AZTEC
www.aztec.us
4561 E. McDowell Road
Phoenix, AZ 85008
602.454.0402
602.454.0403 (fax)

Memorandum

To: Mr. Bing Zhao, PhD, P.E.
Engineering Application Development and River Mechanics Branch, FCDMC

Date: 04-02-2013

Subject: Scour Memorandum: Scour Calculations and Findings

Project: BPG Designs
Zayo Fiber Solutions
Communications Line within the Arizona Canal Diversion Channel

From: Tony Bokich, P.E.
Project Engineer

Registered Professional Engineer (Civil)
CERTIFICATE No. 34971
TONY A. BOKICH
Date Signed 4-2-13
ARIZONA, U.S.A.
Expires 3-31-14

Introduction

Zayo Fiber Solutions, with BPG Designs, is currently developing plans to place, by directional boring methods, a fiber optic communications line buried under the Flood Control District of Maricopa County (FCDMC) Arizona Canal Diversion Channel (ACDC). The fiber optic line is proposed to cross the ACDC just south and parallel to the Thunderbird Road bridge in Glendale, Arizona.

Project Scope

The project scope consists of installing the fiber optic line at a depth within the ACDC below the 100-year scour elevation with consideration to the Thunderbird Road bridge over the ACDC. This memorandum provides the scour calculations that determine the depth at which scour is encountered along the alignment of the proposed fiber optic line. The memorandum also documents the data, plans, reports, and assumptions that were used to perform the calculations.

Background Data

Construction Plans for Thunderbird Road Bridge Over Arizona Canal Diversion Channel, F.C.D. Contract No. 83-19 were obtained and are the basis for the bridge configuration and dimensions used in the project scour analysis.

The Arizona Canal Diversion Channel (Including Cave Creek Channel and Sediment Basins on Cave Creek and Cudia City Wash), Design Memorandum No. 3, General Design Memorandum – Phase II, Project Design – Part 5 (Including Feature Design for Cactus Road to Skunk Creek), U.S. Army Corps of Engineers, March 1985, Final Report was used to provide hydraulic design information for the ACDC. The following parameters were provided by the report:

1. 100-year Flow = 27,800 cfs
2. Manning's n value = 0.035 on the channel bottom
3. Manning's n value = 0.040 on the channel side slopes
4. Invert slope = 0.0004'/ft
5. D_{50} = 3.0 mm bed material within the channel reach

6. D_{84} = 11.0mm bed material within the channel reach
7. D_{95} = 21.0 mm bed material within the channel reach
8. There is a grouted riprap area on the east bank and just upstream of the bridge which includes a 3-foot apron w/ 3-foot cutoff wall.

The geometric data for the channel was determined by the surveyed cross-section at the alignment of the proposed fiber optic line provided by BPG. This survey information along with the flow and bed material information provided was entered into the Cross Section Hydraulics Editor in the Drainage Design Management System (DDMS), Version 4.6.0, computer program by KVL Consultants, Inc. and the FCDMC. This information provided the cross section hydraulic data needed for the scour estimation within the program. The surveyed cross section also provided the following parameters:

1. Channel Bed Elevation
2. Thalweg Elevation = 1,189.80'

The cross section hydraulics were provided by DDMS. DDMS was also used to store and analyze hydraulic data for the channel section upstream of the Thunderbird Road bridge. DDMS provided output for the Design (100-year) and Dominant (10-year) flows. Output for the 100-year flow is as follows:

1. Flow Rate = 27,800 cfs
2. Hydraulic Depth = 12.91 feet
3. Velocity = 4.66 fps
4. Froude Number = 0.23

Output for the 10-year flow (0.35 X 100-year flow) is as follows:

1. Flow Rate = 9,730 cfs
2. Hydraulic Depth = 7.65 feet
3. Velocity = 3.29 fps
4. Froude Number = 0.21

Scour Analysis

The Drainage Design Manual for Maricopa County (DDMMC), Hydraulics, outlines the District's methodology for analyzing and estimating scour. The DDMS computer program was used to store hydraulic data and estimate scour depths for each form of scour and total scour at the project site. Six forms of scour were considered or analyzed for this reach of the ACDC, just upstream of the Thunderbird Road bridge; Long Term Degradation, General Scour, Bend Scour, Bed-Form Scour, and Low Flow Incisement.

I. Long Term Degradation

Long term degradation evaluation considers the amount of man-made features existing and planned within the channel. Considering an existing grade control structure 12,870 feet downstream of the Thunderbird Road bridge, and the average particle size within the reach, an equilibrium slope of 0.00025'/ft was calculated by DDMS. Since the existing slope of the channel is slightly different than the calculated equilibrium slope, long term scour is considered relevant to the analysis of total scour at the Thunderbird Road bridge.

The long term scour calculated by DDMS for the 100-year flow is 1.7 feet. With a factor of safety (FS) equal to 1.3, the long term scour for the 100-year flow is estimated to be 2.2 feet.

II. General Scour

The Lacey equation, according to the DDMMC, is more applicable to a natural river system. However, the equation was developed for use in irrigation canals with uniform section and slope and which are relatively straight. The Lacey equation was determined to be the most applicable equation for the ACDC in the Thunderbird Road bridge reach.

General scour calculated by DDMS for the 100-year flow is 2.5 feet. With a FS equal to 1.3, the general scour for the 100-year flow is estimated to be 3.2 feet.

III. Local Scour

Local scour at a bridge can be caused by three main factors, bridge piers, abutments, and contraction of the channel. The Thunderbird Road bridge abutments are not within the channel and the channel cross section at the bridge does not contract. The channel reach upstream and downstream of the bridge is straight. Therefore the only form of local scour that was examined was pier scour.

The methods DDMS uses to analyze pier scour are presented in the Federal Highway Administration's Hydraulic Engineering Circular No. 18 (HEC-18) publication *Evaluating Scour at Bridges*. Pier scour is a function of bed material characteristics and configuration, velocity and depth of flow upstream, and the geometry and debris accumulation of the piers. For the Thunderbird Road bridge piers, the following conditions apply:

a. Pier nose shape is rounded for a correction factor, $K_1 = 1.0$
b. The angle of attack of flow is 0 degrees for a correction factor, $K_2 = 1.0$
c. Clear water scour was used since it is the most conservative case for a correction factor, $K_3 = 1.1$
d. Armoring of the bed gave a correction factor, $K_4 = 0.85$
e. Pier width was adjusted to include 4 feet of debris accumulation, for a total pier width of 8 feet

Given the parameters above, the local pier scour for the 100-year flow is calculated by DDMS to be 7.1 feet. With a FS equal to 1.3, the local pier scour for the 100-year flow is estimated to be 9.3 feet.

IV. Bend Scour

Bend scour was considered but not analyzed in detail because there are no bends in the channel at the Thunderbird Road crossing location.

V. Bed-Form Scour

The ACDC is not an alluvial channel; it is an engineered channel with uniform dimensions, low sediment load, low debris loads and mild slopes. In addition there are parks with grass and concrete courts within the channel therefore bed-form scour is not anticipated within this reach of the ACDC.

VI. Low Flow Incisement

The ACDC has an existing low-flow channel with an approximate depth of 3 feet and runs along the west toe of slope where crosses under the Thunderbird Road bridge. All scour depths resulting from the calculations use the elevation of the low-flow channel invert as the baseline for computing scour depths.

VII. Total Scour

Total scour is the sum of all applicable forms of scour with FS applied at a given location. Long term degradation, general scour, and local pier scour are the applicable forms of scour at this location in the ACDC. Figure 1 depicts the channel profile, proposed utility crossing and illustrates the bridge, channel, scour and utility geometry.

The total scour at the piers of the Thunderbird Road bridge for the 100-year flow is estimated to be 14.7 feet.

Conclusions

The proposed horizontal distance from Thunderbird Road bridge upstream pier columns to the new fiber optic line, measured along the channel centerline is calculated to be 35.4 feet. For the 100-year flow the total scour depth is 14.7 feet at the pier columns giving an estimated scour elevation of 1175.1. Projecting upstream along the channel centerline at a 2H : 1V scour line (HEC-18, 5th Edition, April 2012: Section 7.8, Figure 7.18) from the total scour elevation of 1175.1, the fiber optic line is outside the influence of the pier scour. The scour elevation at the proposed fiber optic line is subject to long term scour and general scour combined for 5.4 feet of scour. The scour elevation at the proposed fiber optic line is estimated to be 1184.4.

AZTEC
TYPSA Group www.aztec.us
www.typsa.es
4561 E. McDowell Road, Phoenix, AZ 85008-4505
Phone (602) 454-0402 Fax (602) 454-0403

Project: ZAYO FIBER SOLUTIONS
Computed by: MHM
Checked by: TAB
Sheet Name: ACDC SCOUR @ FIBER OPTIC
Project No: AZE1314
Date: 3/20/13
Date: 3/21/13
Sheet: 1 Of: 1

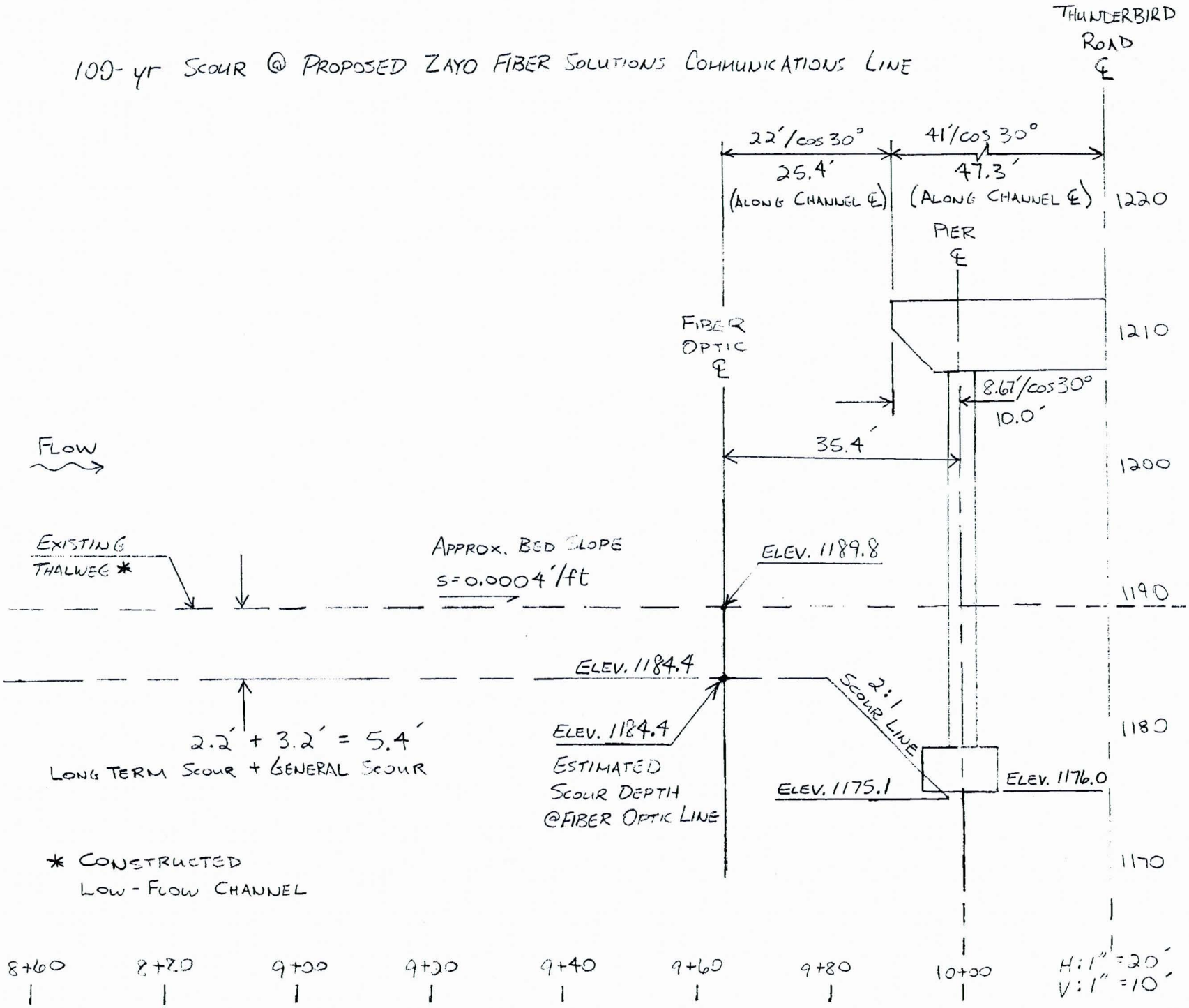


FIGURE 1

Section ID	Flow Type	Entire Section Q (cfs)	Slope (f/f)	Man'g N	W.P. (ft)	Hyd Depth (ft)	Area (sq ft)	Max Depth (ft)	Vel (f/s)	Channel Section Hyd Depth (ft)	Vel (ft/sec)	Froude Num
US THUNDERBIRD RD BRIDGE	Design	27800	0.000400	0.035	465.72	12.91	5969.69	18.09	4.66	12.91	4.66	0.23
	Dominant	9730	0.000400	0.035	388.86	7.65	2959.67	11.00	3.29	7.65	3.29	0.21

Section ID	X	Y
US THUNDERBIRD RD BRIDGE		
	4,900.00	1,218.00
	5,030.00	1,195.00
	5,040.00	1,194.50
	5,055.00	1,189.80
	5,065.00	1,189.80
	5,070.00	1,191.00
	5,110.00	1,191.90
	5,270.00	1,192.30
	5,325.00	1,193.00
	5,350.00	1,194.00
	5,460.00	1,216.00

See Figure 2 (Construction Drawing for Zayo Fiber Solutions) for Cross Section View of Geometry Data

Major Basin: 01

ID: THUNDERBIRD Cross Section ID: US THUNDERBIRD RD BRIDGE

Type	Calc (ft)	FS	Value (ft)	Method
Long Term	1.69	1.30	2.20	Equilibrium Slope for Clear Water Flow
General	2.46	1.30	3.20	Lacey
Local	7.14	1.30	9.28	Piers
Bedform		1.30		Comments
Low Flow		1.30		
Total			**14.68**	

Dominant Flow Rate (cfs)	Existing Slope (ft/ft)	Average Channel Width (ft)	D50 (mm)	Length to Pivot Point (ft)	Equilibrium Slope (ft/ft)	Scour Depth (ft)
Maior Basin ID: 01						
ID: THUNDERBIRD			**Cross Section ID: US THUNDERBIRD RD BRIDGE**			
9,730	0.000400	269.06	3.000	12,870	0.00026896	1.69

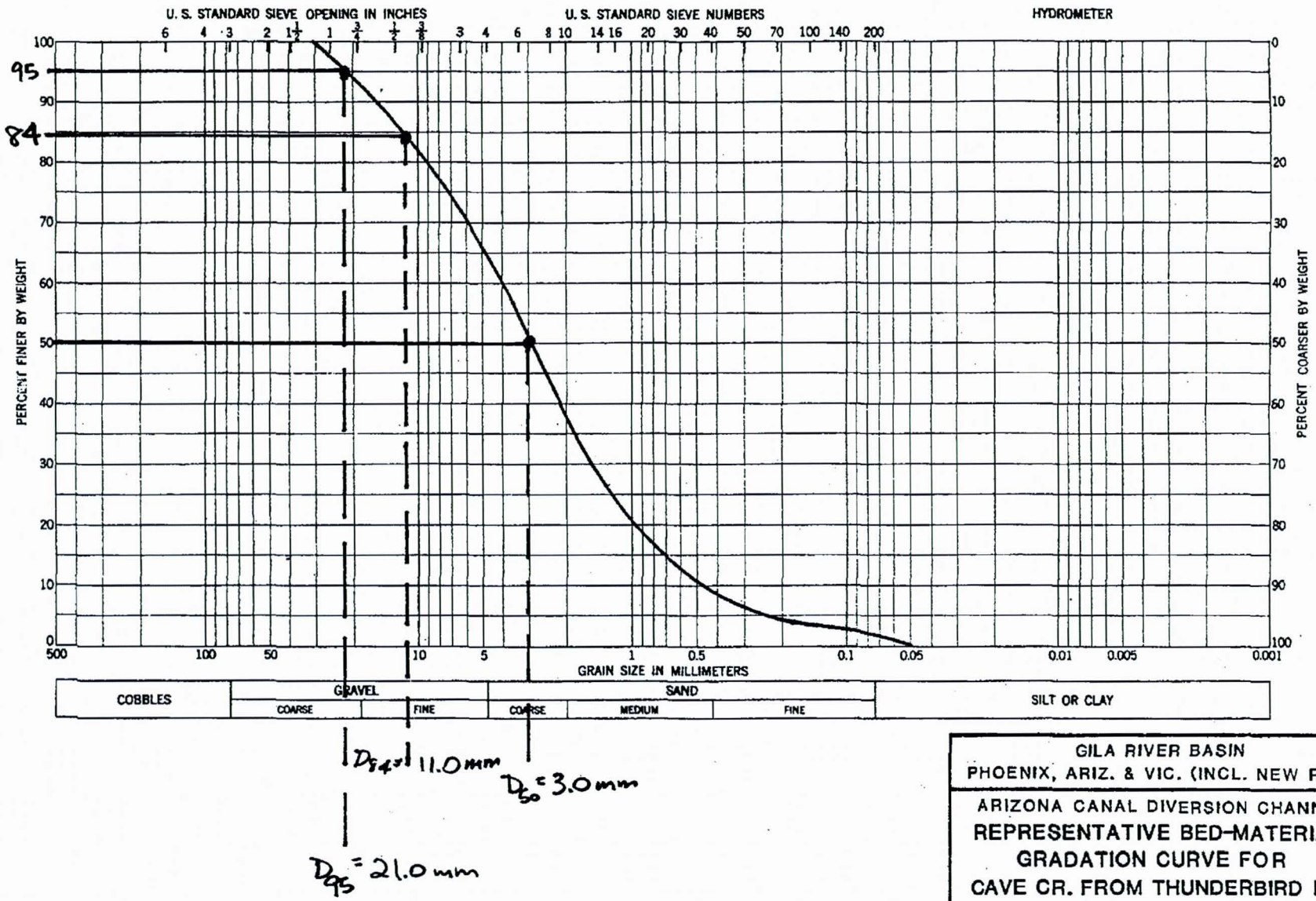
Design FlowRate (cfs)	D50 (mm)	Bend Factor, Z	Scour Depth Including Bend (ft)

Maior Basin ID: 01

ID: THUNDERBIRD **Cross Section ID: US THUNDERBIRD RD BRIDGE**

27,800	3.000	0.25	2.46

Normal or Max Depth (ft)	Average Velocity (ft/sec)	Pier Width,a (ft)	Pier Length, L (ft)	Angle of Attack (Degrees)	Upstream D50 (mm)	Upstream D95 (mm)	Froude Number	Nose Shape Factor, K1	Angle of Attack Factor, K2	Bed Condition Factor, K3	Armoring Factor, K4	Scour Depth (ft)
Maior Basin ID: 01												
ID: THUNDERBIRD				**Supply Reach Cross Section ID: Manual**								
18.09	4.66	8.00	20.00	-	-	-	0.19	1.0	1.00	1.1	0.62	7.14



GILA RIVER BASIN
PHOENIX, ARIZ. & VIC. (INCL. NEW RIV.)

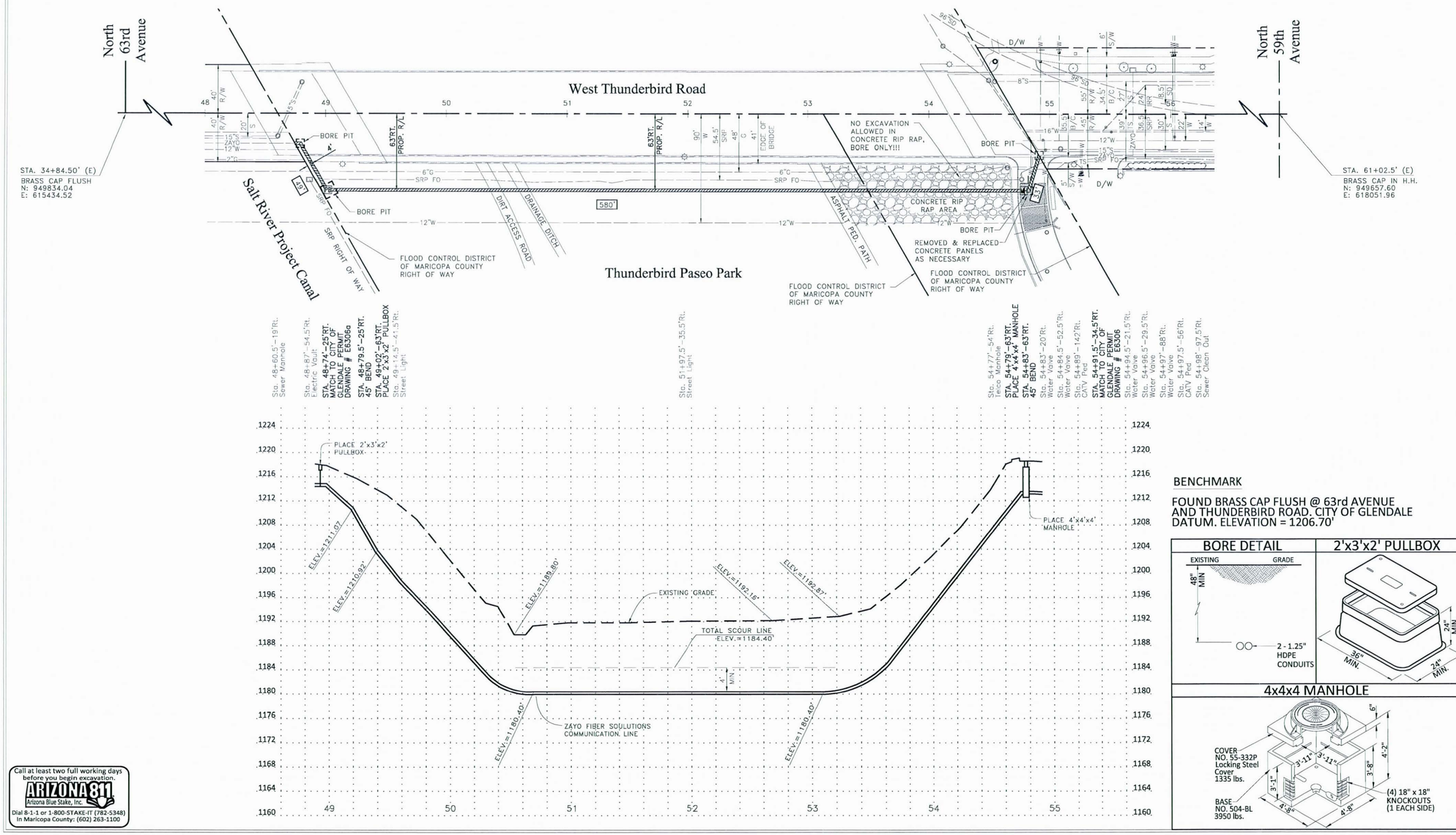
ARIZONA CANAL DIVERSION CHANNEL
REPRESENTATIVE BED-MATERIAL GRADATION CURVE FOR CAVE CR. FROM THUNDERBIRD RD. TO CACTUS RD.

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

CONSTRUCTION DRAWING

CONSTRUCTION DRAWING FOR
ZAYO FIBER SOULUTIONS
A PORTION OF
SEC. 18, TOWNSHIP 3 NORTH, RANGE 2 EAST

FIGURE 2



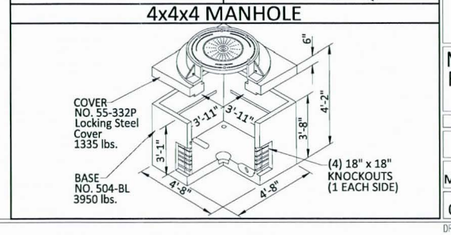
BENCHMARK

FOUND BRASS CAP FLUSH @ 63rd AVENUE AND THUNDERBIRD ROAD. CITY OF GLENDALE DATUM. ELEVATION = 1206.70'

BORE DETAIL

2'x3'x2' PULLBOX

4x4x4 MANHOLE



40 20 0 40 80
(HORIZONTAL) SCALE IN FEET - 1"=40'
4 2 0 4 8
(VERTICAL) SCALE IN FEET - 1"=4'

GENERAL NOTES

1. ALL CONSTRUCTION WITHIN FLOOD CONTROL DISTRICT (DISTRICT) RIGHTS-OF-WAY JURISDICTION SHALL CONFORM TO THE LATEST MARICOPA ASSOCIATION OF GOVERNMENTS' (MAG) SPECIFICATIONS, UNLESS THE STRUCTURE INVOLVED IS A DAM. IF THE STRUCTURE IS A DAM, SPECIAL PERMIT REQUIREMENTS WILL APPLY. DAM SHALL MEAN A STRUCTURE THAT IS UNDER THE JURISDICTION OF THE ARIZONA DEPARTMENT OF WATER RESOURCES AND IS DEFINED IN ARIZONA REVISED STATUES 45-120L.
2. CONTRACTOR MUST OBTAIN NECESSARY DISTRICT PERMIT PRIOR TO COMMENCEMENT OF CONSTRUCTION WITHIN DISTRICT RIGHT-OFWAY AND MAINTAIN A COPY OF THE PERMIT ON THE PROJECT SITE AT ALL TIMES.
3. NOTIFY THE DISTRICT'S PERMITS INSPECTOR AT 602-506-4727 OR 602-506-4723 AT LEAST 48 HRS PRIOR TO ANY WORK BEING PERFORMED IN THE DISTRICT'S RIGHTS-OF-WAY.
4. CONTRACTOR PERFORMING EXCAVATION OPERATIONS IS RESPONSIBLE FOR LOCATING AND PROTECTING ALL UNDERGROUND UTILITIES.
5. ALL COMPACTION AND BACKFILL WITHIN DISTRICT'S RIGHT-OF-WAY SHALL CONFORM TO THE LATEST MAG SPECIFICATIONS UNLESS STIPULATED OTHERWISE IN THE DISTRICT'S PERMIT.
6. ANY DAMAGE TO DISTRICT'S STRUCTURES, EQUIPMENT, MATERIALS, VEGETATION, AND/OR PROPERTY SHALL BE REPLACED AND/OR REPAIRED IN-KIND TO THE SATISFACTION OF THE DISTRICT.
7. TOTAL SCOUR LINE ELEVATION FROM "FINAL SCOUR MEMORANDUM", AZTEC ENGINEERING 4/2/13
8. ALL CONSTRUCTION WITHIN FLOOD CONTROL DISTRICT (DISTRICT) RIGHTS-OF-WAY JURISDICTION SHALL CONFORM TO THE LATEST MARICOPA ASSOCIATION OF GOVERNMENTS' (MAG) SPECIFICATIONS, UNLESS THE STRUCTURE INVOLVED IS A DAM. IF THE STRUCTURE IS A DAM, SPECIAL PERMIT REQUIREMENTS WILL APPLY. DAM SHALL MEAN A STRUCTURE THAT IS UNDER THE JURISDICTION OF THE ARIZONA DEPARTMENT OF WATER RESOURCES AND IS DEFINED IN ARIZONA REVISED STATUES 45-1201.
9. CONTRACTOR MUST OBTAIN NECESSARY DISTRICT PERMIT PRIOR TO COMMENCEMENT OF CONSTRUCTION WITHIN DISTRICT RIGHT-OF-WAY AND MAINTAIN A COPY OF THE PERMIT ON THE PROJECT SITE AT ALL TIMES.
10. NOTIFY THE DISTRICT'S PERMITS INSPECTOR AT 602-506-4727 OR 602-506-4723 AT LEAST 48 HRS PRIOR TO ANY WORK BEING PERFORMED IN THE DISTRICT'S RIGHTS-OF-WAY.
11. CONTRACTOR PERFORMING EXCAVATION OPERATIONS IS RESPONSIBLE FOR LOCATING AND PROTECTING ALL UNDERGROUND UTILITIES.
12. ALL COMPACTION AND BACKFILL WITHIN DISTRICT'S RIGHT-OF-WAY SHALL CONFORM TO THE LATEST MAG SPECIFICATIONS UNLESS STIPULATED OTHERWISE IN THE DISTRICT'S PERMIT.
13. ANY DAMAGE TO DISTRICT'S STRUCTURES, EQUIPMENT, MATERIALS, VEGETATION, AND/OR PROPERTY SHALL BE REPLACED AND/OR REPAIRED IN-KIND TO THE SATISFACTION OF THE DISTRICT.

NOTICE TO PLANHOLDER:

THE UTILITY LOCATIONS AND OTHER FACILITIES SHOWN ON THIS DRAWING ARE REPRESENTATIVE OF INFORMATION FURNISHED BY OTHER PARTIES. IT IS INTENDED FOR REFERENCE ONLY. CONTRACTOR IS REQUIRED TO CONTACT BLUE STAKE CENTER, 602-263-1100 PRIOR TO STARTING CONSTRUCTION AND IS BOUND BY THEIR LAWS AND ORDINANCES.

CONSTRUCTION NOTES:

INSTALL WARNING TAPE IN ALL TRENCHES (A MINIMUM OF 18"-BUT NOT TO EXCEED 30" BELOW EXISTING GRADE) AS PER MAG SPEC. 360.3

LEGEND

PROPOSED	EXISTING
RISER	FIRE HYDRANT
BORE FOOTAGE	UTILITY VALVE
TRENCH FOOTAGE	UTILITY METER
ASPHALT CUT FOOTAGE	BRASS CAP
ASPHALT CUT	UTILITY MANHOLE
BORE	CATV PEDESTAL
TRENCH	UTILITY PEDESTAL
J-BOX	TRAFFIC SIGNAL
VAULT	TRANSFORMER
PULLBOX	STREET LIGHT
MANHOLE	POWER SUPPLY
VACUUM POTHOLE	UTILITY POLE
CATV PEDESTAL	UTILITY CABINET
POWER SUPPLY	JUNCTION BOX
BORE PIT	VAULT
	BACK FLOW PREVENTER
	IRRIGATION CONTROL VALVE
	POLE ANCHOR
	FENCE
	BLOCK WALL

PROPOSED FOOTAGE

ASPHALT CUT: -	TRENCH: -
BORE: 659'	TOTAL: 659'

REVISION A	REVISED DEPTH 03-25-13
REVISION B	REVISION - ADDED FCDMC NOTES & BORE PITS
REVISION C	REVISION - REVISED NOTE #7

zayo FIBER SOLUTIONS

N. 59th Ave. & W. Thunderbird Rd.
Flood Control District Of Maricopa County Right Of Way

PROJECT NO.	
TOWNSHIP AND RANGE: T3N - R2E SEC 18NE	QUARTER SECTION NO.: 32-14
CITY/TOWN/COUNTY: Maricopa County, Arizona	
DATE: 04-02-13	SHEET NO.: 1 OF 1
	DRAWING NO.: E6306b

E6306b - NORTH 59TH AVENUE & WEST THUNDERBIRD ROAD

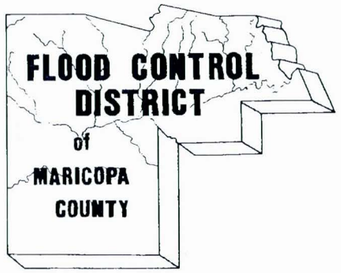
Call at least two full working days before you begin excavation.
ARIZONA 811
Arizona Blue Stake, Inc.
Dial 8-1-1 or 1-800-STAKE-IT (782-5348)
In Maricopa County: (602) 263-1100

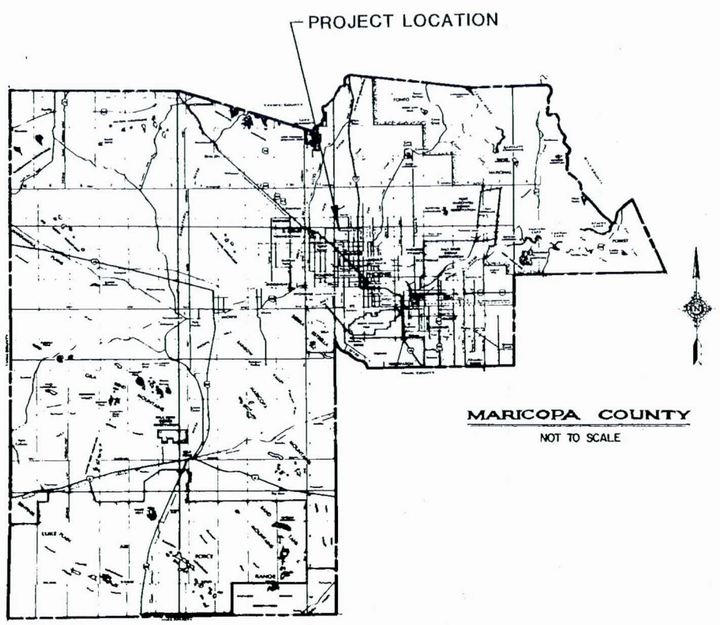
DRAWN BY BPG Designs
2617 SOUTH 21ST STREET
PHOENIX, ARIZONA 85034
(602)954-2223 FAX (602)954-0601
www.bpgdesigns.com

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

CONSTRUCTION PLANS
FOR

THUNDERBIRD ROAD BRIDGE
OVER
ARIZONA CANAL DIVERSION CHANNEL





MARICOPA COUNTY
NOT TO SCALE

INDEX OF DRAWINGS

C-0	COVER SHEET
C-1	BRIDGE APPROACH RD. & DETOUR RD. PLAN STA. 11+50.00 TO STA. 16+12.98
C-2	BRIDGE APPROACH RD. & DETOUR RD. PLAN STA. 16+12.98 TO STA. 21+97.17
C-3	BRIDGE APPROACH RD. & DETOUR RD. PLAN STA. 21+97.17 TO STA. 26+18.59
C-4	DETOUR PROFILE STA. 14+92.00 TO STA. 24+83.00
C-5	BRIDGE AND APPROACH RD. PROFILE STA. 15+20.00 TO STA. 24+00.00
C-6	SANITARY SEWER RELOCATION PHASE II
C-7	SANITARY SEWER RELOCATION PHASE II
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S-2	FOUNDATION DATA SHEET
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S-6	WINGWALL DETAILS
S-7	PIERS #2, #3 & #4
S-8	PIER SECTIONS
S-9	FRAMING PLAN & DIAPHRAGM DETAILS
S-10	BEARING AND DIAPHRAGM DETAILS
S-11	GIRDER DETAILS
S-12	DECK DETAILS
S-13	DECK ELEVATIONS
S-14	BARRIER, PARAPET AND APPROACH SLAB PLANS, SECTIONS AND DETAILS
S-15	HANDRAIL SECTIONS AND DETAILS
S-16	ALTERNATE DECK PLAN

F.C.D. CONTRACT NO. 83-19

10253

THIS INFORMATION IS SHOWN FOR REFERENCE ONLY & WHILE EVERY EFFORT HAS BEEN TAKEN IN ITS COMPILATION, THE CITY OF GLENDALE, ENGINEERING DEPT. DOES NOT GUARANTEE THE ACCURACY OR COMPLETENESS OF THE INFORMATION SHOWN HEREON.

THIS DRAWING IS FOR VISUAL EFFECTS ONLY DO NOT SCALE.

D. E. SAGRAMOSO P.E.
CHIEF ENGINEER AND GENERAL MANAGER

APPROVED BY: [signature]
CITY OF GLENDALE DATE
CITY ENGINEER

FLOOD CONTROL DISTRICT of Maricopa County
3335 W DURANGO STREET · PHOENIX, ARIZONA 85009 · TEL (602) 262-1501

THUNDERBIRD RD. BRIDGE OVER ARIZONA CANAL DIVERSION CHANNEL

COVER SHEET

RECOMMENDED BY: [signature] 5-16-83

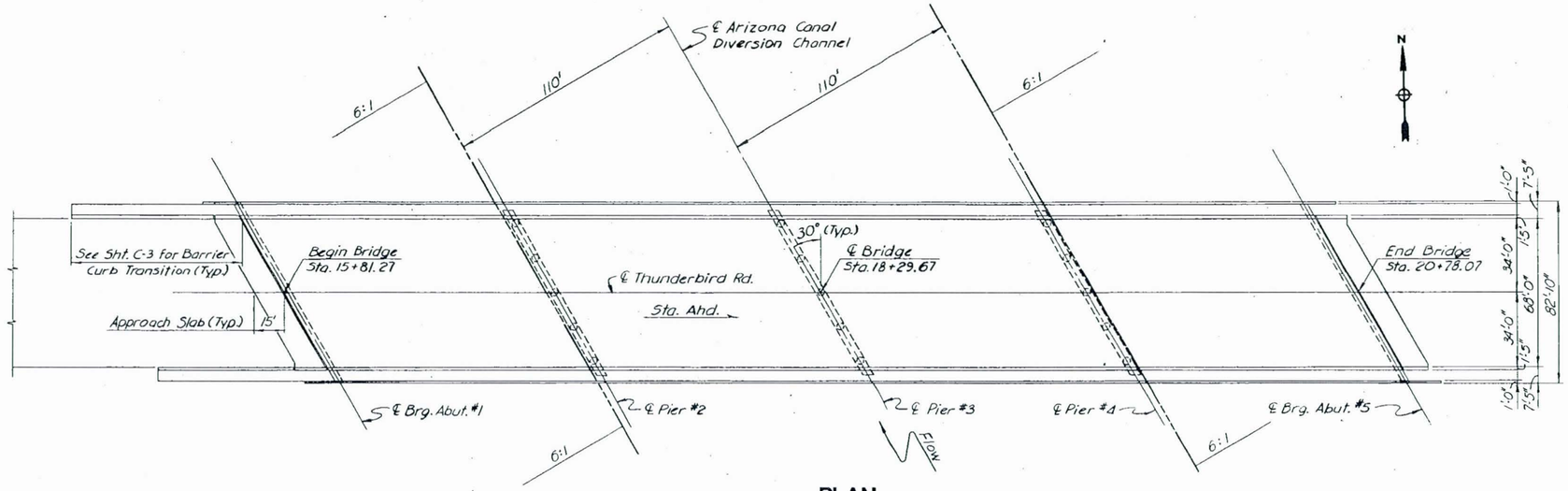
APPROVED BY: [signature] DATE: 5-16-83
CHIEF ENGINEER & GENERAL MANAGER
FLOOD CONTROL DISTRICT of Maricopa County

John T. Fischer 5-30-83

Sverdrup | Sverdrup & Parcel and Associates, Inc. Engineers - Architects

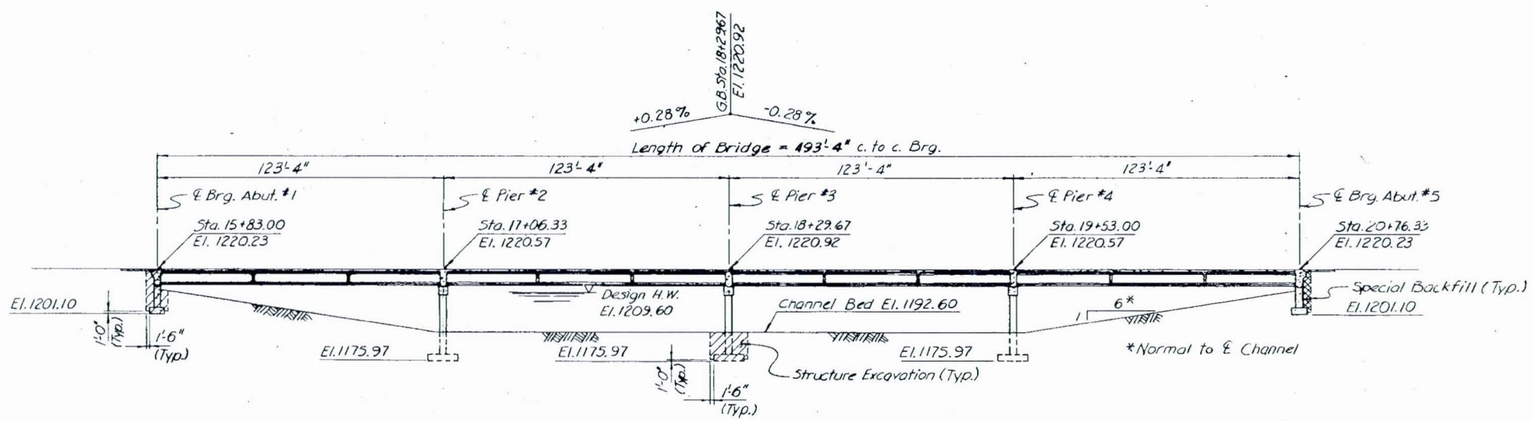
DESIGNED: —
DRAWN: MRH
CHECKED:
DATE:
JOB NO.: 8080

SHEET: C-0
1 OF 24



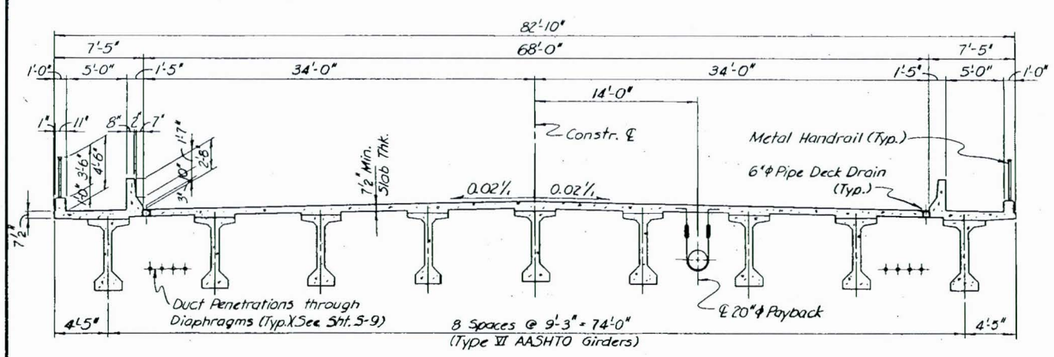
PLAN

Scale: 1" = 30'-0"



SECTION ALONG CONSTR. ℄

Scale: 1" = 30'-0"



TYPICAL SECTION

Scale: 1" = 6'-0"

Stations Looking Ahead

GENERAL NOTES

1. Construction shall conform to Maricopa Association of Governments, Uniform Standard Specifications for Public Works Construction, 1979.
2. Design conforms to American Association of State Highway and Transportation Officials (AASHTO), Standard Specifications for Highway Bridges, 1977 edition, including the 1978 through 1982 Interim Specifications.
3. Dead load includes allowance of 25 psf for future wearing surface.
4. Design live load is AASHTO HS20-44.
5. Design is by the service load method (working stress or allowable stress design).

   Stresses:

   Pretensioned P/S Concrete Girders – f'_c = 5500 psi, f'_{ci} = 4400 psi

   Post-tensioned P/S Concrete Girders – f'_c = 5500 psi, f'_{ci} = 5000 psi

   Class "AA" Concrete – f'_c = 4500 psi, f_c = 1400 psi, n = 8

   Class "A" Concrete – f'_c = 3000 psi, f_c = 1200 psi, n = 9

   Reinforcing Steel – f_s = 20,000 psi
6. Abutments, wingwalls, piers, approach slabs, sidewalks, barriers and parapets shall be class "A" concrete. All other concrete shall be class "AA".
7. Reinforcing steel shall conform to ASTM A615, Grade 40, except that Contractor, at his option, may substitute ASTM A615, Grade 60, but without extra compensation.
8. All reinforcing steel shall have 2" clear cover unless otherwise noted.
9. Barriers and parapets shall be constructed after formwork has been removed.
10. All exposed edges of concrete shall be chamfered 3/4" u.n.o.
11. Allowable soil bearing pressure: 4 tons/s.f. at abutments
    6 tons/s.f. at piers

    Calculated soil bearing pressure: 2.3 tons/s.f. at abutments (max)
    5.0 tons/s.f. at piers (max)
12. Structural steel shall conform to ASTM A36.
13. All welding shall conform to AWS D1.1-79, "Structural Welding Code Steel" published by the American Welding Society.
14. Do not scale drawings. Use dimensions.

APPROXIMATE QUANTITIES

ITEM	TYPE VI P/S CONC. GIRDERS	STRUC. EXCAV.	SPECIAL BACKFILL	CLASS "AA" CONCRETE	CLASS "A" CONCRETE	REINF. STEEL	HANDRAIL	PRECAST PLANKS
	Each	C.Y.	C.Y.	C.Y.	C.Y.	Lbs.	Lin. Ft.	Sq. Ft.
Superstructure	36	—	—	1456	122	275,175	1070	—
Abutment #1	—	611	216	—	164	7,234	—	—
Piers #2, #3 & #4	—	3037	—	—	839	235,700	—	—
Abutment #5	—	611	216	—	164	7,234	—	—
Approach Slabs	—	—	—	—	83	13,627	—	—
Alternate Deck	—	—	—	—	—	—	—	22,998
TOTALS	36	4259	432	1456	1372	538,970	1070	22,998

THIS INFORMATION IS SHOWN FOR REFERENCE ONLY 2. WHILE EVERY EFFORT HAS BEEN TAKEN IN ITS COMPILATION, THE CITY OF GLENDALE, ENGINEERING DEPT. DOES NOT GUARANTEE THE ACCURACY OR COMPLETENESS OF THE INFORMATION SHOWN HEREON.

THIS DRAWING IS FOR VISUAL EFFECTS ONLY DO NOT SCALE.

FLOOD CONTROL DISTRICT of Maricopa County

3335 W. DURANGO STREET · PHOENIX, ARIZONA 85009 · TEL. (602) 262-1501

THUNDERBIRD RD. BRIDGE OVER ARIZONA CANAL DIVERSION CHANNEL

GENERAL PLAN AND ELEVATION

13769 JOHN F. FISCHER

RECOMMENDED BY:

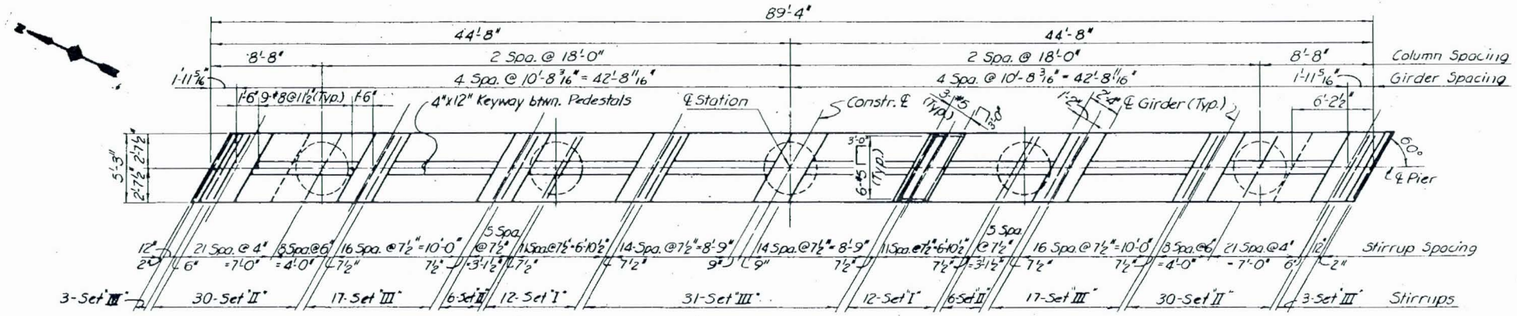
APPROVED BY: DATE:
CHIEF ENGINEER & GENERAL MANAGER
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

Sverdrup | Sverdrup & Parcel and Associates, Inc. Engineers - Architects

DESIGNED: RDT
DRAWN: MRM
CHECKED: RDT
DATE: 4/20/83
JOB NO.: [illegible]

SHEET: S-1

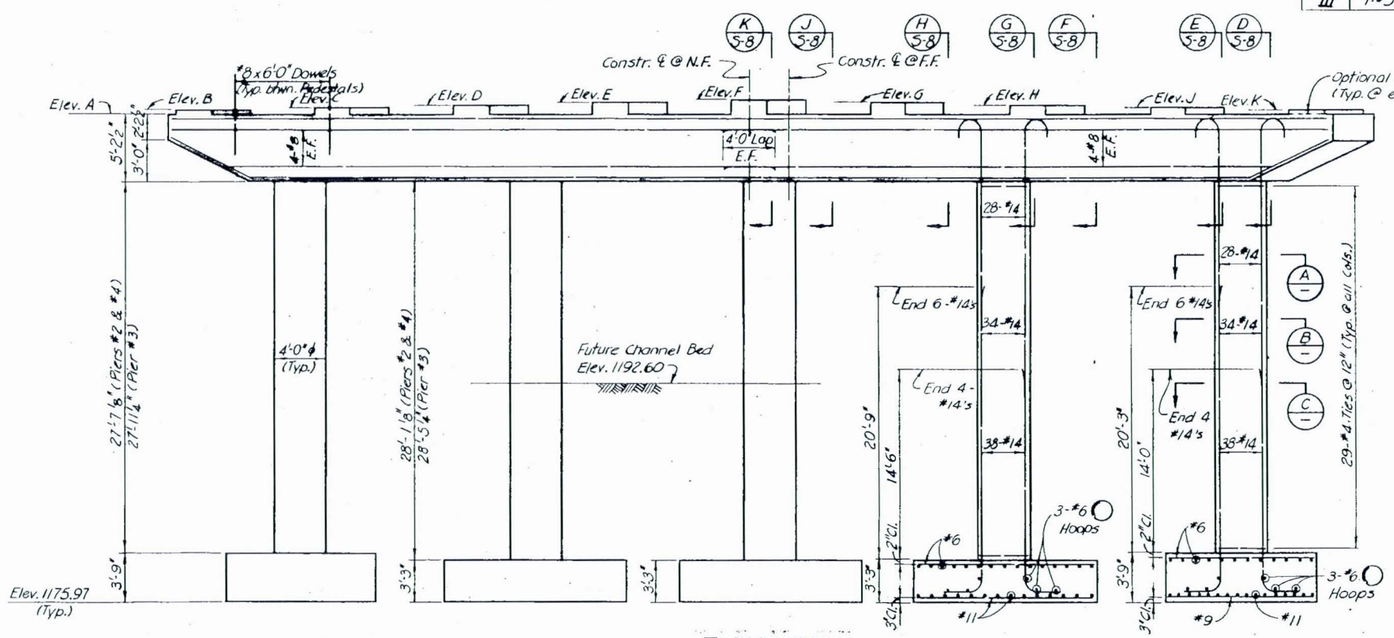
10261



PLAN

Scale: 3/16" = 1'-0"

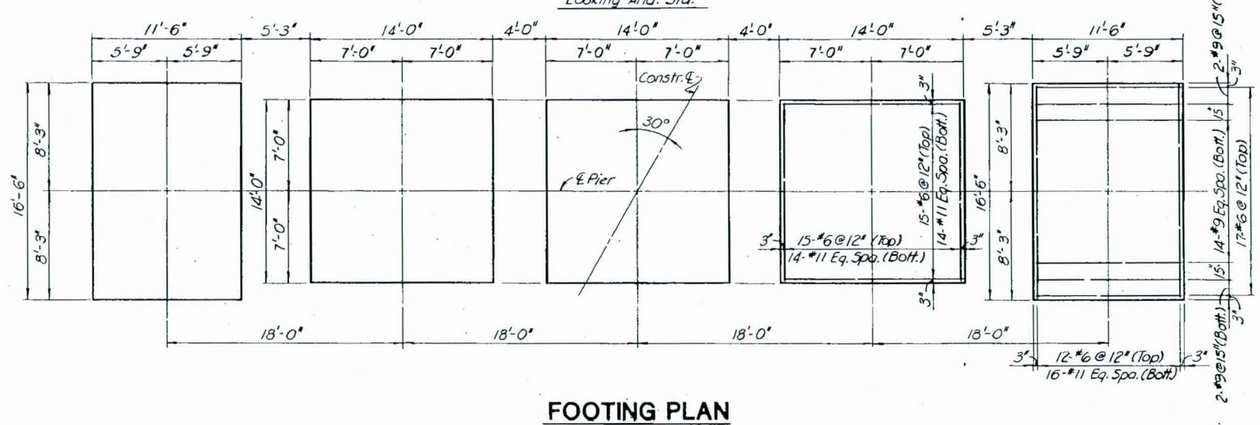
STIRRUP SETS	
I	1-#5 "A" Bar, 1-#5 "B" Bar & 2-#5 "C" Bars
II	Set I + 2-#6 "D" Bars
III	1-#5 "A" Bar, 1-#5 "B" Bar



ELEVATION

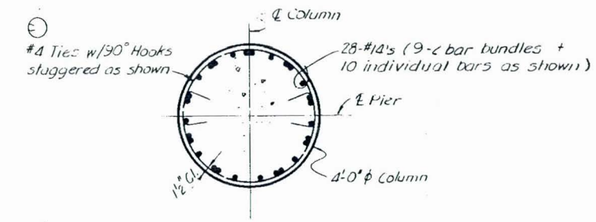
Scale: 3/16" = 1'-0"

Looking Ahd. Sta.



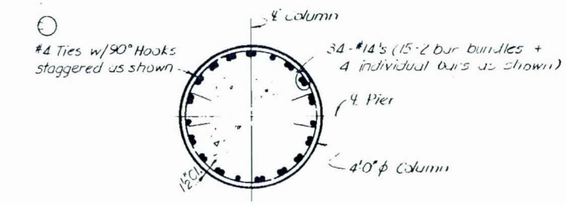
FOOTING PLAN

Scale: 3/16" = 1'-0"



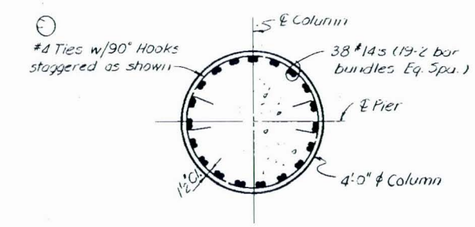
SECTION A

Scale: ½" = 1'-0"



SECTION B

Scale: ½" = 1'-0"



SECTION C

Scale: ½" = 1'-0"

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PIER NO.	℄ STATION	ELEVATIONS A	B	C	D	E	F	G	H	J	K
2	17+06.33	1212.52	1212.85	1213.05	1213.25	1213.45	1213.65	1213.48	1213.31	1213.14	1212.97
3	18+29.67	1212.87	1213.20	1213.40	1213.60	1213.80	1214.00	1213.80	1213.60	1213.40	1213.20
4	19+53.00	1212.52	1212.97	1213.14	1213.31	1213.48	1213.65	1213.45	1213.25	1213.05	1212.85

FLOOD CONTROL DISTRICT of Maricopa County

3335 W. DURANGO STREET · PHOENIX, ARIZONA 85009 · TEL. (602) 262-1501

THUNDERBIRD RD. BRIDGE OVER ARIZONA CANAL DIVERSION CHANNEL

PIERS #2, #3 & #4

RECOMMENDED BY: APPROVED BY: DATE:

CHIEF ENGINEER & GENERAL MANAGER FLOOD CONTROL DISTRICT of MARICOPA COUNTY

Sverdrup — Sverdrup & Parcel and Associates, Inc. Engineers - Architects

DESIGNED: RDT
DRAWN: BRH
CHECKED: RDT
DATE: 3/30/83

SHEET: S-7 of 24

10267

US Army Corps of Engineers
Los Angeles District

Gila River Basin

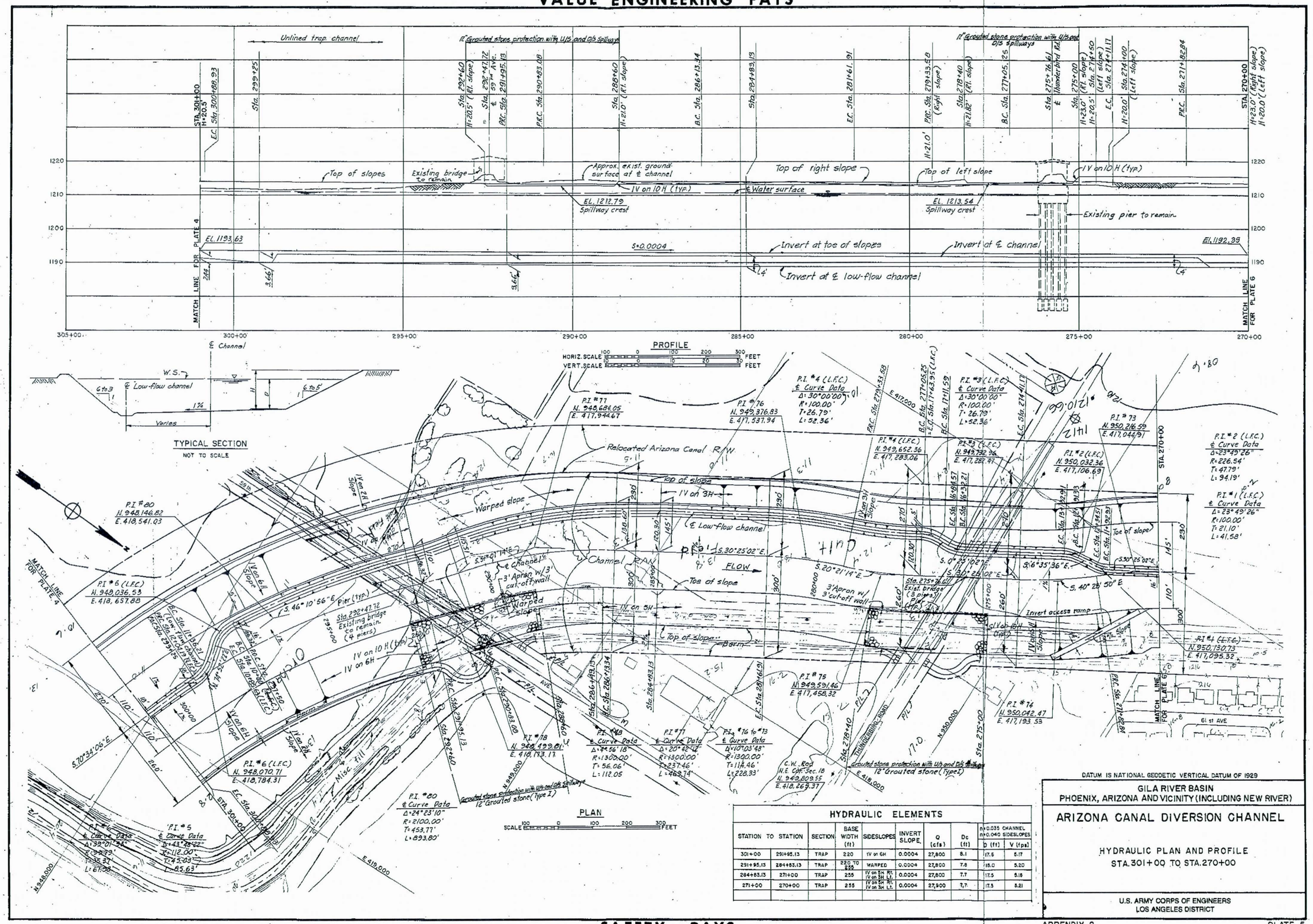
Phoenix, Arizona, and Vicinity (Including New River)

Arizona Canal Diversion Channel

(Including Cave Creek Channel and Sediment Basins on Cave Creek and Cudia City Wash)

FINAL
March 1985

Design Memorandum No. 3
General Design Memorandum — Phase II
Project Design — Part 5 (Including Feature Design for Cactus Road to Skunk Creek)



DATUM IS NATIONAL GEODETIC VERTICAL DATUM OF 1929

GILA RIVER BASIN
PHOENIX, ARIZONA AND VICINITY (INCLUDING NEW RIVER)

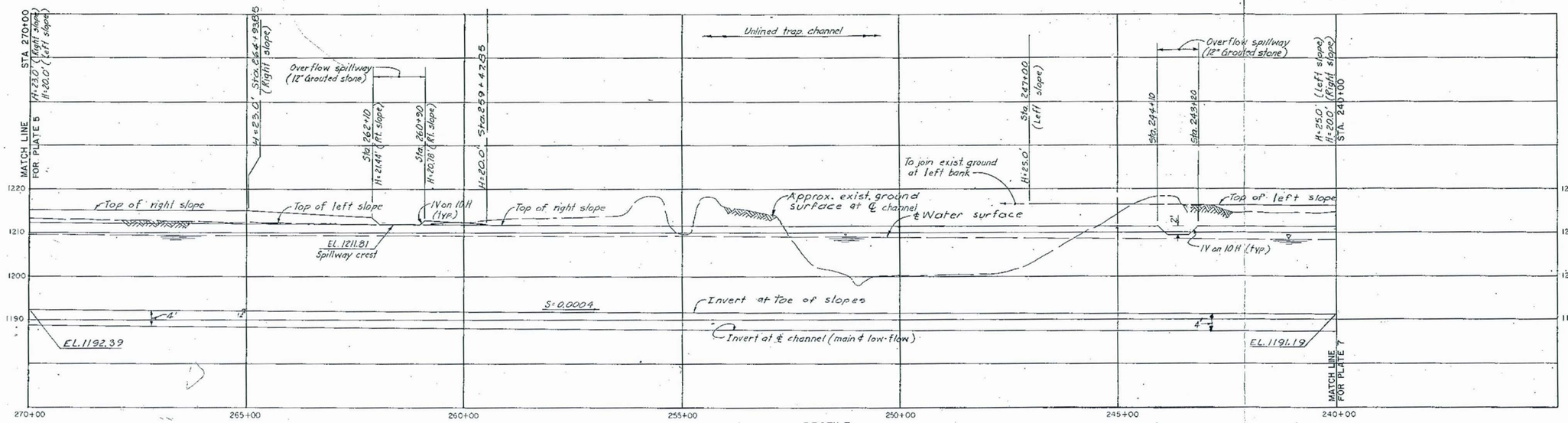
ARIZONA CANAL DIVERSION CHANNEL

HYDRAULIC PLAN AND PROFILE
STA. 301+00 TO STA. 270+00

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

HYDRAULIC ELEMENTS

STATION	TO STATION	SECTION	BASE WIDTH (ft)	SIDESLOPES	INVERT SLOPE	Q (cfs)	Dc (ft)	n=0.035 CHANNEL n=0.040 SIDESLOPES D (ft)	V (fps)
301+00	291+95.13	TRAP	220	1V on 6H	0.0004	27,800	8.1	17.6	5.17
291+95.13	284+83.13	TRAP	220 TO 235	WARPED	0.0004	27,800	7.8	18.0	5.20
284+83.13	271+00	TRAP	255	1V on 5H Rt. 1V on 3H Lt.	0.0004	27,800	7.7	17.5	5.18
271+00	270+00	TRAP	255	1V on 5H Rt. 1V on 3H Lt.	0.0004	27,900	7.7	17.5	5.21

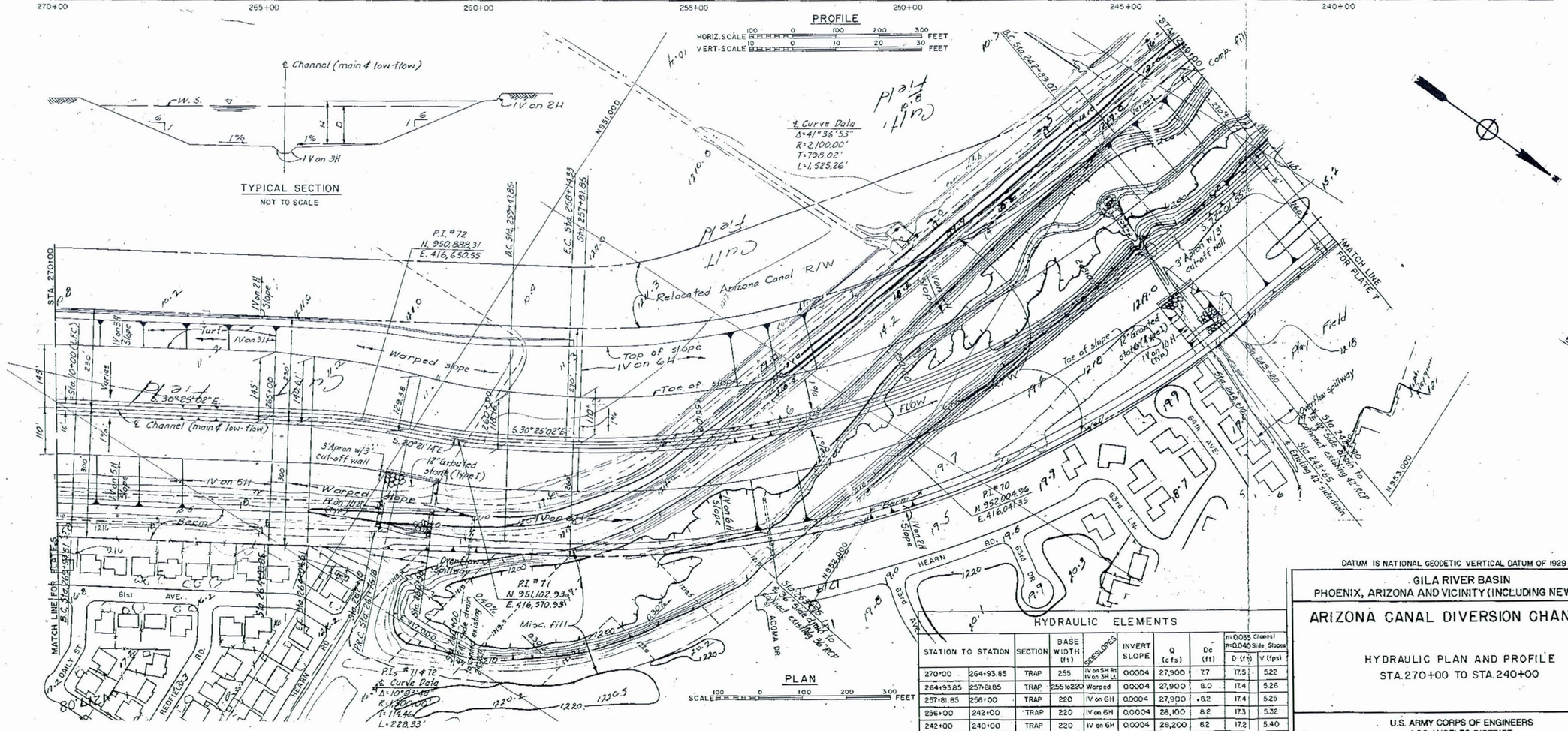


PROFILE

HORIZ. SCALE 100 0 100 200 300 FEET
VERT. SCALE 10 0 10 20 30 FEET

TYPICAL SECTION

NOT TO SCALE



ENVIRONMENTAL ENHANCEMENT THRU ENGINEERING

DATUM IS NATIONAL GEODETIC VERTICAL DATUM OF 1929

GILA RIVER BASIN
PHOENIX, ARIZONA AND VICINITY (INCLUDING NEW RIVER)

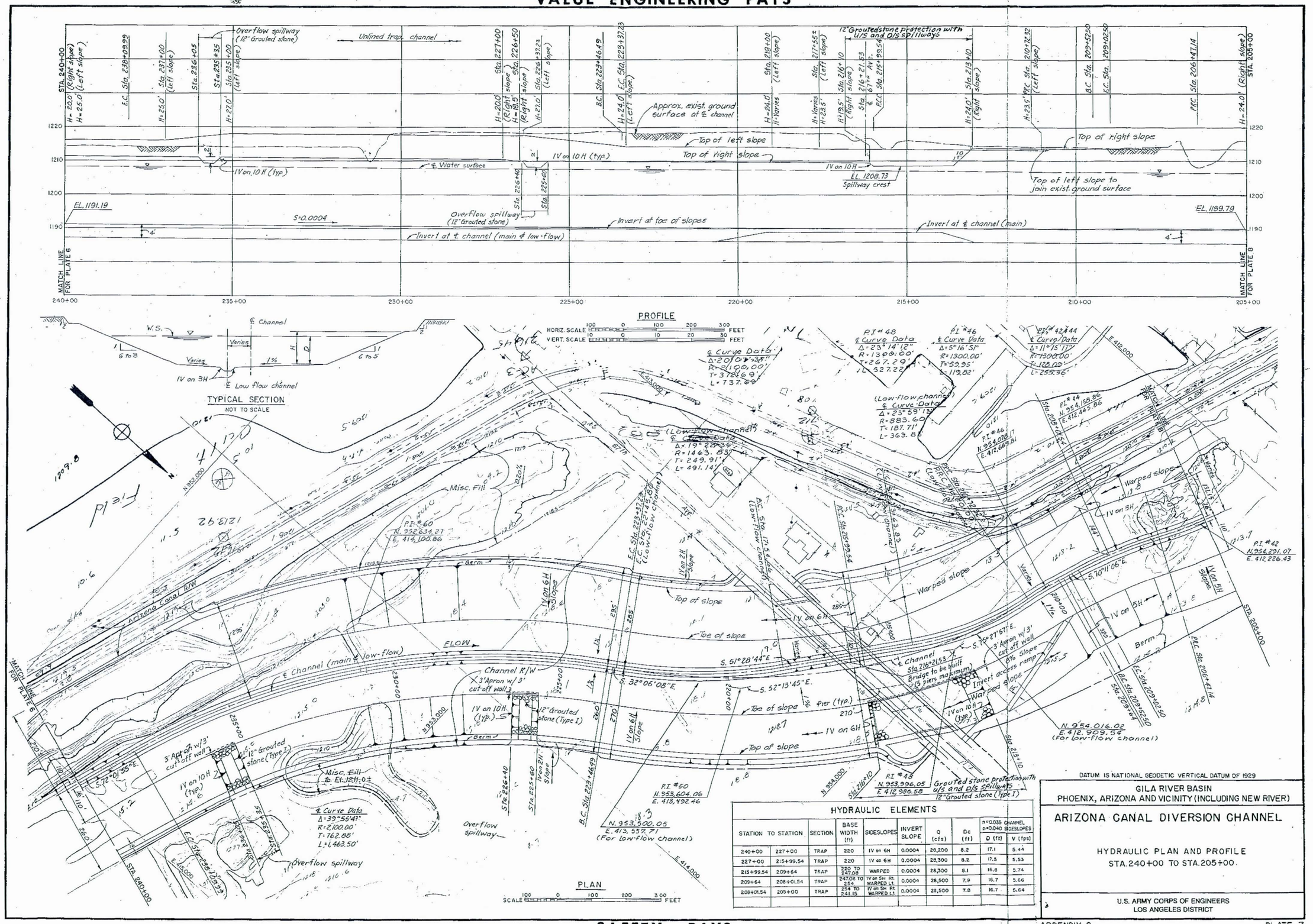
ARIZONA CANAL DIVERSION CHANNEL

HYDRAULIC PLAN AND PROFILE
STA. 270+00 TO STA. 240+00

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

HYDRAULIC ELEMENTS

STATION TO STATION		SECTION	BASE WIDTH (ft)	SIDESLOPES	INVERT SLOPE	Q (cfs)	Dc (ft)	n=0.035 n=0.040 Channel Side Slopes D (ft)	V (fps)
270+00	264+93.85	TRAP	255	1V on 5H Rt. 1V on 3H Lt.	0.0004	27,900	7.7	17.5	5.22
264+93.85	257+81.85	TRAP	255 to 220	Warped	0.0004	27,900	8.0	17.4	5.26
257+81.85	256+00	TRAP	220	1V on 6H	0.0004	27,900	8.2	17.4	5.25
256+00	242+00	TRAP	220	1V on 6H	0.0004	28,100	8.2	17.3	5.32
242+00	240+00	TRAP	220	1V on 6H	0.0004	28,200	8.2	17.2	5.40



HYDRAULIC ELEMENTS									
STATION	TO STATION	SECTION	BASE WIDTH (ft)	SIDESLOPES	INVERT SLOPE	Q (cfs)	Dc (ft)	n=0.035 CHANNEL n=0.040 SIDESLOPES D (ft)	V (fps)
240+00	227+00	TRAP	220	1V on 6H	0.0004	28,200	8.2	17.1	5.44
227+00	215+99.54	TRAP	220	1V on 6H	0.0004	28,300	8.2	17.5	5.53
215+99.54	209+64	TRAP	220 TO 247.08	WARPED	0.0004	28,300	8.1	16.8	5.74
209+64	208+01.54	TRAP	247.08 TO 254	1V on 5H Rt. WARPED Lt.	0.0004	28,500	7.9	16.7	5.66
208+01.54	205+00	TRAP	254 TO 241.15	1V on 5H Rt. WARPED Lt.	0.0004	28,500	7.8	16.7	5.64

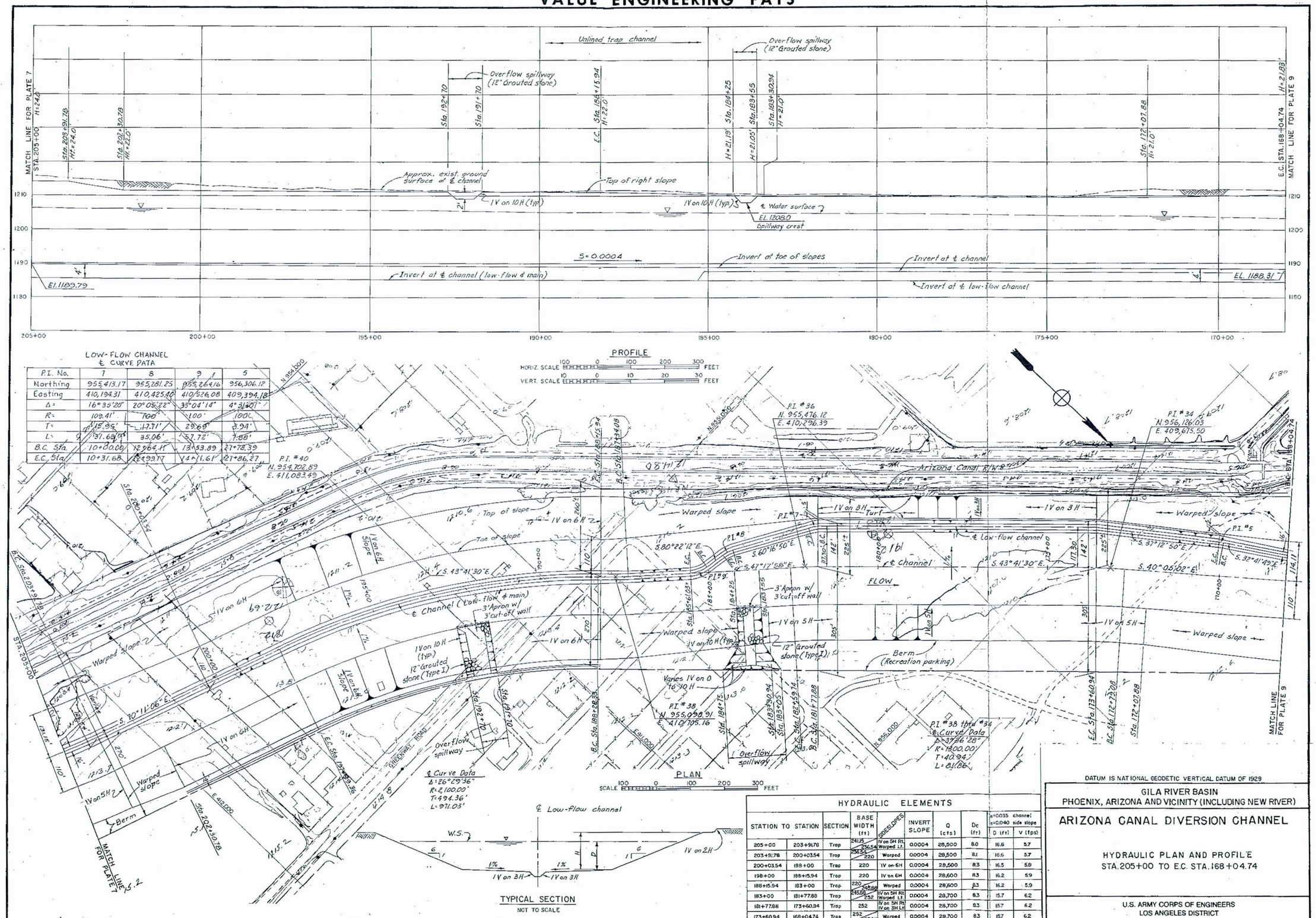
GILA RIVER BASIN
PHOENIX, ARIZONA AND VICINITY (INCLUDING NEW RIVER)

ARIZONA CANAL DIVERSION CHANNEL

HYDRAULIC PLAN AND PROFILE
STA. 240+00 TO STA. 205+00.

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

ENVIRONMENTAL ENHANCEMENT THRU ENGINEERING



LOW-FLOW CHANNEL ℄ CURVE DATA

P.I. No.	7	8	9	5
Northing	955,413.17	955,281.25	955,264.16	956,306.12
Easting	410,194.31	410,425.40	410,526.08	409,394.18
Δ=	16°35'20"	20°05'22"	33°04'14"	4°31'01"
R=	109.41'	100'	100'	100'
T=	15.95'	17.71'	29.69'	3.94'
L=	31.68'	35.06'	57.72'	7.88'
B.C. Sta.	10+00.00	12+64.11	13+53.89	21+78.39
E.C. Sta.	10+31.68	12+99.17	14+11.61	21+86.27

HYDRAULIC ELEMENTS

STATION	TO STATION	SECTION	BASE WIDTH (ft)	SIDE SLOPES	INVERT SLOPE	Q (cfs)	Dc (ft)	n=0.035 channel n=0.040 side slope D (ft)	V (fps)
205+00	203+91.78	Trap	241.5 / 236.54	1V on 5H Rt. Warped Lt.	0.0004	28,500	8.0	16.6	5.7
203+91.78	200+03.54	Trap	236.54 / 220	Warped	0.0004	28,500	8.1	16.6	5.7
200+03.54	198+00	Trap	220	1V on 6H	0.0004	28,500	8.3	16.5	5.8
198+00	188+15.94	Trap	220	1V on 6H	0.0004	28,600	8.3	16.2	5.9
188+15.94	183+00	Trap	220 / 248.88	Warped	0.0004	28,500	8.3	16.2	5.9
183+00	181+77.88	Trap	245.88 / 252	1V on 5H Rt. Warped Lt.	0.0004	28,700	8.3	15.7	6.2
181+77.88	173+60.94	Trap	252	1V on 5H Rt. 1V on 3H Lt.	0.0004	28,700	8.3	15.7	6.2
173+60.94	168+04.74	Trap	252 / 224.11	Warped	0.0004	28,700	8.3	15.7	6.2

ENVIRONMENTAL ENHANCEMENT THRU ENGINEERING

DATUM IS NATIONAL GEODETIC VERTICAL DATUM OF 1929

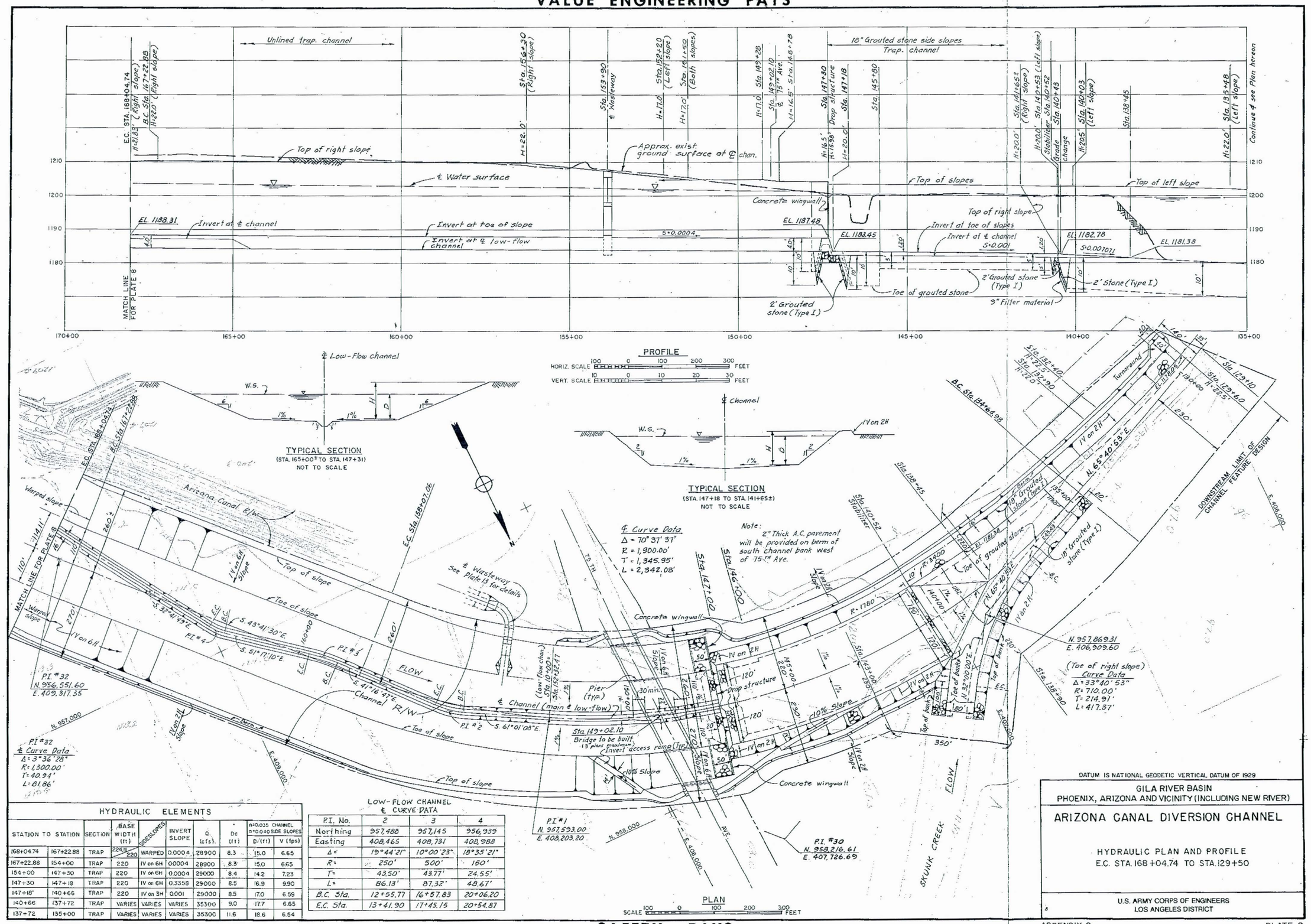
GILA RIVER BASIN
PHOENIX, ARIZONA AND VICINITY (INCLUDING NEW RIVER)

ARIZONA CANAL DIVERSION CHANNEL

HYDRAULIC PLAN AND PROFILE
STA. 205+00 TO E.C. STA. 168+04.74

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

ENVIRONMENTAL ENHANCEMENT THRU ENGINEERING



℄ Curve Data
Δ = 70° 37' 31"
R = 1,900.00'
T = 1,345.95'
L = 2,342.08'

Note: 2" Thick A.C. pavement will be provided on berm of south channel bank west of 75th Ave.

P.I. #32
N. 956,551.60
E. 409,317.35

P.I. #32
℄ Curve Data
Δ = 3° 36' 28"
R = 1,300.00'
T = 40.94'
L = 81.86'

P.I. #1
N. 957,593.00
E. 408,203.20

P.I. #30
N. 958,216.61
E. 407,726.69

N. 957,869.31
E. 406,909.60

(Toe of right slope)
Curve Data
Δ = 33° 40' 53"
R = 710.00'
T = 214.91'
L = 417.37'

HYDRAULIC ELEMENTS

STATION TO STATION		SECTION	BASE WIDTH (ft)	SIDESLOPES	INVERT SLOPE	Q (cfs)	* Dc (ft)	n=0.035 n=0.040 SIDE SLOPES D (ft)	V (fps)
168+04.74	167+22.88	TRAP	224 / 220	WARPED	0.0004	28900	8.3	15.0	6.65
167+22.88	154+00	TRAP	220	IV on 6H	0.0004	28900	8.3	15.0	6.65
154+00	147+30	TRAP	220	IV on 6H	0.0004	29000	8.4	14.2	7.23
147+30	147+18	TRAP	220	IV on 6H	0.3358	29000	8.5	16.9	9.90
147+18*	140+66	TRAP	220	IV on 3H	0.001	29000	8.5	17.0	6.59
140+66	137+72	TRAP	VARIES	VARIES	VARIES	35300	9.0	17.7	6.65
137+72	135+00	TRAP	VARIES	VARIES	VARIES	35300	11.6	18.6	6.54

LOW-FLOW CHANNEL ℄ CURVE DATA

P.I. No.	2	3	4
Northing	957,488	957,145	956,939
Easting	408,465	408,731	408,988
Δ =	19°44'21"	10°00'23"	18°35'21"
R =	250'	500'	150'
T =	43.50'	43.77'	24.55'
L =	86.13'	87.32'	48.67'
B.C. Sta.	12+55.77	16+57.83	20+06.20
E.C. Sta.	13+41.90	17+45.15	20+54.87

DATUM IS NATIONAL GEODETIC VERTICAL DATUM OF 1929

GILA RIVER BASIN
PHOENIX, ARIZONA AND VICINITY (INCLUDING NEW RIVER)

ARIZONA CANAL DIVERSION CHANNEL

HYDRAULIC PLAN AND PROFILE
E.C. STA. 168+04.74 TO STA. 129+50

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT