREAM EL 1360 Shea
DOWNSTREAM EL 1345 IBW
15

L = 4000'

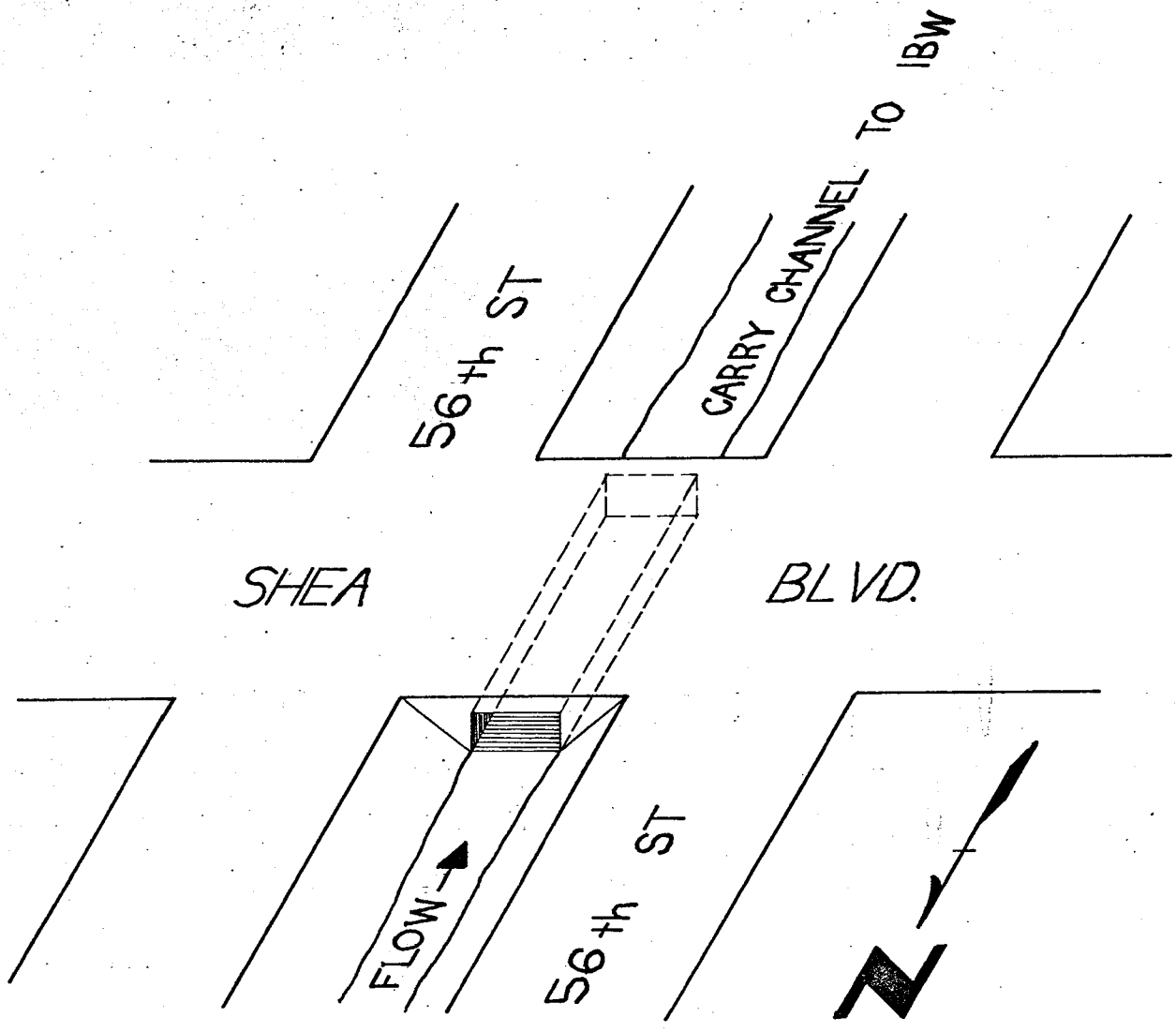
$S = \frac{h}{L} = \frac{15}{4000} = .00375$

S = .0612

NOTE: SEE PLATE 8 FOR CONCEPTUAL DESIGN ONLY BEGINNING NORTH OF SHEA AND CONTINUING TO INDIAN BEND WASH.

PLATE 7
Project "A"
(56th ST)

CENTER LINE TRAPEZOIDAL OR RECTANGULAR CHANNEL TO BE DESIGNED TO CARRY NO LESS THAN 400 cfs FROM NORTH OF SHEA TO INDIAN BEND WASH.



NOT TO SCALE

OPTIONAL DESIGN
FROM SHEA BLVD. TO
INDIAN BEND WASH

PLATE 8
Project "A"
(56th ST.)

Project B ov PVSP, Phase III, consists of a waterway beginning upstream in Detention Basin No. 1 as described in the Master Drainage Plan for Desert Springs and discharging in Indian Bend Wash downstream a distance of approximately 3.9 miles.

The over-all project is shown in its entirety in Plan (Plate I) which also includes Projects A and C of PVSP, Phase III.

The details of the hydraulic features of Project B are shown in Plates B1 through B9 and are described as follows:

Plate No. B1: Surface area of detention basin covers 12.4 acres with a volume of 52 acre feet and a 6' depth of excavation with 1 on 8 side slopes.

Plate No. B2: A 36" diameter pipe required to empty detention basin in approximately 15 hours at the rate of 50 cfs and to daylight at 64th Street a distance of 800 feet. Manning's formula was used to design this length of pipe with an "n" value of .013 and an invert slope of .01375. A free flow of 50 cfs was used although the actual flow would vary from 0 to 80 cfs with a 3-foot head. The velocity of free flow would be approximately 7.4 feet/second.

Plate No. B3: The capacity of 64th Street south of Thunderbird to Joan D'Arc (which has a raised crown) was analyzed as a triangular channel on one-half of the street. The approximate street flow was found to be 60 cfs. An invert slope of .0092 and an "n" value of .018 were used. The resultant velocity was 3.8 feet/second.

Plate No. B4: This plate shows a redesign or improvement of the existing cross-section of 64th Street (which has a normal crown) from Thunderbird to Joan D'Arc. Below Joan D'Arc,

64th Street has an inverted crown. The purpose is to increase the capacity of 64th Street to 150 cfs.

The rectangular box in 64th Street is sized to accept the discharge of an 18" diameter pipe from an existing depression at the northwest corner of 64th and Thunderbird. This pipe will discharge approximately 10 cfs with a 1-foot head.

If this design is used, it will lend itself to connecting the invert elevation to the existing ditch on the east side of 64th Street beginning at Cactus Road. This ditch will be designed to carry 900 cfs.

Plate No. B5: Shows the existing cross-section of 64th Street from Joan D'Arc to Cactus Road to have a depressed crown. This reach is approximately 4100 feet in length and the capacity was found to be approximately 132 cfs with a velocity of 2.9 feet/second.

Plate No. B6: This plate indicates one design or improvement of the existing ditch in the R/W along 64th Street from Cactus Road to Cholla Street.

The invert slope was found to be .0046 and an "n" value of .030 was used in Manning's formula to generate a velocity of 7.5 feet/second with a discharge of 900 cfs.

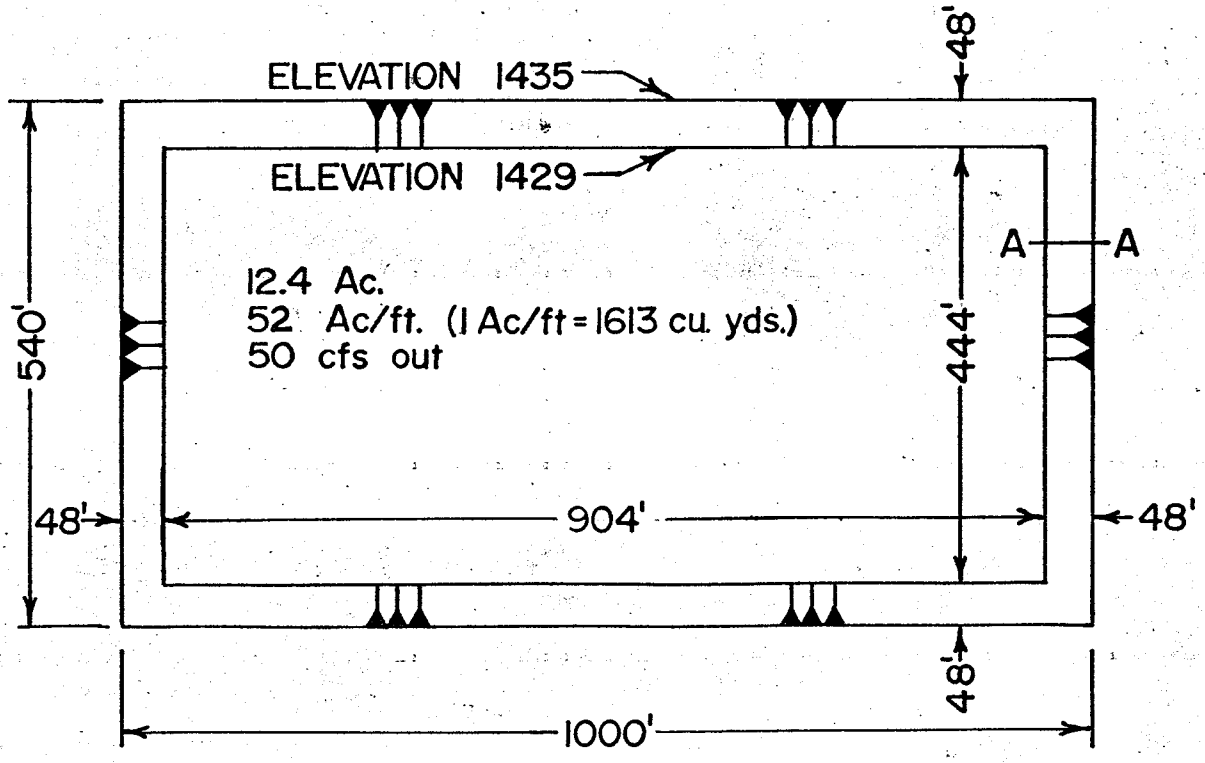
Plate No. B7: The existing culverts at Cholla, Shea, Gold Dust, and Turquoise along 64th Street have a capacity of only 500 cfs, based on field measurements.

If the channel system upstream of these culverts is to carry 900 cfs, a flooding problem will develop at these intersections.

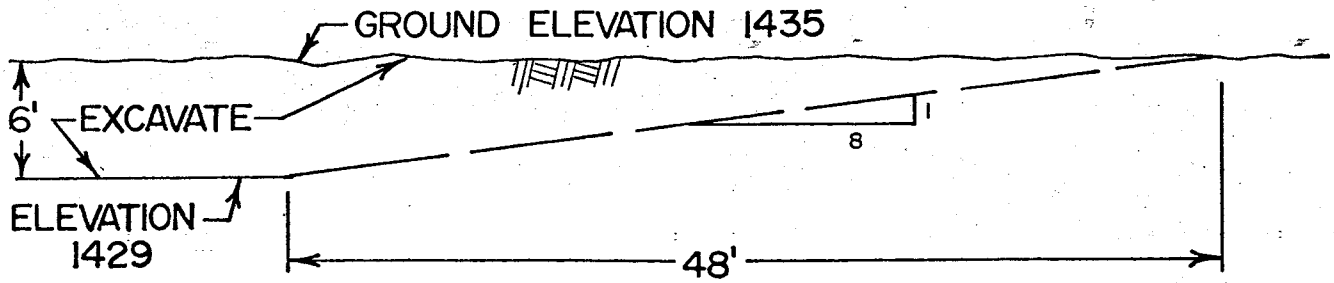
Plate No. B8: This plate is a repeat of Plate No. B6 and shows the channel cross-section with a capacity of 900 cfs. The hydraulic elements are exactly the same and this cross-section should be taken to a terminal point of discharge in Mountain View Road.

Plate No. B9: This plate indicates the capacity of the existing ditch and channel system along 64th Street from Cactus Road to Turquoise Avenue. The dimensions shown have been field measured at a point downstream of Cholla and this uniform cross-section has been assumed for the entire reach for this capacity study.

The invert slope was .005 and an "n" value of .030 was used because of the gabion type of slope revetment. With Manning's formula, a velocity of 8.8 feet/second was generated with a discharge of 900 cfs.



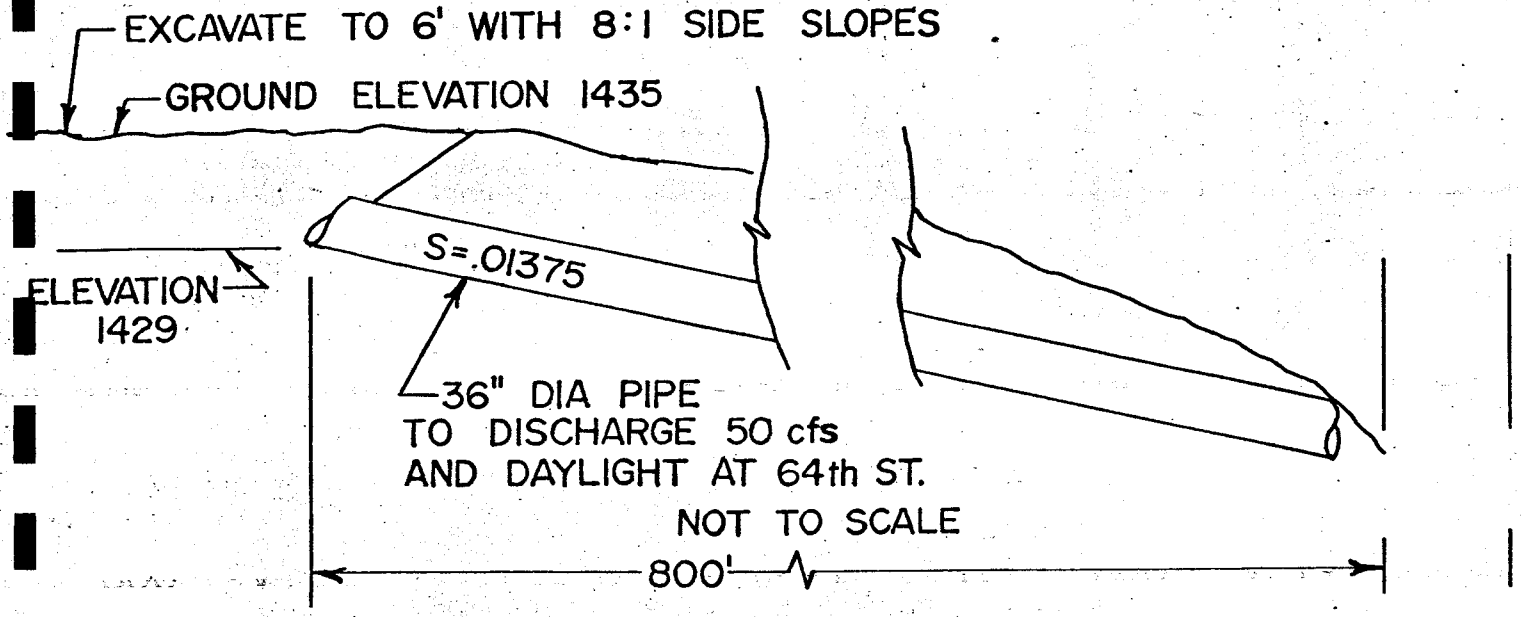
SCALE 1" = 200'



SECTION A-A

VERTICAL AND HORIZONTAL
SCALE 1" = 10'

PLATE 1
Project "B"
(64th ST.)

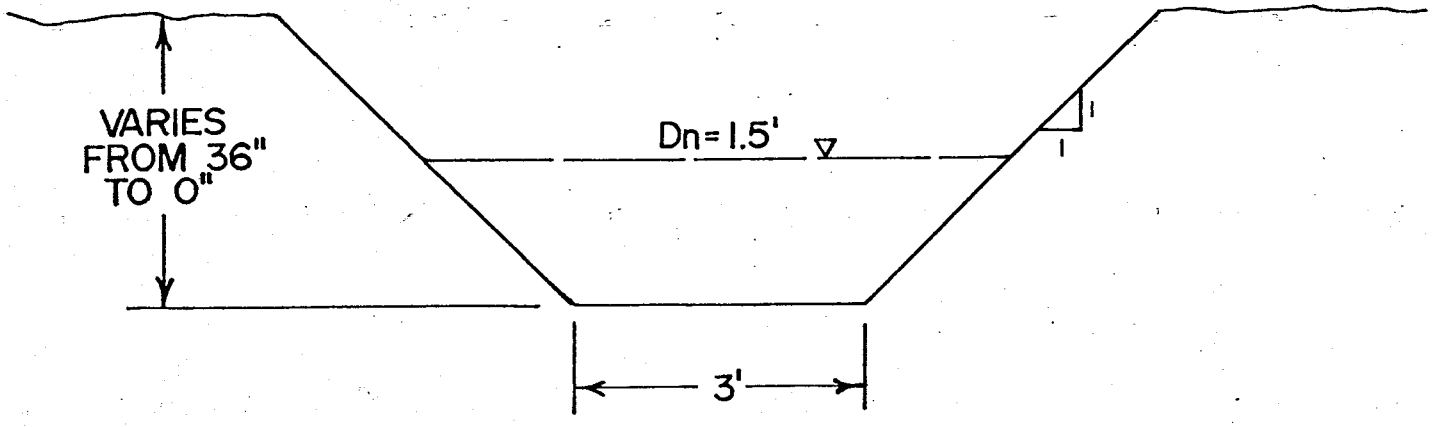


NOTE: Length of above pipe maybe reduced in length and continuing conveyance of flow of 50cfs in a trapezoidal channel of following cross-section:

Q = 50
n = .020
S = .01375
$S^{\frac{1}{2}}$ = .1173
L = 800'

$$\frac{Qn}{S^{\frac{1}{2}}} = \frac{50 \times .020}{.1173} = 7.4$$

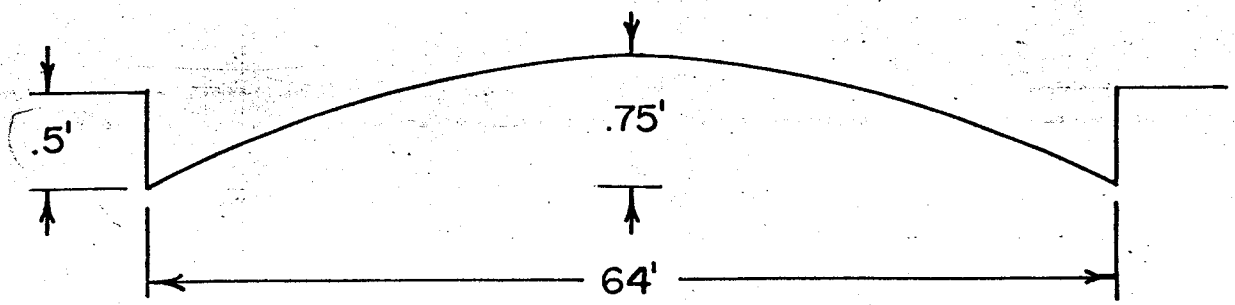
Vn = 8'/sec±



SCALE 1" = 2'

PLATE 2
Project "B"
(64th ST.)

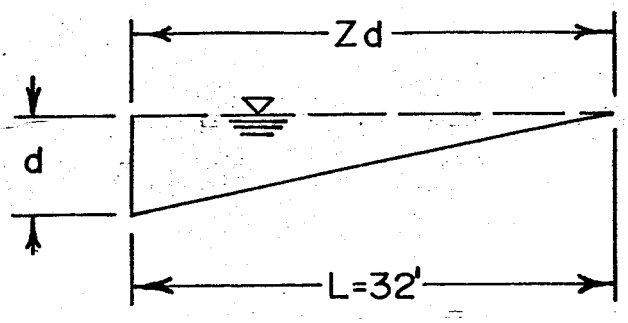
CAPACITY OF 64th ST.
SOUTH OF THUNDERBIRD TO JOAN D'ARC



EXISTING CROSS SECTION
NOT TO SCALE

TO FIND CAPACITY OF
TRIANGULAR CHANNEL
(APPROXIMATE STREET
FLOW WITH RAISED CROWN)

ASSUME FOLLOWING CROSS-SECTION
NOT TO SCALE



$Q = .56(\frac{Z}{n}) S^{\frac{1}{2}} \cdot d^{\frac{8}{3}}$

$Q = .56 \times 3555 \times .09592 \times .157$

$Q = 30$ cfs

TOTAL STREET CAPACITY
WITH BOTH SIDES

$Q = 30 \times 2 = 60$ cfs

GIVEN:

$n = .018$

$d = .5$

$S = .0092$

$S^{\frac{1}{2}} = .09592$

Z = Reciprocal of cross-slope

cross-slope $= \frac{d}{L}$

$\frac{.5}{32} = .0156$

$Z = \frac{1}{.0156} = 64$

$\frac{Z}{n} = \frac{64}{.018} = 3555$

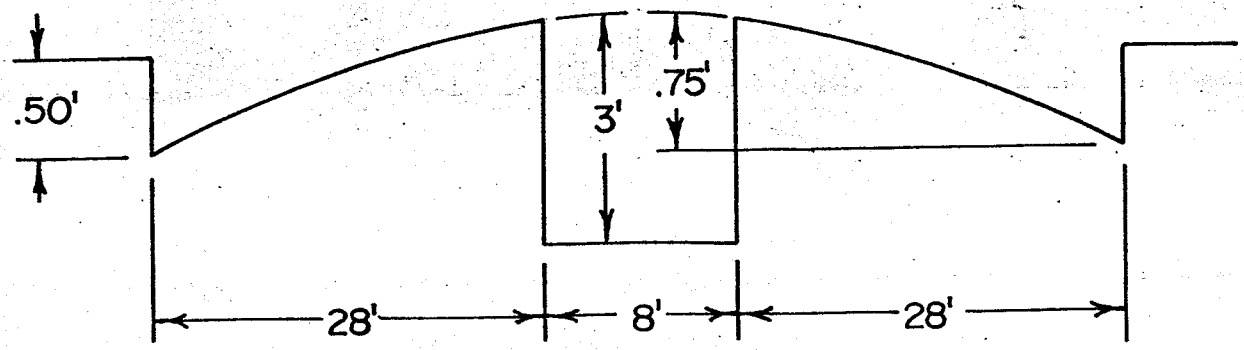
$d^{\frac{8}{3}} = .5^{2.67} = .157$

$V = \frac{60}{16} = 3.75'/sec$

PLATE 3
Project "B"
(64th ST)

IMPROVE CAPACITY OF 64th ST. FROM THUNDERBIRD TO JOAN D'ARC TO CARRY 150cfs

NOT TO SCALE



$\frac{Qn}{S^{\frac{1}{2}}} = \frac{150 X .018}{.095} = 28$

Dn = 1.9 1' F.B.

Vn = 9.8'/sec.

Q = 150 cfs

n = .018

S = .009

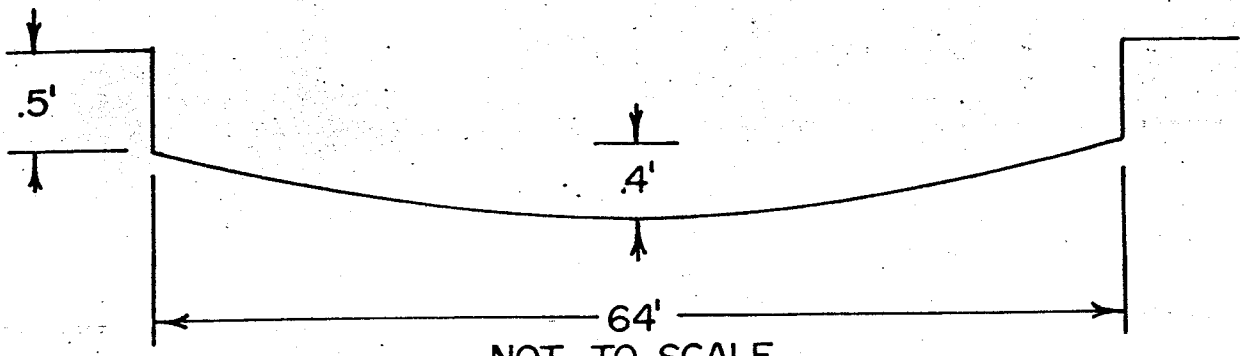
$S^{\frac{1}{2}} = .095$

ABOVE DESIGN WILL ACCEPT FROM AN 18" DIAMETER PIPE NECESSARY TO EMPTY THE EXISTING DETENTION BASIN AT THUNDERBIRD AND 64th ST.

IF THIS DESIGN IS USED IT WILL LEND ITSELF TO CONNECTING THE INVERT ELEVATION TO THE EXISTING DITCH ON THE EAST SIDE OF 64th ST. BEGINNING AT CACTUS RD. AND WHICH WILL BE DESIGNED TO CARRY APPROXIMATELY 900 cfs.

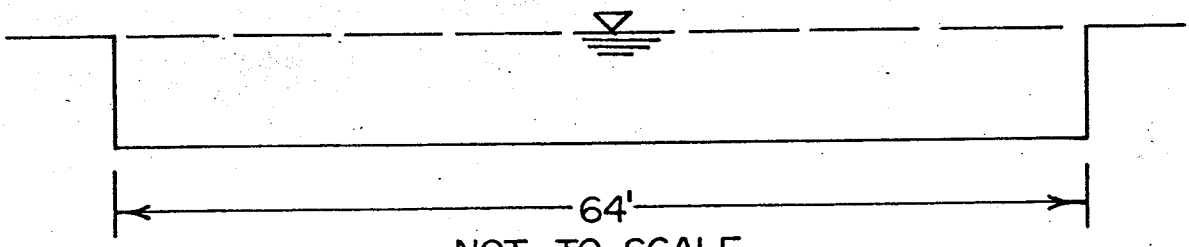
PLATE 4
Project "B"
(64th ST.)

CAPACITY OF 64th ST. SOUTH OF JOAN D'ARC TO CACTUS RD.



NOT TO SCALE

ASSUME RECTANGULAR CROSS-SECTION FOR CAPACITY STUDY FOR A DEPRESSED CROWN



NOT TO SCALE

$\frac{Qn}{S^{\frac{1}{2}}} = \frac{150 \times .018}{.0949} = 28$

Dn = .8'

Vn = 2.9'/sec

ASSUME A REQUIRED DISCHARGE

Q = 150 cfs

n = .018

S = .009

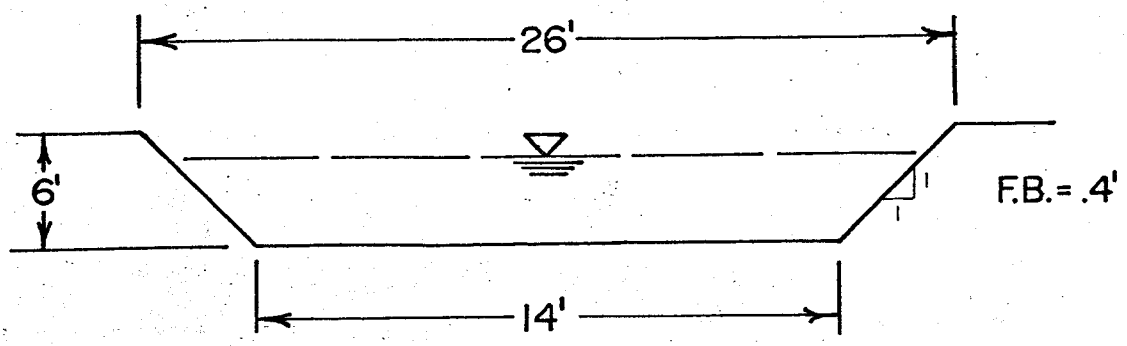
$S^{\frac{1}{2}} = .0949$

EXISTING CROSS-SECTION WILL CARRY 89% OF 150 OR 132 cfs

PLATE 5
Project "B"
(64th ST.)

IMPROVE (DESIGN) EXISTING CHANNEL IN PRESENT R/W ALONG 64th ST FROM CACTUS RD. TO CHOLLA ST., TO CARRY 900 cfs.

NOT TO SCALE



$\frac{Qn}{S^{\frac{1}{2}}} = \frac{900 \times .030}{.068} = 397$

Dn = 5.6

Vn = 7.5'/sec.

Q = 900 cfs

n = .030

S = .0046

$S^{\frac{1}{2}} = .068$

b = 14'

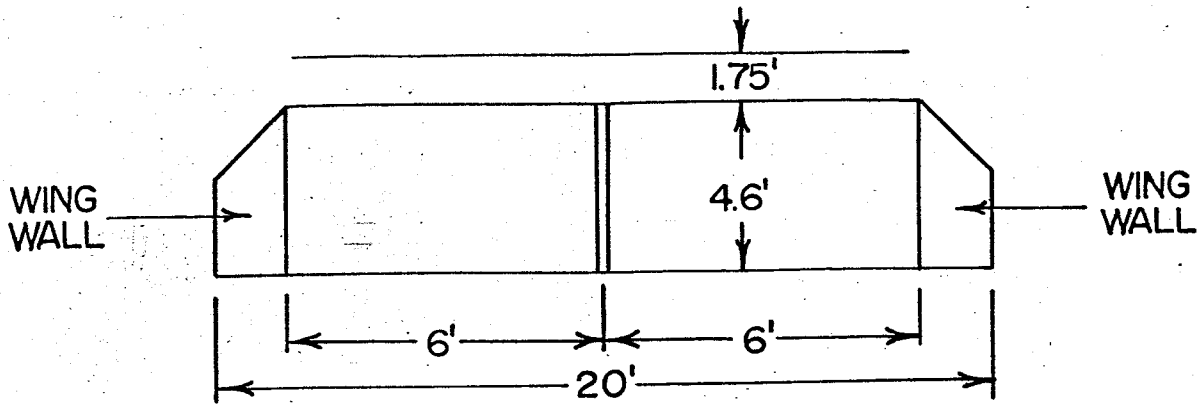
Z = 1

NOTE: THE EXISTING CULVERTS AT CHOLLA AND SHEA WILL TAKE ONLY 600 cfs. THE ADDITIONAL DISCHARGE OF 300 cfs WOULD RESULT IN AN OVERFLOW SURCHARGE. (See following plate 7 for culvert capacities)

PLATE 6
Project "B"
(64th ST.)

CAPACITY OF EXISTING CULVERTS AT CHOLLA, SHEA, GOLD DUST AND TURQUOISE ALONG 64th ST.

NOT TO SCALE



VELOCITY FROM STUDY OF EXISTING CHANNEL

V = 10'/sec

EXISTING AREA OF FLOW

4.6' X 6' X 2 = 55.2

Q = A X V

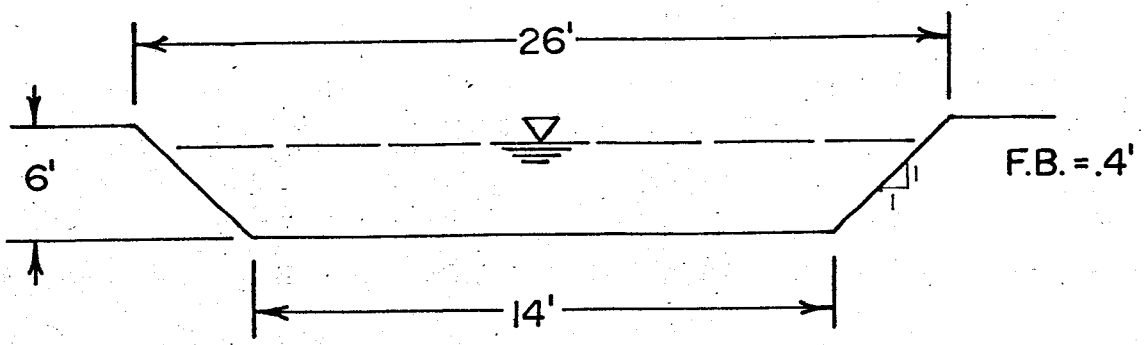
= 55.2 X 7.5

= 414 cfs

USE Q = 500 cfs FOR CULVERT CAPACITY

PLATE 7
Project "B"
(64th ST.)

IMPROVE (DESIGN) EXISTING CHANNEL IN PRESENT R/W ALONG 64th ST FROM TURQUOISE TO MOUNTAIN VIEW



$\frac{Qn}{S^{\frac{1}{2}}} = \frac{900 \times .030}{.068} = 397$

Dn = 5.6

Vn = 7.5'/sec.

Q = 900 cfs

n = .030

S = .0046

$S^{\frac{1}{2}} = .068$

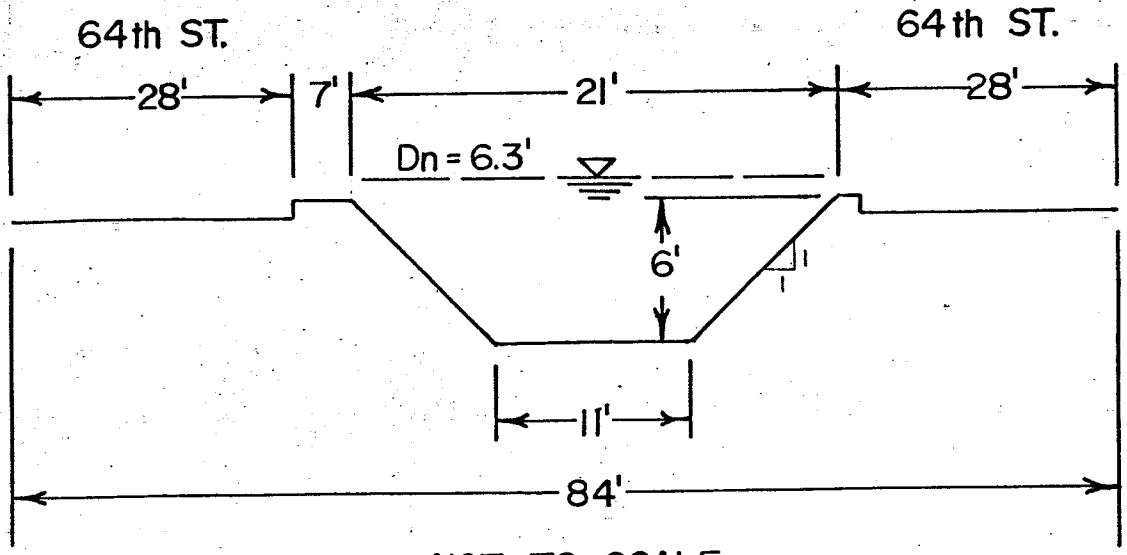
b = 14'

Z = 1

ABOVE CROSS-SECTIONAL CONVEYANCE FOR A Q = 900 cfs TO BE TAKEN TO A POINT OF FINAL DISCHARGE IN INDIAN BEND WASH.

PLATE 8
Project "B"
(64th ST)

CAPACITY OF EXISTING CHANNEL (DITCH) ALONG 64th ST. FROM CACTUS RD. TO TURQUOISE (FIELD MEASURED)



NOT TO SCALE

ASSUME UNIFORM CROSS-SECTION FOR ENTIRE REACH FOR CAPACITY STUDY.

$$\frac{Qn}{S^{\frac{1}{2}}} = \frac{900 \times .030}{.07} = 386$$

Dn = 6.3

Vn = 8.8'/sec.

Q = 900 cfs

n = .030

S = .005

$S^{\frac{1}{2}} = .07$

b = 11'

Z = 1

PLATE 9
Project "B"
(64th ST.)

PVSP PHASE III HYDRAULIC DESIGN

Project C of PVSP, Phase III, consists of a waterway beginning in a detention basin in the southwest end of the Scottsdale airport and terminating in the Camelback golf course or the southern end of the Berniel channel system, a distance of approximately 4.5 miles.

The over-all project is shown in its entirety in Plan (Plate I) which also includes Projects A and B of PVSP, Phase III.

The details of the hydraulic features of Project C are shown in Plates C1 through C19 and are described as follows:

Plate No. C1: The surface area of the first detention basin at the Scottsdale airport covers 6 acres with a volume of 38 acre feet and 8' depth of excavation with 1 on 8 side slopes.

Plate No. C2: A 60" diameter pipe is required to empty detention basin in approximately 3 hours at a maximum free flow rate of 150 cfs. Pipe daylights 500 feet below basin. Manning's formula was used to design this length of pipe with an "n" value of .013 on an invert slope of .0033. A free flow of 150 cfs was used although the actual flow would vary from 0 to 250 cfs with an 8-foot head. The maximum velocity of free flow would be about 9 feet/second at a discharge of 250 cfs.

Plate No. C3: A culvert approximately 30' wide with five 60" diameter pipes is required to take a discharge of 650 cfs under Scottsdale Road from west to east.

Plate No. C4: This plate indicates the size of a trapezoidal channel from the culvert crossing Scottsdale Road (Plate C3) to the junction with outlet pipe from detention basin (Plate C2). The required discharge for this

channel is 650 cfs. An invert slope of .008 was used with an "n" value of .030 and a velocity of 8.4 feet/second was generated with a normal depth of 3.9 feet.

Plate No. C5: The total discharge of 650 and 150 cfs to equal 800 cfs was the basis for design for this trapezoidal channel from a point of confluence to Sutton Drive. All the hydraulic design features are the same as those shown for the channel on Plate No. C4. The discharge of 800 cfs generates a velocity of 9.3 feet/second at a normal depth of 4.2 feet.

Plate No. C6: The culvert shown on this plate is designed exactly as the culvert on Plate No. C3. The discharge of 650 cfs on the Plate 4 culvert was designed with a slight freeboard whereas the discharge of 800 cfs on this plate will pass with a slight head of pressure.

Plate No. C7: The cross-section shown is based on field measurements of a gabion-type channel under construction on June 14, 1978. The required discharge of 800 cfs will not be entirely contained by this channel. The capacacity study was based on an invert slope of .0083, an "n" value of .030, and a velocity of 9.7 feet/second.

Plates No. C8 and No. C9: These two plates show the design of culverts exactly as that shown on Plate No. C6. These two street crossings at Sweetwater and Larkspur will be connected with trapezoidal gabion-type channels conveying approximately 800 cfs.

Plate No. C10: The surface area of this large detention basin north of Cactus and east of Scottsdale Road is 15 acres with a volume of 100 acre feet. The depth of excavation is to be 8 feet with side slopes of 1 on 8.

Plate No. C11: The 60" diameter pipe shown is designed to empty the detention basin of Plate No. C10. This pipe

will extend from the detention basin to about Gary Road crossing under Scottsdale Road from east to west to discharge outside the west wall of the existing nursery property, a distance of approximately 4000 feet. A free-flow discharge of 150 cfs was used for this design but the actual flow will vary from 0 to 250 cfs with an 8-foot head. An invert slope of .00625 and an "n" value of .013 was used which generated a maximum velocity of 7.7 feet/second at a discharge of 250 cfs.

Pressure flow would increase this velocity but a Stilling Basin at the discharge point would act as an energy dissipator and reduce the velocity to an acceptable level.

Plate No. C12: The detention basin at 68th Place and Gary Road has a surface area of 10 acres and a volume of 42 acre feet with a depth of excavation of 7 feet and side slopes of 1 on 8.

Plate No. C13: The detention basin of Plate No. C12 will be emptied with a 60" diameter pipe discharging 150 cfs for approximately 4 hours. The actual flow will vary from 0 to 250 cfs with an 8-foot head. The invert slope would be .00375 with an "n" value of .013 and a mean velocity of 7.7 feet/second.

The discharge of this pipe should be trained into the Stilling Basin mentioned in Plate No. 11 which would also be the terminal point of discharge from the pipe described in Plate C11.

The actual design and detailing of the Stilling Basin should be sized and located to accept a total in flow of 1100 cfs.

Plate No. C14: This cross-section of a trapezoidal channel is sized to control a discharge of 1100 cfs and should begin at the Stilling Basin mentioned in Plate C13 and terminate at the existing Berniel channel at Mountain View Road a distance of 4500 feet. The invert slope was found to be .00533 with an "n" value of .030 and a velocity of 8.1 feet/second. A normal depth of 5' with side slopes

of 1 on 2 and a base width of 17 feet were the result of this analysis.

Plate No. C15: The culverts designed on this plate are to be placed at Shea Blvd., Cochise Road and Gold Dust Avenue. These culverts are sized to pass 1100 cfs from the channel explained on Plate 14. Eight 60" diameter pipes on approximate invert slopes of .006 will generate a velocity of 7 feet/second. The width required for these culverts would be no less than 50 feet.

Plate No. C16: The storm drain shown was to run on the west side of Scottsdale Road and south of Shea to Gold Dust Avenue to join the trapezoidal channel described on Plate 14.

However, this storm drain may be relocated by the City of Scottsdale and a probable redesign may be developed. It will not be shown in Plan.

Plate No. C17: The surface area of the last detention basin in this system covers 7 acres of Chaparral High School with a volume of 19 acre feet (approximate) and a 3-foot depth of excavation with 1 on 8 side slopes.

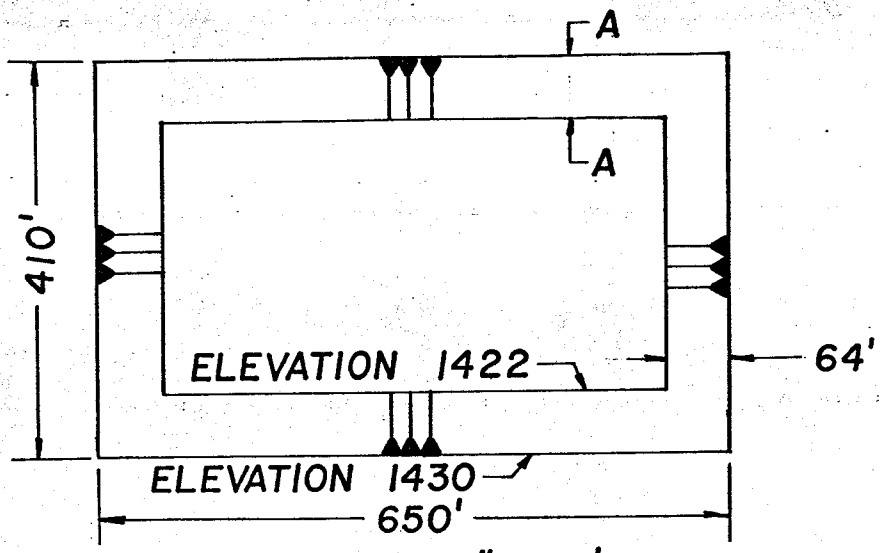
Plate No. C18: A 15" diameter pipe is required to empty the detention basin in approximately 48 hours at the rate of 5 cfs. This pipe will discharge into the Berniel channel, a distance of approximately 100 feet. A culvert design approach was used because of the short length which sloped at the rate of 2% and generated a velocity of 5 feet/second. The actual flow in this pipe would vary from 0 to 14 cfs with a 3-foot head.

Plate No. C19: This plate indicates the improvement of the Berniel channel near Berniel Drive that will equal the upstream capacity of the system. A design discharge of 2000 cfs was used because a contribution of 600 cfs from the bifurcation

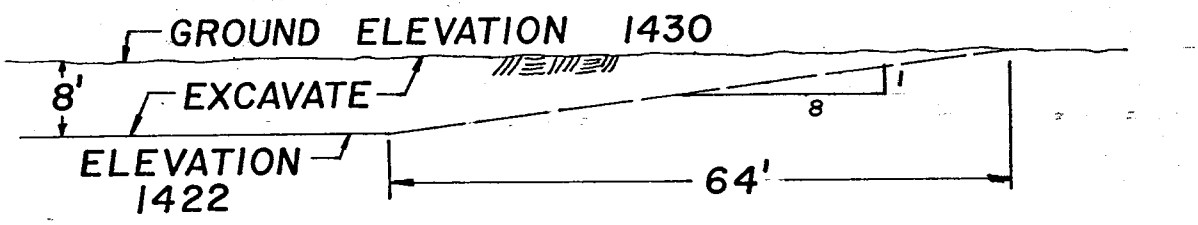
structure at 64th Street is brought into the system at the Chaparral High School detention basin. If this increment is added to a conceivably increased discharge of 1100 cfs, prudence would urge a design for this larger discharge. The sizing of this trapezoidal channel conforms to the existing condition. The invert slope was found to be .0016 and the side slopes were based on 1 on 3 with an "n" value of .025. These conditions generated a velocity of 6.2 feet/second.

DETENTION BASIN
SCOTTSDALE AIRPORT

6 ACRES
38 Ac/ft
150 cfs out
1 Ac/ft = 1613 cu. yds.



SCALE 1"=200'



SECTION A-A
VERTICAL AND HORIZONTAL
SCALE 1" = 20'

PLATE 1
Project "C"
(SCOTTSDALE RD.)

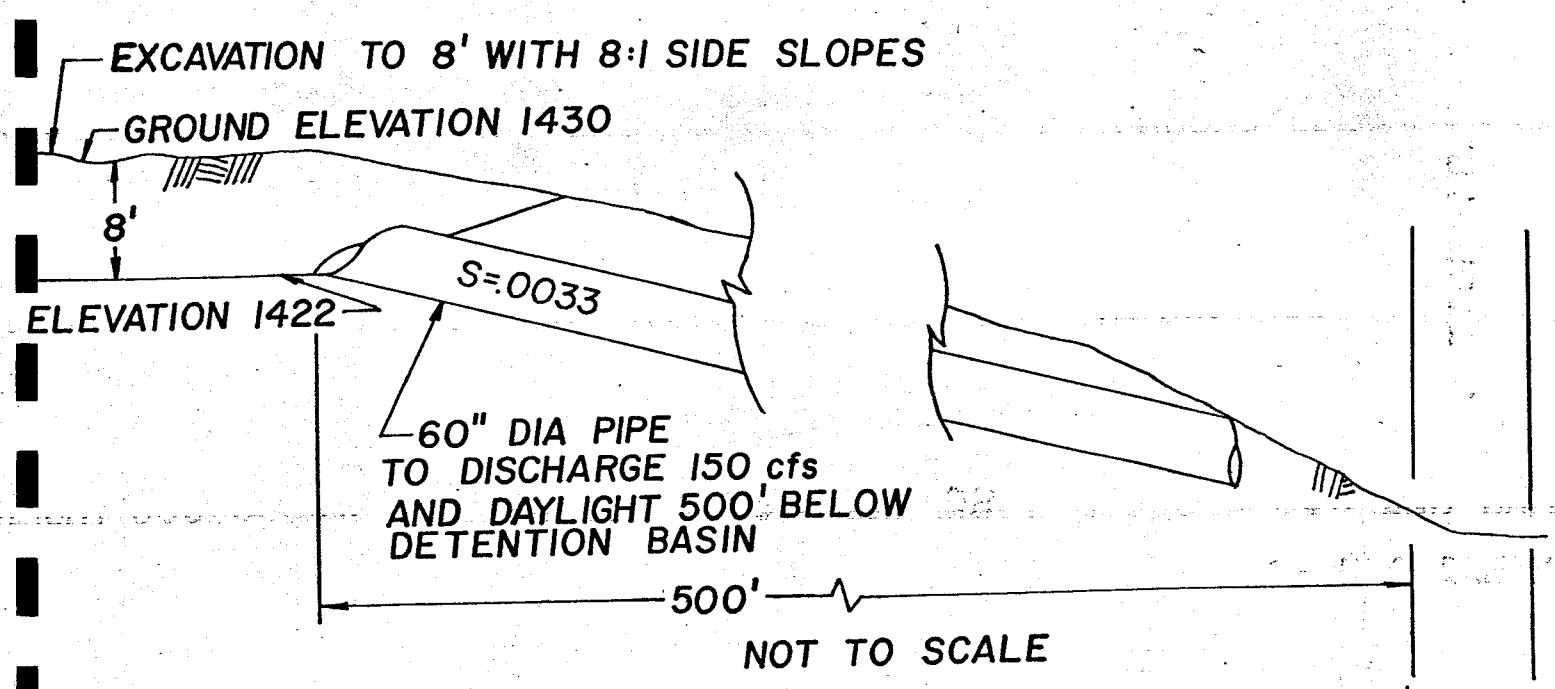
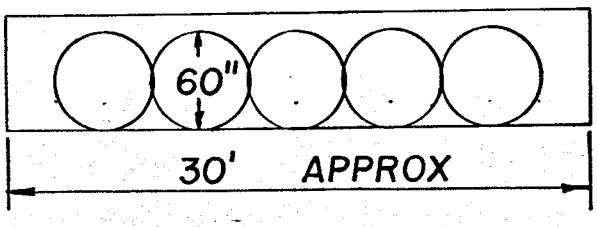


PLATE 2
Project "C"
(SCOTTSDALE RD

Required Culvert at Scottsdale Road to take 650 cfs.



NOT TO SCALE

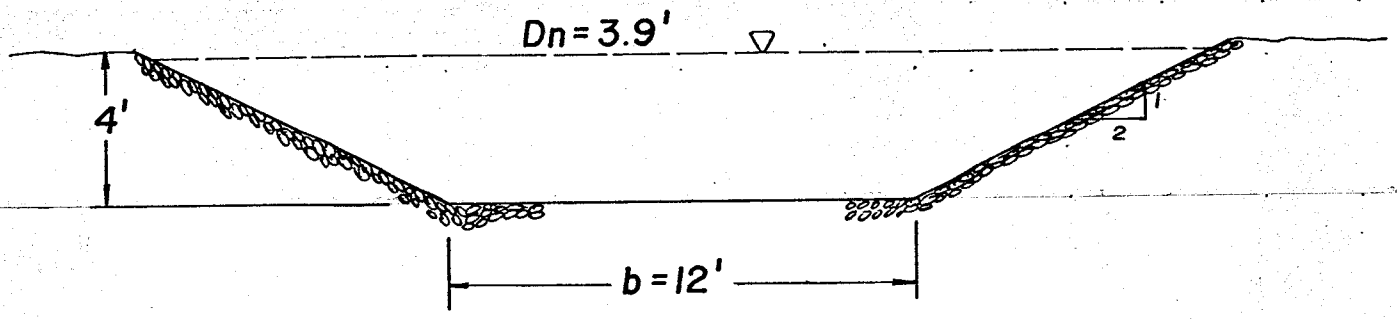
Q=650 cfs
n=.013
V=10.6'/Sec.
S=.008
$S^{\frac{1}{2}}$=.0894

(ONE 60" DIA PIPE AT Dc=150 cfs

$$\frac{Qn}{S^{\frac{1}{2}}} = \frac{150 \times .013}{.0894} = 21.8$$

A 60" Dia pipe would flow at .6D or .6 x 60" = 36" or 3'. And 5 x 150 = 750 cfs.

PLATE 3
Project "C"
(SCOTTSDALE RD.)



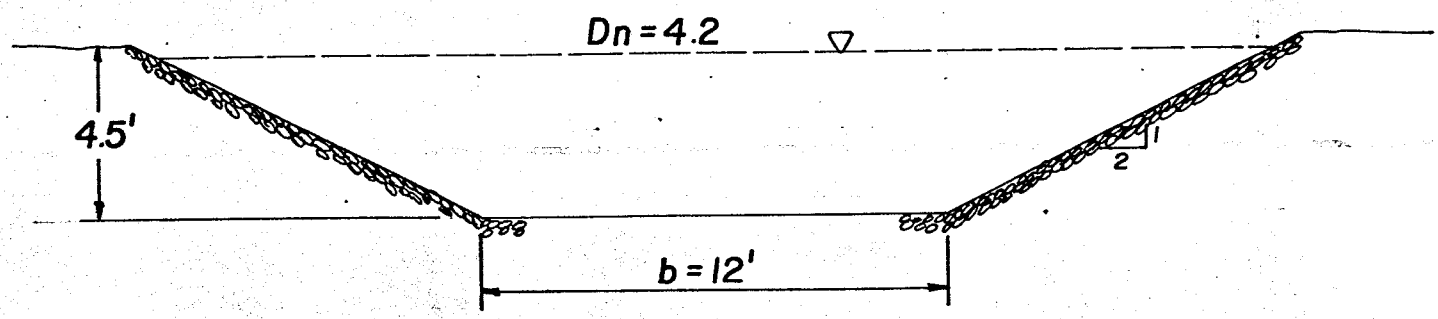
SCALE: 1"=5'

$$\frac{Qn}{S^{\frac{1}{2}}} = \frac{650 \times .030}{.0894} = 218$$

Q=650 cfs
n=.030
Assume S=.008
$S^{\frac{1}{2}}$=.0894
Z=2
Dn=3.9
Dc=3.3
Vn=8.3'/sec

Gabion-Type trapezoidal channel to transmit flow from culvert (Plate C-3) to point of junction with pipe discharging from Detention Basin.

PLATE 4
Project "C"
(SCOTTSDALE RD.)



SCALE: 1"=5'

$\frac{Qn}{S^{\frac{1}{2}}} = \frac{800 \times .030}{.0894} = 268$

Q= 800 cfs
n=.030
Assume S=.008
S_2^1 =.0894
Z = 2
Dn= 4.2
Dc = 4

$\frac{Dn}{Dc} = \frac{4.2}{4} = .95$ Unstable Flow

$A = \begin{array}{l} 4.2 \times 12 = 50.4 \\ 4.2 \times 8.4 = 35.3 \\ \hline 85.7 \end{array}$

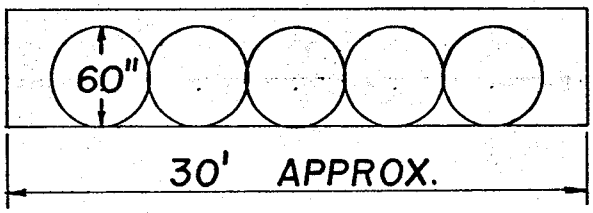
$V = \frac{Q}{A} = \frac{800}{85.7} = 9.3'/Sec$

Velocity to be reduced by flattening invert slopes with drop structures.

Gabion-Type trapezoidal channel from point of junction to Sutton Drive, thence, south on east side of Scottsdale Road.

PLATE 5
Project "C"
(SCOTTSDALE RD.)

Required culvert at Sutton to take 800 cfs.



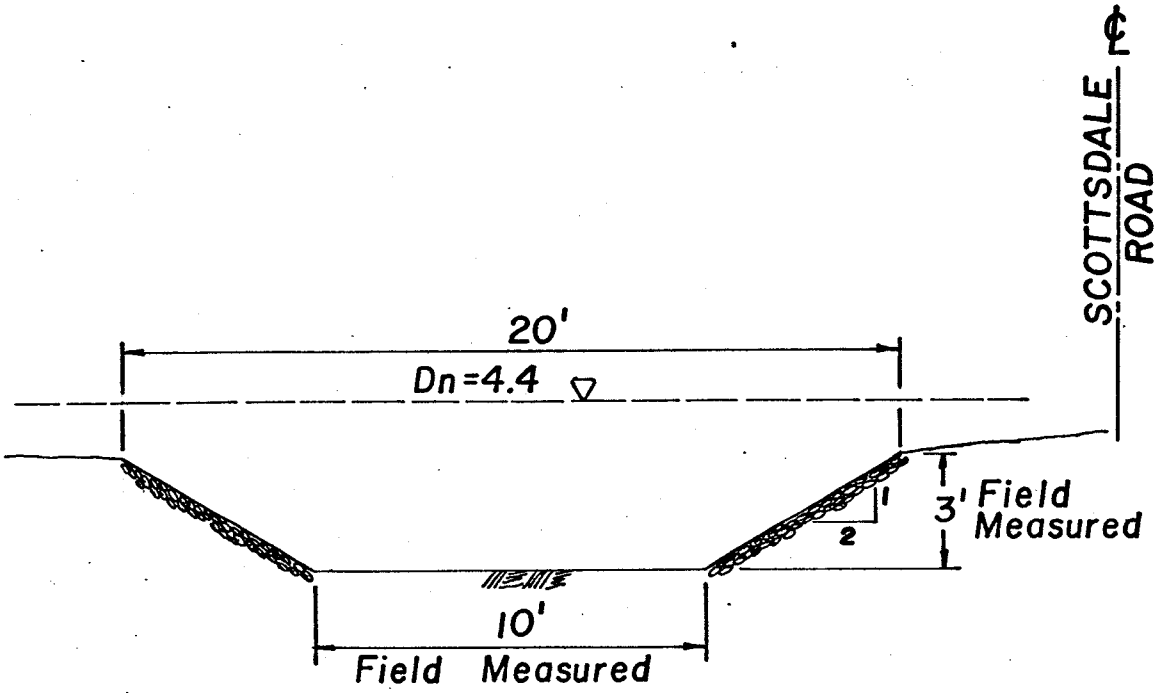
NOT TO SCALE

$Q = 800$ cfs
$n = .013$
$.8D = 48"$

$A = .674\,D^2$
$= 16.85 \times 5 = 84.25$
$V = \frac{800}{84.25} = 9.5'/Sec.$

Wing walls to be designed in keeping with R/W.

PLATE 6
Project "C"
(SCOTTSDALE RD.)



NOT TO SCALE

$$\frac{Qn}{S^{\frac{1}{2}}} = \frac{800 \times .030}{.0913} = 263$$

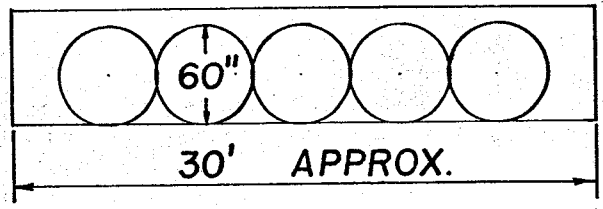
Z = 2
Dn = 4.4
Vn = 9.7 '/Sec

Gabion-Type channel improvement under construction (14 June 1978). Looking downstream.

This existing design will not control 800 cfs.

PLATE 7
Project "C"
(SCOTTSDALE RD.)

Required culvert at Sweetwater Ave. to take 800 cfs.

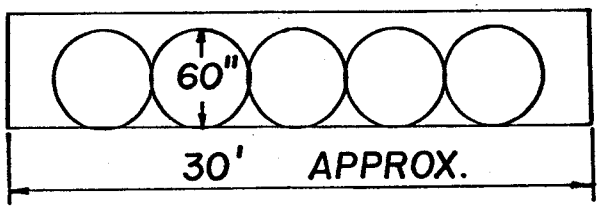


NOT TO SCALE

It is recommended this a culvert similar to that designed for Sutton Dr. be placed at this crossing, Sweetwater Ave. to carry a discharge of 800 cfs and a gabion-type trapezoidal channel be continued south of Sweetwater. See plate C-6.

PLATE 8
Project "C"
(SCOTTSDALE RD.)

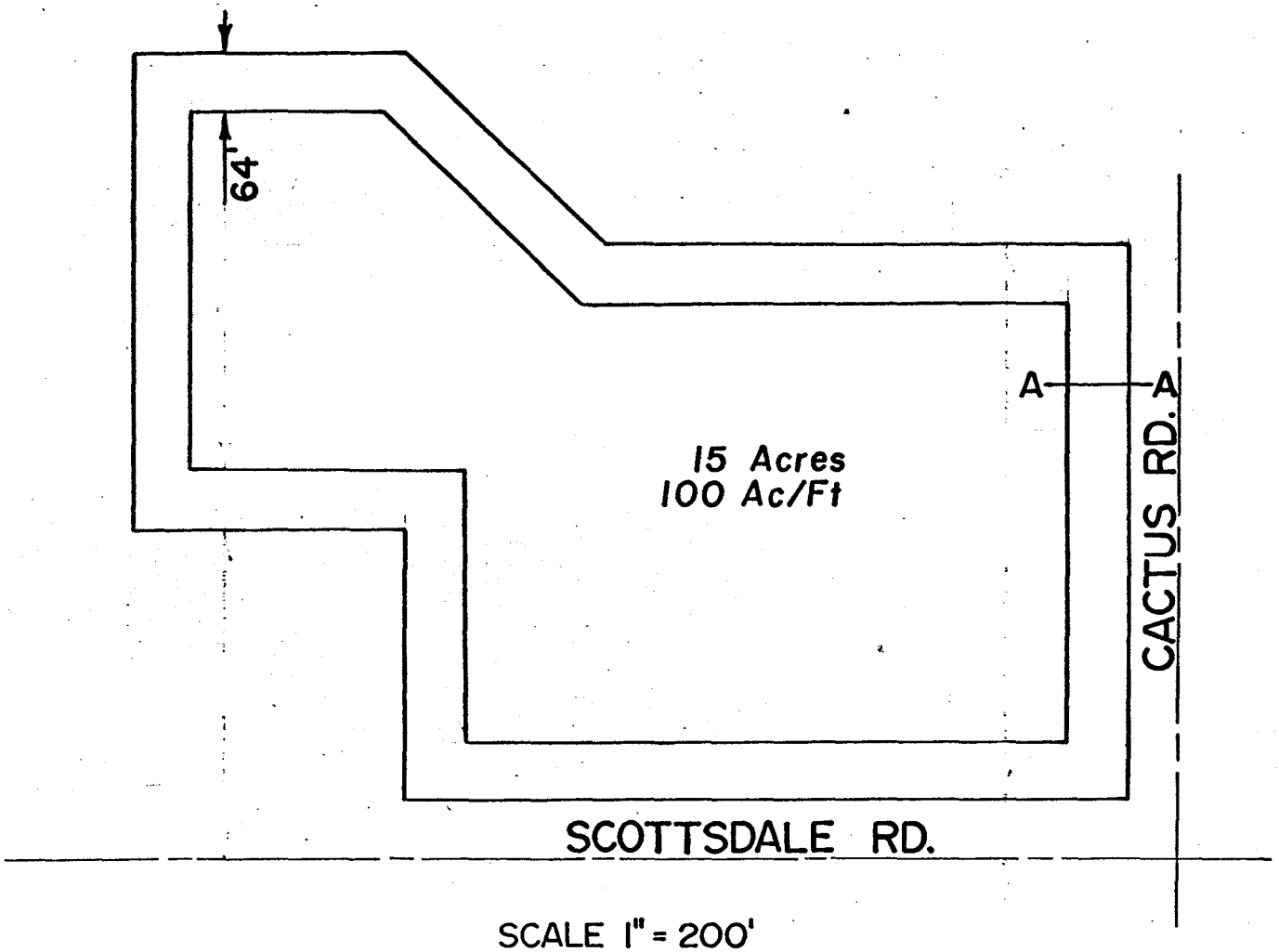
Required culvert at Larkspur Dr. to take 800 cfs.



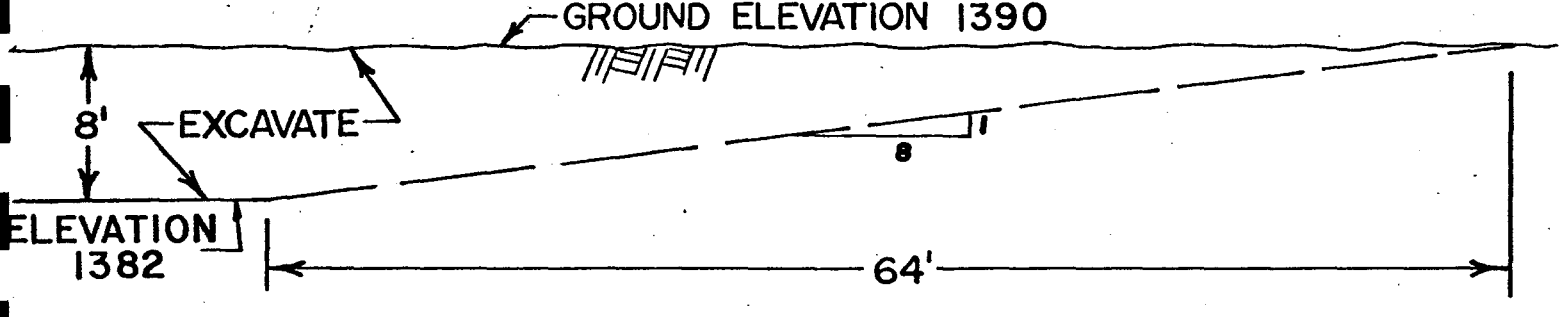
NOT TO SCALE

It is recommended that a culvert similar to that designed for Sutton Dr. be placed at this crossing, Larkspur Dr. to carry a discharge of 800 cfs and a gabion-type trapezoidal channel be continued south of Larkspur Dr. to discharge into proposed 100 Ac/Ft detention basin. See Plate C-6.

Detention Basin at
Cactus Rd. & Scottsdale

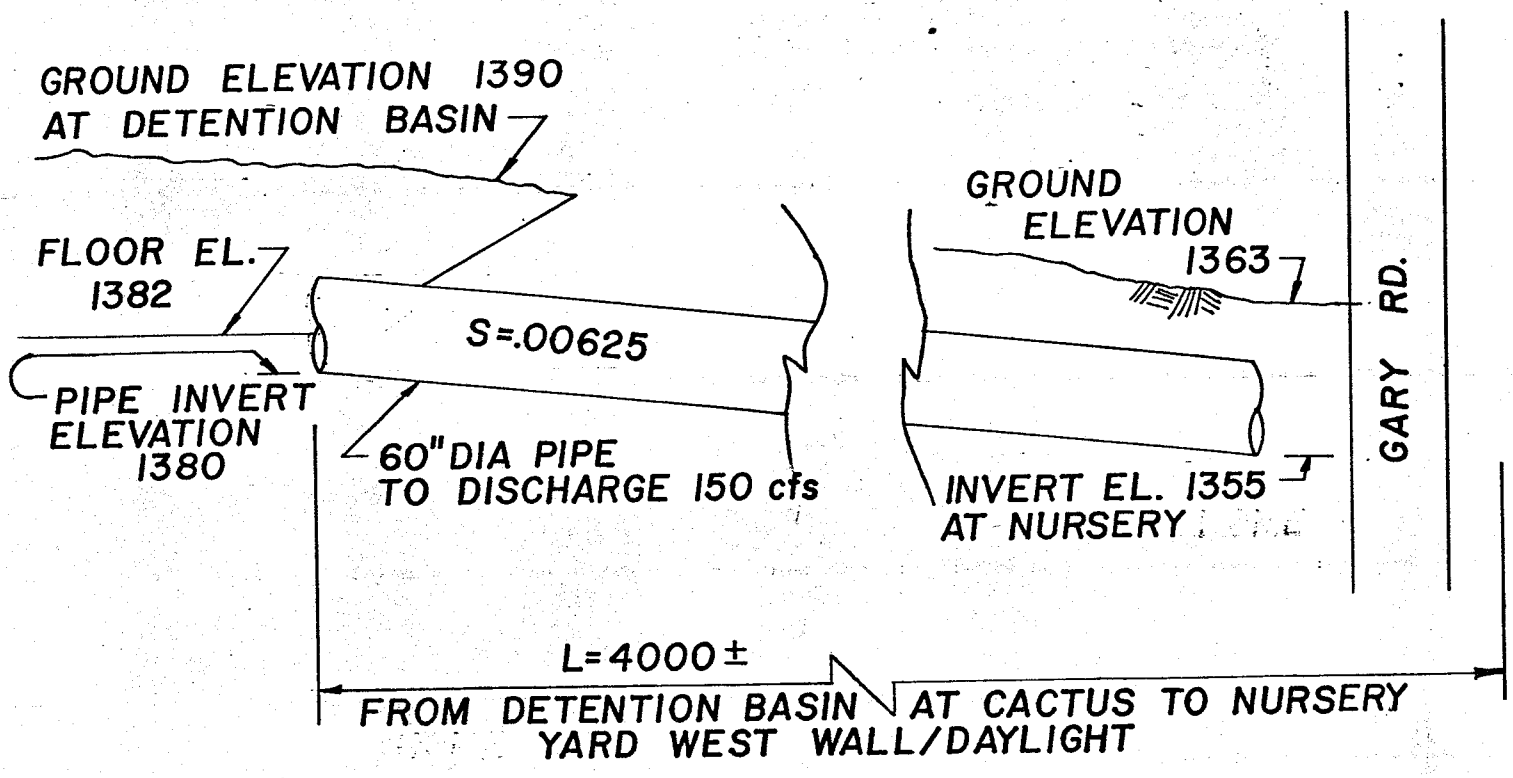


SCALE 1" = 200'



SECTION A-A
VERTICAL AND HORIZONTAL
SCALE 1" = 10"

PLATE 10
Project "C"
(SCOTTSDALE RD.)



$$\frac{Qn}{S^{\frac{1}{2}}} = \frac{150 \times .013}{.0791} = 25$$

$$V = \frac{150}{19.6} = 7.7'/\text{Sec.}$$

Q = 150 cfs
n = .013
Dn = 3' FREE FLOW

$$S = \frac{25}{4000} = .00625$$

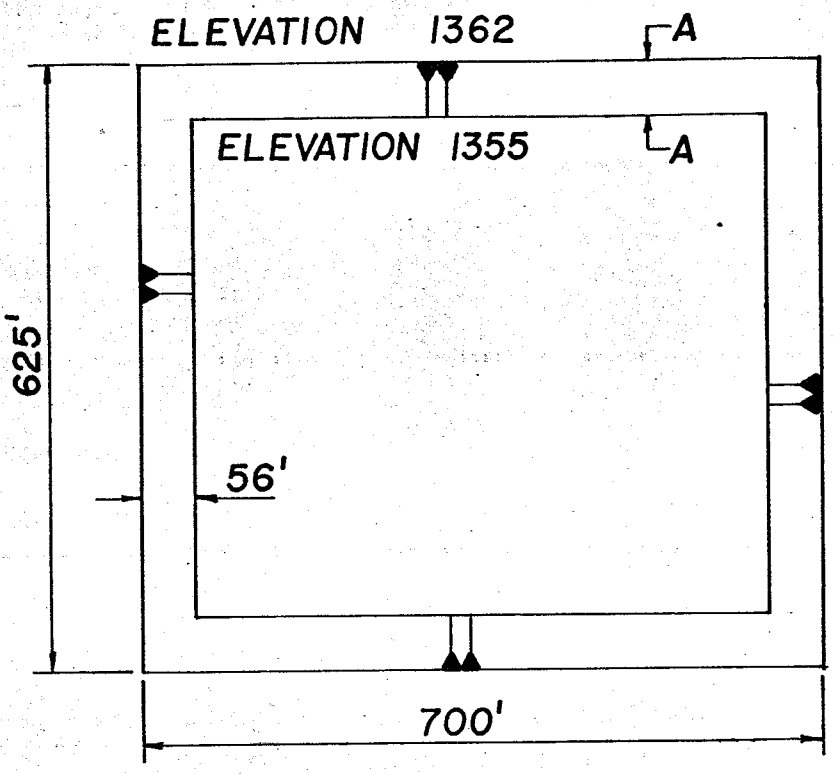
$$S^{\frac{1}{2}} = .0791$$

Velocity to be reduced at outlet with a dropped structure Stilling Basin.

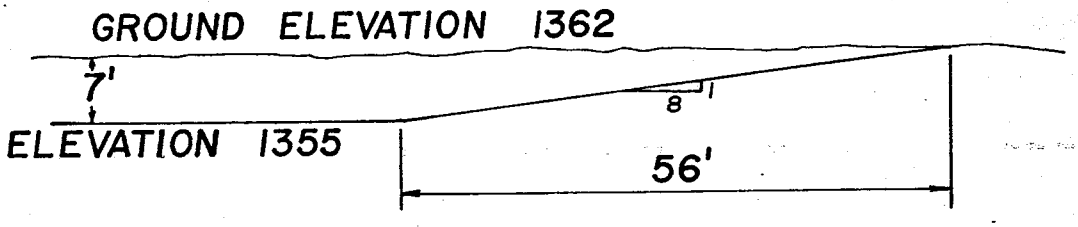
PLATE II
Project "C"
(SCOTTSDALE RD.)

Detention Basin at Gary Rd. & 68TH Place

10 ACRES
42 Ac/Ft
50 cfs out
1 Ac/Ft = 1613 cu. yds.

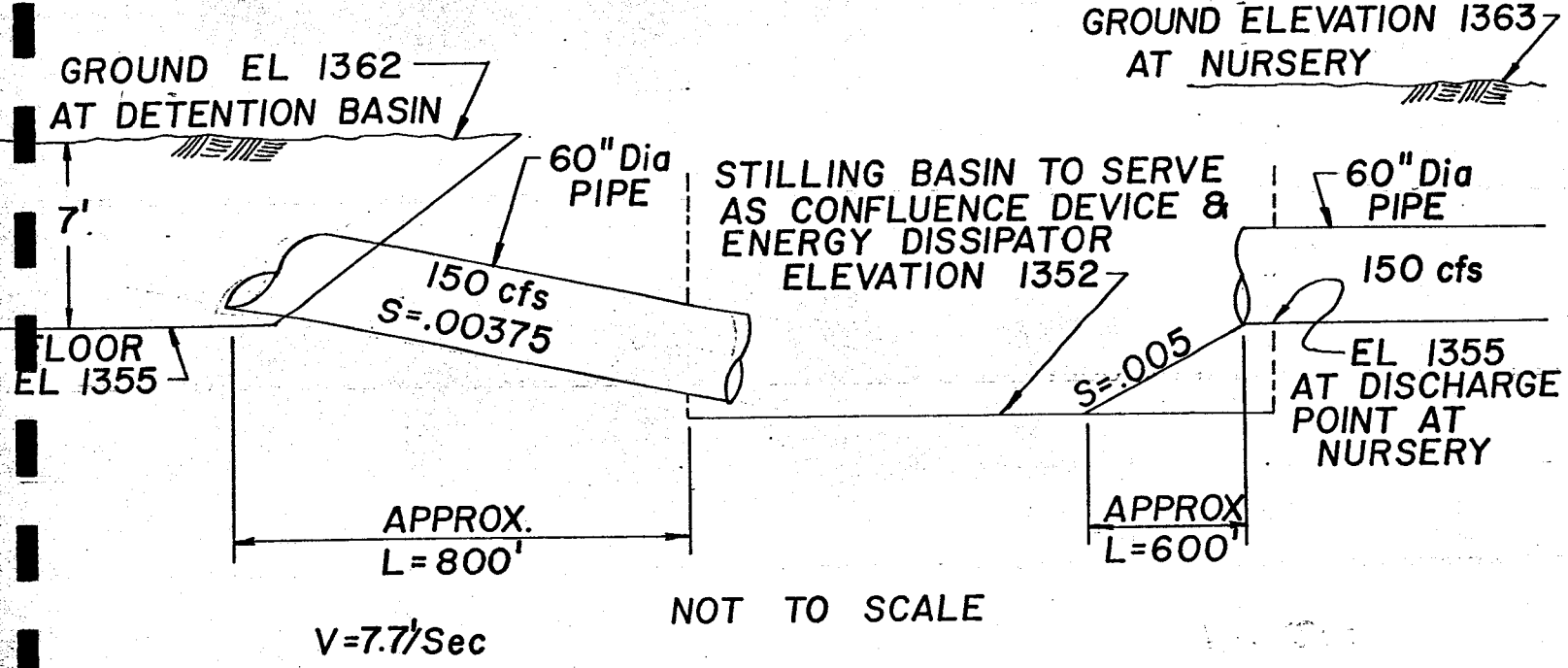


SCALE: 1" = 200'



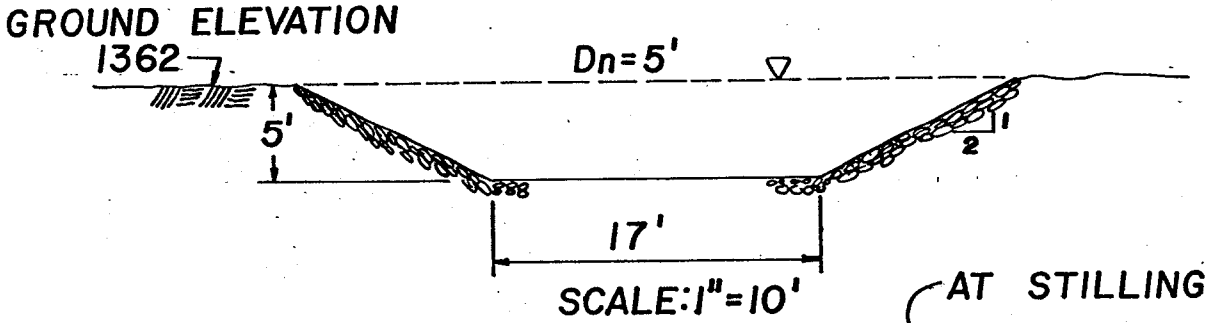
Section A-A
SCALE: 1" = 20'

PLATE 12
Project "C"
(SCOTTSDALE RD.)



NOTE: Location of above Stilling Basin is approximate and is to be detailed to accept a total maximum inflow of 1100 cfs.

PLATE 13
Project "C"
(SCOTTSDALE RD.)



AT STILLING BASIN
INVERT EL 1352

AT BERNIEL — INVERT EL $\frac{1328}{24}$

Q = 1100 cfs
n = .030
Z = 2

$\frac{Qn}{S^{\frac{1}{2}}} = \frac{1100 \times .030}{.0730} = 452$

Dn = 5'
Vn = 8.1'/Sec

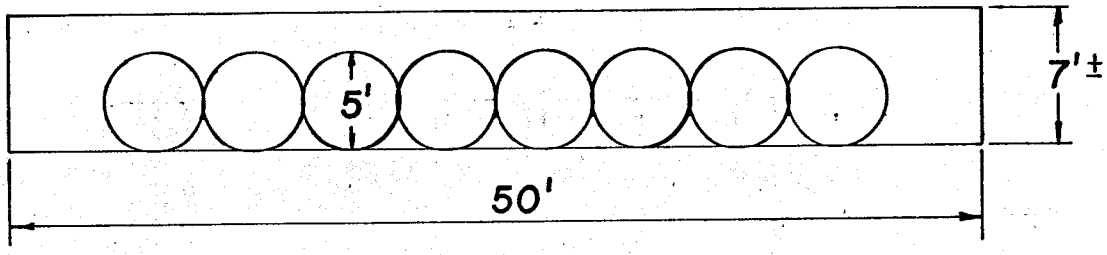
$S = \frac{24}{4500} = .00533$

$S^{\frac{1}{2}} = .0730$

This channel should begin at the outlet point of the required Stilling Basin for control of the 100 yr. frequency flood.

PLATE 14
Project "C"
(SCOTTSDALE RD.)

8 – 60" Dia Pipe



NOT TO SCALE

CULVERT CROSSINGS AT

(Q = 1100 cfs) Shea Blvd.
(Q = 1100 cfs) Cochise Rd.
(Q = 1100 cfs) Gold Dust Ave.

PLATE 15
Project "C"
(SCOTTSDALE RD.)

Design Storm Drain from Scottsdale Road and Shea Boulevard along west side of Scottsdale Road to Gold Dust Avenue and thence West to discharge into Trapezoidal channel carrying 1100 cfs from Stilling Basin north of Shea.

$$\frac{Qn}{S^{\frac{1}{2}}} = \frac{150 \times .013}{.0707} = 27.6$$

$n = .013$

$L = 1800' \pm$

Assume $S = .005'$

$S^{\frac{1}{2}} = .0707$

Assume 2yr summer storm 150 cfs

$$A = .674\, D^2 = 13.6'$$

$$V = \frac{150}{13.6} = 11'/\text{Sec.}$$

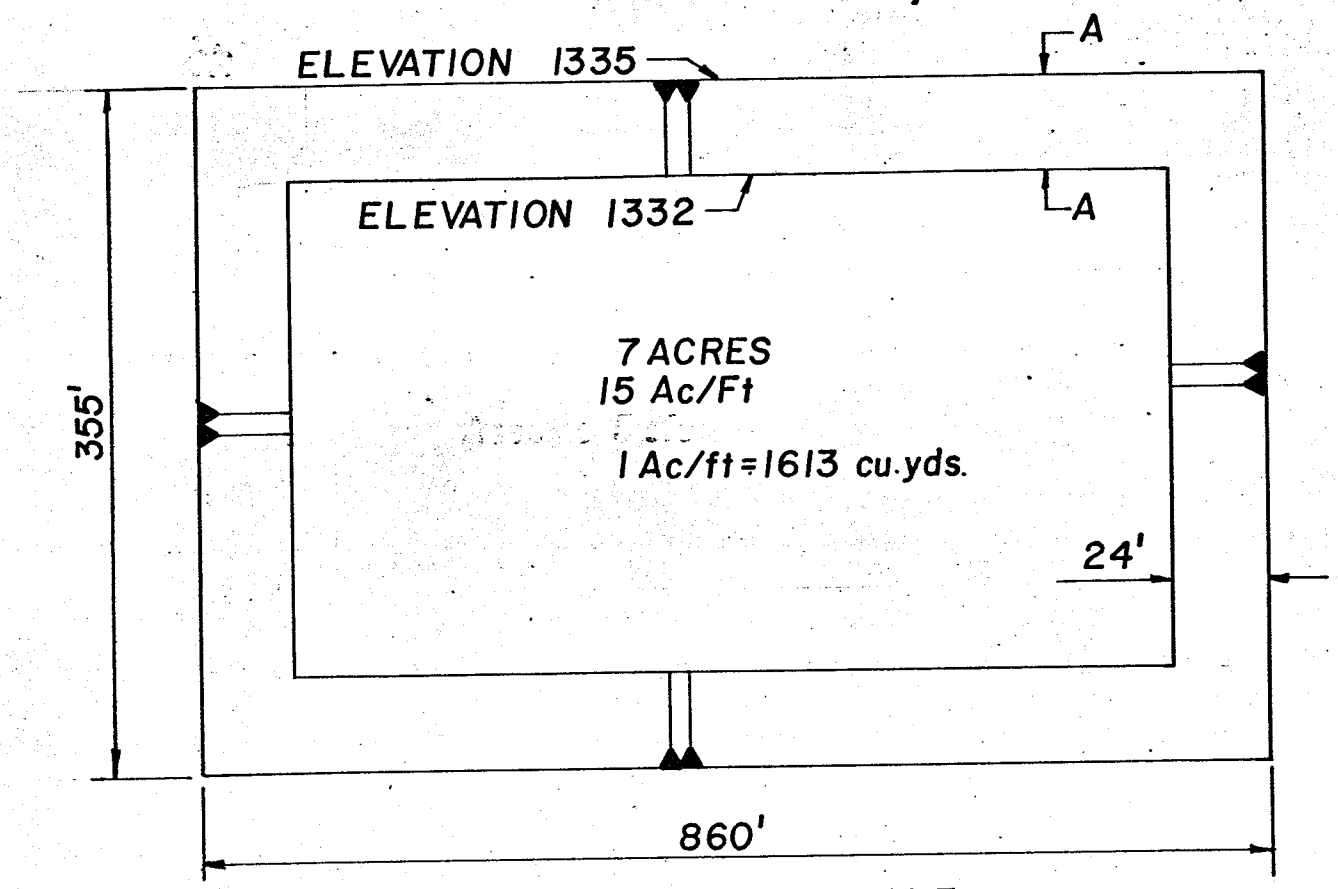
Velocity to be reduced before construction

NOTE:

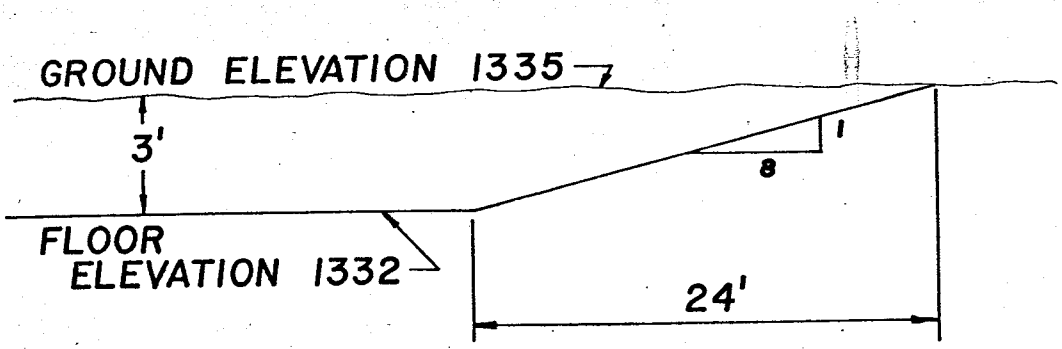
This Storm Drain is to be re-aligned by City of Scottsdale.

PLATE 16
Project "C"
(SCOTTSDALE RD.)

Detention Basin at
Chaparral High School

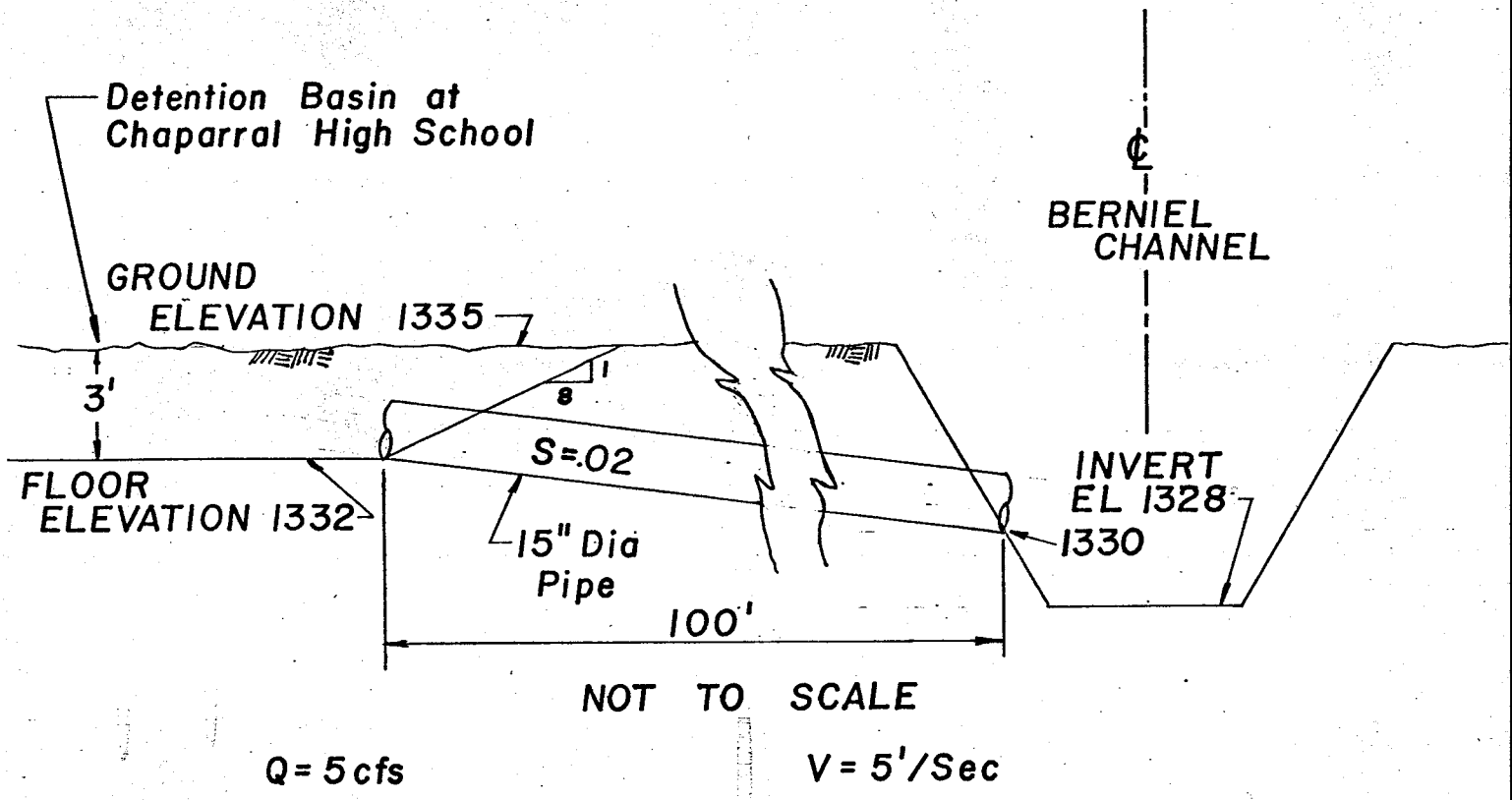


NOT TO SCALE



NOT TO SCALE
SECTION A–A

PLATE 17
Project "C"
(SCOTTSDALE RD.)



NOT TO SCALE

Q = 5 cfs

V = 5'/Sec

PLATE 18
Project "C"
(SCOTTSDALE RD.)

Improve Berniel Ditch near Berniel Drive to equal upstream capacity:

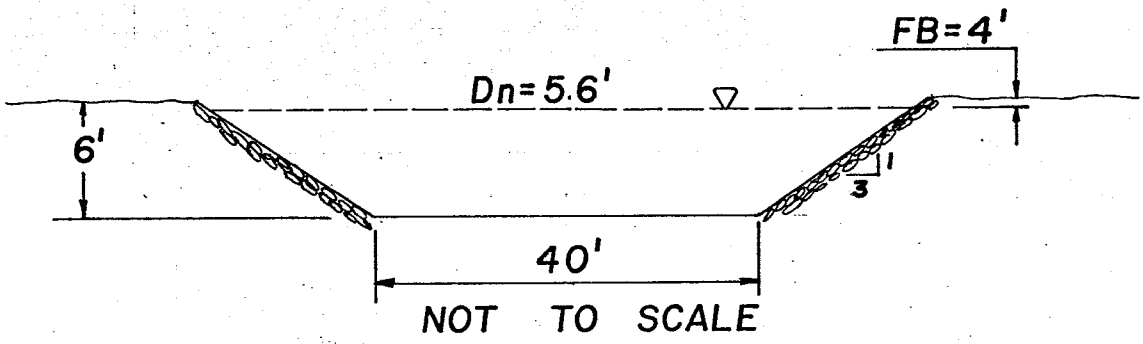
Q= 1100 cfs Berniel: From east of playground D.B.
+ 600 cfs Berniel: From west of playground D.B.
1700 cfs Design "Q"

Design for TOTAL Q = 2000 cfs

Berniel invert EL 1328 at H.S. playground

Berniel invert EL $\frac{1315}{13}$ at I.B.W.

Scaled length L= 8100'



$\frac{Qn}{S\frac{1}{2}} = \frac{2000 \times .025}{.0400} = 1250$

$S = \frac{13}{8100} = .0016$

$S\frac{1}{2} = .0400$

Dn= 5.6'

Vn= 6.2 Ft/Sec

Q = 2000
n = .025
Z = 3

PLATE 19
Project "C"
(SCOTTSDALE RD.)

60th PLACE FLOOD PROTECTION SYSTEM
LENGTH = .8 MI.

60th PLACE HAS A DEPRESSED CROWN FROM SHEA TO INDIAN BEND WASH.

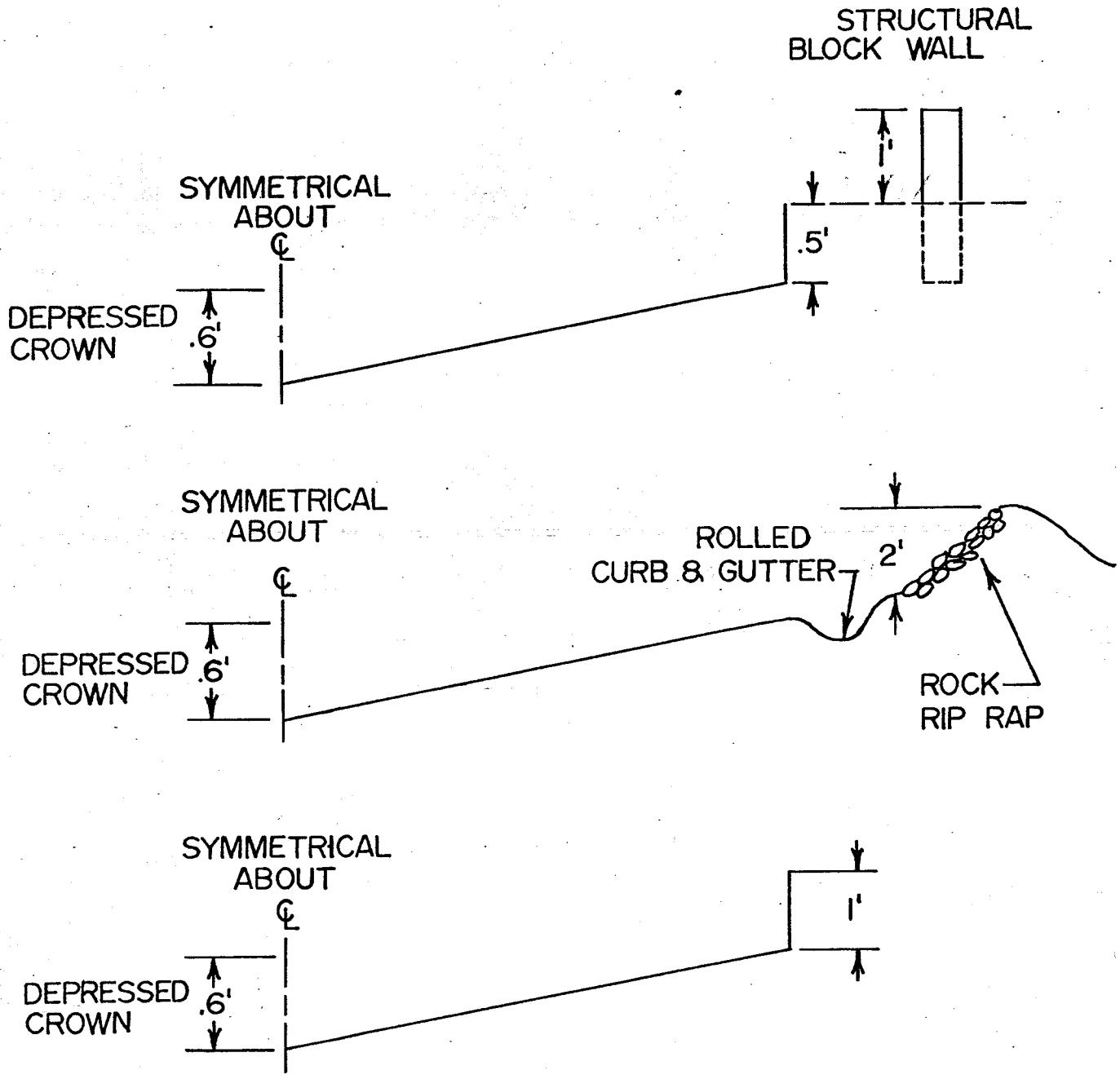
THE CAPACITY OF THIS EXISTING CROSS-SECTION COULD BE INCREASED BY PLACING A ROLLED CURB GUTTER DESIGN FROM MOUNTAIN VIEW RD. TO INDIAN BEND WASH. FROM MOUNTAIN VIEW TO SHEA, 60th PLACE HAS AN ADEQUATE EXISTING CROSS-SECTION.

HOWEVER THE PROFILE OF SHEA BLVD. AT 60th PLACE WOULD HAVE TO BE ALTERED TO INDUCE FLOOD FLOWS IN A SOUTHERLY DIRECTION ALONG 60th PLACE.

THE ABOVE TREATMENT WOULD RESULT IN AN INCREASED CAPACITY OF 60th PLACE FROM SHEA BLVD. TO INDIAN BEND WASH.

SEE PLATE 2 FOR SUGGESTED TREATMENTS OR IMPROVEMENTS THAT WILL INCREASE THE FLOOD FLOW CAPACITIES OF STREET CROSS-SECTIONS.

PLATE 60-1
FOR 60th PL. FLOOD
PROTECTION SYSTEM



NOT TO SCALE

SUGGESTED TREATMENTS THAT WILL INCREASE FLOW CAPACITIES OF STREET CROSS-SECTIONS.

PLATE 60-2
60th PL FLOOD
PROTECTION SYSTEM

66th ST. FLOOD PROTECTION SYSTEM

① 66th ST. IS UNIMPROVED FROM CACTUS RD. TO A POINT APPROXIMATELY 200' SOUTH OF PARADISE DR. (SEE PLATE I FOR AN APPROXIMATE REQUIRED CROSS-SECTION)

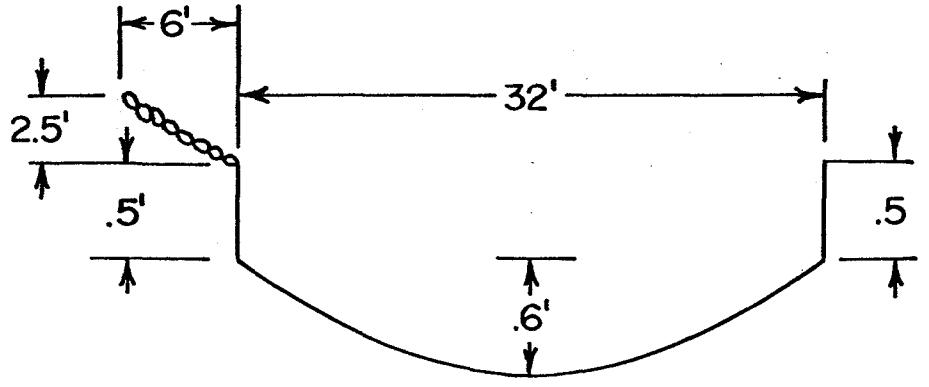
② 66th ST. IS IMPROVED WITH A DEPRESSED CROWN AND A CURBED GUTTER DESIGN FROM A POINT SOUTH OF PARADISE DR. TO SHEA BLVD. THIS REACH COULD BE LEFT IN ITS PRESENT CONDITION.

③ AT SHEA BLVD. THE STREET FLOWS FROM 66th ST. ARE TURNED ABRUPTLY TO THE EAST FOR DISTANCE OF APPROXIMATELY 150'. A DEPRESSED COVERED BOX UNDER SHEA WOULD IMPROVE THE TURNING OF FLOOD FLOWS FROM WEST TO EAST AT THIS JUNCTURE.

④ 66th ST. SOUTH OF SHEA BLVD. TO GOLD DUST, SHOULD BE CONTINUED SOUTH OF GOLD DUST IN A STRAIGHT ALIGNMENT IN THE EXISTING OPEN AREA FOR A DISTANCE OF APPROXIMATELY 1300' TO THE BERNIEL CHANNEL. THIS COULD BE A RECTANGULAR (16'X2') CONCRETE BOX.

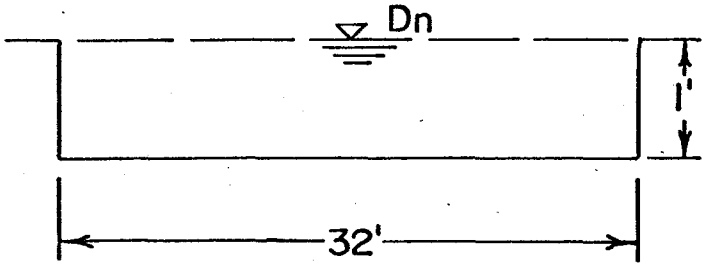
PLATE 66-1
FOR 66th ST. FLOOD
PROTECTION SYSTEM

66th ST. FLOOD PROTECTION SYSTEM
CAPACITY OF GOLD DUST AVE.



NOT TO SCALE
ABOVE CROSS-SECTION FIELD MEASURED
AT A POINT SOUTH OF EAST ONYX AVE.

ASSUME A RECTANGULAR CROSS-SECTION
FOR CAPACITY STUDY FOR A DEPRESSED CROWN



LONGITUDINAL
SLOPE = .7%
$S = .007$
$S^{\frac{1}{2}} = .0837$
$n = .018$
$Q = 230$
$Dn = 1'$
$Vn = \frac{230}{32} = 7.2'/sec$

$$Q = \frac{1.486}{n} AR^{\frac{2}{3}} S^{\frac{1}{2}}$$

$$\frac{Qn}{S^{\frac{1}{2}}} = 1.486\, AR^{\frac{2}{3}}$$

$49.5 = 44.7$

LENGTH = 1.5 MILES

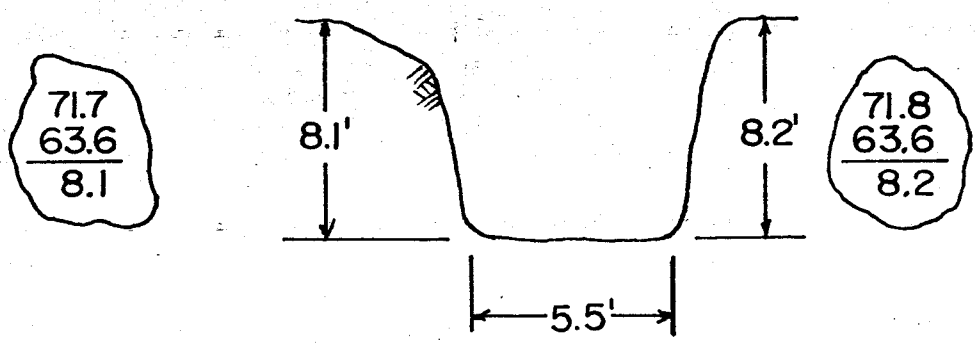
PLATE 66-2
FOR 66th ST. FLOOD
PROTECTION SYSTEM

DETERMINE CAPACITY OF EXISTING CHANNEL

DESERT COVE CHANNEL SYSTEM IN SUNDOWN RANCHOS DEVELOPMENT.

REFERENCE : LTR. DTD. 25 MAY 1978
FLOOD CONTROL DIST. MARICOPA COUNTY
TO COLLAR, WILLIAMS & WHITE

USE CROSS-SECTION
AT STA 14+50
(FIELD MEASURED)



NOT TO SCALE

$$\frac{Qn}{S^{\frac{1}{2}}} = \frac{(250)(.030)}{.0721}$$

$= 104$

$dn = 8'$

$Vn = 5.7'/sec$

64.9
57.1
7.8

$L = 1500'$

$S = \frac{7.8}{1500} = .0052$

$S^{\frac{1}{2}} = .0721$

$n = .030$

$Q = 250$

$A = 5.5 \times 8 = 44$

$V = \frac{250}{44} = 5.7'/sec$

PLATE DC-1
DESERT COVE
CHANNEL SYSTEM

C O S T

E S T I M A T E S

ESTIMATED COSTS
PHASE III
PVSP

The following cost estimates are based on current July 1978 cost data. They include cost of structures, rights of way (where applicable), and all utilities.

Details may be found on the following data sheets. Summary by Project areas is as follows:

	Grand Totals
Project A	$1,364,088.00
Project B	1,681,780.00
Project C	3,324,124.00
60th Place	32,108.00
66th Street	274,886.00
Total	$6,676,986.00

PVSP PHASE III ESTIMATED COSTS

PROJECT "A"

PLATE 1:

Retention Excavation -

85,579 C.Y. @ $1.50/C.Y. (Cost of clearing, excavation & haul-off only)	$128,369.00

PLATE 2:

42 Inch dia. conc. pipe complete in place -

2600 L.F. @ $51.00/L.F.	$132,600.00
Headwalls - 2 Ea. @ $3,000.00/Ea.	6,000.00
Transition Channel Ex. 220 C.Y. @ $1.50/C.Y.	330.00
Total Plate 2	$138,930.00

(Assume all necessary easements are provided in the Desert Springs Development)

PLATE 3:

Assume that Thunderbird Road will be designed and constructed to provide for storm water overflow to 58th St.

Cost Assigned to PVSP	0.00

PLATE 4:

Retention Excavation -

64,533 C.Y. @ $1.50/C.Y.	$96,800.00
(42" Pipe Outlet) 48 L.F. @ $51.00/L.F.	2,448.00
(Rip-Rap Outlet Channel to the Street) $\frac{20 \times 100 \times 1}{27}$ x $50.00/C.Y.	3,704.00
Total Plate 4	$102,952.00

PLATE 5:

Existing street section adequate

Cost Assigned to PVSP	0.00

PLATE 6:

Remove existing pavement -	16,911 S.Y. @ $1.00/S.Y.	$16,911.00
Remove existing C. & G. -	2,500 L.F. @ $1.50/L.F.	3,750.00
Remove existing S.W. -	10,000 S.F. @ $0.75/S.F.	7,500.00
Adjust existing S.S. M.H.-	15 Ea. @ $350.00/Ea.	5,250.00
Reset existing F.H. -	9 Ea. @ $400.00/Ea.	3,600.00
Reset existing water meters -	Lump Sum	1,500.00
Relocate A.P.S. facilities - (Street lights, overhead power - cost may be assumed by Utility Co.)	Lump Sum	15,000.00
Relocate Mountain Bell facilities - (Adjust manholes - cost may be assumed by Utility Co.)	Lump Sum	5,000.00
Right-of-Way acquisition (West side)	2940 X 25 = 1.69 Ac @ $22,000.00/Ac.	37,180.00
Roadway subgrade preparation	21,985 C.Y. @ $1.50/C.Y.	32,978.00
Construct new pavement (Assume 2"/9")	45,344 S.Y. @ $5.00/S.Y.	226,720.00
Construct new curb & gutter (Assume 7")	10,600 L.F. @ $4.50/L.F.	47,700.00
Construct new sidewalk	42,400 S.F. @ $1.00/S.F.	42,400.00
Reconstruction of driveways & side street intersections	Lump Sum	6,000.00
	Total Plate 6	$451,489.00

PLATE 7:

Remove existing pavement	7,711 S.Y. @ $1.00/S.Y.	$7,711.00
Remove existing C. & G.	660 L.F. @ $1.50/L.F.	990.00
Remove existing S.W.	2,640 S.F. @ $0.75/S.F.	1,980.00
Adjust existing S.S. M.H.	6 Ea. @ $350.00/Ea.	2,100.00
Reset existing F.H.	2 Ea. @ $400.00/Ea.	800.00
Reset existing water meters	Lump Sum	1,500.00
Relocate A.P.S. facilities (Cost may be assumed by Utility Co.)	Lump Sum	10,000.00
Relocate Mountain Bell facilities- (Cost may be assumed by Utility Co.)	Lump Sum	4,000.00
Right-of-Way acquisition	5,000 X 25 = 2.87 Ac. @ $22,000/Ac.	63,140.00
Roadway subgrade preparation	17,422 C.Y. @ $1.50/C.Y.	26,133.00
Construct new pavement (Assume 2"/9")	36,000 S.Y. @ $5.00/S.Y.	180,000.00
Construct new curb & gutter (Assume 7")	8,000.00 L.F. @ $4.50/L.F.	36,000.00
Construct new sidewalk	32,000 S.F. @ $1.00/S.F.	32,000.00
Reconstruction of driveways & side street intersections	Lump Sum	4,000.00
	Total Plate 7	$370,354.00

(Note: In the reconstruction of Shea Boulevard, a dip section will be required at the 56th St. crossing.)

PLATE 8: (An alternate design for the reach from Shea Blvd. to Indian Bend Wash)

Remove existing pavement (from Plate 7)	$7,711.00
Remove existing C. & G. (from Plate 7)	990.00
Remove existing S.W. (from Plate 7)	1,980.00
Rebuild existing S.S. M.H. - 4 Ea. @ $1,000.00/Ea.	4,000.00
Reset existing F.H. (from Plate 7)	800.00
Reset existing water meters (from Plate 7)	1,500.00
Relocate A.P.S. facilities (from Plate 7)	10,000.00
Relcocate Mountain Bell facilities (from Plate 7)	4,000.00
Right-of-Way acquisition (from Plate 7)	63,140.00
Roadway subgrade preparation - 7,111 C.Y. @ $1.50/C.Y.	10,666.00
Channel excavation 12,148 C.Y. @ $1.50/C.Y.	18,222.00
Construct concrete culverts @ Shea Blvd., Mountain View Road & 1320 Feet South of Shea Blvd. (Assume 3 Single Box 10' X 4')	
130 C.Y. Concrete @ $175.00/C.Y.	22,750.00
Guard Rail Etc. - Lump Sum	8,000.00
Construct new pavement (Assume 2"/9") 21,333 S.Y. @ $5.00/S.Y.	106,665.00
Construct new C. & G. (from Plate 7)	36,000.00
Construct new Single Curb 8,000 L.F. @ $4.00/L.F.	32,000.00
Construct new sidewalk (from Plate 7)	32,000.00
Reconstruction of driveways & side street intersections Lump Sum	4,000.00
Total Plate 8	$364,424.00

(Note: This alternate will require an adjustment of the design of the profile of Shea Blvd.)

Estimated Cost Project "A"	$1,192,094.00
Contingencies @15%	178,814.00
ESTIMATED GRAND TOTAL COST	$1,370.908.00

Estimated Cost Project "A" with Alternate	$1,186,164.00
Contingencies @ 15%	177,924.00
ESTIMATED GRAND TOTAL COST WITH ALTERNATE	$1,364,088.00

PVSP PHASE III COST ESTIMATE

PROJECT "B"

PLATE 1:

Excavation of detention basin No. 1	
104,085 C.Y. @ $1.50/C.Y.	$156,128.00
(Cost of clearing, excavation & haul-off only)	

PLATE 2:

36 Inch dia. conc. pipe complete in place -	
800 L.F. @ $48.00/L.F.	$38,400.00
Headwalls - 2 Ea. @ $3,000/Ea.	6,000.00
Transition channel Ex.	
220 C.Y. @ $1.50/C.Y.	330.00
Total Plate 2	$44,730.00
(Assume all necessary easements are provided in the Desert Springs Development)	

PLATE 3:

Existing street section adequate	
Cost assigned to PVSP	0.00

PLATE 4 & 5:

Channel - (Box in 64th St. from Thunderbird Rd. to Cactus Rd.)	
Sawcut and remove existing pavement	
54,000 S.F. @ $0.40/S.F.	$21,600.00
Construct concrete box including grates	
4,400 C.Y. @ $190.00/C.Y.	836,000.00
Structural excavation	
9,000 C.Y. @ $7.00/C.Y.	63,000.00
Lower existing water mains	
(11 crossing) 20 L.F. @ $25.00/L.F.	5,500.00
18 Inch dia. conc. pipe outlet from retention basin at Thunderbird Rd. and 64th St.	
140 L.F. @ $25.00/L.F.	3,500.00
Headwall - Lump Sum	1,000.00
Pvmt. Replacement - Lump Sum	450.00
Total Plates 4 & 5	$931,050.00

PLATE 6:

Channel excavation	
12,711 C.Y. @ $1.50/C.Y.	$19,067.00
Gabion bank protection	
1156 C.Y. @ $70.00/C.Y.	80,920.00
Box culvert at Sunnyside Dr.	
55 C.Y. @ $175.00/C.Y.	9,625.00
Guard rail, etc. - Lump Sum	6,000.00
Storm drain in Cactus from 62nd St. to 64th St. and from 66th St. to the 64th St. Channel	
42 Inch conc. pipe - 2600 L.F. @ $51.00/L.F.	$132,600.00
18 Inch conc. pipe - 160 L.F. @ $25.00/L.F.	4,000.00
24 Inch conc. pipe - 80 L.F. @ $30.00/L.F.	2,400.00
Catch basins- 12 Ea. @ $800.00/Ea.	9,600.00
Man holes - 6 Ea. @$1,000.00/Ea.	6,000.00
Headwalls - 2 Ea. @ $1,000.00/Ea.	2,000.00
Pvmt Replacement - 1893 S.F. @ $15.00/S.F.	28,395.00
Adjust water services - Lump Sum	1,500.00
Sewer tap encasement - Lump Sum	1,500.00
	$187,995.00
Total Plate 6	$303,607.00

PLATE 8:

Improve existing channel between Turquoise & Mountain View Roads

Channel excavation:	
3,422 C.Y. @ $1.50/C.Y.	$5,133.00
Gabion bank protection	
311 C.Y. @ $70.00/C.Y.	21,770.00
Total Plate 8	26,903.00
ESTIMATED COST PROJECT "B":	$1,462,418.00
Contingencies @ 15%	219,362.00
ESTIMATED GRAND TOTAL COST:	$1,681,780.00

PVSP PHASE III COST ESTIMATE

PROJECT "C"

PLATE 1:

Excavation of Detention Basin No. 1		
	60,076 C.Y. @ $1.50/C.Y.	$90,114.00
(Cost of clearing, excavation & haul-off only)		

PLATE 2:

60 Inch dia. conc. pipe complete in place -		
	500 L.F. @ $73.00/L.F.	36,500.00
	Headwall - Lump Sum	6,000.00
	Right-of-Way acquisition -	
	0.17 Ac @ $25,000.00/Ac.	4,250.00
	Total Plate 2	$46,750.00

PLATE 3:

Concrete pipe culvert complete in place		
(5 barrel - 115 Ft. in length, Skew 60°)		
	Pipe - 115 X 5 = 575 L.F.	
	@ $73.00/L.F.	$41,975.00
	Headwalls & guard rails -	
	Lump Sum	6,000.00
		$47,975.00
	Relocate sewer:	
	8" V.C.P. - 100 L.F. @ $6.00/L.F.	600.00
	1 Drop M.H. - Lump Sum	1,000.00
		$1,600.00
	Adjust 8" Water Main	
	8" A.C.P. - 80 L.F. @ $15.00/L.F.	$1,200.00
	Total Plate 3	$50,775.00

PLATE 4:

Channel Excavation	1,956 C.Y. @ $1.50/C.Y.	$2,934.00
	Gabion bank protection	
	356 C.Y. @ $70.00/C.Y.	24,920.00
	Right-of-Way acquisition	
	0.62 Ac. @ $25,000.00/Ac.	15,500.00
	Total Plate 4	$43,354.00

PLATE 5:

Channel excavation 16,483 C.Y. @ $1.50/C.Y.	$24,725.00
Gabion bank protection 2,867 C.Y. @ $70.00/C.Y.	200,690.00
Sewer encasement 75 L.F. @ $6.00/L.F.	450.00
Adjust 6" water main 75 L.F. @ $10.00/L.F.	750.00
Relocation of A.P.S. facilities Lump Sum (Natural gas & overhead power) (Cost may be assumed by Utility Co.)	15,000.00
Right-of-way acquisition 3.55 Ac. @ $35,000.00/Ac.	124,250.00
Total Plate 5	$365,865.00

PLATE 6:

Conc. pipe culvert complete in place (5 barrel - 45 Ft. in length)	
Pipe - 45 X 5 = 225 L.F. @ $73.00/L.F.	$16,425.00
Headwalls & guard rails - Lump Sum	6,000.00
Utility relocation - Lump Sum	2,000.00
Pvmt.replacement 147 S.Y. @ $15.00/S.Y.	2,205.00
Total Plate 6	$26,630.00

PLATE 7:

Cost to PVSP	0.00

PLATE 8:

Cost equal to Plate 6	$26,630.00

PLATE 9:

Cost equal to Plate 6	$26,630.00

PLATE 10:

Excavation of detention basin 160,430 C.Y. @ $1.50/C.Y. (Cost of clearing, excavation & haul-off only)	$240,645.00
Storm drain in Larkspur Dr. (60 inch dia. pipe - length 2,900± Ft.) Located under pavement in Larkspur under the Scottsdale Road Channel, with direct discharge into detention basin at Cactus Road)	
60 Inch dia. conc. pipe - 2,900 L.F. @ $73.00/L.F.	$211,700.00
18 Inch dia. conc. pipe - 160 L.F. @ $25.00/L.F.	4,000.00
24 Inch dia. conc. pipe - 40 L.F. @ $30.00/L.F.	1,200.00
Catch basins - 10 Ea. @ $800.00/Ea.	8,000.00
Manholes - 5 Ea. @ $900.00/Ea.	4,500.00
Pavement replacement 2,180 S.Y. @ $15.00/S.Y.	32,700.00
Utility adjustments - Lump Sum	2,000.00
Headwall - Lump Sum	2,000.00
	$266,100.00
Total Plate 10	$506,745.00

PLATE 11:

60 Inch dia. conc. pipe line	
60 Inch pipe - 4,000 L.F. @ $73.00/L.F.	$292,000.00
Headwalls - Lump Sum	3,000.00
Manholes - 5 Ea. @ $1,200.00/Ea.	6,000.00
Pavement replacement 152 S.Y. @ $15.00/S.Y.	2,280.00
Adjust sewer 8" V.C.P. - 20 L.F. @ $6.00/L.F.	120.00
Drop M.H.'s -2 Ea. @ $1,000.00/Ea.	2,000.00
Adjust 6 Inch water main 50 L.F. @ $10.00/L.F.	500.00
Right-of-Way acquisition 0.21 Ac. @ $20,000.00/Ac.	4,200.00
Total Plate 11	$310,100.00

PLATE 12:

Excavation of detension basin 95,000 C.Y. @ $1.50/C.Y. (Cost of clearing, excavation & haul-off only)	$142,500.00

PLATE 13:

Excavation stilling basin 2,222 C.Y. @ $1.50/C.Y.	3,333.00
60 Inch pipe - 800 L.F. @ $73.00/ L.F.	58,400.00
Headwalls - Lump Sum	3,000.00
Right-of-Way acquisition 0.5 Ac. @ $20,000.00/Ac.	10,000.00
Total Plat 13	$74,733.00

PLATE 14:

Clearing, excavation & haul-off 24,704 C.Y. @ $1.50/C.Y.	$37,056.00
Gabion bank protection 3,407 C.Y. @ $60.00/C.Y.	204,420.00
Relocate 4 Inch water main 500 L.F. @ $6.00/L.F.	2,000.00
Sewer encasement 40 L.F. @ $6.00/L.F.	240.00
Right-of-Way acquisition 5.3 Ac. @ $24,900.00/Ac.	131,970.00
Total Plate 14	$375,686.00

PLATE 15:

Concrete pipe culverts complete in place Shea Blvd. - (8 barrel - 100 Ft. length) 60" dia. pipe - 800 L.F. @ $73.00/ L.F.	58,400.00
Headwalls & guard rails-Lump Sum	6,000.00
Pavement replacement 178 S.Y. @ $15.00/S.Y.	2,670.00
Lower 12" water main 60 L.F. @ $30.00/L.F.	1,800.00
	$68,870.00

PLATE 15 (con't):	Cochise Road - (8 barrel - 44 Ft. length)	
	60" dia. pipe - 352 L.F. @ $73.00/L.F.	$25,696.00
	Headwalls - Lump Sum	6,000.00
	Pavement replacement 133 S.Y. @ $15.00/S.Y.	1,995.00
	Lower 6" water main 60 L.F. @ $10.00/L.F.	600.00
		$34,291.00
	Gold Dust Ave. (8 barrel - 44 Ft. length)	
	(Cost equal to Cochise Rd. Culvert)	34,291.00
	Total Plate 15	$137,452.00
PLATE 17:	Excavation of detension basin 30,746 C.Y. @ $1.50/C.Y.	46,119.00
	(Cost of clearing, excavation & haul-off only)	
Plate 18:	Concrete pipe drain 15 Inch dia. pipe - 100 L.F. @ $18.00/L.F.	1,800.00
	Outlet protection Gunite - 150 S.F. @ $1.50/S.F.	225.00
	Total Plate 18	$2,025.00
Plate 19:	Channel excavation 36,000 C.Y. @ $1.50/C.Y.	$54,000.00
	Bank protection Gunite - 324,000 S.F. @ $1.50/S.F.	486,000.00
	Extend spillway Concrete - 29 C.Y. @ $120.00/C.Y.	3,480.00
	Pavement Replacement 533 S.Y. @ $15.00/S.Y.	7,995.00
	Right-of-way acquisition 3.72 Ac. @ $18,000.00/Ac.	66,960.00
	Total Plate 19	$618,435.00
	ESTIMATED COST PROJECT "C"	$2,890,543.00
	Contingencies @ 15%	433,581.00
	ESTIMATED GRAND TOTAL COST	$3,324,124.00

PVSP PHASE III COST ESTIMATE

60th PLACE FLOOD PROTECTION SYSTEM

PLATE 2:

Increase capacity of Street by the installation of concrete curbs having an effective height of 1.0 Foot (Length - 1,800 ± Ft.)

Curb - 3,600 L.F. X 0.06 = 216 C.Y.	
216 C.Y. @ $120.00/C.Y.	$25,920.00
Reconstruct driveway entrance - Lump Sum	2,000.00
ESTIMATED COST	$27,920.00
Contingencies @ 15%	4,188.00
ESTIMATED GRAND TOTAL COST	$32,108.00

(Note: In the reconstruction of Shea Blvd., a dip section will be required at 60th Place.)

PVSP PHASE II ESTIMATED COSTS

66th STREET FLOOD PROTECTION SYSTEM

PLATE 2:

Item 1

Remove existing strip pavement:	
3,200 S.Y. @ $0.40/S.Y.	$1,280.00
Construct new street section:	
(Assume 2"/9")	
Pavement - 3,867 S.Y. @ $4.50/S.Y.	17,402.00
Curb & Gutter - 2400 L.F. @ $4.50/ L.F.	10,800.00
Driveway reconstruction - Lump Sum	5,000.00
Sub Total	$33,202.00

Item 3

Box culvert under Shea Blvd:	
Structural excavation	
417 C.Y. @ $7.00/C.Y.	$2,919.00
Structural concrete	
204 C.Y. @ $190.00/C.Y.	38,760.00
Reconstruct approximately 300 Ft. of Shea Blvd.	
Pavement removal, import fill, reconstruct roadway, traffic control Lump Sum	18,000.00
Lower 12 inch dia. water main	
80 L.F. @ $30.00/L.F.	2,400.00
Sub Total	$62,079.00

Item 4

Concrete box channel:	
Structural excavation	
2600 C.Y. @ $4.00/C.Y.	10,400.00
Structural concrete	
645 C.Y. @ $190.00/C.Y.	122,550.00
Right-of-Way acquisition	
0.6 Ac. @ $18,000.00/Ac.	10,800.00
Sub Total	$143,750.00
ESTIMATED COST	$239,031.00
Contingencies @ 15%	35,855.00
ESTIMATED GRAND TOTAL COST	$274,886.00

PVSP
PHASE III

FEASIBILITY STUDY
JULY 1978

LEGEND

PIPE & DIRECTION OF FLOW

DIRECTION OF FLOW IN STREET

CHANNEL

CULVERTS

PLATE I

SCALE: 1" = 800'

Collar, Williams & White Engineering, Inc.
Consulting Engineers and Land Surveyors
2922 NORTH 70TH STREET
SCOTTSDALE, ARIZONA 85251
PHONE: 947-5432

JOB NO. 770125

PVSP
PHASE III

FEASIBILITY STUDY
JULY 1978

LEGEND

CP 114 — CONCENTRATION POINTS

SUB DRAINAGE AREA

SUB SUB DRAINAGE AREA

PLATE II

SCALE: 1" = 800'

Collar, Williams & White Engineering, Inc.
Consulting Engineers and Land Surveyors
2922 NORTH 70TH STREET
SCOTTSDALE, ARIZONA 85251
PHONE 947-3422

JOB NO 770125

CAP

"A"-1 "A"-2 "A"-3 "A"-4 "A"-5 "A"-6 "A"-7 "A"-8

"B"-1 "B"-2 "B"-3 "B"-3A "B"-4 "B"-5 "B"-6 "B"-7 "B"-8 "B"-9 "B"-10 "B"-11 "B"-12 "B"-13 "B"-14 "B"-15

"C"-1 "C"-2 "C"-3 "C"-4 "C"-5 "C"-6 "C"-7 "C"-8 "C"-9 "C"-10 "C"-11 "C"-12 "C"-13 "C"-14 "C"-15 "C"-16 "C"-17 "C"-18

"DC"-1 "DC"-2 "DC"-3 "DC"-4 "DC"-5 "DC"-6 "DC"-7 "DC"-8 "DC"-9

"C"-2 (SUB DRAINAGE AREA TRIBUTARY TO CP 103)

"B"-12 (SUB DRAINAGE AREA TRIBUTARY TO CP 205)

"A"-4 (60% TRIBUTARY TO CP 305) (40% TRIBUTARY TO CP 306)

CP 101 CP 102 CP 103 CP 104 CP 105 CP 106 CP 107 CP 108 CP 109 CP 110 CP 111 CP 112 CP 113 CP 114
CP 201 CP 202 CP 203 CP 204 CP 205 CP 206 CP 207 CP 208 CP 209
CP 301 CP 302 CP 303 CP 304 CP 305 CP 306 CP 307 CP 308
CP 401
CP 500 CP 501 CP 502 CP 503 CP 504

SCOTTSDALE ROAD
GREENWAY ROAD
HAYDEN ROAD
PIMA ROAD
STREET
THUNDERBIRD
HEARN RD.
JOAN DE ARC AVE
CAMINO DE LOS RANCHOS
SUTTON DRIVE
SWEETWATER AVE.
LARKSPUR DRIVE
CACTUS
CHOLLA
GARY ROAD
SHEA BOULEVARD
COCHISE RD.
GOLD DUST AVE.
MOUNTAIN VIEW RD
FANFOL DRIVE
DOUBLE TREE RANCH ROAD
MOCKINGBIRD LANE
INDIAN BEND WASH
56TH
60 TH
64 TH
66 TH
68 TH
68TH PL.
SERENO PARK
INVERGORDON
HAYDEN
INDIAN BEND WASH PROPOSED INLET

PVSP
PHASE III

FEASIBILITY STUDY
JULY 1978

PLATE II

SCALE: 1"=800'

LEGEND

CP 114 — CONCENTRATION POINTS

SUB DRAINAGE AREA

SUB SUB DRAINAGE AREA

Collar, Williams & White Engineering, Inc.
Consulting Engineers and Land Surveyors
7922 NORTH 70TH STREET
SCOTTSDALE, ARIZONA 85251
PHONE: 941-3555

JOB NO. 770125

PVSP
PHASE III
EXISTING RIGHT OF WAY

SCALE: 1" = 800'

Collar, Williams & White Engineering, Inc.
Consulting Engineers and Land Surveyors
2922 NORTH 70TH STREET
SCOTTSDALE, ARIZONA 85251
PHONE: 947-6433

JOB NO. 770125

PVSP PHASE III

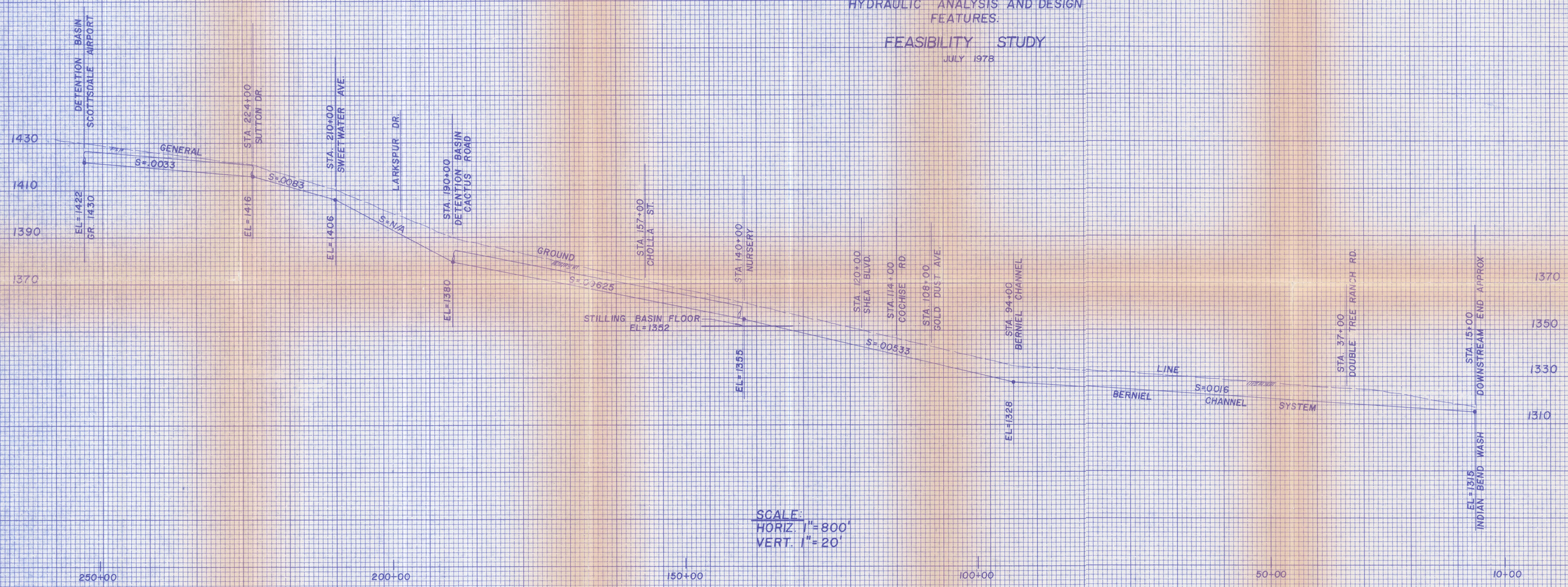
PROFILE

PROJECT "C" (SCOTTSDALE RD.)

REFER TO PLATES C-1 THRU C-19 FOR HYDRAULIC ANALYSIS AND DESIGN FEATURES.

FEASIBILITY STUDY

JULY 1978



SCALE:
HORIZ. 1"=800'
VERT. 1"=20'

Collar, Williams & White Engineering, Inc.
Consulting Engineers and Land Surveyors
2922 NORTH 70TH STREET
SCOTTSDALE, ARIZONA 85251
PHONE: 947-3433

JOB NO. 770125

WATER RESOURCES ASSOCIATES, INC.
SCOTTSDALE ARIZONA
JULY 1978

PVSP PHASE III

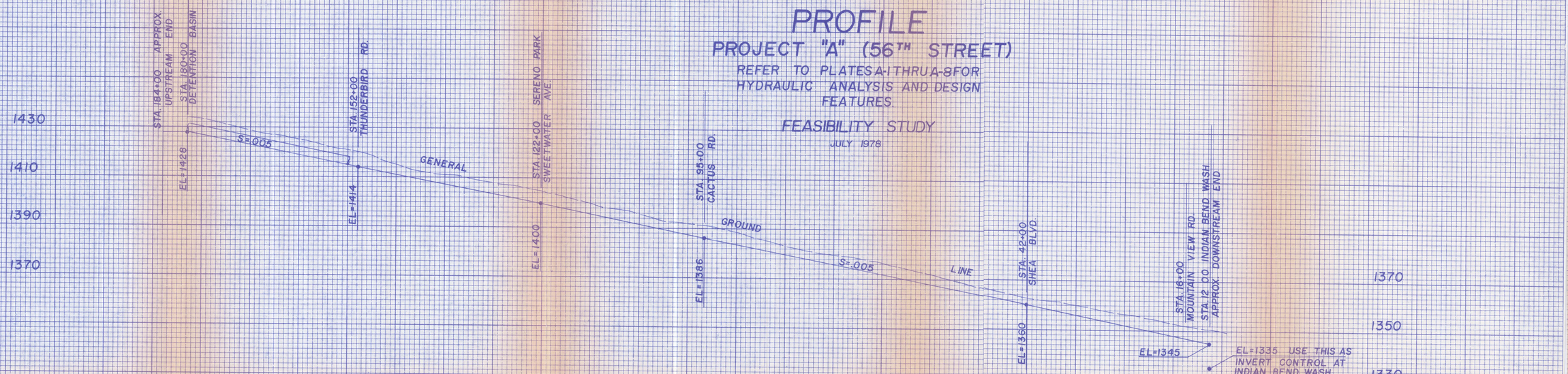
PROFILE

PROJECT "A" (56TH STREET)

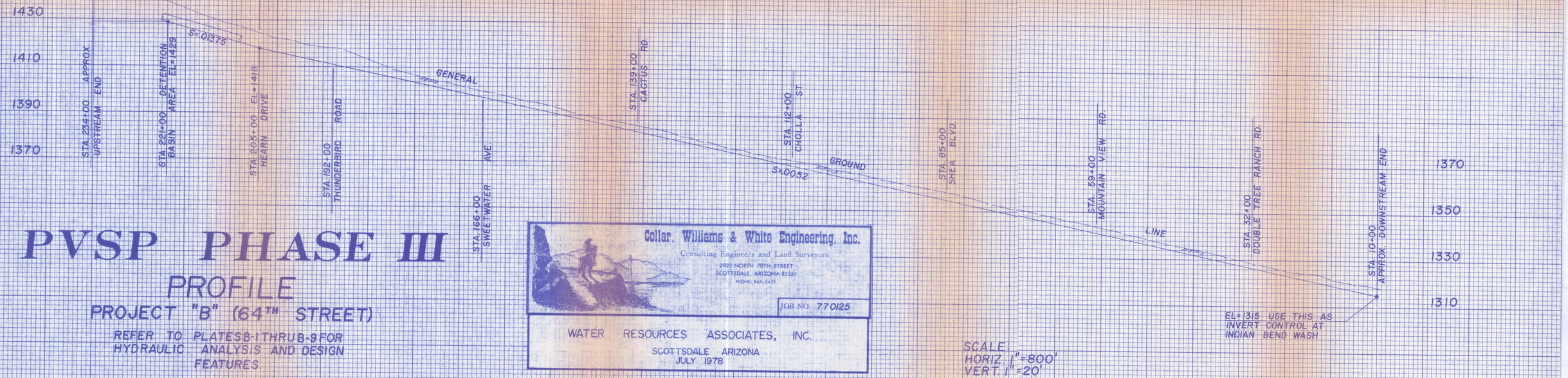
REFER TO PLATES A-1 THRU A-8 FOR HYDRAULIC ANALYSIS AND DESIGN FEATURES

FEASIBILITY STUDY

JULY 1978



SCALE:
HORIZ. 1"=800'
VERT 1"=20'



SCALE:
HORIZ. 1"=800'
VERT 1"=20'

PVSP PHASE III

PROFILE

PROJECT "B" (64TH STREET)

REFER TO PLATES B-1 THRU B-9 FOR HYDRAULIC ANALYSIS AND DESIGN FEATURES

FEASIBILITY STUDY

JULY 1978

Collar, Williams & White Engineering, Inc.
Consulting Engineers and Land Surveyors
2922 NORTH 70TH STREET
SCOTTSDALE, ARIZONA 85251
PHONE: 947-5433

JOB NO. 770125

WATER RESOURCES ASSOCIATES, INC.

SCOTTSDALE ARIZONA
JULY 1978